Environmental Health in Southern Nevada

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Abstract

There are a multitude of environmental factors that influence public health. The purpose of this manuscript is to evaluate the Southern Nevada community with respect to environmental conditions and health, including both positive and negative traits, and develop realistic goals and strategies aimed at improving these conditions. Southern Nevada is located in one of the most arid regions of North America. Since annual rainfall averages less than four inches per year, Southern Nevada depends upon the Colorado River for its water supply. It is predicted that water flow to the area will decrease by 5% to 20% by 2050. As a result, efforts to reduce consumptive water use (use of water that is permanently withdrawn and not returned to the source) were employed and have been effective at reducing consumptive water use by 21 billion gallons annually. Access to quality water is a fundamental determinant of health, and the water quality of Southern Nevada continues to meet safe drinking water standards set by the EPA. Air quality is another important determinant of population health and sustainability. Between 2009 and 2011, the region had 36 days in which the ozone levels were considered dangerous and 2 days in which the particulate pollution (PM 2.5) were considered dangerous. The six Criteria Air Pollutants defined in the Clean Air Act, have declined consistently in the region since the mid 1990's. Due to the increase in population and changing landscape, parts of Southern Nevada are considered urban heat islands, or urban areas with higher temperatures than rural areas. On average, the regions temperature has risen four degrees Fahrenheit in four decades. Based on the existing conditions, a number of goals and strategies aimed at promoting environmental health and sustainability were developed as part of the *Southern Nevada Regional Plan for Sustainable Development* (SNvRPSD); a single, integrated and consolidated plan that will promote and guide sustainable regional development in Southern Nevada over the next 20 years.

Introduction

There are numerous factors of both the natural and built environment which can impact public health. Access to an adequate amount of clean and potable water, air quality, and proper waste disposal, for example, are fundamental determinants of health. Human behavior is a central part of ensuring a healthy environment. Maintaining a balance between human behavior and environmental health is a prerequisite of sustainability. Conserving and protecting natural resources and being cognizant of the interplay between urban development and environmental health are critical elements of both health and sustainability (EPA, n.d.).

The purpose of this manuscript is to evaluate the Southern Nevada community with respect to environmental conditions and health. These data on existing conditions was used by members of the Southern Nevada Strong team to set goals and priorities for future development of the region aimed at improving these conditions. The overall goal of the Southern Nevada Strong project was to develop the *Southern Nevada Regional Plan for Sustainable Development* (SNvRPSD); a single, integrated and consolidated plan that will promote and guide sustainable regional development in Southern Nevada over the next 20 years.

Methods

In order to develop goals and strategies for Southern Nevada's environment and sustainability, numerous data sources were queried to determine the existing conditions of Southern Nevada. Data sources for Southern Nevada's water quality included the Southern Nevada Water Authority's 2012 Source Water Assessment, the 2012 Water Quality Report, and the 2009 Water Resource Plan. Air Quality data included the American Lung Association's State of the Air 2013 report, the Clark County Department of Air Quality and Environmental Management's 2012 Annual Network Plan and Aeroallergen History and Cycles. Recycling data included the Nevada Division of Environmental Protection 2013

Recycling and Waste Reduction Report, the Southern Nevada Health District's 2013 Annual Recycling Report, and the City of Henderson's 2012 Green Report. Data on Nevada's biodiversity came from the 2008 Adaptive Management Report for Clark County Nevada. Heat Island data was taken from the City of Las Vegas' 2010 Summary Report on Urban Heat Islands.

1.1 Water

Southern Nevada is located in one of the most arid regions of North America. However, water was the feature that initially attracted people to the area. The natural springs of Las Vegas, Spanish for "the meadows," made it a watering stop for nomadic Native Americans, Spanish and American traders, Mormon settlers and the Los Angeles & Salt Lake Railroad. As Las Vegas transformed from a train depot to a city, pressure on the water supply increased (UNLV Digital Collections, 2012).

Annual rainfall averages less than four inches; consequently Southern Nevada depends upon the Colorado River for its water supply. The region only draws about 3 percent of the Colorado River's total flow, but that accounts for almost 97 percent of the region's entire supply. Municipal water for Southern Nevada is provided from the Colorado River via Lake Mead. Water is drawn from Lake Mead and sent to one of two treatment facilities, the Alfred Merritt Smith or River Mountain Treatment Center (Southern Nevada Water Authority (SNWA), 2012). The other 3 percent of Lake Mead's inflow comes from groundwater, the Virgin and Muddy Rivers and the Las Vegas Wash. The Colorado is the only major surface water source in the American Southwest, and through the construction of thirteen dams, was the first river on Earth to come under complete human control. The river is the primary water source for 25 million people and irrigates 2.5 million acres of farmland in seven states and Mexico (SNWA, 2012). Table 18 shows the amount of water from the Colorado River utilized by Colorado, Utah, Wyoming, New Mexico, Arizona, California, Nevada and Mexico as measured in volume units of million acre feet (one million acres of surface area to the depth of one foot) .

Table 1
Colorado River Apportionment, 2012

Allocation	Million Acre-Feet Per Year (MAFY)
Upper Basin	
Colorado	3.9 MAFY
Utah	1.7 MAFY
Wyoming	1 MAFY
New Mexico	0.85 MAFY
Lower Basin	
Arizona	2.85 MAFY
California	4.4 MAFY
Nevada	0.3 MAFY
Additional Allocations	
Mexico	1.5 MAFY
TOTAL	**16.5 MAFY**

Source: Southern Nevada Water Authority (2012)

Construction of the Hoover Dam, which began in 1931 and created Lake Mead, ensured a water source for Southern Nevada. Lake Mead, with a surface area of 157,900 acres (at full pool) and a 29-million-acre-ft storage capacity, is the largest reservoir in North America. In addition to being the main source for water for the region, Lake Mead is a water-based recreational area which hosts more than 8 million people per year and a critical habitat for many species (National Park Service, Lake Mead, 2012). Lake Mead and the Colorado River receive most of their water supply from snow melt in the Rocky Mountains (SNWA, 2012b)

While 97 percent of the drinking water for Southern Nevada comes from the Colorado River (via Lake Mead), a small percentage comes from the Las Vegas Wash. The wash consists of water comprised of urban runoff, shallow groundwater, reclaimed water, and storm water (Las Vegas Wash Coordination Committee, 2013). Though the wash carries the water through the wetlands, which acts as a natural filter, there is potential for contamination which includes: urban chemicals (fertilizers and pesticides), industrial activities and wildlife (SNWA, 2012b). However, because there is little agricultural activity upstream of the region, potential contamination of drinking water by farm-related contaminants is limited.

