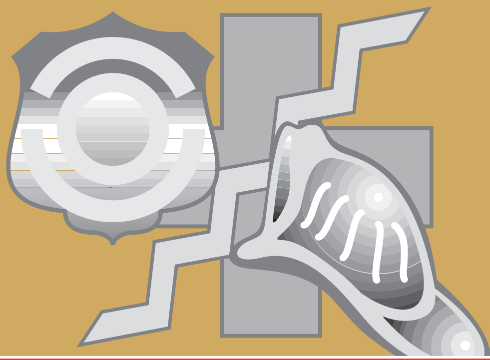

SAFETY & SEISMIC SAFETY ELEMENT

LAS VEGAS 2020 MASTER PLAN

CITY OF LAS VEGAS NEVADA

Adopted by
City Council 8-4-10

The City of Las Vegas Safety & Seismic Safety Element

of the Las Vegas 2020 Master Plan

was adopted by

City Council on August 4, 2010

(Ordinance 6103).

Safety & Seismic Ele;MPlan;indd;rs/8-4-10

CITY OF LAS VEGAS SAFETY & SEISMIC SAFETY ELEMENT TABLE OF CONTENTS

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EXECUTIVE SUMMARY

The Nevada Revised Statutes (NRS), which sets out planning law for the State of Nevada, mandates the preparation of comprehensive, long-term general plans, known as master plans. The NRS also identifies a series of required elements to be covered by the master plan for entities located within counties of more than 400,000 persons. This Safety & Seismic Safety Element is a required element of the Master Plan per NRS 278.160.

For purposes of the City of Las Vegas, the Safety & Seismic Safety Element will address the following sub-elements:

- Fire Hazards
- Flood Hazards
- Seismic Hazards
- Noise Hazards
- Hazardous Materials
- Landslide Hazards

As an element of the City's Master Plan, the planning horizon for the Safety & Seismic Safety Element is 20 years, with updates scheduled every five years. This element has been prepared, as an amendment to and augmentation of the Master Plan, through input from various cities, citizen groups, and public agencies directly responsible for providing the services addressed in this plan. Each of the following sub-elements includes the following recommendations:

- **Fire Protection Services:** Mitigate both natural and man-made fire hazards found in the City of Las Vegas.

  The Fire & Rescue Department will continue to identify fire hazards and develop policies to respond in case of an emergency.

- **Flood Control Hazards:** Provide infrastructure to mitigate issues caused by excessive rainfall.

  Due to natural and man-made factors, flooding is a critical concern of many within the entire Las Vegas Valley. Because of the regional significance and consequences of this issue, steps have been taken by the jurisdictions within the Valley to address this matter in a cohesive manner, mainly through the creation of the Clark County Regional Flood Control District (CCRFCD) in 1985. This agency has identified the critical areas of the Valley that are prone to flooding, or are major causes of flooding, and developed a master plan for the construction of facilities (detention basins, channels) that will prevent property damage and/or injury or loss of life as a result of this storm water runoff and associated flooding. The construction of these facilities will also aid in the prevention of water contamination at the primary source of drinking water for Las Vegas: Lake Mead.

- **Seismic Hazards:** Mitigate damage to property related to geologic hazards found in Las Vegas.

  There are three (3) geologic factors that greatly influence development patterns and practices within the City of Las Vegas: seismic, soil composition, and subsidence.

  - Seismically, a number of faults are present throughout the City of Las Vegas, thus construction practices have to take this factor into consideration, although no major earthquakes have ever been reported in Clark County.

  - The soils present within the City of Las Vegas are directly attributed to the topography and physiographic conditions that prevail in this portion of the state, and have a great impact on the development of a particular site. Some of the soils found locally have a high alkaline content, which compromises the integrity of untreated steel and concrete, while others could jeopardize a building's foundation due to the shrink/swell potential of soil (the reaction of the soil when water is introduced). The City should continue to monitor these areas of concern, and require measures to address adverse soil conditions on a case-by-case basis.

  - Arguably, the most severe geologic hazard present within the City of Las Vegas would be the problem of subsidence, or the lowering of the earth's crust. Due to the continued withdrawal of water from the ground, and other natural and man-made phenomenon, certain sections of the city have experienced ground subsidence, which often results in severe damage to a structure's integrity, as evidenced by a number of documented cases. Efforts to address the problem, through groundwater recharge and/or tighter building controls and requirements, should continue.

- **Noise Hazards:** Mitigate excessive noise pollution within the City.

  As the City of Las Vegas continues to become an increasingly urbanized municipality (as a result of the rapid growth rate and sprawling growth patterns), the urban noise levels that result from increased activity are logically going to increase as well. These increased levels are expected to have a number of impacts on the health and welfare of the residents, including non-auditory, speech interference, and sleep interference. The City of Las Vegas should take a proactive approach to mitigate noise impacts on the general population. This can be accomplished through proper zoning and site design measures, the use of open space buffers, and the construction of noise barriers where appropriate.

- **Hazardous Materials:** Mitigate any negative effects from the movement of hazardous materials within City limits.

  In Las Vegas, the issue of hazardous materials is primarily focused on the disposal of nuclear waste, and a proposal by the Federal Government to utilize Yucca Mountain (within the Nevada Test Site) as a nuclear waste disposal facility. There are several questions raised about this proposal including health risks to general population along transportation routes, highway transportation risks, accident potential, performance of nuclear waste holding containers, and the amount of waste anticipated for transportation and storage. In response to growing concerns about the shipment of such hazardous materials through the city of Las Vegas, the City Council recently declared the city to be a nuclear-free zone. The city should continue to closely monitor this issue and devise a plan to safeguard the residents of the community in the event the transportation of nuclear waste crosses into the city's boundaries.

- **Landslide Hazards:** Mitigate damage caused by landslides within the city.

  The topography found within the city limits does not pose a risk of landslides.

INTRODUCTION

The Safety & Seismic Safety Element is intended to provide policy direction to the city with regard to issues that affect the safety, health and welfare of the general public. The range of safety issues addressed through this Element are covered under the following sections:

- Fire Hazards
- Flood Hazards
- Seismic Hazards
- Noise Hazards
- Hazardous Materials
- Landslide Hazards

Under each of these headings, this Element will:

- Inventory the number and location of public facilities intended to address a particular component;
- Identify established policies and standards, where they exist, to address safety issues;
- Identify gaps or shortcomings that may exist in the current structure of policies and standards; and
- Propose policies and actions intended to address areas of concern.

For purposes of this element, unfamiliar terms are defined in the Definitions section and unfamiliar concepts will be discussed in detail as they are introduced.

RELATIONSHIP TO THE MASTER PLAN

The Nevada Revised Statutes require the preparation and adoption of a comprehensive, long-term general plan for the physical development of the city. For cities like Las Vegas, which is located in a county having a population of 400,000 or greater, state law requires the master plan to address 18 different subject areas. A safety plan and a seismic safety plan are both required components per NRS and are both specifically addressed by this Safety & Seismic Safety Element. Additionally, this Element addresses noise hazards within the city.

This Element forms a component part of the Las Vegas 2020 Master Plan. It is intended to address where possible, the goals, objectives and policies of the Las Vegas 2020 Master Plan document that was approved by City Council in September 2000. In particular, this Element addresses Objective 7.3 of the Master Plan capstone document, which states:

"To ensure that public safety problems are fully and adequately identified and that long term solutions are identified and implemented by the respective local government departments and agencies vested with those responsibilities."

As a follow up to this objective, the document contains a number of policies which are addressed by this Element. These policies focus on protective services, noise issues, seismic activity and hazardous material. These policies are as follows:

POLICY 7.3.2: That the City continue to provide efficient and cost effective services and facilities for fire prevention, fire suppression, hazardous material control and emergency medical care for the City of Las Vegas and assist Clark County as deemed appropriate in the provision of these services for County islands and County areas north of Cheyenne Avenue and west of Decatur Boulevard.

POLICY 7.3.3: That the City participate with local governments within the Las Vegas Valley, and with other levels of government, to research, monitor and assess the effect on public safety and property that may arise from geologic hazards such as seismic activity, from land subsidence and related groundwater usage practices, and from poor soil conditions such as collapsible and expansive soils.

POLICY 7.3.4: That the City establish and enforce maximum acceptable levels for noise within residential and public areas in conjunction with state and local agencies.

POLICY 7.3.8: That the City coordinate with the appropriate entities to ensure that any contaminants from federal facilities, such as the Nevada Test Site and Yucca Mountain, do not flow into the Valley water supply as a result of seismic activities or other forces of nature. The City will ensure that wastes of all types are disposed of in an appropriate manner.

The policies and actions contained in the following sections of this Safety & Seismic Element have been designed to comply with and implement the broader general goals, objectives and policies of the Master Plan as listed above.

FIRE HAZARD SAFETY

The geographic condition of the city of Las Vegas does not present a natural fire risk, such as wild land fire. For those fires considered man-made, whether intentional or unintentional, most occur in buildings. In 2006, Las Vegas Fire & Rescue obtained Accredited Agency status through the Commission for Fire Accreditation International (CFAI). Part of this designation requires the department to conduct a thorough community risk assessment for all possible hazards within its jurisdiction for which it provides responses services.

In order to perform community risk assessment, department staff identifies fire types and assigns a score for the hazard level, probability of the occurrence of a fire event, and the likely consequences of the fire event (i.e., economic or loss of life), which yields a total risk score. Based on the risk score for each hazard type, the appropriate level of deployment (number of firefighters and equipment) is determined for each classification, resulting in the department's fire safety plan for man-made fire hazards.

The purpose of this section of the Safety and Seismic Safety Plan is to explain how the services of Las Vegas Fire & Rescue (LVFR) will be incorporated in the accomplishment of public safety in a comprehensive manner. Discussion will detail how LVFR will interact with the city of Las Vegas per Policy 7.3.2 of the 2020 Master Plan.

BACKGROUND

Las Vegas Fire & Rescue operates under a vision statement, mission statement, and strategic business plan that aligns to City Council priorities and promotes community risk reduction and safety. The Department's mission is "to provide fire, medical, and other emergency response and prevention services to residents, businesses, and visitors so they can live, work, and play in a safe community."

Las Vegas Fire & Rescue adopted its first strategic plan in 1990 with the aim of guiding the department into the next millennium and propelling it toward world-class status. Each plan, which functions as a dynamic, living document, has proven to be a successful tool during times of changing variables and explosive growth. As part of a city-wide initiative focused on performance-based budgeting, the department developed a new Strategic Business Plan and implemented its use as of July 1, 2007.

Las Vegas Fire & Rescue is organized into four divisions: Emergency Services / Training; Medical Services / Communication; Fire Prevention; and Planning that provide fire suppression, fire investigations, emergency medical services, patient transports, technical rescues, hazardous materials responses, and bomb squad, and administrative services.

As the Las Vegas Valley contends with issues relating to Homeland Security, its ability to respond to and handle terrorist acts must be considered in planning, resource allocation, and training. Through local, regional, and statewide collaboration, LVFR is involved in several projects that, when realized, will provide the permanent and transient populations a level of protection against domestic terrorism.

LEVEL OF SERVICE: EXISTING INVENTORY

As of July 1, 2009, LVFR operates out of nineteen stations that provide coverage to all areas within city of Las Vegas boundaries (133.20 square miles) and a resident population of 599,087 (2009 City Estimate). In response to a growing community and increased service demands, LVFR opened six new fire stations between 2001-2008 (Stations 10, 43, 44, 45, 47, and 48). Current fire station locations and 1.5-mile service areas are plotted on ***Map 1***.

Las Vegas Fire & Rescue is organized into four divisions: Emergency Services / Training; Medical Services / Communication; Fire Prevention; and Planning that provide fire suppression, fire investigations, emergency medical services, patient transports, technical rescues, hazardous materials responses, and bomb squad, and administrative services.

LEVEL OF SERVICE: FUTURE INVENTORY

Las Vegas Fire & Rescue maintains a ten-year plan for acquiring land and building fire stations. Most immediately, the Department has entered into a partnership with the College of Southern Nevada (CSN) to build Fire Station 46 on its West Charleston campus. This station will include over 3000 sq. feet of classroom space in which the Department will assist in the delivery of fire-related education courses. The project will be completed and staffed by October 2010.

The Department has also identified three ideal locations for future stations – Fire Station 103 to be located at Mount Mariah Drive and Stella Lake Street; Fire Station 107 at Del Webb Boulevard and Sundial; and Fire Station 108 at Lamb and Bonanza road. These stations are currently proposed to be built in the next five years, and are dependent upon capital funding and prioritization.

AUTOMATIC AID AGREEMENTS

The city has an automatic aid agreement with the Clark County and City of North Las Vegas fire departments. Under this agreement, jurisdictional boundaries between the cities and county are ignored and the closest available emergency response vehicle is dispatched to an incident. The total resources of all agencies are available to respond should a regional emergency occur anywhere in the metro area. Las Vegas Fire & Rescue provides coverage to several Clark County "islands" located within its jurisdiction. ***Map 2*** identifies existing and proposed City of Las Vegas, Clark County, and North Las Vegas fire stations and their service areas.

Through similar automatic aid agreements, the Department's Bomb Squad provides emergency response coverage throughout Clark, Lincoln, and Nye Counties. ***Map 3*** shows the area of coverage provided by the bomb squad.

LAND USE

The city of Las Vegas is home to a diverse and rapidly growing population. Increasing commercial- and industrial-based businesses add to the economic base, but make planning effective fire and rescue services a challenge for public safety officials.

The density of the population affects the department's ability to service an area effectively. Higher density areas require more equipment and personnel to service a greater number of residents, tourists, and structures. The higher density areas also represent a greater risk for fire spreading due to the close proximity of buildings. As seen on ***Map 4***, fire stations are generally distributed so that more stations are located in the areas of greatest density. The location of the stations is not so much what areas are considered downtown or suburban, but how (residential) areas are expected to develop over time.

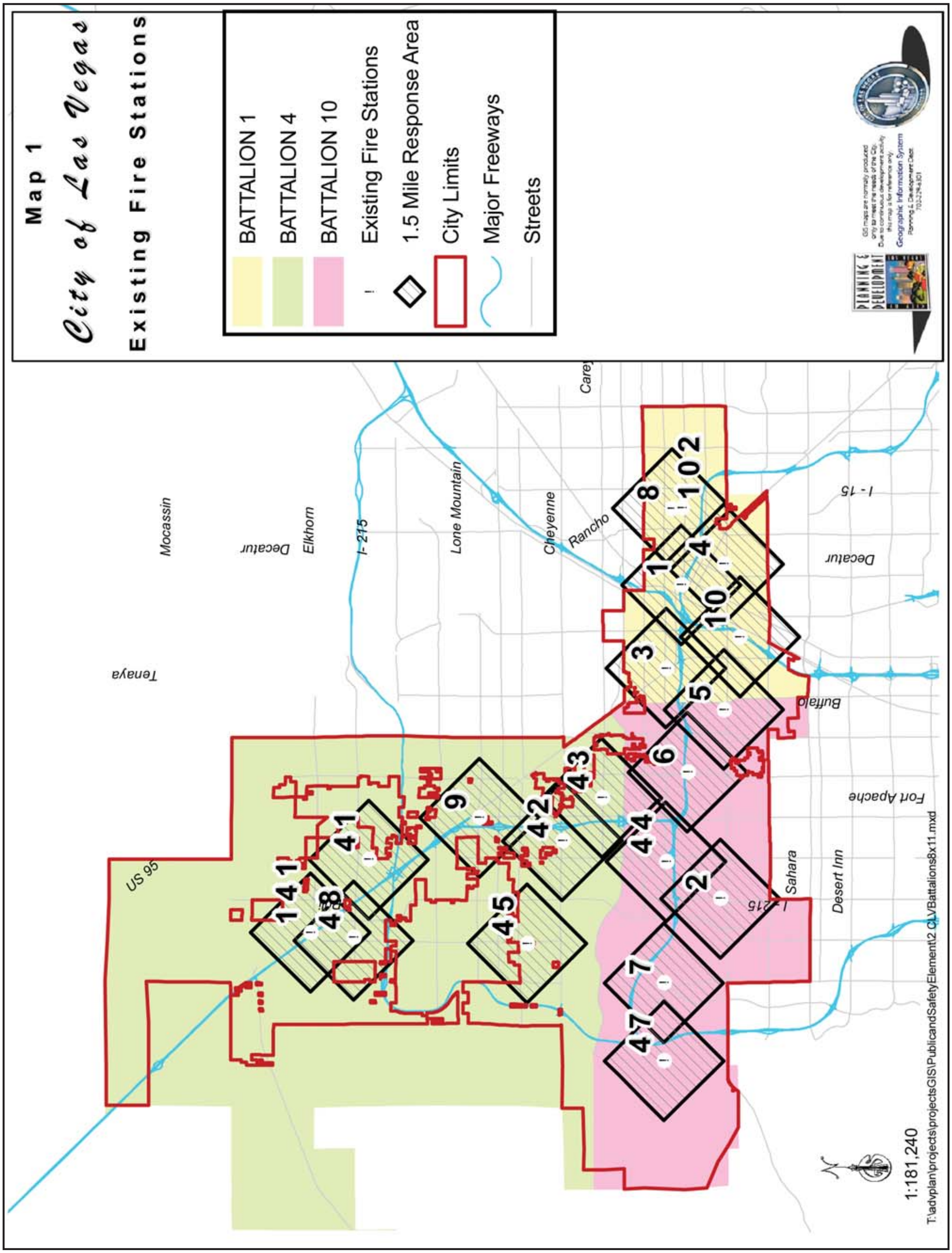
In response to potential high-rise development in its downtown urban core, the Department is planning a fire station in Symphony Park and an additional rescue at Station 10. As densities increase, revisions of the location plan for future stations and resources may occur.