Access to clean drinking water is at the foundation of a healthy community. Based on surface water assessments for water quality at the Southern Nevada Water System, intake is within state and federal-drinking water standards except for microbiological contaminants naturally found in all surface waters, even before undergoing treatment, (SNWA, 2012b). Some sources of water contamination may include volatile organic compounds (VOCs) from chemicals such as petroleum products, industrial cleaners, pesticides, and dry cleaning chemicals; synthetic organic carbon (SOC) which are man-made compounds such as pesticides or herbicides; and inorganic contaminants, substances containing no carbon which are metal or non-metal, originating from natural or unnatural sources such as arsenic, mercury and cyanide (Kansas Department of Health and Environment, 2014). Potential contaminating activities with the highest vulnerability rating (chance for contamination of drinking water intake) include: septic systems, golf courses/parks, storm channels, gasoline stations, automotive repair shops, construction and wastewater treatment plant discharges (SNWA, 2012b). According to the SNWA:

> Based on water-quality data (prior to treatment) and the results of the vulnerability analysis of potential contaminating activities, the drinking water intakes are at a moderate level of risk for volatile organic (VOC), synthetic organic carbon (SOC), microbiological and radiological contaminants and at a high level of risk for inorganic (IOC) contaminants. All of the Las Vegas Valley governmental agencies coordinate their watershed management programs to minimize the

vulnerability risk to Lake Mead. (SNWA, 2012)

The Southern Nevada Water System is tested for more than 100 regulated and unregulated substances each month (SNWA, 2012b). A summary of the Las Vegas Valley Water District (LVVWD) Quality report in 2012 showed that the region's water did not exceed the maximum contaminant level set by the Environmental Protection Agency (EPA) for any of the substances tested (SNWA, 2012b).

Fluoride is added to the drinking water supply in Southern Nevada. Fluoridated water has been associated with a decrease in dental caries in the United States over the last 35 years. The CDC recognizes water fluoridation as one of the ten greatest public health achievements of the twenty first century (CDC, 2013).

In 1999, the Nevada Legislature passed Assembly Bill 284, requiring the SNWA to add fluoride to Southern Nevada's municipal water supply beginning in March 2000. In November 2000, Clark County residents voted to continue fluoridation of their municipal water supply. Low levels of fluoride, about 0.3 milligrams per liter (mg/L), occur naturally in Southern Nevada's water supply. Per regulations developed by the Nevada State Health Division and administered by the Nevada Department of Environmental Protection, SNWA adds 0.5 mg/L of fluoride to bring the level within the required range of 0.7 - 1.2 mg/L in the municipal water supply. These levels are considerably lower than the federal Safe Drinking Water Act limit of 4.0 mg/L and the Nevada secondary standard of 2.0 mg/L. (SNWA, 2012c)

Most climate models predict a drier, hotter, Southwest with more variable precipitation. Water use will remain a fundamental challenge to sustainability in the region. Water stress will increase even if demand remains constant. The U.S. Department of the Interior, Bureau of Reclamation (2012) state that the Colorado River's "mean annual flows are projected to continue to decrease over time (from -7.5 percent around 2025 to -10.9 percent around 2055, to -12.4 percent around 2080) as compared to the 1906–2007 mean". Additionally, drought or low levels of snow and precipitation in the Rocky Mountains has caused Lake Mead's water level to drop approximately 100 feet since 2000 (Las Vegas Valley Water District, 2012). Because of this, the LVVWD has adopted a number of water conservation programs to help curb the demand for water.

The SNWA has sufficient resources available or in development to meet future demands until 2060. To keep up with the water demand, current and in development resources include Nevada's basic apportionment of the Colorado River, Las Vegas Valley ground water rights, continued conservation efforts, development of intentionally created surpluses (ICS) of water, development of in state ground water and non-Colorado river sources. Projected demand, current and future water resources are depicted in *Figure 1*.

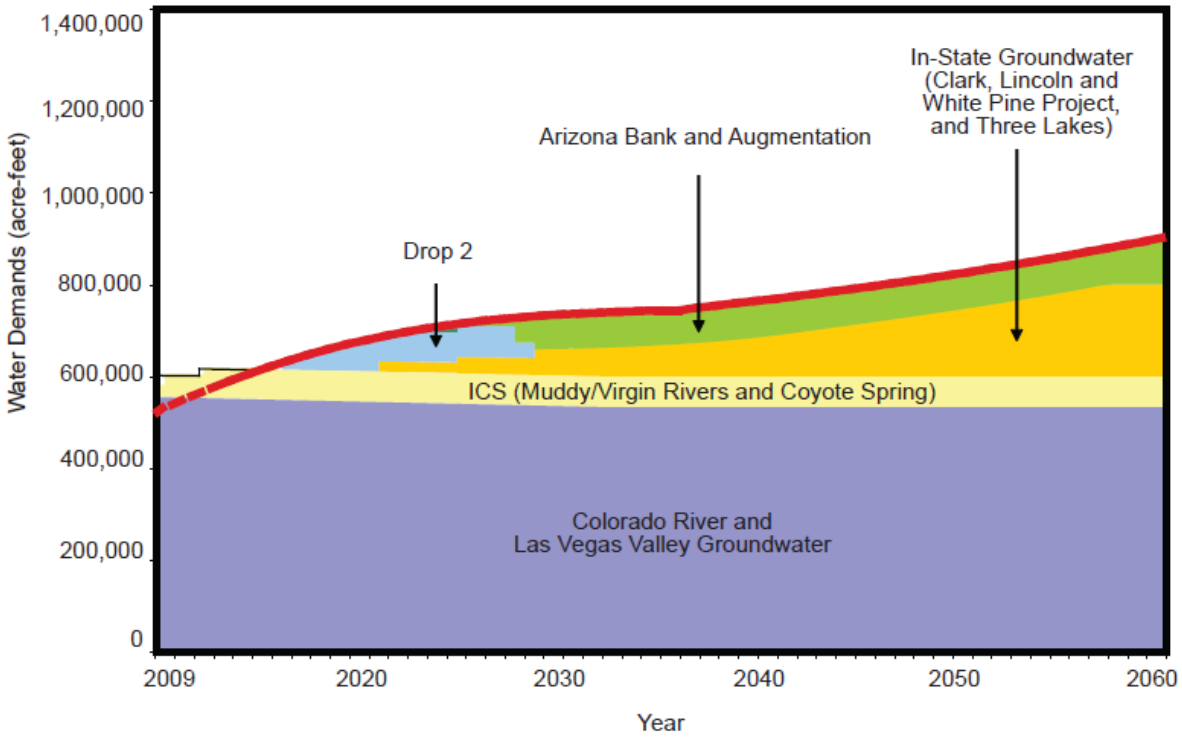


Figure 1. Projected water demands, current and future resources, 2009 (SNWA Water Resource Plan, 2009)

Development patterns influence water demand. Low density development and large lot sizes consume more water resources than compact development. Lawn care accounts for about 50 percent of household water usage nationally and large lots typically have large lawns. In addition to lawn care, large lots increase the length and price of piping necessary to service the area. The further the lot is located from the main water lines, the greater the infrastructure needs and pumping capabilies. Longer piping systems necessary to service disprersed development are at greater risk for leaks and breaks. It is estimated that water systems lose 6 to 25 percent of their water through leaks and breaks (EPA, 2006). Thus, low density and dispersed development results in inefficient water usage. Promoting compact development and smart growth principles would substantially lower infrastructure costs and conserve water resources (EPA, 2006).

Residental use accounts for 59 percent of water use in Southern Nevada (see *Figure 2*). Most of this water is used consumptively for outdoor landscaping. Thus, conservation efforts are best directed toward management of outdoor water use. Since its creation in 1991, the SNWA has introduced a number of conservation efforts and programs. City and County governments have adopted a number of codes and regulations aimed at water conservation and they are described in Table 1. Conservation efforts include "water smart" incentive programs which allow the community to particpate in conservation (Table 1). These efforts have been effective and resulted in significant reductions of water use; consumptive water use has decreased by 21 billion gallons annually between 2002 and 2008. Water use was reduced from approxiamtely 350 gallons per capita per day to 250 gallons per capita per day, shown in *Figure 3*. SNWA and member agencies hope to continue conservation and have set a goal to reduce water use to 199 gallons per capita per day (SNWA, 2009). Conservation of Southern Nevada's finite sources of water are critical in the development of a healthy and sustainable community.

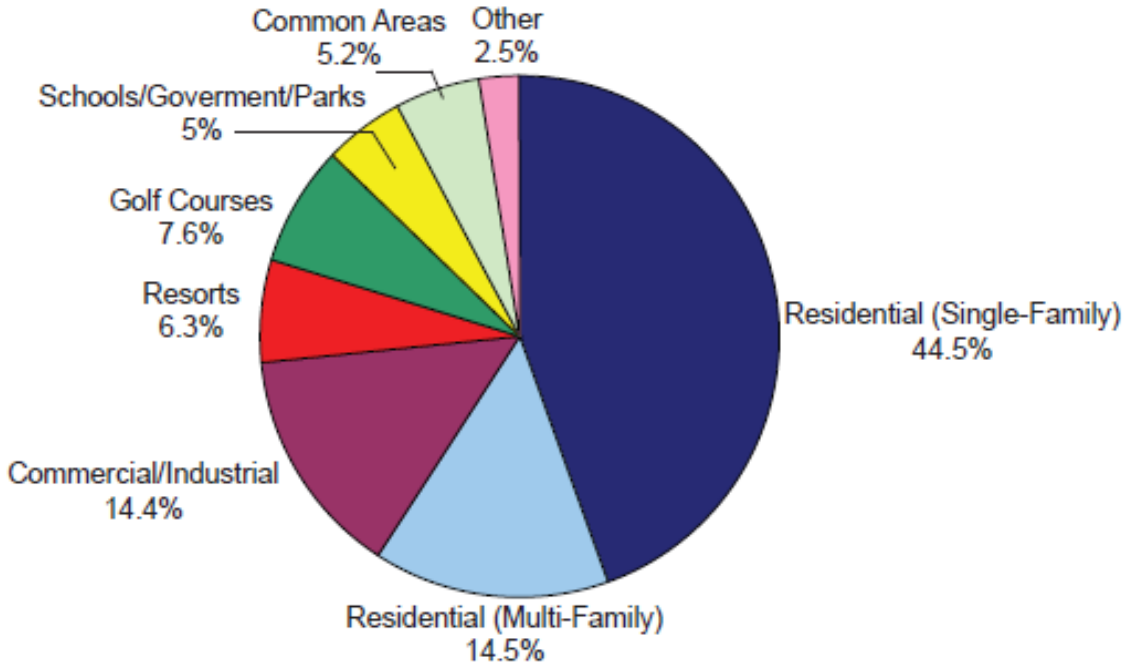


Figure 2. Municpal metered water use in Clark County 2007 (SNWA Water Resource Plan, 2009)

Table 1
Water conservation codes, regulations, and incentive programs 2009

Codes and regulations	"Water smart" incentive programs
• Restrictions on watering landscape during the hottest times of the day in summer months	• Rebates for residential and commercial properties to convert to water-efficient landscaping
• Regulations mandating commercial vehicle washes to capture water so it can be treated and reused	• Rebates of up to half the cost of replacing inefficient irrigation controllers to “smart” irrigation controllers
• Prohibition of turf installation in new residential front yards and limitations of 50% coverage for turf in back yards	• Rebates for business customers retrofitting existing equipment for approved water efficient technologies
• Limiting commercial misting systems to only summer months	• Rebates of up to half the cost of a pool cover
• Budgeting of golf course water allotment	• Water smart car wash incentives encouraging residents to use smart water car washes over home washing
• Barring water waste including water runoff into streets and non-compliance with lawn watering schedules	• Partnerships with landscaping contractors whose projects meet specific criteria to conserve water
• Tiered rate charges which increase as rate of use increases	• Certification of new homes as water smart, ensuring they can save as much as 75,000 gallons/year
	• Partnership with local restaurant to only serve water upon request