Over the past several years, the majority of the city's population growth occurred in suburban and rural areas

In response to potential high-rise development in its downtown urban core, the Department is planning a fire station in Symphony Park and an additional rescue at Station 10. As densities increase, revisions of the location plan for future stations and resources may occur.

in the northwest and west. Substantial growth in the city's northwest area has affected Fire & Rescue services with the addition of major retail facilities, power centers, single- and multi-family residences, businesses, office and industrial parks, gaming, entertainment and recreational facilities. Recent completion of Fire Stations 48 and 47 helps provide emergency medical and fire response services to these expanding parts of the city.

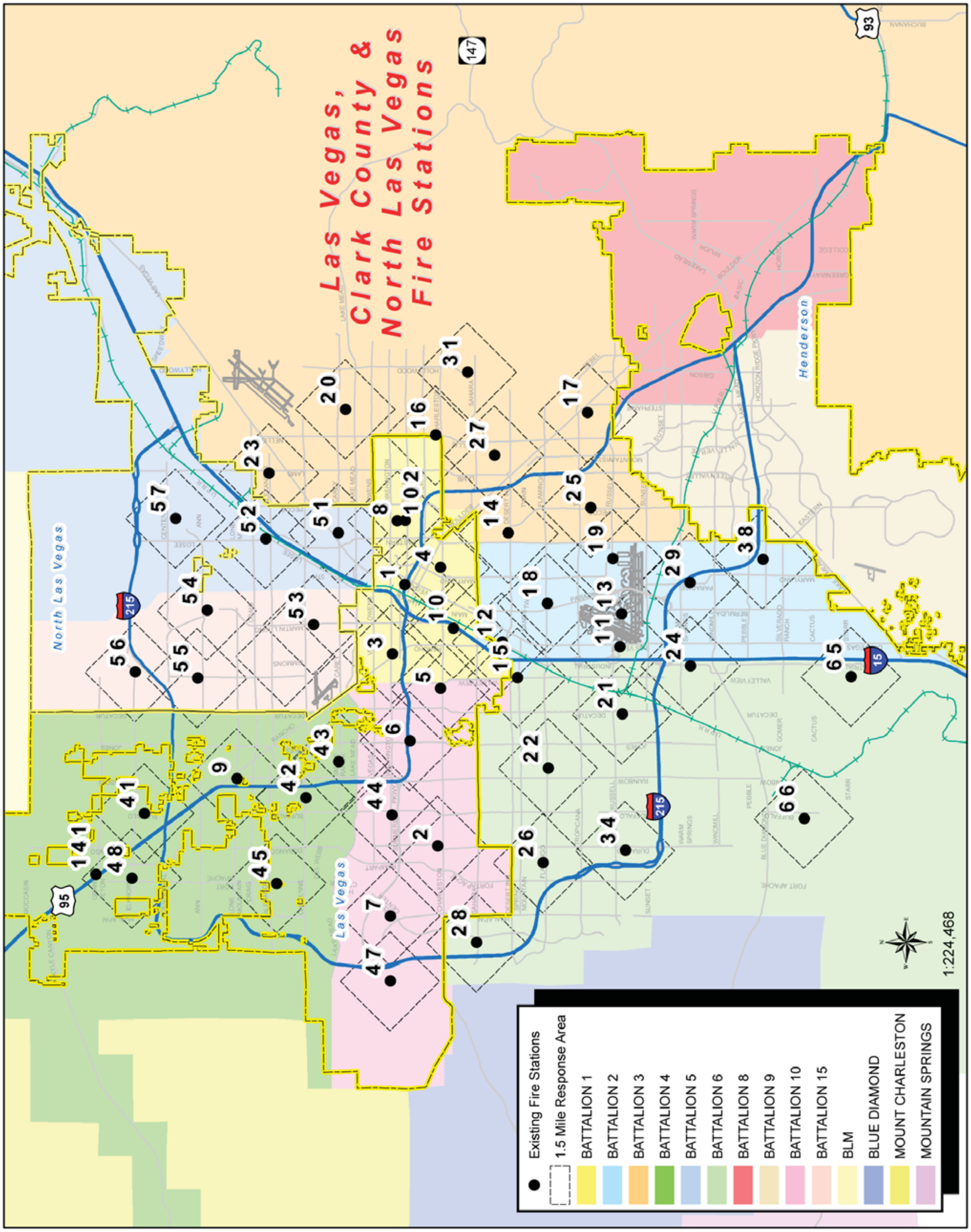
Map 1: Existing Fire Stations, City of Las Vegas



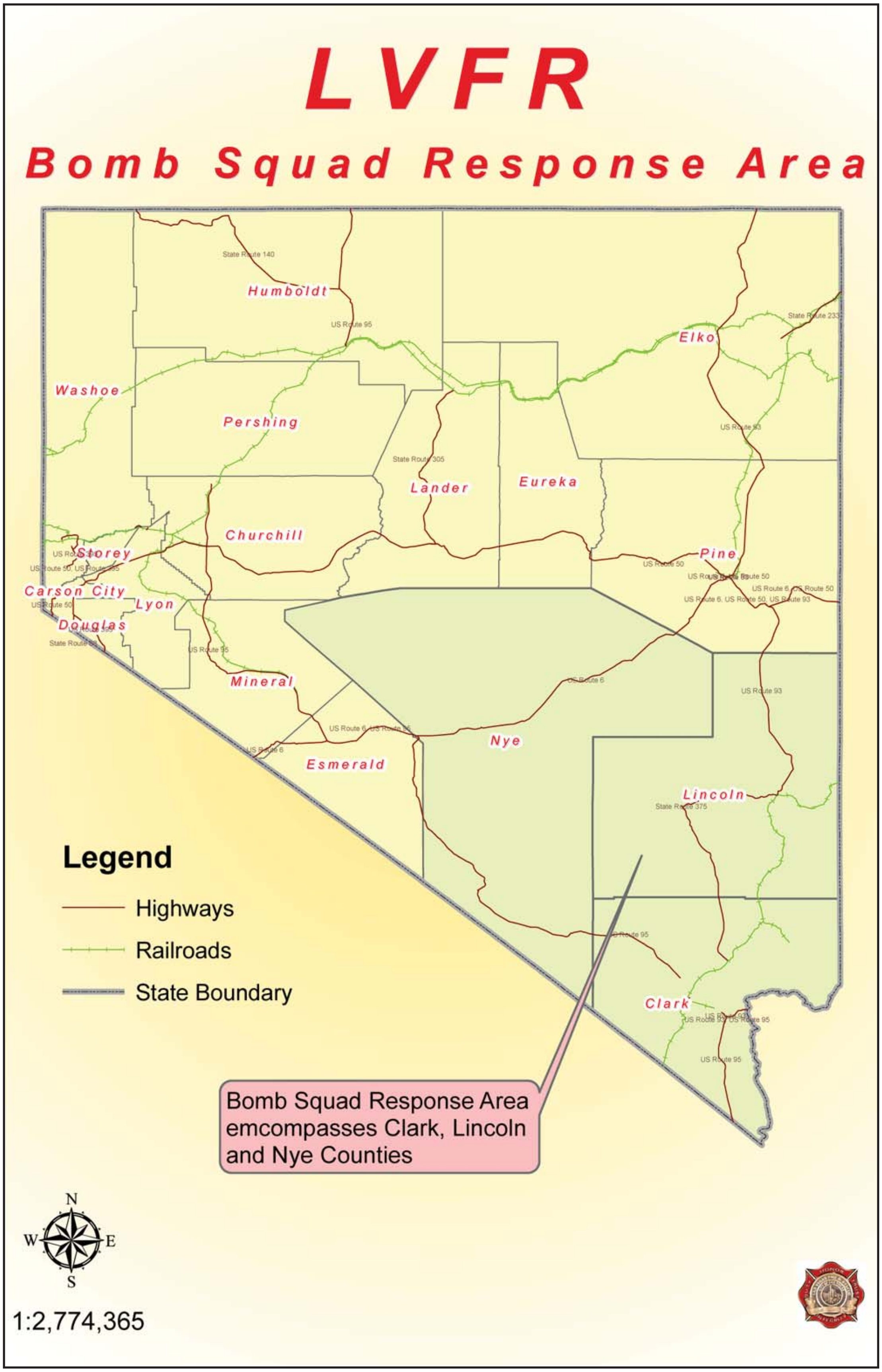
Fire Hazard Safety

SAFETY & SEISMIC SAFETY ELEMENT

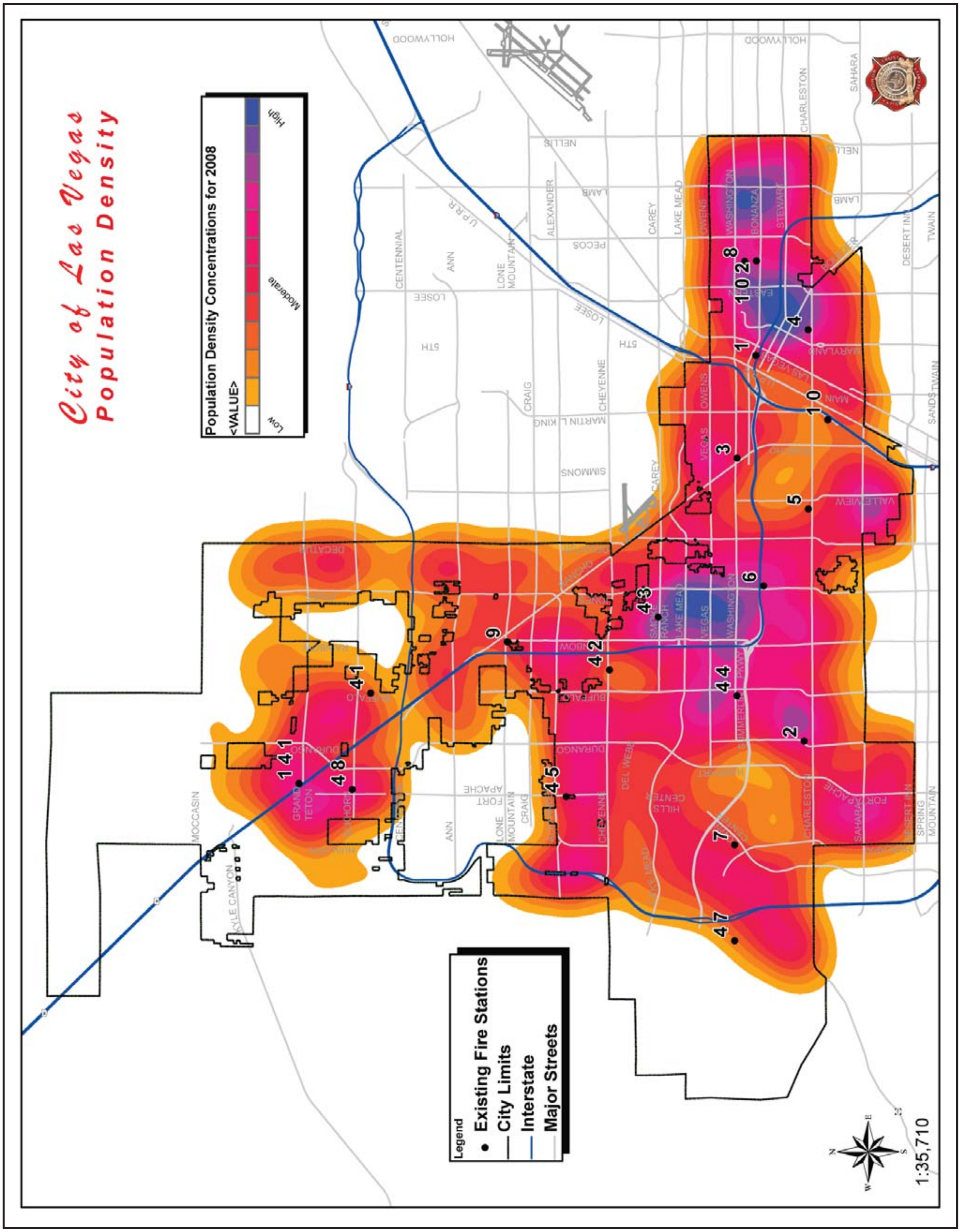
Map 2: Las Vegas, Clark County & North Las Vegas Fire Stations



Map 3: LVFR Bomb Squad Response Area



Map 4: Population Density, City of Las Vegas



FLOOD CONTROL HAZARD SAFETY

The purpose of this section of the Safety & Seismic Safety Plan is to explain how the services of the Las Vegas Public Works Department and the Clark County Regional Flood Control District will be incorporated in the accomplishment of public safety in a comprehensive manner. Discussion will detail how these agencies will interact with the City of Las Vegas per the general policies of the Las Vegas 2020 Master Plan.

INTRODUCTION

Flooding is one of the more severe environmental hazards affecting the Las Vegas Valley area, despite an average annual precipitation of only four inches. Winter storms cover a large area and historically have not produced major flooding. The summertime high-intensity thunderstorms produce a large amount of rainfall in a short time which historically has caused most of the flooding in the area. Washes fill quickly and overflow onto surrounding areas.

Natural and man-made factors contribute to flooding. The natural factor is the presence of predominantly shallow soils overlaying hardpan, a hardened or cemented soil horizon that inhibits the infiltration of rainfall into the underlying soils. Also, there is a lack of natural ground cover shrubs, trees, and grasses that would slow this runoff. The resulting water builds in velocity and quantity as it flows down the washes resulting in downstream flooding. The man-made factor is contributed through development of paved roads, roofs, parking lots, and other impervious surfaces. These provide hard surfaces that prohibit the percolation of water into the area where it falls and collects. The collection and concentration of runoff caused by urbanization can result in an increase in downstream flooding. Development in flood plains without adequate flood control facilities has also resulted in flood damage.

The primary purpose of flood control is to develop a comprehensive Stormwater Management Plan that will safely convey floodwaters through our neighborhoods. The plan must integrate both regional and local drainage programs allowing for the timely elimination of both flooding potential and nuisance drainage problems.

REGIONAL FLOOD CONTROL PLANNING

The Clark County Regional Flood Control District (CCRFCD) was created in 1985 in an effort to enhance regional flood planning and control in Clark County. By December, 1986, the CCRFCD published the Clark County Flood Control Master Plan. Clark County and each of the incorporated cities within the County adopted the Master

Plan. NRS Chapter 543 requires that all the local governments in the CCRFCD adopt drainage regulations. The regulations restrict new development in areas known to flood, require drainage studies on proposed new developments to address localized flooding, and require CCRFCD review of all new developments in areas of regional flood control significance.

STORMWATER MANAGEMENT

Stormwater Management emphasizes the need to protect the public from potential flooding while maximizing the usage of these public facilities. This is accomplished through the integrated planning efforts of the CCRFCD and the City of Las Vegas. The CCRFCD Master Plan details the facilities needed to help protect the public. The City of Las Vegas has integrated the CCRFCD Master Plan into detailed Neighborhood Stormwater Management Plans to further define the needs and impacts of potential flooding within the City. These Neighborhood Plans are the guide to development within the City. Additionally, the Uniform Regulations for the Control of Drainage revised effective December 13, 2007 requires that technical drainage studies be submitted for developments over two acres in size and any project within a flood zone. These studies ensure compliance to the City of Las Vegas Neighborhood Plans and the Clark County Regional Flood Control District (CCRFCD) Master Plan.

Overall stormwater management strategies combine the use of natural and man-made facilities to convey, route, and store the drainage impacts from storms. The designed use of local and Master planned facilities incorporate multiple public functions where practical.

Detention basins must be considered with multi-use recreation facilities whenever feasible. When designed as multi-use facilities, a minimum 10-year pool for stormwater below the recreation facility will be maintained. Natural/unlined channels are encouraged within Master Planned Communities. The City of Las Vegas does not maintain the unlined channels. This responsibility falls to the Master Planned Community. The use of these washes by Master Planned Communities for both drainage and open space/trail systems is encouraged. The trails along natural and concrete lined channels are encouraged to be integrated into the overall Trails Master Plan for the City. The washes must meet the Regional Flood Control Criteria as outlined in the Clark County Hydraulic Criteria and Drainage Design Manual. The design for such facilities must be done through a Technical Drainage Study that is submitted to Public Works.

STORMWATER QUALITY

Stormwater Quality is a joint effort between the federal, state and local governments to assure the continued improvement of our water quality from storm water discharges.

In 1988, the United States Environmental Protection Agency (EPA) proposed regulations that required cities with populations of 100,000 or more to apply for National Pollution Discharge Elimination System (NPDES) permits for controlling stormwater discharges to water ways, such as rivers, streams, lakes, etc. An EPA study indicated that 38 states reported urban run-off as a major cause of water quality impairment in the United States. Stormwater runoff can pick up such contaminants as pesticides and fertilizers from lawns; oil, grease, and fuel from gas stations; and other contaminants from construction sites, restaurants, dry cleaners, lumberyards, landfills, junk yards, and industrial sites.[1] These contaminants find their way directly into bodies of water without going through sanitary treatment first.