Source: SNWA Water Resource Plan (2009)

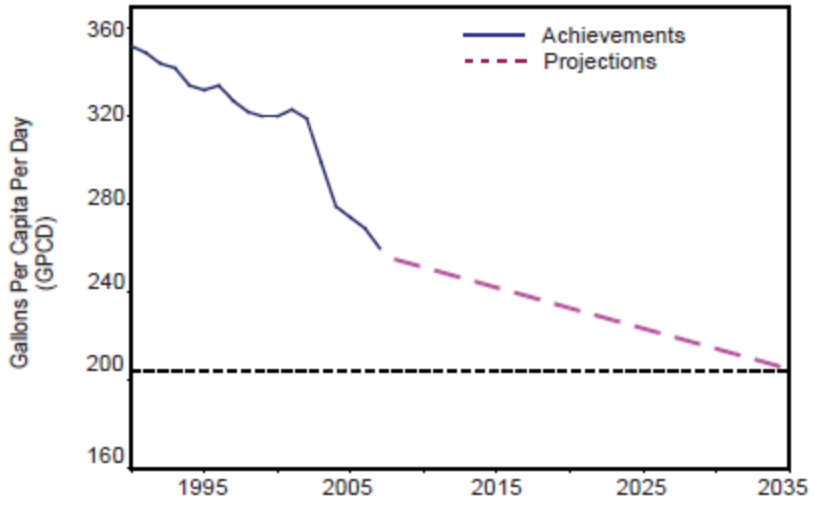


Figure 3. Reductions in water use in Southern Nevada due to conservation 2009 (SNWA Water Resource Plan, 2009)

1.2 Air

Air pollution plays a critical role in health and sustainability. Poor air quality has been linked to numerous negative health outcomes including asthma attacks, poor lung function and tissue damage, cancer, neurological impairment and cardiovascular disease (EPA, 2013). In an effort to preserve air quality and promote human health, the Clean Air Act was amended in 1990 to require the EPA to set National Ambient Air Quality Standards for six criteria air pollutants considered harmful to public health. The six criteria pollutants include: ozone, particulate matter (PM), carbon monoxide, nitrogen oxides, sulfur dioxide, and lead.

The American Lung Association published *State of the Air, 2013* in which it reports measures of ozone and particle pollution (PM) in 277 metropolitan areas across the US between 2009 and 2011. A list of the 25 best and 25 worst cities for ozone and PM pollution was created. Southern Nevada did not rank in the top 25 (best) or bottom 25 (worst) cities for PM pollution; however, the region was ranked the 16th most polluted city for ozone. The region had 36 days between 2009 and 2011 where ozone concentrations were unhealthy for sensitive groups and 2 days where particulate matter was unhealthy for sensitive groups. The region received a score of F and B, respectively in these two categories. An 'F' score represents 9 days or more over the standard: 10 orange days or 9 total including at least 1 or more red, purple or maroon. A 'B' score means 1 to 2 over the standard with no red, purple or maroon days (orange = unhealthy for sensitive groups, red = unhealthy, purple = very unhealthy, and maroon = hazardous). Results for non-attainment days between 2009 and 2011 are shown in Table 2.

Table 2
Number of Poor Air Quality Days, 2009-2011

	Ozone Orange	Ozone Red	Ozone Purple	Particulate Orange	Particulate Red	Particulate Purple
Southern Nevada	36	0	0	2	0	0

Explanation of Colors: Orange: Individuals with respiratory disorders are likely to be affected by high levels of ozone and individuals with respiratory disorders and heart disease are likely to be affected by high levels of particulates. Red: Members of the general population may experience adverse effects, and individuals in sensitive populations may experience serious health effects. Purple: All individuals may experience serious health effects (American Lung Association, State of the Air, 2013)

Southern Nevada faces an air quality challenge due to its natural geography. The mountains surrounding the valley create a bowl, which results in air pollution being trapped over the metropolis for long periods of time. Thermal inversions, when a layer of warm air settles on top of cool air at ground level, are also common; the trapping of cool, polluted air prevents the pollutants from leaving the metropolitan area. Additionally, its location at the center of a great desert means that there are not any oceans, large lakes, or dense forests nearby to naturally filter pollution out of the air (known as ecosystem services) (de Groot, Wilson & Boumans, 2002). However, Nevada uses less coal for electrical production than the U.S. as a whole (under 16 percent for Nevada compared to over 40 percent for the U.S. in 2011) and the state's use of coal has declined dramatically since 2000, resulting in improved air quality (EPA, 2012)

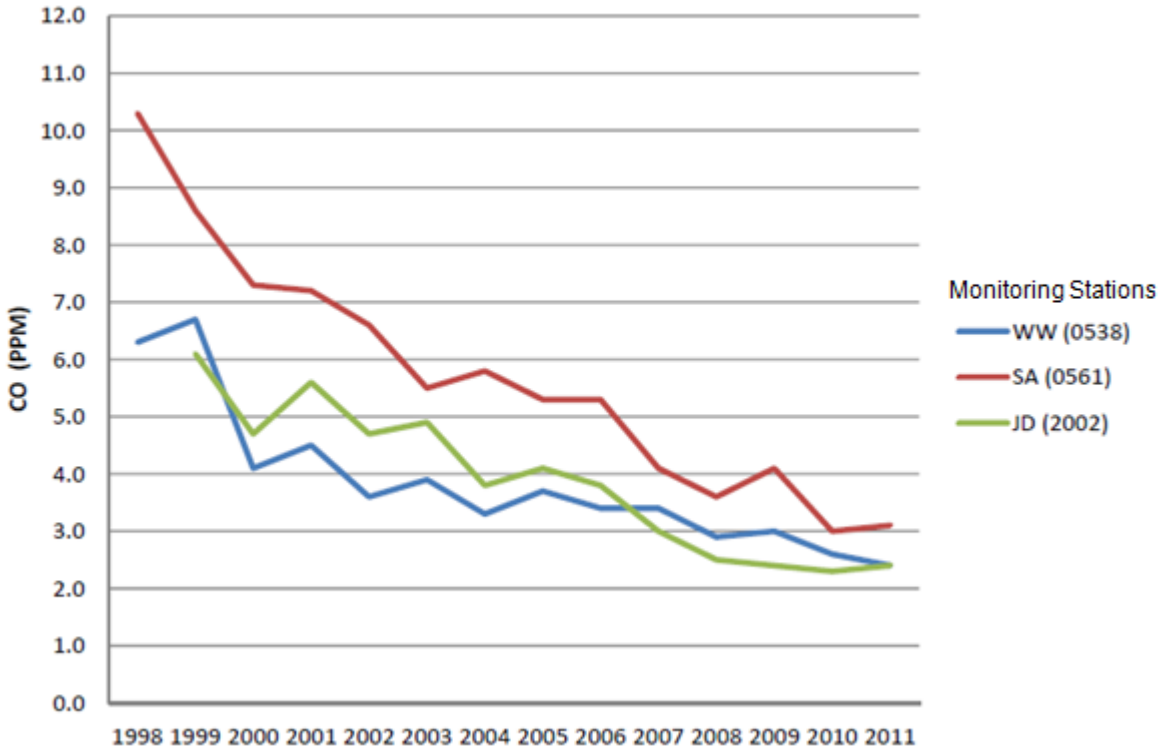
Carbon monoxide (CO) levels peaked in the mid 1970's which resulted in the region being designated a CO nonattainment area in 1978 by the EPA. In response to this designation, Clark County and Nevada "adopted and implemented new air quality plans and control measures, including state

and local wintertime gasoline fuel requirements. These measures helped reduce the number of exceedances of the CO standard from over 40 each year in the mid-1980s to less than 5 by the mid-1990s. The last recorded exceedances of the CO air quality standard occurred in 1998" (EPA, 2012).

Each year the Clark County Department of Air Quality and Environmental Management (CCDAQEM) issues the Annual Network Plan Report. This report provides air quality data for Clark County. Data is collected from fifteen different air monitoring stations which are dispersed throughout Clark County. Annual average levels of criteria air pollutants from 2011 for the City of Las Vegas and Henderson are listed below (CCDAQEM, 2012):

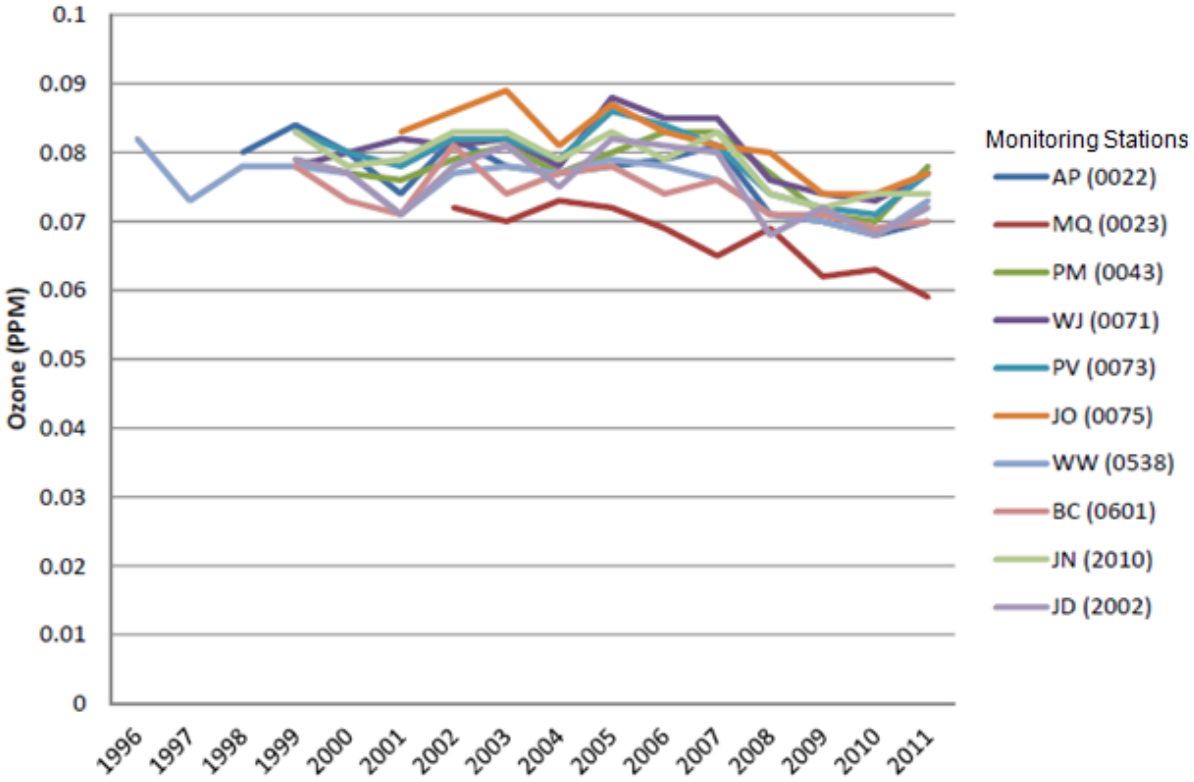
- City of Las Vegas
  - Annual average CO concentration is 0.59 ppm
  - Annual average O_3 concentration is 0.039 ppm
  - Annual average PM_{10} concentration is 26.66 µg/m^3
  - Average $PM_{2.5}$ concentration is 8.4 µg/m^3
  - Annual average NO_2 concentration is 0.013 ppm.
- City of Henderson
  - Annual average PM10 concentration is 17.28 µg/m3
  - Average PM2.5 concentration is 6.24 µg/m3

Based on this information, Clark County has zero CO exceedance days, zero NO_2 exceedance days, two $PM_{2.5}$ exceedance days (because of fireworks) and one PM_{10} exceedance day in 2011 (because of fireworks) (CCDAQEM, 2012). As shown in *Figure 4* through *Figure 8*, criteria pollutants have declined since the mid 1990's.