Rather than requiring additional treatment plants or expansions to existing plants to accommodate end-of-pipe treatment of stormwater, EPA favors non-structural best management practices (BMPs) and stormwater management plans to control pollutants at their source.[2] BMPs include the following:

- find and remove illicit connections to storm drains instead of sanitary sewers;
- develope and implement local ordinances to reduce pollutants from construction sites, new development sites, and new industrial sites;
- public education on the use of chemical fertilizers and pesticides;
- encourage proper disposal and the recycling of used oil and hazardous wastes from households; and
- improve operations and maintenance practices of commercial enterprises.

The City of Las Vegas is a co-permittee of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit. The permit designates the CCRFCD as Lead Agency for permit implementation, with CCRFCD and the Cities of Las Vegas, North Las Vegas, Henderson, Clark County identified together as Co-permittees. The effective date of the current permit is June 19, 2003. This permit was reissued based on the original NPDES municipal stormwater discharge permit of December 13, 1990. In compliance with the conditions of the permit, an annual report is prepared in August of each year. The report is organized based on the “Monitoring Requirements and Conditions” in the new permit and the “Schedule of Compliance, Monitoring Requirements, Best Management Practices and Conditions” in the original permit.

SERVICE STANDARDS

The service standards for Flood Control are those that are required by Nevada Division of Environmental Protection. The standards are the requirements for the implementation of the Best Management Practices set forth in the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit. The City of Las Vegas and the other co-permittees are in full compliance with the requirements of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit.

THE SYSTEM

The comprehensive drainage and flood control system will integrate both regional and local drainage facilities. The facilities will include detention basins, large diameter pipes, reinforced concrete boxes, natural washes and man-made channels to allow for the mitigation of both flooding potential and nuisance drainage problems.

THE CCRFCD SYSTEM

These facilities include large diameter pipes, concrete channels, man-made channels, reinforced concrete boxes, and detention basins, which are designed to collect the 100-year flow (***Map 5***). This system includes 15 existing detention basins along with approximately 140 miles of existing storm drains and channels. Construction and maintenance funding of these facilities comes through the Clark County Regional Flood Control District (CCRFCD). Regional facilities provide the infrastructure or trunk lines for the local City system and storm drain facilities.

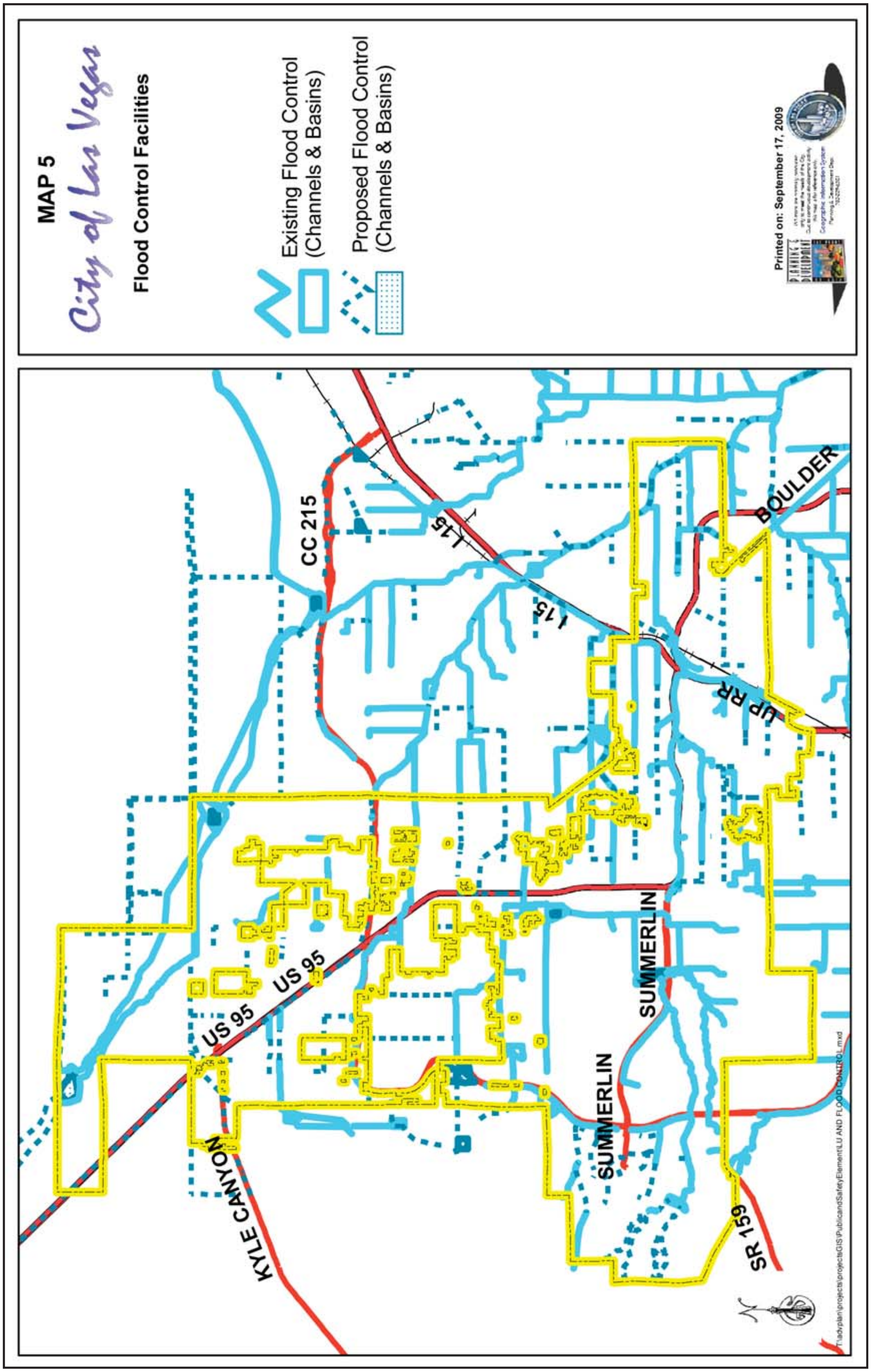
THE CITY SYSTEM

The City system includes smaller diameter pipes, which are designed to collect either 10-year flows, or nuisance flows. There are approximately 240 miles of local facilities within the City. Flood Control has completed three neighborhood drainage studies, which identify proposed local facilities needed within the City. These neighborhood studies serve as the planning tools for development and allow the City to provide the storm drain facilities for both new development and mature neighborhoods. These facilities are constructed primarily within Regional Transportation Commission (RTC) road corridors with RTC projects or with private developments.

CURRENT DEVELOPMENT NEEDS

Proposed developments are required to comply with the Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual. All development projects 2-acres or greater are required to complete a Technical Drainage Study. In the study the engineer identifies the drainage impacts of the project and provides a means to mitigate them.

Map 5: Flood Control Facilities, City of Las Vegas



ADDRESSING FUTURE NEEDS

The proposed drainage facilities will ensure the CCRFCD Design Manual criteria are met which provides for the safe conveyance of stormwater flows. This generally means in RTC road corridors the 10-year flow will be intercepted to meet the CCRFCD design manual criteria. The proposed regional facilities will collect the 100-year flows and safely convey them to channels or detention basins. The future system of local and regional facilities will greatly reduce the flooding that currently exists across the valley.

Map 5 shows the planned expansion and improvement of the existing system and how the system will be in 20 years or at system build-out. The major elements of the planned system are the regional drainage facilities. The minor elements are the facilities under the control of local agencies.

ISSUES

1. **Areas Prone to Flooding**
   The Las Vegas Valley is susceptible to flash floods affecting the safety and quality of life of the residents. Flooding occurs due to heavy localized rainfall combined with the natural topography and soil conditions found in the Valley. Historically, the adverse effects of flooding to Valley residents is due partly to poor planning in the past and to the lack of flood control facilities preceding urbanization.

2. **Contaminated Runoff**
   Stormwater runoff picks up contaminants such as pesticides and fertilizers from lawns, trash and debris, oil, grease, and gasoline, etc. These contaminants discharge to the Las Vegas Wash and Lake Mead without sanitary treatment. Appropriate stormwater management practices and discharge regulations need to be continually upgraded to provide the necessary improvements to abate polluted runoff.

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: The City should participate in the protection of the environmental quality of the Las Vegas valley and to promote the conservation of our natural resources.

Objective 4A: Public Works should implement where possible a diversified (which includes use of natural washes or green space such as parks or golf courses), efficient flood control system to protect life and property from severe flood damage at a reasonable cost.

Policy 4A1: Public Works should develop a two-tiered flood control system which should include an appropriate mix of large regional and smaller city neighborhood flood control facilities.

Program 4A1.1: Public Works should implement stormwater channel and drain improvements in accordance with the adopted stormwater management program for the City.

Policy 4A2: The City should continue the implementation of the adopted Master Plan of the Clark County Regional Flood Control District. This Plan provides for construction and maintenance of the large regional component of the City's flood control system, including detention basins, drainage channels and storm drains.

Policy 4A3: Public Works should develop neighborhood master plans consisting of relatively small city drains and other flood control facilities to safely convey flood and nuisance flows to the larger regional facilities. These plans should be prioritized as part of the capital facilities programming process.

Policy 4A4: Public Works should continue the review of plans and drainage studies for new development of property under zoning and subdivision regulations to ensure optimal property drainage in accordance with Uniform Regulations for the Control of Drainage and the Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual.

Program 4A4.1: Public Works should continue the review of development plans to incorporate, where required, the neighborhood storm drain system plans for the City and the master plan for Clark County Regional Flood Control District.

Policy 4A5: Public Works should investigate and, where necessary, implement funding mechanisms for city neighborhood stormwater capital programs. Funding sources may include, but not be limited to, special improvement districts or stormwater utility fees.

Policy 4A6: Public Works should continue the inspection and maintenance of existing stormwater facilities to provide for the safe and efficient passage of flood water.

Policy 4A7: Public Works should continue to maintain a broadly based Flood Hazard Reduction Program which meets the requirements of the National Flood Insurance Program (NFIP). The City should continue to participate in the federal Community Rating System, thus assuring the availability of flood insurance to city residents and businesses at the least possible cost.

Policy 4A8: Public Works should continue to support the update of Flood Insurance Maps for existing city areas and to create new maps for developing areas, subject to FEMA review.

Objective 4B: The City should continue to participate in a multi-jurisdictional effort to develop, implement and monitor water quality standards for stormwater discharge.

Policy 4B.1: Public Works should continue to implement the comprehensive Stormwater Quality Management Plan in accordance with the valley-wide NPDES stormwater discharge permit.

Program 4B1.1: Public Works should continue to be a participant in valley-wide programs for stormwater quality management.

Program 4B1.2: Public Works should initiate the implementation program for the Stormwater Quality Management Plan.

Program 4B1.3: Public Works should continue to inventory the existing stormwater facilities to address nonpoint pollution sources.

Program 4B1.4: Information Technologies Department should encourage the use of the City Geographic Information System (GIS) in coordination with Clark County GIS in the creation and maintenance of Stormwater Quality Management Plan data to evaluate the plan's effectiveness.

Policy 4B2: Public Works should modify City regulations as needed in order to implement stormwater quality discharge standards as they are developed by the State and the U.S. Environmental Protection Agency.

Program 4B2.1: Public Works should coordinate with all appropriate entities and agencies in the Valley to establish individual stormwater quality responsibilities and to prepare a funding strategy.

SEISMIC HAZARD SAFETY

The purpose of this section of the Safety & Seismic Safety Plan is to explain how the services of the City Las Vegas will be incorporated in the accomplishment of public safety in a comprehensive manner as it relates to seismic hazards. Discussion will detail how the City of Las Vegas should interact with other government agencies per Policy 7.3.3 of the 2020 Master Plan.

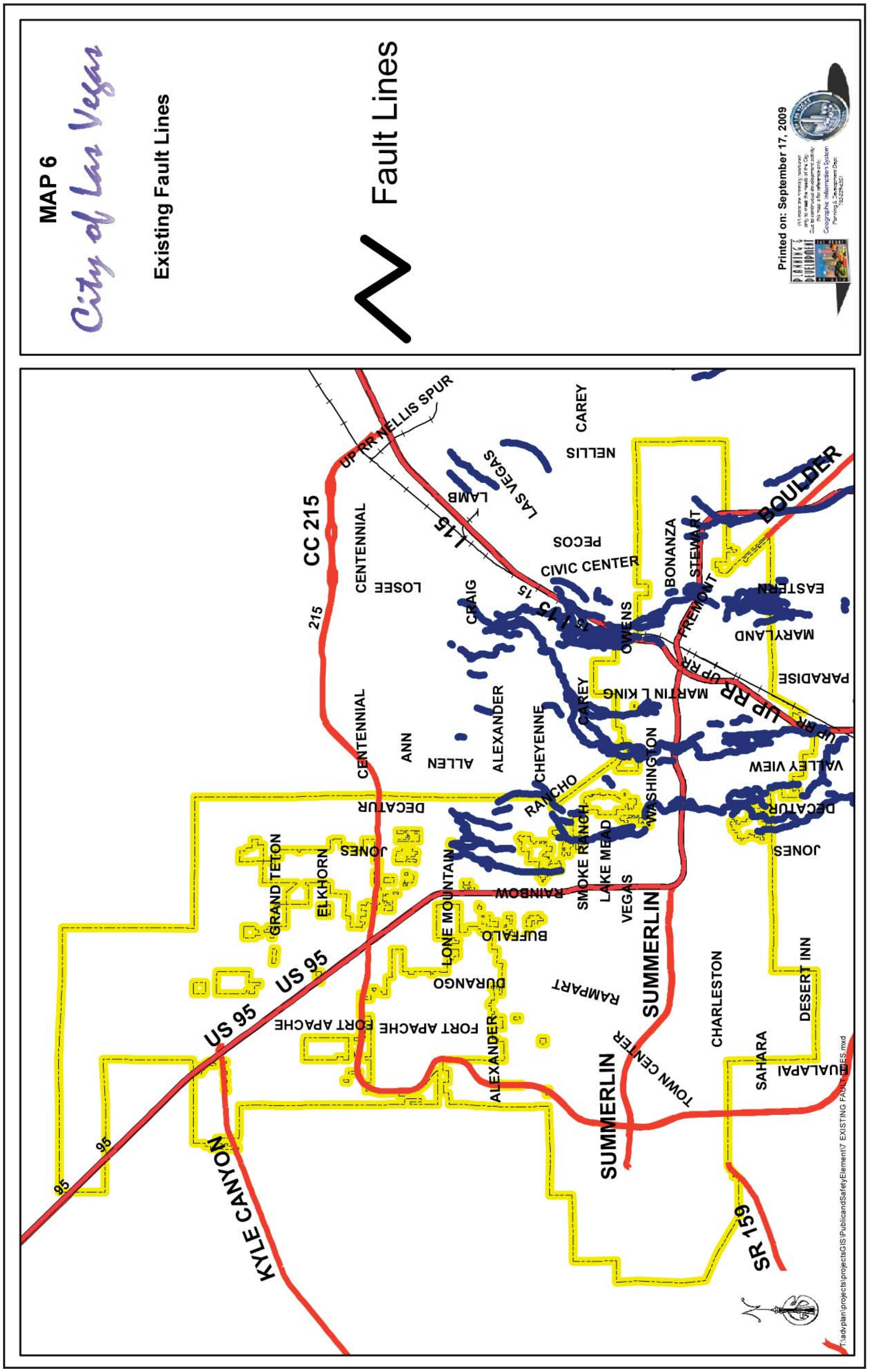
SEISMICITY/EARTHQUAKE HAZARDS

Seismic activity in the Las Vegas Valley has been and is related to man-made and natural causes. Man-made seismic activity has resulted from underground nuclear testing. It was generally of short duration with the only effect being minor inconvenience to those that experienced the tremor. There is no evidence that any structural damage to local buildings has resulted from nuclear testing. However, between 1974 and 1976, there were claims that nuclear testing and the resulting subsidence damaged a number of wells in the Northwest part of the valley. The U.S. Department of Energy established a monitoring program in 1976 that included a number of technical surveys such as: level line, tiltmeter, hydrograph and seismic station surveys. The results of these surveys led to the conclusion that land subsidence was occurring continually with no direct correlation to nuclear events.[3]

Natural causes of seismic activity are due to shifts in the earth's crust. Faulting results from the differential or shearing motion of the earth's crust. Tectonic faulting is found in the Las Vegas Valley and the surrounding mountains. These faults resulted from plate movement that occurred in the middle to late Pleistocene era and traverse the Las Vegas Valley floor in a north-south trending series (***Map 6***). A good example of a major active tectonic fault is the San Andreas Fault running up the coast of California from San Diego to San Francisco. Movement along this fault has resulted in numerous costly earthquakes.

Major earthquake activity in Nevada is concentrated along a series of faults extending in a northerly direction from the Owen's Valley in California to Winnemucca, with the greatest activity in the Reno/Winnemucca/Tonopah triangle, nearly two hundred miles northwest of the Las Vegas Valley.[4] In Clark County there have been no major earthquakes. However, tremors of intensities ranging between VI and VII on the Modified Mercalli Scale have been felt in the Clark County area as a result of strong earthquakes in west-central Nevada and Southern California. Because of these occurrences, the Las Vegas area is classified in Seismic Zone 2B of the Uniform Building Code (UBC) so that construction should remain sound if subjected to Modified Mercalli Scale intensities of VII (see ***Map 7***).

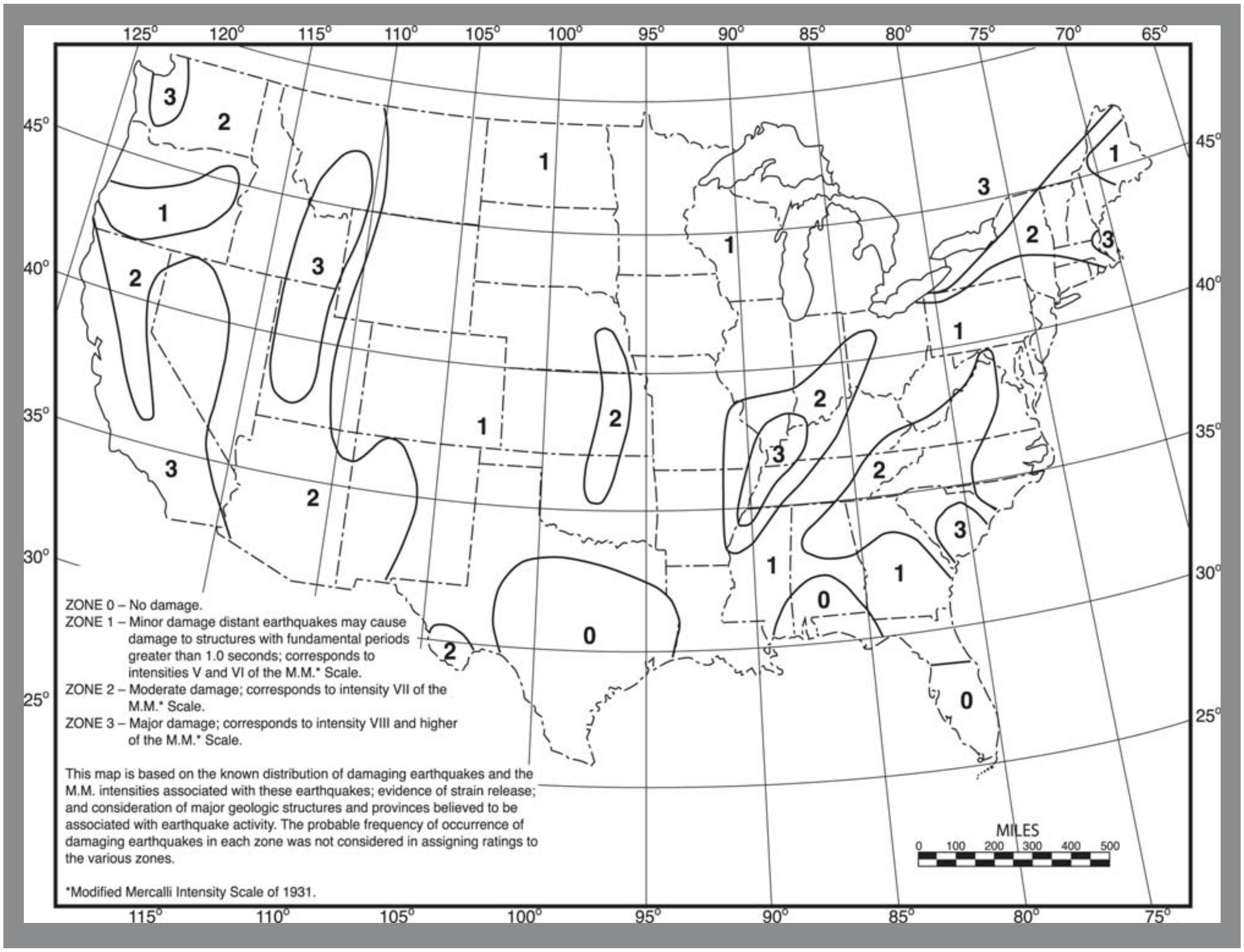
Map 6: Existing Fault Lines, City of Las Vegas



Seismic Hazard Safety

SAFETY & SEISMIC SAFETY ELEMENT

Map 7: Seismic Risk Map of the United States



TOPOGRAPHY AND SOIL TYPES

The Las Vegas Valley area lies in the southwestern part of the Great Basin, within the Basin and Range physiographic province. The valley is bound on the west by the Spring Mountains, the highest range in Clark County. This range contains Charleston Peak which is the third highest peak in Nevada at 11,918 feet. To the north the valley is bounded by the Desert, Sheep, and Las Vegas Ranges; on the east it is bounded by the Frenchman and Sunrise Mountains; and on the south by the River Mountains and the McCullough Range.[5] Major drainage in the Las Vegas Valley flows through the Las Vegas Wash to Lake Mead. The floor of this basin ranges from 1,800 to 2,500 feet in elevation. The basin floor is bounded on all sides by alluvial fans or aprons with slopes of 50 to 150 feet per mile and pediment surfaces (collectively called piedmont surfaces). Many of these piedmont surfaces are old and occur only as remnants, the most prominent being Whitney and Paradise Mesas in the southern part of the valley.[6]

The sedimentary formations in the Mountain Ranges consist mainly of limestone and mixtures of sandstone, shale, dolomite, gypsum, and in some places, interceded quartzite. The alluvial fan piedmont is composed of many coalescing fans dissected by numerous drainage channels. The upper portion of the fan piedmont, about 4,500 feet above sea level, is made up of poorly sorted gravelly, cobbly, and stony sand deposits that grade to finer textured material near the valley floor. The basin floors are depositional areas of lake-laid silt and clay and younger alluvial deposits.[7]

Soil formation and deposit characteristics are an important consideration in land use planning and land development decisions. Location of soil types can be used to identify the potentials and limitations of an area for specific land uses and to help prevent construction failures caused by particular soil properties, i.e., slope, depth, drainage, and physical characteristics. For example, impervious soil horizons are an important factor in desert flooding. Construction costs for building roads and preparing building sites are higher in shallow soils overlaying hardpan due to the need for heavy equipment such as backhoes, rippers, and trenching machines to penetrate the hardpan. Occasionally, blasting is necessary. Soils that are moderately to strongly alkaline can cause corrosive chemical reactions to uncoated steel and concrete. The shrink/swell potential of soils is a factor in soil movement that could damage foundations (see also discussion on subsidence, section 5.3, specifically “collapsible soils”).

Consideration of the impacts of adverse soil and deposit characteristics is conducted through the permit review process. The review of building plans for geologic hazards, the requirement of a soil engineering report of non-residential development plans, and a geo-technical investigation report on any housing development within 500 feet of a documented fault or fissure are incorporated in the current plot/site plan review process currently being conducted by City staff.

As of this update, staff is not aware of any areas of the city which have seismic or subsidence problems which cannot be mitigated. However, if the existence of such areas becomes known, then the City of Las Vegas should consider a policy that discourages development of such areas and encourages amendments to the Land Use Plan to properly reclassify those areas unsuitable for development because of geologic conditions. If appropriate, a subsidence district could be designated so monitoring can be conducted and mitigation measures determined and carried out when necessary.

Beginning with data available from the Clark County Building Department and in cooperation with the other neighboring governments and agencies, the city maintains and periodically updates maps of documented areas of collapsible soils, subsidence, faulting and fissuring within the city limits. The city makes available to the public information concerning documented areas of seismic hazard, subsidence, and poor soil conditions.

Table 1, Soil Impacts, summarizes individual soil type and **Map 8**, Soils Map, indicates where these soils are within city limits. The information presented in the table and maps are intended as a general representation and not for the purpose of determining hazards to construction. For example, use of this information does not substitute the need for site-specific soils analysis. The following terms and characteristic ratings are used in the table.

- **Shallow Excavations:**
  Rated by the ease of digging, filling, and compacting soils for trenches or holes dug to a maximum depth of five to six feet. The ease of digging is affected by depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The limitations are slight if soil properties and site features are generally favorable for excavation; moderate if soil properties and site features are not favorable and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design; significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where soil limitations are severe.

Map 8: Soils Map/ Soils Classifications, City of Las Vegas

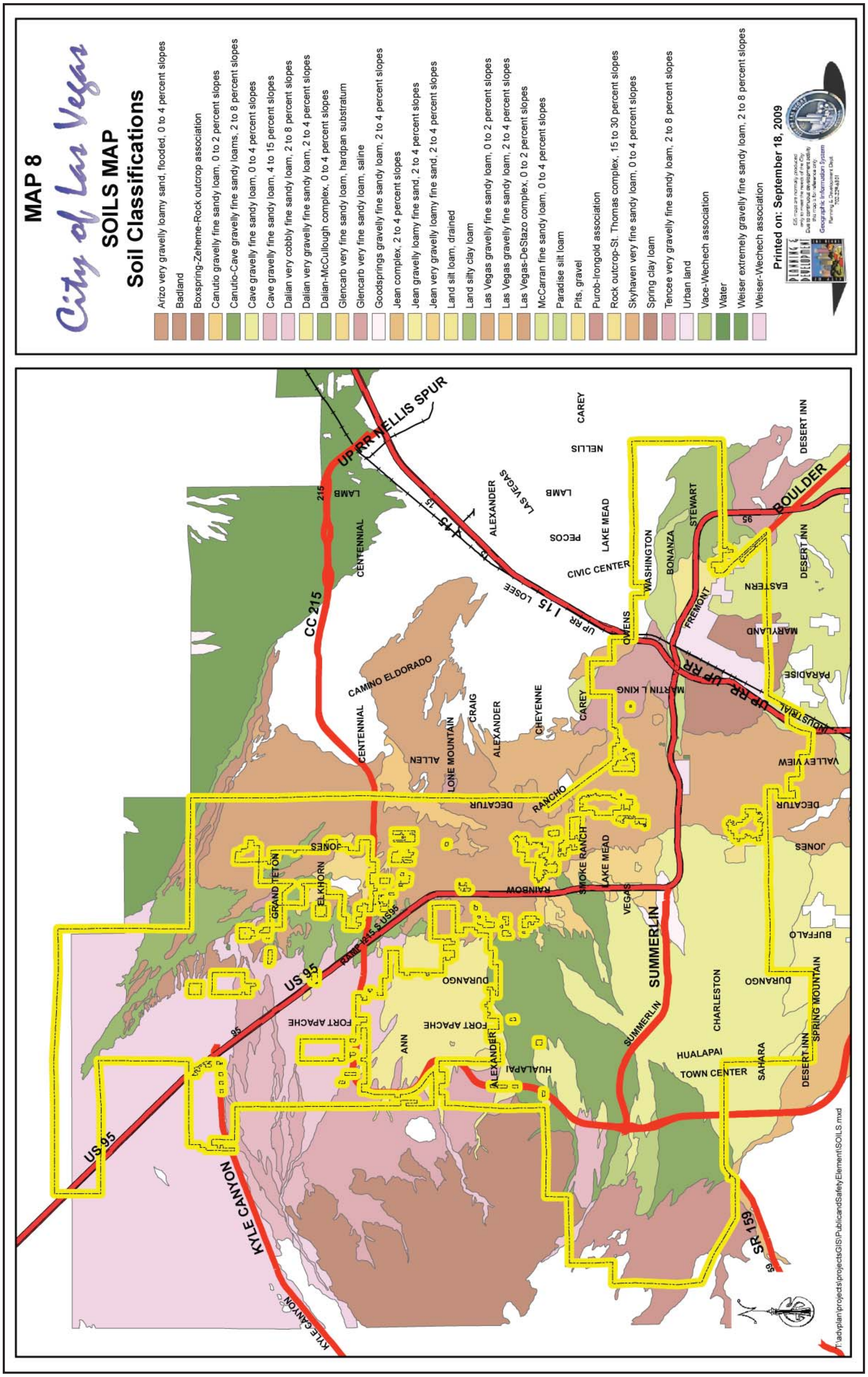


Table 1: Soil Impacts

Soil Name	Typical Map Symbol	Shallow Excavations	Risk of Corrosion Uncoated Steel	Concrete	Shrink-Swell Potential
Arizo	112	Severe: Cutbacks Cave	High	Low	Low
Cave	152	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Cave	155	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Dalian	190	Slight	High	Low	Low
Dalian	191	Slight	High	Low	Low
Dalian-McCullough	192	Slight	High	Low	Low
Glencarb	200	Slight	High	Moderate	Low-Moderate
Glencarb	236	Slight	High	High	Low-Moderate
Glencarb	237	Moderate: Cemented Pan	High	Low	Low-Moderate
Goodsprings	240	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Jean	260	Severe: Cutbacks Cave	High	Low	Low
Jean	263	Severe: Cutbacks Cave	High	Low	Low
Jean	264	Severe: Cutbacks Cave	High	Low	Low
land	270	Moderate: too clayey, wetness	High	High	Low-Moderate
land	282	Moderate: too clayey, wetness	High	High	Low-Moderate
Las Vegas	300	Severe: Cemented Pan	High	High	Low
Las Vegas	301	Severe: Cemented Pan	High	High	Low-Moderate
Las Vegas Destazo	305	Severe: Cemented Pan	High	High	Low-Moderate
McCarran	325	Slight	High	High	Low
Paradise	341	Moderate: wetness	Low		
St Thomas	360	Severe: depth to rock, large stones, slope	High	Low	Low
Skyhaven	380	Severe: Cemented Pan	High	High	Low-Moderate
Spring	390	Slight	High	High	Moderate

Table 1: Soil Impacts, continued

Soil Name	Typical Map Symbol	Shallow Excavations	Risk of Corrosion Uncoated Steel	Concrete	Shrink-Swell Potential
Tencee	400	Severe: Cemented Pan	High	Low	Low
Canutio	501	Moderate: large stones	High	Low	Low
Canutio-Cave	502 Moderate: large stones	High	Low	Low	
Weiser	540	Slight	High	Low	Low
Pits-Gravel	610	N/A	N/A	N/A	N/A
Urban land	615	N/A	N/A	N/A	N/A
Badland	630	N/A	N/A	N/A	N/A

- **Risk of Corrosion:**
  Pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. For uncoated steel, the risk of corrosion, expressed as low, moderate, or high, is based on soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. For concrete, the risk of corrosion is also expressed as low, moderate, or high. It is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design should be required if the combination of factors creates a severe corrosion environment.

- **Shrink-Swell Potential:**
  The potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. When the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed. Shrink-swell potential classes are based on the change in length or diameter of an unconfined clod (of soil) as moisture content is increased from air-dry to saturation. The change is based on the shrinkage or expansion of less than 2 millimeters in diameter. The classes are low, a change of less than 4 percent; moderate, 4 to 8 percent; and high, 8 to 12 percent. Critical, greater than 12 percent, is sometimes used.

SUBSIDENCE

Land subsidence, or the lowering of the earth's surface, can be due to natural causes or man-made processes. These causes are grouped into two categories: endogenic and exogenic subsidence. [8] Endogenic subsidence occurs within the earth and is due to tectonism, volcanism, and continental drift. Exogenic subsidence occurs mainly at the earth's surface and can result from natural causes as well as be induced by the activities of man.

Exogenic subsidence is basically the result of a loss of support. There are three processes that could result in a loss of support. First, loss of support can be caused by fluid extraction as in the case of groundwater withdrawal. Second, loss of support on a regional scale can be caused by an increase of loading from the weight of a body of water such as a lake. A third process that could cause a loss of support is the adding water to, or saturating, of a collapsible soil that has a susceptible structure due to water soluable binding agents. According to John Bell of the Nevada Bureau of Mines and Geology (NBMG), when "dry loose density soils are wetted they undergo compaction due to loss of intergranular strength." Water dissolves the binding agents, such as gypsum, and the soils collapse possibly under their own weight. Collapse is almost certain if in addition the collapsible soils have been supporting a house or some other structure.

Regional subsidence in the Las Vegas Valley was due to the creation of Lake Mead. The weight of the lake and its sediment load is over forty million tons. This weight along with tectonic activity already having occurred in the area is thought to have tilted the Las Vegas Valley four to five inches. However, this regional subsidence is thought to have had little effect on subsidence related problems in the Las Vegas Valley. These tend to be localized. Groundwater withdrawal is thought to be the most common reason for localized ground subsidence in the Las Vegas Valley.

Land subsidence in the Las Vegas Valley has been studied for more than fifty years. In 1978, a panel of U. S. Geological Society (USGS) scientists investigated the potential hazard posed by the subsidence problem concluding that a potential hazard for fissuring and surface faulting existed due to groundwater withdrawal in the valley. The USGS released a Notice of Potential Hazard in accordance with the Disaster Relief Act of 1974. As a supplement to the USGS Notice of Potential Hazard, NBMG prepared a comprehensive overview and analysis of subsidence in the Las Vegas Valley. The report was completed in 1981. This report has been and should continue to be updated by several research groups with NBMG serving as the lead agency. Table 2, Specific Cases of Damage Caused by Subsidence, is a summary of the report and documents the effects of subsidence valley wide. ***Map 9*** details the location of the cases and the variations of soil elevation due to subsidence.