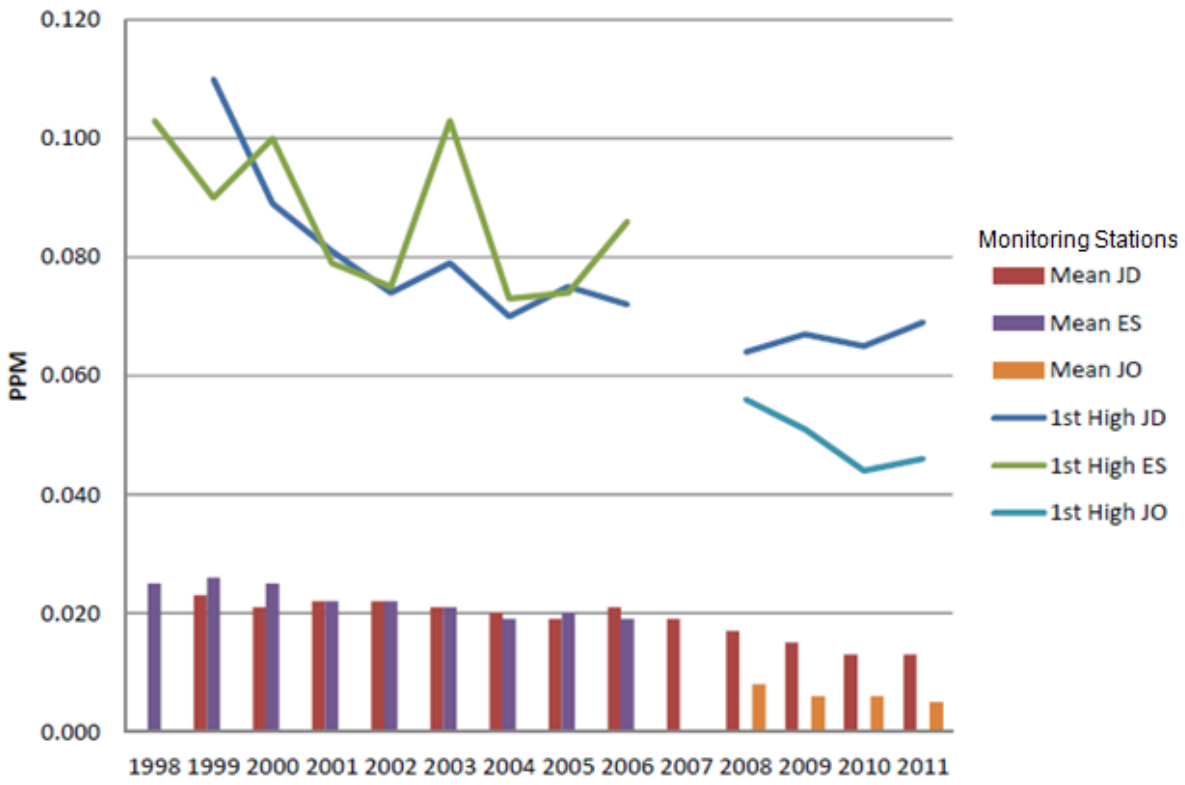
*WW=Winterwood SA=Sunrise Acres JD=JD Smith

Figure 4. Carbon Monoxide Trends (high 8 hour average), 1998-2011 (Clark County Department of Air Quality, Annual Network Plan Report, 2012)



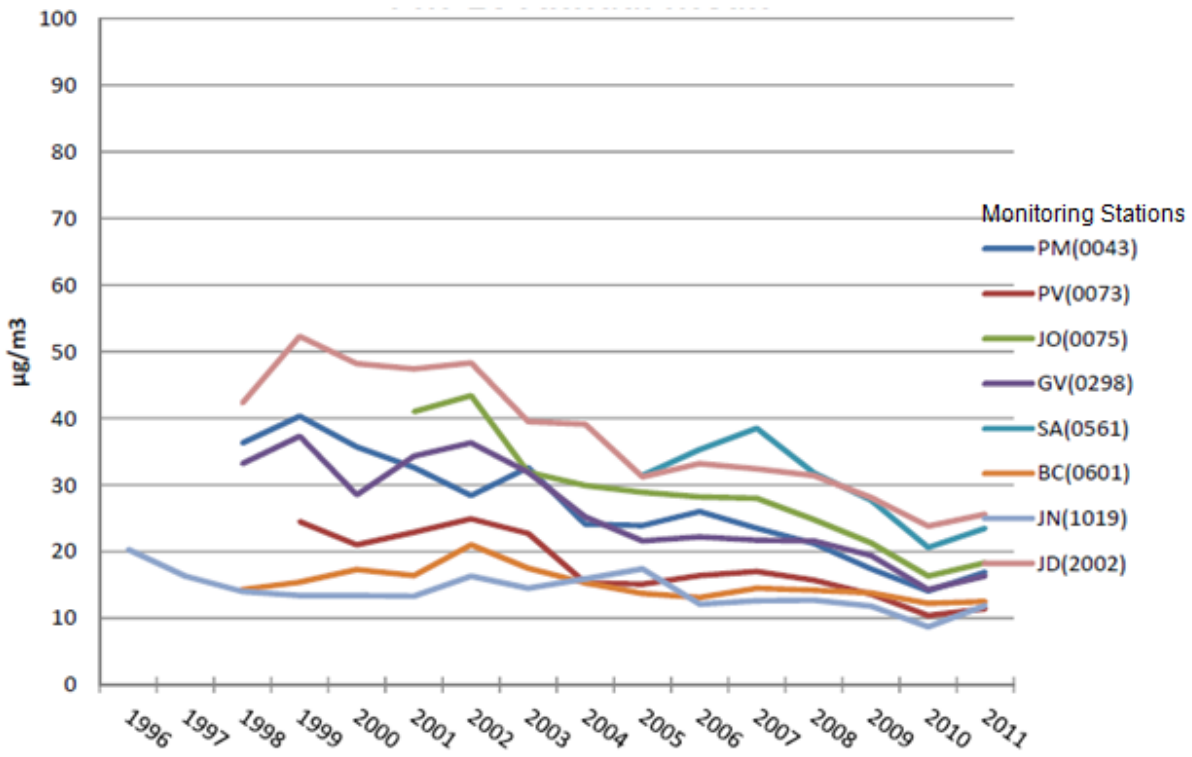
*AP=Apex MQ=Mesquite PM=Paul Meyer WJ=Walter Johnson PV=Palo Verde JO=Joe Neal WW=Winterwood BC=Boulder City JN=Jean JD=JD Smith

Figure 5. Ozone Trends (fourth high, 8 hour average), 1996-2011 (Clark County Department of Air Quality, Annual Network Plan Report, 2012)