Map 9: Subsidence Potential, City of Las Vegas

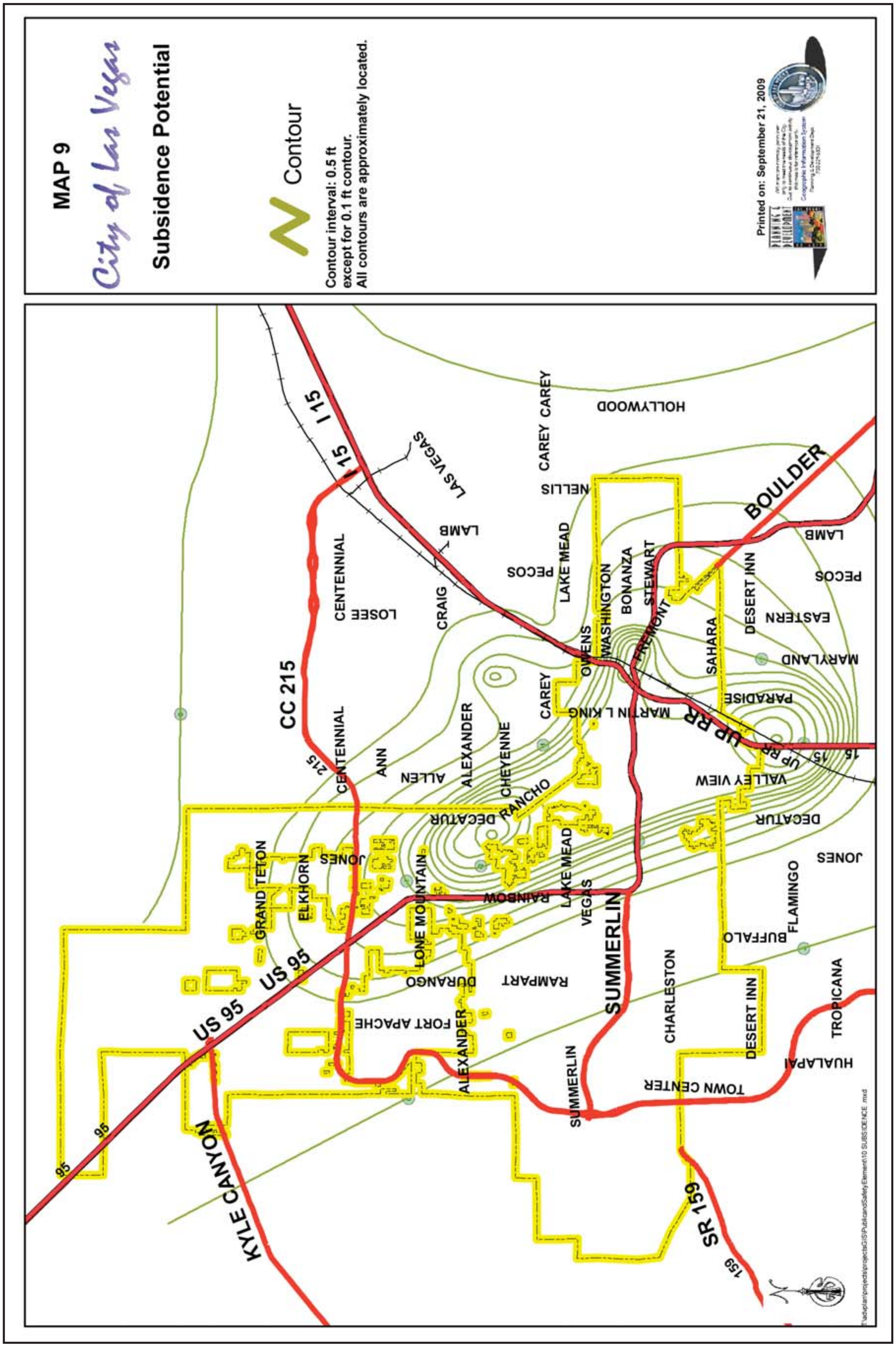


Table 2: Specific Cases of Damage Caused by Subsidence

Map ID	Type of Damage	Location	Date of Occurrence	Remarks
1	Protruding well	Las Vegas Valley Water District Well Field No. 5	1963	1.5 ft. of protrusion
			As of 1978	4 ft. of protrusion of well head, casing pumping in 1971; pumped much sand.
2	Protruding well	City of N. Las Vegas Stocker (west tank) Well	1936- 1963	3 ft. of protrusion
			1963- 1969	6 in. protrusion; causing re-placements in 1969; shows no present protrusion.
3	Protruding well	City of North Las Vegas Losee Well	1968- 1971	7 in. protrusion; casing replaced in 1969; shows no present protrusion.
4	Protruding well	City of North Las Vegas Tonopah Well	Unknown	
5	Protruding well	City of North Las Vegas Tonopah Well	Unknown	Presently shows 6 in. of protru-sion with broken well pad.
6	Protruding well	Nellis AFB area Nellis Well No. 4		Wellhead and pad show 4 in. of protrusion.
7	Protruding well	City of North Las Vegas LVVWD Well No. 57	As of 1978	2.5 ft. protrusion of casing; well abandoned.
8	Warping of railroad tracks	UPRR at Owens Ave.	1961	5 in. gradual displacement; 6 in. rapid displacement associated with fissuring.
9	Damaged house	Harrison and Owens	1961	2 in. rupture in house believed result of fissuring.
10	Damaged house	Near Craig Ranch near Country Club	Unknown	Reportly large separation
11	Damaged house	Twin Lakes Drive be-tween Bonanza Rd. and Washington Ave.	Pre 1974	Two residences damaged; ex-tent of damage unknown; on-line with fissures from LVVWD well field.
12	Damaged house	Adams St at Las Vegas Blvd.	Pre 1963	Result of movement on scarp III.
13	Popped windows, cracked driveways, bro-ken curbs	Twin Lakes Drive area	Pre 1965	Attributed to movement on scarp II.
14	Cracked pavement and curbs	Between Owens and Harrison Aves. And A and B Sts.	Pre 1970	Accompanied renewed fissuring.
15	Cracked pavement	Commerce St. near Losee Well	Pre 1971	
16	Cracked pavement	Craig Rd. near Nellis AFB well filed	Unknown	
17	Cracked asphalt in playground	Gilbert School in North Las Vegas	Unknown	Occurs where fissure extends beneath pavement.
	Well failures	Strip area	1970- 1974	At least two failures due to sheared casing.

Table 2: Specific Cases of Damage Caused by Subsidence, continued

Map ID	Type of Damage	Location	Date of Occurrence	Remarks
18	Damaged wells	Northwest of North Las Vegas Airport	1974- 1976	15 claims or complaints of: decreased productivity, turpid or sandy water, and deformation of casing.
19	Ruptured water mains; damaged pavement	Charleston Blvd at Maryland Pkwy.	1964	$10,000 damage reportly related to movement on scarp III.
20	Ruptured water main	Highland Ave at Hastings Ave.	1964	$2,000 damage
21	Ruptured water main	1626 Thelma Ln	1964	$1,500 damage
22	Ruptured water main	12th St between Bonneville and Clark Aves.	1964	$1,500 damage
23	Ruptured water main	1128 Francis Ave	1964	$14,000 damage
24	Ruptured water main	400 E. Garces Ave	1964	$12,000 damage
25	Ruptured water mains	Near Owens Ave and UPRR	1961	Related to fissuring
26	Warped sewage line	Charleston Blvd. Between Eastern Ave. and Pecos Rd.	Unknown	Differential movement attributed to land subsidence; lowered flow gradient required construction of new line.
27	Ruptured gas line	Washington Ave near Twin Lakes Dr.	Unknown	Two reported breaks attributed to movement on scarp II.
28	Ruptured swimming pool	Near Commerce St. and Losee Rd.	Unknown	Concrete pool back rotated and cracked; attributed to movement on scarp III.
29	Buckled drainage channel	In Flamingo Wash	1974	

Source: Appendix, 1992 City of Las Vegas General Plan

Parallel to this update, the NBMG is spearheading an integrated modeling research project within the University System, known as Subsidence Modeling and Prediction. ***Map 10*** shows those areas most susceptible to subsidence. Emphasis is on the poorly understood phenomenon of horizontal movement and related fissuring. Participants in the study intend to establish a reliable method of predicting fissure initiation and propagation.

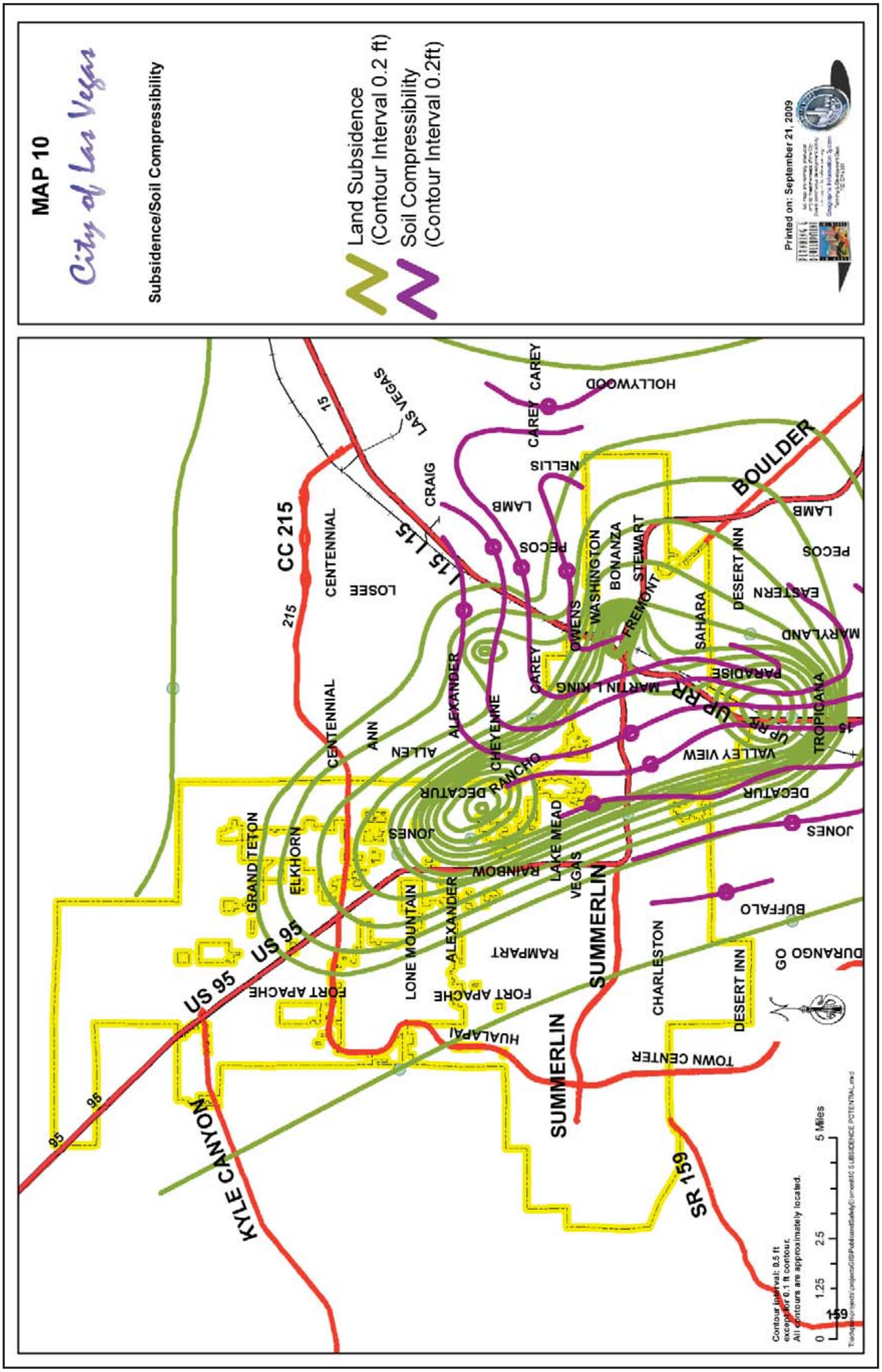
It is important to understand the distinction between "fault movement" and "fissure movement". Fault movement is associated with the release of natural forces, while fissure movement is associated with hydraulically driven forces associated with groundwater withdrawal. Fissures tend to occur near faults for very good reasons, but what causes fissure movement is very different from what causes fault movement. Thus, one can understand why exploring the causes of groundwater withdrawal related fissures and possibly discovering a method of making accurate predictions about when and where they should occur is very important in the Las Vegas Valley. The results of the study should provide a significant management tool for government agencies, public utilities and private industry in order to avoid or mitigate the potential hazards of subsidence.

According to ongoing analysis, subsidence is continuing at a rate similar to that found during the 1950s and 1960s when pumping of groundwater was at its peak. However, the magnitude and location of the subsidence effects varies according to the hydraulic connection between geologic strata underlying areas of groundwater withdrawal. Coarse grain deposits (sand and gravel) are less susceptible to vertical compaction and recover well when recharged. In contrast, fine-grain deposits (silts and clays) are highly compressible and are not as likely to recover from groundwater withdrawal when recharge begins. Soil samples taken from basin-fill sediments show that the most compressible deposits are located in the center of the Las Vegas valley basin near the city of Las Vegas (***Map 11***). The Subsidence Modeling and Prediction research plan mentioned above should help identify those areas susceptible to subsidence.

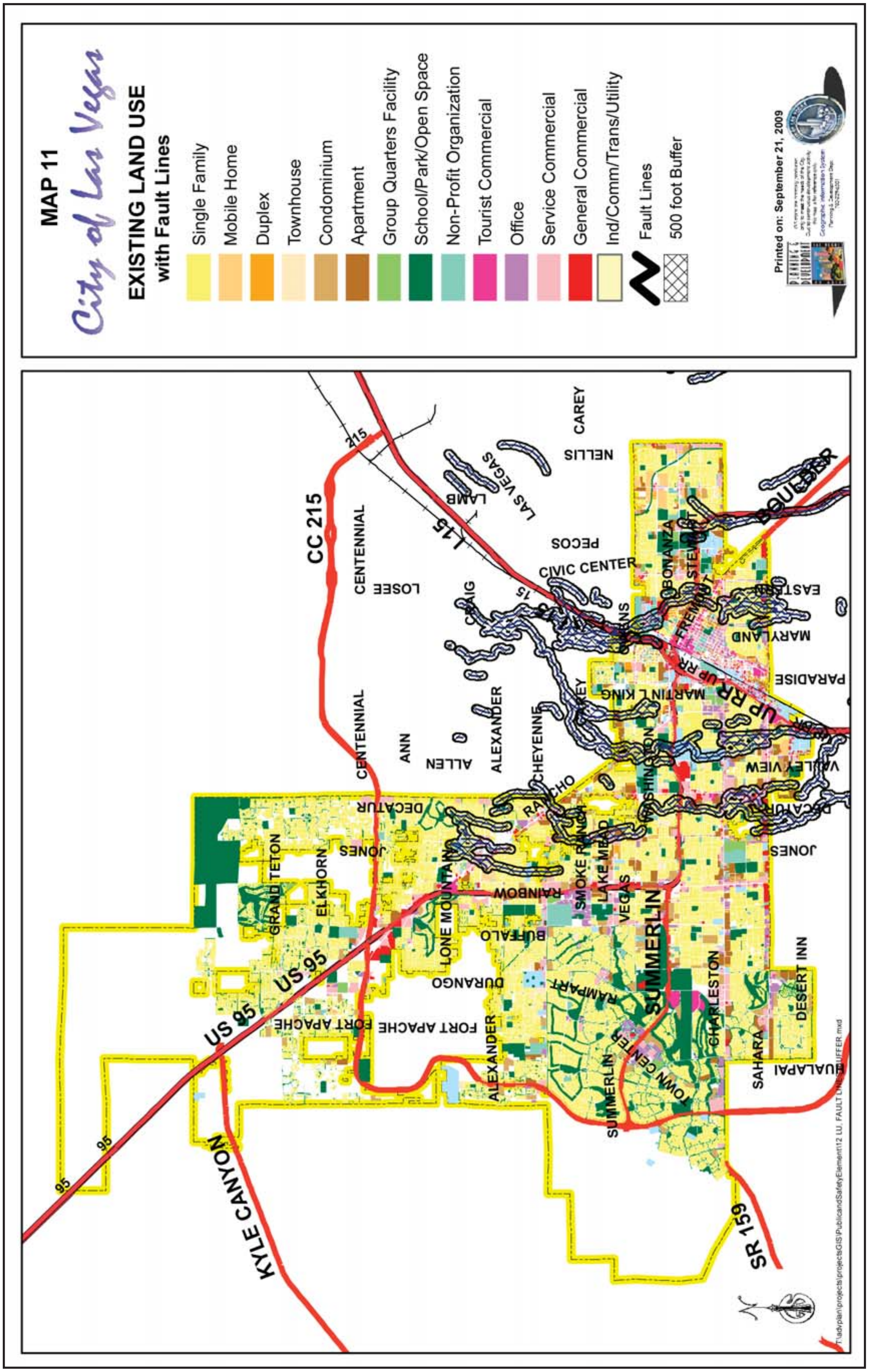
Map 10 also shows areas of the Las Vegas Valley that have experienced land subsidence due to the effects of groundwater withdrawal. Consequences of the valley floor sinking include evidence of new fissuring and possible spreading of existing faults and fissures. In most cases, these were originally caused by a combination of tectonic activity and the natural dewatering and subsequent compaction of basin-fill sediments during the warm, dry Pleistocene interglacial period.

Not all damage of this nature is caused by groundwater withdrawal, however. According to geologists and building officials there are localized problems associated with different types of soils and sometimes poor construction techniques. Updates of the 1981 subsidence report should contain a more thorough analysis of these differences. In the meantime, some governmental entities have initiated a policy that discourages the building of structures on land already documented as a subsidence area. For example, the Clark County School District currently rejects new school site locations if they are located in areas where subsidence damage has occurred in the past. Sites located on or near fissures caused by groundwater withdrawal would be expensive to build on and maintenance costs could be higher over time due to the resulting structural changes in the building. The Las Vegas office of the Department of Housing and Urban Development issued new guidelines requiring anyone building within 500 feet of a mapped fissure or fault to perform a geotechnical study as a condition for receiving federal assistance (***Map 11***). The City of Las Vegas Department of Public Works presently requires a soils investigation on any new construction and depending on the outcome of that report construction recommendations will be stipulated.

Map 10: Existing Land Use Subsidence/Soil Compressibility, City of Las Vegas



Map 11: Existing Land Use With Fault Lines, City of Las Vegas



Seismic Hazard Safety

SAFETY & SEISMIC SAFETY ELEMENT

SUMMARY

The subsidence problem will continue to occur as long as groundwater withdrawal exceeds annual recharge, natural or injected. The most damaging result will be the spreading of existing fissures and the likely formation of new ones. These phenomena will make such things as the enforcement of adequate construction regulations necessary. It will also require consideration of land use density restrictions on susceptible geographic areas. The NBMG study referenced above should be used by the City of Las Vegas to map high hazard areas. Then, policy can be made regarding the safe use of the land.

Seismic activity in the Las Vegas Valley has had significance in a geologic sense and in geologic time. Current building practices have been adequate to withstand seismic activity both man-induced through nuclear testing and natural from earthquakes. Research intending to update local seismic information may result in more stringent building standards. The pivotal issue in the valley is dealing with certain geologic deposits that are susceptible to horizontal movement and fissuring that may cause structural damage to buildings. Efforts to stabilize groundwater withdrawal practices should be prioritized locally and through State level legislation.

ISSUES

Existing in the Las Vegas Valley are soil and geologic conditions that are susceptible to subsidence problems. Continued withdrawal of groundwater in excess of annual recharge contributes substantially to the subsidence problem. In order to mitigate this phenomenon, efforts to stabilize groundwater withdrawal practices should have higher priority locally than through State level legislation. In the meantime, research, conducted and coordinated by an interagency body such as the Southern Nevada Regional Planning Coalition, will be funded that should develop prediction methods (especially of fissuring events) and continue to update data that can be used to determine development opportunities and constraints due to geologic hazards such as seismic hazards, collapsible soils, subsidence and related groundwater management practices in the Las Vegas Valley.

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: The City should participate in the protection of the environmental quality of the Las Vegas valley and to promote the conservation of our natural resources.

Objective 5A: The City should preserve life and property from geologic hazards such as seismic hazards, subsidence and related groundwater management practices, and poor soil conditions such as collapsible soils.

Policy 5A1: Building and Safety should continue the review of building plans for geologic hazards, i.e., collapsible soils, faults and fissuring, and subsidence.

Program 5A1.1: Public Works and Information Technologies should continue to maintain and periodically update maps of documented areas of collapsible soils, subsidence, faulting and fissuring with the latest data available from research.

Policy 5A2: In cooperation with neighboring agencies, the City should develop a policy which shall include, but not be limited to, discouraging development where seismic problems cannot be mitigated, and prepare land use amendments to properly reclassify areas.

Program 5A2.1: As part of development review, the Planning and Development Department should review applications in terms of seismic problems.

Program 5A2.2: If it is determined that there are areas in the city where seismic problems cannot be mitigated the City shall amend the Land Use Plan to prevent development.

Policy 5A3: The city should make available, to the public, information concerning documented areas of seismic hazard, subsidence, and poor soil conditions.

NOISE HAZARD SAFETY

The purpose of this section of the Safety & Seismic Safety Element is to protect people living and working in the city of Las Vegas from an excessive noise environment. Through advance planning and shared responsibility, city government and developers, working cooperatively with Federal and State governments, can plan, design, and construct new development projects and roadways that minimize the adverse effects of noise on the environment. This section details the maximum acceptable levels of noise per Policy 7.3.4 of the Las Vegas 2020 Master Plan.

INTRODUCTION

Noise in excessive levels can affect our environment and our quality of life. Noise is subjective since it is dependent on the listener's reaction, the time of day, distance between source and receptor, and its tonal characteristics. Studies have shown that excessive noise can have adverse physiological and psychological effects. Extreme levels can cause pain and hearing loss. Continuous exposure to low-level noise can have such insidious, long-term effects as raising blood pressure, lessening the quality of sleep, or inhibiting children's ability to learn.

The Noise Hazard Safety Section provides goals and policies to guide compatible land uses and the incorporation of noise attenuation measures for new uses to protect people living and working in the city from an excessive noise environment. This purpose becomes more relevant as the city continues to grow with infill and mixed-use development consistent with the Land Use and Rural Preservation Neighborhood Element.

Guidelines developed by several federal agencies including the Federal Highway Administration, the Federal Aviation Administration, the Environmental Protection Agency and the Department of Housing and Urban Development stipulate that residential land use sound levels not exceed 45-55 decibels. Schools, hospitals, lodging, and certain recreational facilities are "noise sensitive uses" which should be protected from a variety of environmental and public problems.

The decibel (dB) is a unit for measuring the volume of sound. A rating scale, dB (A), was devised to measure sound relative to the sensitivity of the human ear. The dB (A) scale is logarithmic so an increase on ten decibels is a tenfold increase in sound energy. However, measuring sound does not necessarily determine what actually constitutes noise on a community level. The Day-Night Average Sound Level (Ldn) scale is a sound measurement technology that was developed to measure cumulative noise exposure in the community over the twenty-four hour day (Leq). The Environmental Protection Agency recommends outdoor Ldn noise levels of 55 dB or lower and indoor levels of 45 dB or lowers in residential areas with outdoor space, rural areas, and hospitals.

The city will use the Land Use – Noise Compatibility Guidelines shown on Table 3 for evaluating land use noise compatibility when reviewing proposed land use development projects. A "compatible" land use indicates that standard construction methods will sufficiently attenuate exterior noise to an acceptable indoor noise level and people can carry out outdoor activities with essentially no noise interference. In general, evaluation of land use that falls into the "conditional compatible" noise environment should include consideration of the type of noise source, the sensitivity of the noise receptor, and the degree to which the noise source may interfere with speech, sleep, or other activities characteristic of the land use. Structures must be capable of attenuating exterior noise to an acceptable indoor noise level. For land uses indicated as incompatible, new construction should generally not be undertaken. Due to severe noise interference, outdoor activities are unacceptable and for structures, extensive mitigation techniques are required to make the indoor environment acceptable.

Table 3: Land Use – Noise Compatibility Guidelines

Land Use Category	Exterior Noise Exposure (dBA CNEL)					
	60	65	70	75	80	
Open Space and Parks and Recreational						
Community & Neighborhood Parks; Open Space; Natural Resources Preservation; Park Maintenance Facilities						
Outdoor Spectator Sports, Golf Courses; Athletic Fields; Outdoor Spectator Sports, Water Recreational Facilities; Horse Stables						
Agricultural						
Crop Raising & Farming; Aquaculture, Dairies; Horticulture Nurseries & Greenhouses; Animal Raising, Maintain & Keeping; Commercial Stables						
Residential						
Single Units; Mobile Homes; Senior Housing		45				
Multiple Units; Mixed Use Commercial/Residential; Live Work.		45	45	45		
Institutional						
Hospitals; Nursing Facilities; Intermediate Care Facilities; Educational Facilities; Libraries; Museums; Places of Worship; Child Care Facilities		45				
Cemeteries						
Sales						
Building Supplies/Equipment; Food, beverage & Groceries; Pets & Pet Supplies; Sundries, Pharmaceutical, & Convenience Sales; Wearing Apparel & Accessories			50	50		
Commercial Services						
Building Services; Business Support; Eating & Drinking; Financial Institutions; Assembly & Entertainment; Radio & Television Studios; Golf Courses			50	50		
Visitor Accommodations		45	45	45		
Offices						
Business & Professional; Government; medical, Dental & health Practitioner; Regional & Corporate Headquarters			50			
Vehicle and Vehicular Equipment Sales and Services Use						
Commercial or Personal Vehicle Repair & Maintenance; Commercial or Personal Vehicle Sales & Rentals; Vehicle Equipment & Supplies Sales & Rentals			50	50		
Wholesale, Distribution, Storage Use Category						
Equipment & Materials Storage Yards; Moving & Storage Facilities; Warehouse; Wholesale Distribution; Mining & Extractive Industries				50	50	
Industrial						
Heavy Manufacturing; Light Manufacturing; Marine Industry; Research & Development; Trucking & Transportation Terminals				50	50	

Source: City of San Diego Noise Element May 2006

Table 4: Land Use Compatibility

	Compatible	**Indoor Uses**	Standard construction methods should sufficiently attenuate exterior noise to an acceptable indoor noise level.
		Outdoor Uses	Activities associated with the land use may be carried out.
	Conditionally Compatible	**Indoor Uses**	Building structure must attenuate exterior noise to the indoor noise level indicated by the number for occupied areas.
		Outdoor Uses	Feasible noise mitigate techniques should be analyzed and incorporated to make the outdoor activities acceptable.
	Incompatible	**Indoor Uses**	New construction should generally not be undertaken, extensive mitigation techniques are required to make the indoor environment acceptable for activities.
		Outdoor Uses	Severe noise interference makes outdoor activities unacceptable.

EFFECTS OF NOISE

Community or neighborhood noise is emitted from a variety of sources including roadway, rail and air traffic and industrial, construction, and neighborhood activities. The health consequences of harmful levels of noise can be significant, including hearing impairment and loss, interference with speech communication, disturbance of rest and sleep, as well as the potential for physiological, mental-health and performance effects. It has been shown, mainly for workers and children, that noise can adversely affect performance of cognitive tasks. Although noise-induced arousal may produce better performance when doing simple tasks, cognitive performance substantially decreases for more complex tasks. Tasks such as reading, problem solving and memorization are among the cognitive activities most strongly affected by noise (WHO 1999). In addition to these health effects, noise can be an annoyance and interfere with one's day-to-day activities. Table 5 below shows the average sound levels, in decibels, of typical noise sources. Hearing impairment or loss can occur at decibel levels of about 70.

Table 5: Common Outdoor and Indoor Noises

Outdoor Noises	Indoor Noises	Sound Pressures (uPa)	Sound Pressure Levels (dB)
Jet Flyover at 300m	Rock Band at 5m	6,324,555	110
Gas Lawn Mower at 1m	Inside Subway Train	2,000,000	100
Noisy Urban Daytime	Garbage Disposal at 1m	200,000	80
Gas Lawn Mower at 30m	Normal Speech at 1m	63,246	70
Quiet Urban Daytime	Dishwasher Next Room	6,325	50
Quiet Urban Nighttime	Small Theatre	2,000	40
Quiet Rural Nighttime	Bedroom at night	632	30

Source: Corbusier 2003

The Federal Noise Control Act of 1972 (NCA) was established "to promote an environment for all Americans free from noise that jeopardizes their public health and welfare." The NCA provides for a division of powers between the federal, state and local governments. In the past, the Environmental Protection Agency (EPA) coordinated all federal noise control activities through its Office of Noise Abatement and Control; however, in 1982, the EPA officially shifted the primary responsibility of regulating noise to state and local governments. Exceptions include transportation noise sources including aircraft and railroad operations and commercial motor vehicle traffic involved in interstate transport, which have some federal oversight (U.S. EPA 2007).

The Federal Railroad Administration (FRA), which regulates rail safety, requires trains to sound horns when approaching all intersections, regardless of time of day. While the FRA has studied the possibility of eliminating the need for horns at intersections with full quadrant gates (gates constructed so cars are unable to drive around them), at this point no action in that direction has been taken. The only currently acceptable way to eliminate the sounding of the horns is for a pass-through over or under pass.

NOISE MITIGATION METHODS

The major sources of noise in the City are from roadways, aircraft and the railroad. Several methods can be employed to protect the public from these noises and their effects. Guiding the location of noisy activities can be accomplished through the zoning process. Other noise problems can be ameliorated by construction and design measures. Open space buffers, berm and barrier construction; placement of non-sensitive uses to buffer sensitive uses; and proper building orientation, layout and construction are a few methods that can be used to minimize noise effects. Furthermore, evaluation of potential noise conflicts with new or expanded transportation facilities, such as airports and roadways, can incorporate noise mitigation measures in the design. Prohibiting nuisance noise is detailed in Chapter 9.16 of the Municipal Code.

NOISE ISSUES

A. Motor Vehicle Traffic Noise

Motor vehicle traffic noise is ubiquitous within the city. Excessive noise levels along major roads, interstate freeways, and state highways affect much of the urban environment. Traffic noise level is dependent upon volume, speed, flow, vehicle mix, and pavement condition as well as distance to the receptor. The city has no control over the noise generated by vehicular traffic on state freeways and highways. For these and more appropriately for city-controlled major roads, the city can, however, influence daily traffic volumes and reduce peak-hour traffic by promoting alternative transportation modes and integration of mixed-use infill development. In addition, local roadway design features and traffic management and calming techniques can minimize noise from traffic speed and frequent vehicle acceleration and deceleration, and innovative roadway paving material can further reduce traffic noise. Future use of hybrid transit buses could help to reduce noise along mixed-use transit corridors. For noise-sensitive land uses adjacent to freeways and highways, these uses should be buffered from excessive noise levels by intervening, less sensitive, industrial-commercial uses or shielded by sound walls or landscaped berms.

B. Train Noise

Daily traffic from freight train operations produces noise that may disrupt adjacent noise-sensitive uses. Trains can generate high, yet relatively brief, intermittent noise events. The interaction of the steel wheels and rails is a major component of train noise. Factors that influence the overall rail noise include the train speed, train horns, type of engine, track conditions, use of concrete cross ties and welded track, the intermittent nature of train events, time of day, and sound walls or other barriers.

The Federal Railroad Administration (FRA), which regulates rail safety, requires trains to sound horns when approaching all intersections, regardless of time of day. While the FRA has studied the possibility of eliminating the need for horns at intersections with full quadrant gates (gates constructed so cars are unable to drive around them), at this point no action in that direction has been taken. The only currently acceptable way to eliminate the sounding of the horns is for a pass-through over or under pass.

Within the city, at grade crossing is only located at Union Pacific Railroad and Wyoming Avenue. Given the traffic count on Wyoming Avenue at the rail crossing (18,000 ADT), and its proximity to residential development at Oakey Boulevard and Martin L. King Boulevard, the city should begin to explore the possibility of creating a grade-separated crossing at this location.

C. Aircraft Noise

Aircraft noise primarily affects communities within an airport influence area. The noise impact or the perceived annoyance depends upon the noise volume, length of the noise event and the time of day. In general, aircraft noise varies with the type and size of the aircraft, the power the aircraft is using, and the altitude or distance of the aircraft from the receptor. Another variable affecting the overall impact of noise is a perceived increase in aircraft noise at night.

Federal Aviation Regulation, Part 150, Airport Noise Compatibility Planning, is the primary Federal regulation guiding and controlling planning for aviation noise compatibility around airports. This regulation establishes the 65-dBA CNEL as the boundary for the normally acceptable level of aircraft noise for noise-sensitive land uses including residential uses near airports. ***Map 12*** indicates that there are no areas within the City exposed to noise levels of 65 dBA CNEL or greater.

It should also be noted that there are several approved heliports within the City. The noise levels associated with operations at a heliport depend upon the flight path, the helicopter types used, the number of operations, and the time of day (***Map 13***). Helicopter activity from military, private, police, fire/rescue, medical, and news/traffic monitoring helicopters contribute to the general noise environment in the city. In particular, low-flying helicopters are a source of noise complaints in the city, especially at night.

GOALS, OBJECTIVES, AND POLICIES

Goal: The City should minimize the adverse effects of noise through proper land use planning.

Objective 6A: The City should work to reduce unacceptable community noise levels.

Policy 6A1: Ensure that new development can be made compatible with the noise environment by using noise/land use compatibility standards.

Policy 6A2: The City should adopt an ordinance that mandates that exterior noise levels of 55 dB and interior noise levels of 45 dB as the noise limits for residential, public and quasi-public uses in the City of Las Vegas.

Policy 6A3: Require the inclusion of noise-reducing design features in development and reuse/revitalization projects to address the impact of noise on residential development.

Objective 6B: Minimize transportation-related noise impacts.