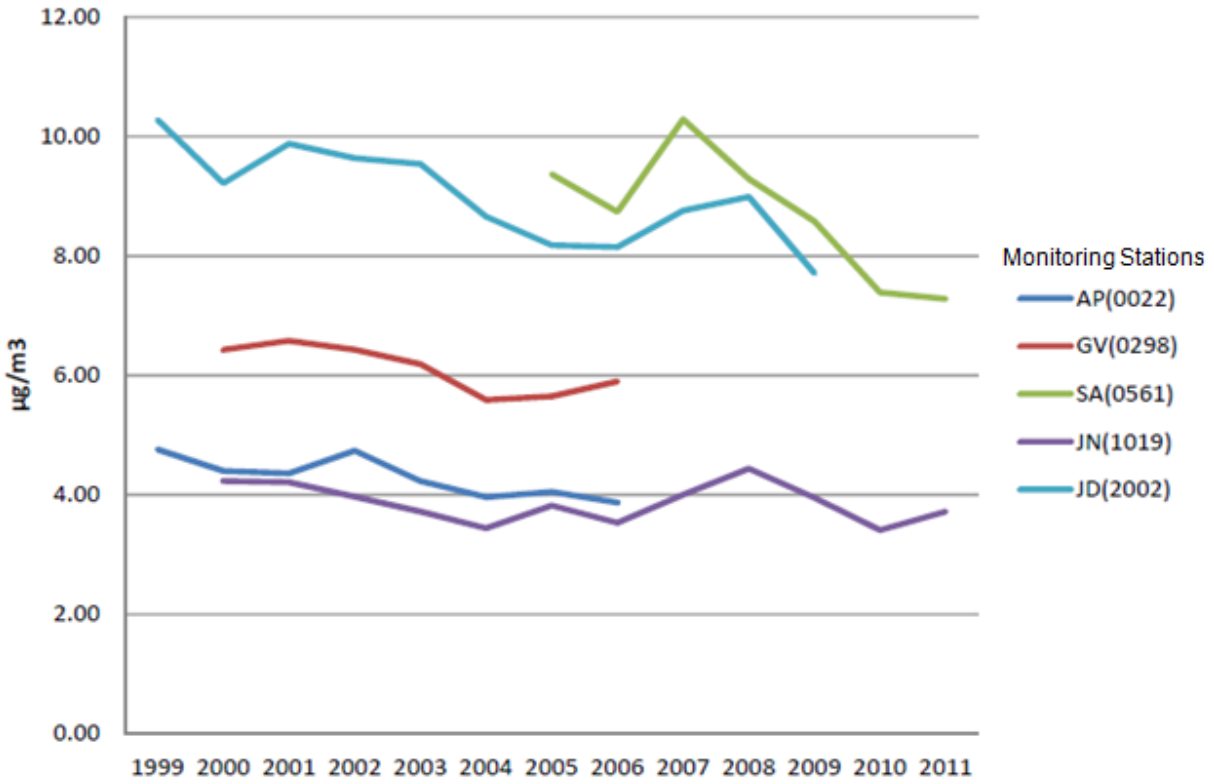
* JD=JD Smith JO=Joe Neal

Figure 6. Nitrogen Dioxide (NO2) Trends (first high and annual mean), 1998-2011 (Clark County Department of Air Quality, Annual Network Plan Report, 2012)



* PM=Paul Meyer PV=Palo Verde JO=Joe Neal GV=Green Valley SA=Sunrise Acres BC=Boulder City JN=Jean JD=JD Smith

Figure 7. Particulate Matter (PM) 10 Trends (annual mean), 1996-2011 (Clark County Department of Air Quality, Annual Network Plan Report, 2012)



*AP=Apex GV=Green Valley SA=Sunrise Acres JN=Jean JD=JD Smith

Figure 8. Particulate Matter (PM) 2.5 Trends (annual mean), 1999 – 2011 (Clark County Department of Air Quality, Annual Network Plan Report, 2012)

In addition to air pollutants, aeroallergens can cause or exacerbate allergic disease. Allergic diseases are the sixth most common chronic disease and impose burden both economically and to human health (CDC, 2009). Approximately 20 million Americans suffer from asthma and about 55% test positive for an allergic response to one or more allergens (CDC, 2009; Reid & Gamble, 2009). Additionally, allergies and asthma are estimated to cost more than $56 billion annually (CDC, 2012). There are two primary sources of allergens in Clark County, fruitless mulberry which pollinates in March and European olive which pollinates in April. Clark County banned further planting of these trees after April 1, 1991 (except certified low-pollinating varieties) because of their higher levels of pollen (CCDAQEM, 2010).

1.3 Brownfields

According to the Nevada Department of Environmental Protection (2012), brownfields are "sites that are currently being underutilized because of real or potential contamination." Approximately 165 brownfield sites exist in the region. There have been projects focused on re-developing Brownfields in the region. Two examples are Symphony Park and Nellis Solar Plant. Symphony Park, a 61 acre mixed use neighborhood in downtown Las Vegas, is being developed on a former brownfield and is LEED Gold certified for Neighborhood Development. It includes the recently constructed nearly $470 million Smith Center for the Performing Arts. The Las Vegas Valley currently has more LEED-certified buildings, per capita, than any metropolitan area in the U.S. Nellis Solar Plant, a 14-megawatt solar energy site serving Nellis Air Force Base, is built on a former

brownfield. Additionally, Landwell, a 2,200 acre master-planned community which will accommodate 30,000 residents, is currently planned to be built on a reclaimed industrial site in Henderson.

1.4 Recycling

Recycling has many benefits for both the environment, human health, and the economy. Recycling materials that would otherwise be thrown away reduces the amount of waste sent to landfills, conserves natural resources such as timber and water, and prevents pollution by reducing the need for new materials (EPA, 2013b). Additionally, manufacturing products from recycled materials takes less energy, in turn, reducing greenhouse gas emissions created from manufacturing of new products using raw materials (South Carolina Department of Health and Environmental Control, 2013). Recycling also stimulates the economy by creating jobs. It is estimated that the recycling industry creates about one million manufacturing jobs and $100 billion in revenue (EPA, 2013c).