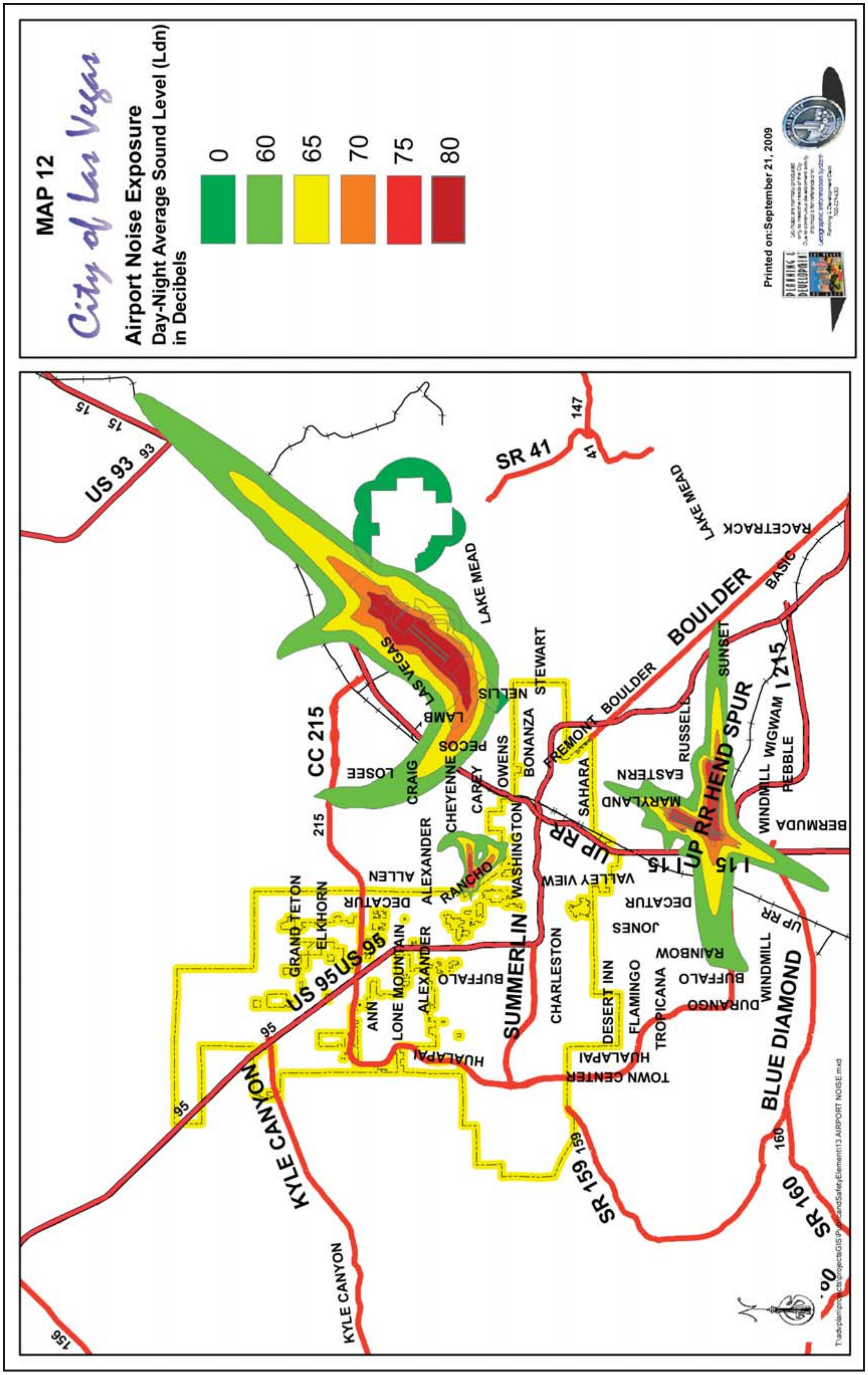
Policy 6B1: The City should seek funding to install an overpass at the intersection of Wyoming Avenue and the Union Pacific Railroad crossing. This would eliminate the requirement for trains to blow their horns at each passing.

Policy 6B2: The City should support the use of landscaping and sound walls as a means to buffer transportation corridors.

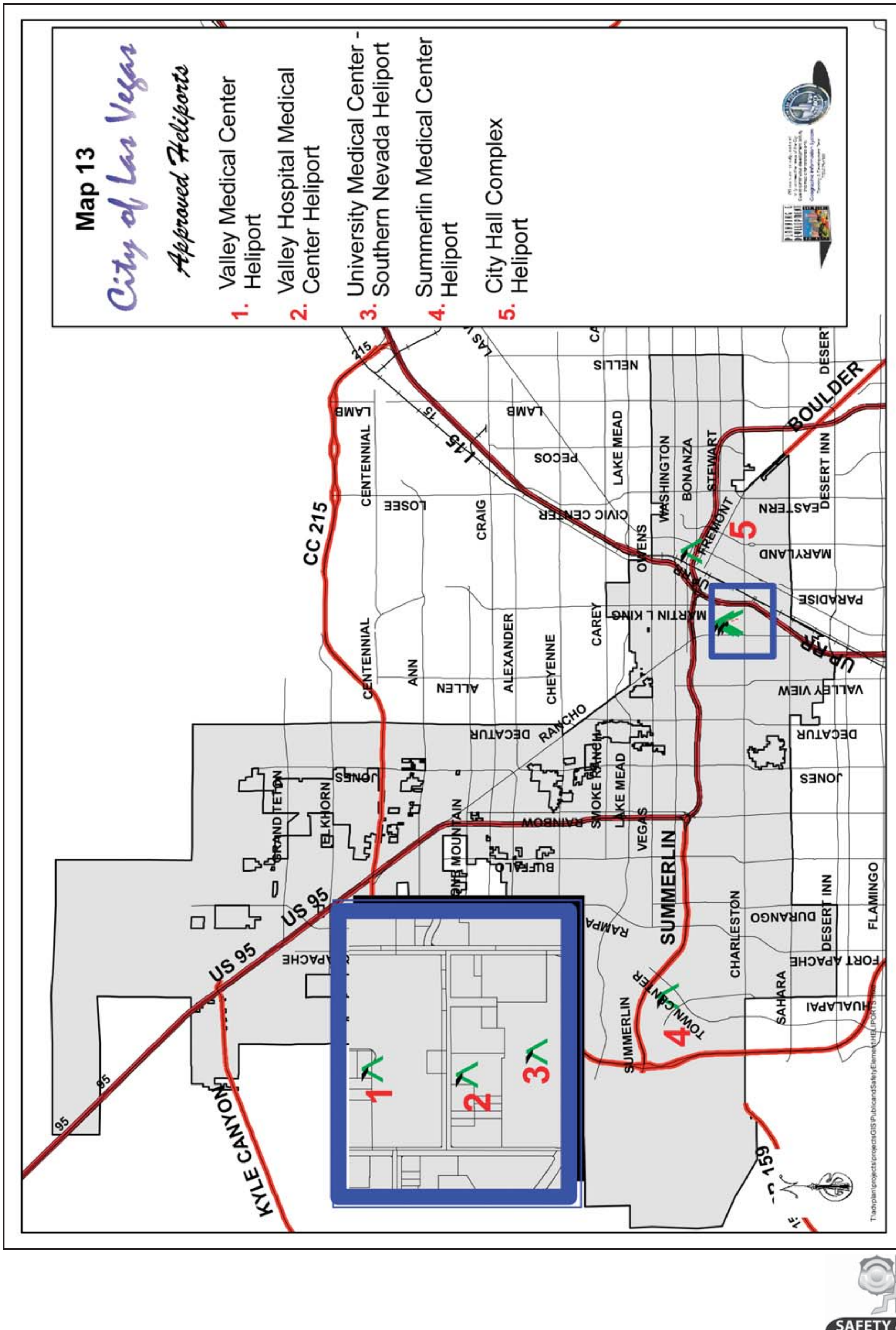
Policy 6B3: The Department of Public Works and other applicable agencies and departments should support the use of transportation technologies that minimize vehicular noise along freeways and nearby airports.

Policy 6B4: Control truck traffic routing to reduce transportation-related noise impacts on sensitive uses.

Map 12: Airport Noise Exposure, City of Las Vegas



Map 13: Approved Heliports, City of Las Vegas



HAZARDOUS MATERIAL SAFETY

The purpose of this section of the Safety and Seismic Safety Plan is to explain how the services of the City of Las Vegas will be incorporated in the accomplishment of public safety in a comprehensive manner as it relates to hazardous materials, particularly high level nuclear waste. Discussion will detail how the City of Las Vegas should coordinate with other agencies on matters concerning hazardous materials per Policy 7.3.2 and 7.3.8 of the Las Vegas 2020 Master Plan.

INTRODUCTION

Hazardous materials are a part of modern life. When properly managed, their potential to harm people and the environment can be minimized. This is done through limiting and regulating the transportation, distribution, storage, use, and disposal of hazardous materials within the community.

The citizens also have a responsibility in the management of hazardous materials. Used motor oil and many common household cleaning and pest control products can negatively impact the environment when they are dumped on the soil or put into landfills. Disposal of hazardous materials is an individual responsibility and collection of hazardous house wastes can be coordinated with the local bulk waste disposal management company. Recycling or disposal of such materials helps reduce groundwater contamination.

The term "hazardous materials" encompasses a large number of substances, including toxic metals, chemicals, and gases; flammable and / or explosive liquids, solids, and gases; erosive materials; infectious substances; and radioactive materials. The transport, distribution, storage, use, and disposal of materials are of extreme concern to the community. There is a potential for catastrophe as well as the pollution of the environment. Of general concern to the Las Vegas valley, and the city of Las Vegas in particular, is the potential of transportation of radioactive waste through the City to the proposed repository at Yucca Mountain, not to mention the potential to impact communities across the nation.

THE RADIOACTIVE WASTE ISSUE: THE CITY'S POSITION

In July 2009, the Federal Government removed all funding in the FY 2011 budget for proceeding with the Nuclear Regulatory Commission (NRC) license application review of a proposed high-level nuclear waste repository site at Yucca Mountain. However, it is important to note that killing the project outright would require an act of Congress to change the Nuclear Waste Policy Act. Until that happens, the project could be restarted if the Federal Government decides to fund it again.

Therefore, in light of issues such as:

- Yucca Mountain is the preferred high-level nuclear waste repository site,
- the waste that will be stored at the repository is potentially extremely dangerous, and
- accidents are possible while the waste is in transit, the city of Las Vegas has been compelled to make its position clear about the transport of radioactive waste through the City.

On September 6, 2000 the Mayor and City Council of the city of Las Vegas adopted a resolution (R-85-2000) that opposes all legislation that would require or allow the transportation of radioactive waste near or through the city. By the resolution, the city maintains that such waste should be stored at the sites where the waste is generated and the funding that is focused on Nevada as being the only storage option should be shifted to the task of finding a scientifically defensible and publicly acceptable method of disposal. Through the resolution, the Mayor and Council, because of their opposition of legislation that would allow the transportation, storage, or production of high-level nuclear waste, has designated the city of Las Vegas as a Nuclear Free Zone.

This section will review the facts about how highly radioactive waste is generated, the plans for transporting the waste, and how the waste is to be stored. If Yucca Mountain is ever selected as the repository of high level nuclear waste this section will provide long-term policy, objectives, and programs for the city's role in this sensitive issue.

IMPACTS OF NUCLEAR WASTE TRANSPORT

Studies by the State of Nevada(10) and the Department of Energy (DOE) indicate that 43 states would be directly impacted by thousands of spent nuclear fuel and high-level radioactive wastes shipments to Yucca Mountain. At least 109 cities with populations over 100,000 plus thousands of smaller communities could be affected by such shipments.

The many uncertainties surrounding the transportation of nuclear waste to a repository make it extremely difficult to assess potential impacts and plan for contingencies. DOE and the nuclear industry point to the past history of spent nuclear fuel shipments as an indication of the inherent safety of this type of transport activity. While it is true that, since 1962, there have been no radioactive releases as a result of transportation accidents, the amount of waste shipped to the repository in the first full year of operations alone will exceed the total amount shipped in the United States for the past 30 years. In addition, the distances over which spent nuclear fuel and high-level radioactive wastes would have to be shipped will be much greater for future repository shipments than for past shipments. Past shipments of nuclear waste have often been shorter-distance transfers of spent nuclear fuel from one utility location to another.

The State of Nevada has been examining transportation issues associated with the proposed repository for over 10 years. As a result of the State's work, a number of unresolved safety issues have been identified. These will be discussed in detail in the following pages.

ISSUES ON NUCLEAR WASTE

1. **Transportation Feasibility and Risks**
   The way in which waste is shipped is an area of uncertainty. DOE believes it would be safer to ship waste by rail, since rail shipments could be larger, carry more waste and ultimately require fewer numbers of shipments. However, a number of reactor sites, where waste is currently generated, do not have rail access or are not capable of handling large rail casks.

   To date, DOE has identified three potential rail spur routes in Nevada. Detailed analysis has been performed on only one, and DOE has no plans to study the others in more detail anytime in the near future. The route DOE has studied would require the construction of 360 miles of new track from the Union Pacific main line near Caliente, NV along a roundabout route to Yucca Mountain. The cost would be between $1 billion and $1.4 billion (in 1990 dollars). DOE's own analysis indicates there would be significant engineering challenges and, because of environmental hurdles involved with this spur construction, would have to undergo detailed and lengthy environmental reviews under the National Environmental Policy Act (NEPA).

   All of the other possible rail spur options identified by DOE have similar problems, and it is questionable whether rail access can be provided or whether Congress will appropriate the funds needed for an exceedingly expensive and potentially controversial rail line when highway access is presently available.

   Legislation currently before Congress would require DOE to use an intermodal system of spent nuclear fuel and high-level radioactive wastes transportation to Yucca Mountain or an interim storage site. This would entail the shipment of wastes in large containers by rail to eastern Nevada, and then transferring the canisters to very large "heavy haul" trucks for the trip to Yucca Mountain. Such transport poses new problems, including interference with routine traffic on existing state and U.S. highways, possible weather related problems and risks for large heavy haul vehicles in the winter months, added risks associated with extra handling and long distance truck transport, susceptibility to terrorist attack, and other problems.

2. **Highway Transport Risks**
   Without rail access to Yucca Mountain or some form of intermodal transfer system, all waste would have to be shipped by truck along the nation's interstate highways or alternative routes designated by states. This creates the possibility that between 35,000 and 100,000 shipments, during the 25-year emplacement phase of the proposed repository will be required through urbanized areas.

   Under present federal routing requirements for spent nuclear fuel and high-level radioactive wastes materials, most of these shipments would be routed through heavily populated areas of major U.S. cities. Under federal regulations, alternative routes could be designated by the states, but any alternative route designations would involve tradeoffs in terms of risk to population centers in contrast to those risks associated with the use of longer routes on two lane highways over difficult terrain and through rural communities. Actions by states to designate alternative routes are complicated by a recent court decision in New Mexico that could make state and local governments liable for loss of property values along designated shipping routes.

   Truck shipments in the numbers needed for moving waste to a repository from reactor sites around the nation would put nuclear waste trucks on the country's interstate highways in large numbers year round for almost three decades. Because of the numbers of shipments involved, the chances for accidents will increase, and because the new casks will carry more waste per shipment, the consequences of a very severe accident could also increase.

3. **Radiological Effects of Routine Shipments**
   One of the areas of concern in nuclear waste transportation is the exposure of waste handlers, drivers, and the general public to radiation even during routine (non-accident) conditions. Even though shipping containers are shielded and designed to reduce exposures to radiation from spent nuclear fuel or high-level radioactive wastes, federal regulations allow a low level of radiation to emanate from the casks. This level is not dangerous under normal conditions. Nevertheless, repeated and long-term exposure to these low levels of radiation can have health consequences that need to be monitored and managed.

   The radiation level of the material within the containers remains high, even after ten years of cooling, and spent nuclear fuel emits dangerous levels of gamma and neutron radiation. A person standing one yard away from an unshielded spent nuclear fuel assembly could receive a lethal dose of radiation (about 500 rems) in less than three minutes. A 30 second exposure (about 85 rems) at the same distance could significantly increase the risk of cancer and/or genetic damage. Defense high-level waste, which contains even higher concentrations of gamma-emitting fission products, is similarly dangerous. The surface dose rate of spent nuclear fuel is so great (10,000 rem/hour or more), that shipping containers with enough shielding to completely contain all emissions would be too heavy to transport economically. Federal regulations allow shipping casks to emit 10 millirems/hour at 2 meters from the cask surface. This is equivalent to about one chest x-ray per hour of exposure.

Routine exposures become especially problematic in situations where the transport vehicle is caught in heavy traffic with cars and other vehicles in close proximity for extended periods. Routine exposures also are of concern when the cask vehicle is stopped for repair, fueling, inspections, etc.

The health effects of even low-level radiation are poorly understood. There is evidence that even small amounts of radiation can have long-term health implications. The potential effects of repeated exposures to large numbers of nuclear waste shipments along highways or railroads during the 25-year repository emplacement phase have not been adequately addressed and could have adverse health consequences for certain segments of the public.

4. **Probability of Serious Accidents**

Between 1957 and 1964, there were 11 transportation incidents and accidents involving spent nuclear fuel shipments by the US Atomic Energy Commission and its contractors. Several of these incidents resulted in radioactive releases requiring cleanup, including leakage from a rail cask in 1960 and leakage from a truck cask in 1962. There is no comparable data for the period from 1964 to 1970, when utility shipments to reprocessing facilities began. Between 1971 and 1990, there were six accidents and 47 incidents involving nuclear waste shipments. Three accidents (two truck, one rail) involved casks loaded with spent nuclear fuel. No radioactivity was released in these accidents. Most of the incidents involved excess radioactive contamination on cask surfaces, a result of the so-called "weeping" phenomena on casks loaded and unloaded in wet storage pools.

Based on the 1971-1990 accident data, DOE calculated accident and incident rates for commercial spent nuclear fuel shipments to a repository. For truck shipments, DOE calculated 0.7 accidents and 10.5 incidents per million shipment miles. For rail shipments, DOE calculated 9.7 accidents and 19.4 incidents per million shipment miles. Although the number of spent nuclear fuel shipments and accidents during these years was small, DOE compared these accident/incident rates to the general accident rates for large commercial truck and freight rail movements. The DOE concluded the general rates should be used in repository transportation risk and impact studies. DOE recommended use of a truck accident rate of 0.7 - 3.0 accidents per million shipment miles and a rail accident rate of 11.9 accidents per million shipment miles.

An estimate of the number of accidents likely to occur during spent nuclear fuel shipments to a repository can be obtained by multiplying the anticipated accident rates by the anticipated cumulative shipment miles. If all spent nuclear fuel were to be shipped to the repository by truck in larger-capacity casks, requiring about 46,000 shipments and over 100 million shipment miles, between 70 and 310 accidents and over 1,000 incidents would be expected over the operating life of the repository. Under the DOE base case scenario (88% rail, 12% truck), about 50 to 260 accidents and 250 to 590 incidents would be expected.

While accidents severe enough to cause a failure of the transport cask, with a resulting release of radioactive material, are likely to be rare, the potential exists for serious accidents to occur. Transport containers for repository bound waste shipments have not yet been designed or built. Although Nevada and other states have been advocating it for ten years, DOE has not committed to full scale testing of the casks.

Both DOE and State of Nevada researchers have looked at the potential for a worst-case accident to occur. While there is disagreement over the specifics of a credible worst-case scenario, there is agreement that such an accident would involve the release of some of the radioactive material inside the shipping cask.

Spent nuclear fuel is both highly radioactive and thermally hot. Nuclear fission inside a reactor transforms a small percentage of the original uranium fuel into additional uranium isotopes, isotopes of plutonium and other transuranic elements, and fission products such as strontium-90 and cesium-137. Fission products, which account for most of the radioactivity in spent nuclear fuel during the first hundred years after removal from a reactor, emit both beta and gamma radiation. Reactor operations may also coat the exterior of the fuel rods with corrosion products, or “crud”, containing radioactive isotopes of cobalt, nickel, and iron.

A typical ten-year old spent nuclear fuel assembly from a Pressurized Water Reactor (PWR) contains about 26,000 curies of strontium-90 (plus many thousands of curies of other dangerous isotopes). The strontium-90 in just one spent PWR assembly would be sufficient to contaminate twice the volume of water in Lake Mead (23 trillion gallons). While the strontium -90 and most of the other dangerous radionuclides are part of the solid pellets that make up the fuel, and therefore not easily dispersed, a severe accident or series of human errors could cause a release of fuel and/or crud particles mixed with smoke accompanying a fire. The airborne particles could then be inhaled or enter the soil and contaminate the food chain. There are other related isotopes that remain highly radioactive for decades are so hazardous that inhalation or ingestion of even amounts too small to be seen can lead to cancer, radiation-induced disease, and death.

A 1985 DOE contractor report concluded that a severe accident involving a single, current-generation rail cask could result in release of radioactive materials to the environment. The study assumed a severe impact followed by a massive fire fed by large quantities of fuel. According to the study, release of only a small fraction (1380 curies) of the cask's contents would be sufficient to contaminate a 42 square mile area. The costs of cleanup after such an accident would exceed $620 million, and the cleanup effort would require 460 days, if it occurred in a rural area. An alternative analysis by a DOE contractor estimated cleanup costs for the same rural accident ranging from $176 million to $19.4 billion, depending primarily upon post-accident soil concentrations of cobalt-60, cesium-134, and cesium-137, and upon regulatory requirements for disposal of the contaminated soil.

If a similar accident occurred in a typical urban area, the clean up would be considerably more expensive and time consuming. It is estimated that it would cost $9.5 billion just to raze and rebuild the most heavily contaminated square mile or so. Much more detailed studies are necessary to estimate accident cleanup costs for a specific urban location such as metropolitan Las Vegas.

The conditions under which a worst-case accident could occur are poorly understood. DOE places great faith in the design and performance of the shipping container to prevent such an occurrence. However, without full-scale testing, shipping cask performance is, of itself, an area of significant uncertainty. Moreover, new shipping cask designs create new opportunities for human error. The longer shipping distances required because of Yucca Mountain's location (more than 2,200 miles on average compare to 600 miles for past shipments) would create additional opportunities for equipment failures and human errors.

5. **Shipping Cask Performance**

The first line of defense against an accident involving the release of radioactive material is, in DOE's planning for repository shipments, the shipping container. Designed to be extremely rugged and to withstand severe accident conditions, these casks are intended to assure adequate containment of spent nuclear fuel and nuclear wastes as these are transported from the reactor to a repository. DOE and the nuclear industry point to a good (although not flawless) record of shipping spent nuclear fuel since 1964 as evidence that casks will perform as they are intended.

The State of Nevada's concerns regarding cask performance involve questions about the cask's ability to withstand severe accidents under projected shipment volume conditions, the adequacy of testing requirements, and implications of new cask designs.

While shipping casks are required to be licensed by the U.S. Nuclear Regulatory Commission (NRC), there is no requirement for the actual testing of full-scale casks to determine how they perform. A scaled down cask is required by NRC to be able to withstand, in succession, the following four tests: a drop from 30 feet onto an unyielding surface; a drop from 6 feet onto a spike (a puncture test); a 30 minute fire at 1425 degrees (F); and then a 30 minute submersion in three feet of water. The NRC allows cask designers to substitute scale-model (1/10 to scale) tests and computer simulations for full-scale design testing. Moreover, the NRC performance standards are based on hypothetical accident scenarios supported mainly by a technical study known as the Modal Study, prepared by Lawrence Livermore National Laboratory. The Modal Study's transportation assumptions are not relevant to DOE's Yucca Mountain transportation plans. Additionally, detailed case studies of recent truck and rail accidents have raised serious doubts about how well the NRC standards reflect real world accident conditions. This is particularly the issue regarding accidents involving high-speed impacts (over 55 miles per hour), long duration of accident conditions (up to several days) and high temperature (over 2000 degrees F) fires, and collisions with vehicles carrying high-energy explosives.

None of the spent nuclear fuel casks currently in use have been tested full-scale. The spectacular crash and burn films shown by DOE and the nuclear industry actually depict obsolete casks (withdrawn from service) being tested in the 1970s to validate computer models. Those tests were successful for that purpose, and also provided valuable insights into the importance of cask tie-down systems and other issues. The tests also demonstrated the vulnerability of lead gamma shielding to long duration fires and to multiple impacts. However, the tests were not intended to simulate worst-case accidents or to prove the overall safety of spent nuclear fuel shipments.

The casks that might be used in a repository shipping campaign are currently being designed. None of the designs have yet been licensed or fabricated. Due to the planned increase of cask size, such casks are very likely to be markedly different from current casks. All of the new designs proposed by DOE would hold more fuel assemblies and be less heavily shielded (due to the age of the fuel to be shipped and weight considerations). How these casks will perform in real world accident situations is uncertain.

The new, larger transportation casks (100-125 tons each) being considered for future spent nuclear fuel shipments have the potential, if not properly loaded, to allow the fuel assemblies to go critical under certain conditions i.e., start a nuclear chain reaction that would cause a catastrophic temperature rise in the canister. The imperative for accurate and verified fuel loading calculations increases the potential for human error and thereby increases the risks and uncertainties associated with waste transport.

The use of such larger shipping containers raises questions about the adequacy of current NRC cask licensing regulations and about the appropriateness of these regulations for assuring these new and much larger canisters will be able to withstand real world accident conditions.

The State of Nevada, the Western Interstate Energy Board, the Western Governors' Association, and numerous other states and multi-state organizations have made detailed recommendations to DOE for full-scale cask testing to demonstrate compliance with the current NRC performance standards, reexamination of the adequacy of the NRC standards, and possible extra-regulatory testing to determine cask failure thresholds. To date, DOE has not implemented these recommendations and has no plans to test proposed new cask designs.

6. Waste Type and Volume

The issue of how much and what type of wastes would be shipped to a repository remain unclear. The first repository is currently limited by law to be no more than 70,000 metric tons of uranium (MTU). However, given the expected amount of spent nuclear fuel from currently operating reactors and defense high-level waste requiring disposal in a repository, more than 100,000 MTU of high-level radioactive wastes could be earmarked for the proposed Yucca Mountain repository. Additionally, an unknown amount of miscellaneous wastes could also be shipped to Yucca Mountain.

The volume and types of waste make a great deal of difference in terms of transportation operations and transportation risks. If all waste available for disposal in a repository is shipped to Yucca Mountain, the number of shipments increases significantly. Civilian spent nuclear fuel from nuclear power plants will be the largest source of high-level radioactive waste shipped to the repository. Under current law, with capacity limited to 70,000 MTU, DOE has reserved 90% of the repository capacity, or about

63,000 MTU, for civilian spent nuclear fuel. However, the currently operating nuclear power plants are projected to generate between 80,000 MTU and 85,000 MTU of civilian spent nuclear fuel by the year 2030. Since there are presently no plans for constructing a second repository, the Agency's planning studies assume that DOE will attempt to ship all civilian spent nuclear fuel to Yucca Mountain if the site is licensed. DOE-owned spent nuclear fuel, from foreign and domestic research reactors and from nuclear-powered naval vessels, will likely also be shipped to Yucca Mountain. This has implications for increased accident risks and routine exposures, and the need for heightened emergency preparedness.

The total amount of defense high-level radioactive wastes requiring geologic disposal is unknown. DOE has allocated 7,000 MTU of capacity at the repository (about 14,000 canisters) for high-level defense wastes. This waste has been generated at DOE weapons facilities at Hanford, Washington, Idaho Falls, Idaho, and Savannah River, South Carolina. Most of this waste is presently stored in liquid form in underground tanks. Prior to shipment, these wastes would be solidified in borosilicate glass logs inside stainless steel canisters. The total amount of such high-level radioactive wastes requiring disposal in a repository has been estimated to be as high as 40,000 canisters, which is equivalent to 20,000 MTU of spent nuclear fuel. The shipping containers for these wastes have not been designed yet, but for planning purposes, DOE has assumed two canisters per truck cask and five canisters per rail cask. Shipment of 7,000 MTU of these high-level radioactive wastes would require 7,000 truckloads or 2,800 rail casks; shipment of 20,000 MTU would require 20,000 truckloads or 8,000 rail casks.

In addition to spent nuclear fuel and high-level radioactive wastes, a significant quantity of miscellaneous wastes will likely be shipped to a repository. These are transuranic wastes from commercial reactors and industrial facilities, radioactive cesium capsules used in commercial irradiation facilities, reactor decommissioning wastes, and wastes from routine nuclear power reactor operations which are too radioactive for disposal in low-level waste sites. No one knows for sure what will be the amount of these wastes or their transportation package capacities. In 1987, DOE estimated that these wastes could total between 12,100 and 20,600 cubic meters. Such an amount would be equivalent to between 12,100 and 20,600 canisters of defense high-level waste in volume.

7. **Emergency Response**
   In the event of an accident or release of hazardous materials within the City of Las Vegas, the Department of Fire and Rescue would lead the response. All department emergency responders are trained to the hazardous materials first responder operations level, and an additional 45 members are certified Hazardous Materials (HazMat) Technicians and make up the HazMat team. They are all available for response 24 hours a day. Because of automatic and mutual aid agreements with Clark County, the city would also have the Clark County HazMat Team available as an additional resource, if needed.

GOAL, OBJECTIVES, POLICIES, AND PROGRAMS

Goal: The City should protect the community from the risks inherent in the use, storage, transportation, and handling of hazardous materials, recognizing that the use of such substances is an integral part of our society and economy.

Objective 8A. The City should require the safe storage, transportation, and disposal of hazardous materials.

Policy 8A1: The City should cooperate with other government agencies in the development of standards for the proper storage, transportation, and disposal of hazardous materials.

Program 8A1.2: Fire and Rescue, along with Clark County and the State of Nevada should continue the process of determining how a transportation incident could affect the city.

Policy 8A2: The City should support State and Federal legislation that strengthens safety requirements for the transportation of hazardous materials.

Program 8A2.1: The City should continue the adoption of new or revision of existing codes and ordinances that strengthen hazardous materials transportation requirements.

Program 8A2.2: The City should encourage interagency cooperation and communication that should strengthen local hazardous materials transportation requirements.

Policy 8A3: Fire and Rescue should continue the preparation of strategies and plans for the evacuation of inhabitants for emergencies involving hazardous materials.

LANDSLIDE HAZARDS

The topography within the city limits does not pose a landslide hazard.

IMPLEMENTATION

The goal for any long-range master plan element is to remain relevant throughout the life of the document. The primary tool to assure that this goal is achieved is to address the recommendations. The Safety & Seismic Safety Element has highlighted five primary goals. The recommendations are:

- Provide emergency response and fire preventive services to the residents and visitors of the City of Las Vegas;
- Provide infrastructure and policies to mitigate issues caused by excessive rainfall;
- Mitigate damage to property related to geologic hazards found in Las Vegas;
- Mitigate excessive noise pollution within the City; and
- Mitigate any negative effects from the movement of hazardous materials within the city limits.

The recommendations were developed to achieve the desired outcomes stated in the Las Vegas 2020 Master Plan document. The strategies to reach these outcomes are detailed below.

RECOMMENDATION #1: PROVIDE EMERGENCY RESPONSE AND PREVENTATIVE FIRE SERVICES FOR RESIDENTS AND VISITORS OF LAS VEGAS

STRATEGIES:

- Prepare a cost-benefit analysis of maintaining Commission on Fire Accreditation International (CFAI) Accredited Agency status.

- Implement the Fire Safety Plan.

RECOMMENDATION #2: PROVIDE INFRASTRUCTURE AND POLICIES TO MITIGATE ISSUES CAUSED BY EXCESSIVE RAINFALL

STRATEGIES:

- Install stormwater channel and drain improvements in accordance with the
adopted stormwater management program for the City.
- Continue to cooperate with the Clark County Regional Flood Control District.
- Maintain a Flood Hazard Reduction Program which meets the basic requirements of the National Flood Insurance Program (NFIP).

- Continue to update Flood Insurance Maps subject to FEMA review.
- Continue to integrate new material, technology and techniques in the construction and maintenance of existing and proposed development.

RECOMMENDATION #3: MITIGATE DAMAGE TO PROPERTY RELATED TO GEOLOGIC HAZARDS FOUND IN LAS VEGAS

STRATEGIES

- Review all building plans for geologic hazards.
- Maintain updated maps of documented areas of collapsible soils, subsidence, faulting and fissuring.
- Require a soils engineering report on non-residential development plans.

RECOMMENDATION #4: MITIGATE EXCESSIVE NOISE POLLUTION WITHIN THE CITY OF LAS VEGAS

STRATEGIES:

- Utilize the Land Use-Noise Compatibility Guidelines (Table 4) for evaluating land use noise compatibility when reviewing development projects.
- Eliminate at-grade railroad crossing at the intersection of Wyoming Avenue and the Union Pacific Railroad.

RECOMMENDATION #5: MITIGATE ANY NEGATIVE EFFECTS FROM THE MOVEMENT OF HAZARDOUS MATERIALS WTIHIN THE CITY LIMITS

STRATEGIES:

- Actively oppose the development of Yucca Mountain into a nuclear waste repository.
- Support State and Federal legislation that strengthens safety requirements for the transportation of hazardous materials.

DEFINITIONS

Apparatus– A motor driven fire truck, or a collective group of such trucks, which may be different types such as pumper trucks, ladder trucks, etc.[11]

Automatic Aid– A form of mutual aid involving a pre-arrangement between two or more departments that routinely provides emergency response assignments to each other.

Badlands– Badlands area moderately steep to very steep barren dissected by many intermittent drainage channels that have cut into soft geological material. The areas ordinarily are not stony. Local relief generally ranges from 25 to 100 feet. Potential runoff is very high, and erosion is active. Some small areas of identifiable soils support vegetation.

Characteristic– An attribute, descriptive feature, or identity.

Community– A commonly located, interacting population people and business.

Compaction Faults– Shifts in the ground surface due to natural prehistoric dewatering and differential consolidation of sediments.

Data– Raw facts or observations; factual material used as a basis especially for discussion or decision: information.

Endogenic Subsidence– Subsidence due to changes occurring within the earth, such as natural movement of the earth's tectonic plates, volcanic activity, and continental drift.

Evaluation– Measuring the success of a program or concept.

Exogenic Subsidence– Subsidence occurring mainly at the earth's surface due to loss of support, as in the case of fluid extraction, or an increase of loading from the weight of a body of water, such as Lake Mead, or heavy irrigation.

Fire Prevention– That part of fire protection activities exercised to prevent ignition of unwanted fires and to minimize loss when fire does occur.

Fire Protection– The science of reducing losses of life and property due to fire, including both prevention and extinguishment by public or private means. Also, the degree to which such protection is applied.

Fire Protection System– An organized arrangement of people and things performing defined functions to prevent or control unwanted fires.

Function– Something a system does, an activity.

Goal– The general end toward which an effort is directed. That which a system is intended to eventually accomplish.

Hardpan– A hardened or cemented soil horizon or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substances.

Mutual Aid– Two way assistance by fire departments of two or more communities freely given under prearranged plans or contracts on the basis that each will aid the other.

Noise– Any useless sound which annoys or disturbs humans or which causes or tends to cause an adverse psychological or physiological effect on humans.

Objective– Something specific toward which an effort is directed. A specific accomplishment necessary in order to achieve goals, the results of which can be measured.

Optimum– Most desirable thing, or status, greatest degree, etc. under implied or specified conditions. Not necessarily either a maximum or minimum.

Pits, Gravel– Consists of open excavations from which soil material and gravel have been removed, exposing rock, a hard pan, or other material.

Projected– Looking forward to the future; forecast in the basis of present information.

Repository– a place where things are stored for safekeeping.

Response– An act responding to an alarm.

Response Time– The length of time required by a complement of firefighters and equipment to respond to a reported fire or other emergency. Response time usually is measured from the time alarm is received by the fire units to the time of arrival at the fire or in the area of the fire.

Risk– Possibility of loss, as in "acceptable fire risk".

System– An arrangement of parts or elements (people, things, and / or organizations) working together to perform a set of operations in the accomplishment of the purpose of the whole, as in "heating system".

Tectonic Faults– Cracks in the earth, resulting from changes in the structure of the earth's crust.

Urban Land– Consists of areas covered by asphalt, concrete, and buildings or other urban structures.

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