The NV legislature set a recycling goal in 1992 of 25 percent, in 2011 this goal was exceeded with a state recycling rate of 25.3 percent (Nevada Division of Environmental Protection, 2013). Clark County's recycling rate increased from 17.88 percent in 2010 to 25.3 percent in 2012 (Southern Nevada Health District, 2013). However, this is lower than the national average of 34.7 percent (EPA, 2013e). This increase is likely due, in part, to recycling initiatives which were recently put into place. Many communities within LVMA have been part of a pilot program to introduce single stream recycling, a system in which all recyclable materials are combined into one bin and are sorted at the recovery facility. In the pilot neighborhoods the amount of waste which was diverted from the landfills was much higher than non-pilot neighborhoods, 29.4 percent versus 6.9 percent (City of Henderson, 2012). This is evidence that single stream recycling is environmentally advantageous and enhances the sustainability of LVMA.

Composting of organic materials is another method to reduce waste production. Compost is a medium of organic material, such as food waste and yard trimmings, that can be used as a soil amendment and natural fertilizer. This has environmental health benefits, as it diverts organic material from landfills and is a cost effective way to add nutrients to soil without the use of chemical fertilizers (EPA, 2014g). Currently Clark County has one composting plant.

1.5 Biodiversity

With 3800 plant and animal species, Nevada ranks between 4th and 10th overall in various measures of biodiversity (Nature Serve, 2002; Fenstermaker, 2009). Clark County, which includes Mount Charleston (part of the Spring Mountain Range which reaches almost 12,000 ft in elevation) and Lake Mead, consists of 11 ecosystems and 209 species of plants and animals. Table 20 includes the ecosystems along with the number of species in each system. Threats that are common to many of these ecosystems include: human disturbances such as recreation, urbanization, rural and urban development, foot traffic, non-native and invasive species, fire, over grazing, climate change, decreased pollinators, altered air quality, and desert dumping (Adaptive Management Report for Clark County Nevada, 2008).

Table 3
Ecosystems within Clark County, NV

Ecosystem	Number of Species (Plant and Animal)
Spring	14
Desert Riparian	14
Alpine	11
Bristle Cone Pine	24
Mix Conifer	34
Pinyon Juniper	33
Sagebrush	20
Blackbrush	10
Mojave Desert Scrub	22
Salt Desert Scrub	17
Mesquite Catclaw Acacia	10

Source: Clark County, Adaptive Management Report (2008)

1.6 Urban Heat Island

The term heat island describes urban, developed areas that are hotter than nearby rural areas. This is due to changes in the landscape of manmade infrastructure replacing vegetation or open land that was once permeable to moisture (EPA, 2012b). The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F warmer than surrounding areas with lower population density. In the evening, the difference can be as high as 22°F (EPA, 2012b). Heat islands can affect the environment, health, and quality of life. Due to the increase in temperature, energy demands for air conditioning are increased. One study found that the heat island effect was responsible for 5 to 10 percent of peak electricity demand for cooling buildings (EPA, 2013d). This change in energy demand increases air pollution and greenhouse gas emissions. Further human health effects can include respiratory difficulties, heat stroke, and heat related mortality (EPA, 2013d).

Southern Nevada's temperature increase has corresponded to the population increase. As more people have moved to the region, there has been a greater demand for roads, highways, residential and commercial buildings. These new surfaces absorb and radiate heat which has resulted in an increase in the average temperature (City of Las Vegas, 2010). The region's average temperature (as measured at McCarran Airport) has risen four degrees in four decades (City of Las Vegas, 2010).

Landsat satellite images have been used to evaluate the heat island effects in the region. Results from this imagery show that non-urban areas have higher temperatures than low to medium-density urban areas and lower temperatures than high-density urban areas (City of Las Vegas, 2010). Urban land use and land cover in low to medium-density urban areas create a daytime cooling effect from new landscape and vegetation. High-density urban areas are more likely to have hardscape which creates a heat island. Landsat satellite imagery shows 'hot characteristics' for the Strip and downtown areas (City of Las Vegas, 2010). These areas are comprised of tall commercial buildings which reduce airflow and are surrounded by parking lots, roads and highways. These buildings also use air conditioners which produce additional heat. New developments on the west side of the metropolitan area do not show heat island characteristics due to newer construction materials (stucco and clay/fiber tile roofs) and larger quantities of vegetation and landscape. Heat islands can be mitigated through the use of trees and vegetation, green roofs, cool roofs and cool pavement (EPA, 2012b).

Discussion

Environmental health plays an important role in the health and sustainability of Southern Nevada. Given that the region is one of the most arid in North America, water will continue to play a central role in the promotion of a healthy community. While the region has adequate water to support current demand, continuation of water conservation efforts is critical. Southern Nevada faces air quality challenges due to the natural geography; therefore continued efforts to monitor and reduce air pollution are essential for public health. While recycling rates in Clark County have increased due to single stream recycling, rates still lag behind the national average. As more communities are added to the single stream recycling program, rates are likely to continue to increase. Highly developed areas of Southern Nevada have been deemed urban heat islands. Efforts to retrofit these areas may mitigate the existing heating effect, and new construction should focus on avoiding the creation of heat islands.

As part of Southern Nevada Strong Sustainable Communities Planning Grant project, six task groups made up of subject matter experts were formed. Subject matter experts came from the public, non-profit and private sectors from across the valley. The task groups included: Healthy Communities, Economic Development and Education, Transportation, Housing, the Environment and Public Engagement and Equity. The Environment group used the above information as well as their experience and expertise to identify goals to be included in the *Southern Nevada Regional Plan for Sustainable Development* (SNvRPSD). The SNvRPSD will be a single, integrated and consolidated plan that will promote and guide sustainable regional development in Southern Nevada over the next 20 years. Goals and strategies formulated to address environmental health issues in Southern Nevada included:

Goal 1. Promote resource-efficient land use and development practices.

Objective 1.1. Support compact development and regulations that help the Southern Nevada Water Authority achieve water conservation goals and encourage reduction in water consumption.

- Support a variety of regulations by local governments to promote efficient use of water resources (e.g., turf restrictions, plumbing code requirement for high efficiency fixtures, etc.).
- Continue to encourage the use of incentives to manage and reduce overall water use (e.g., providing rebates on water efficient technologies program).
- Continue and expand education and outreach programs to improve water efficiency (e.g., school programs) and reduce water consumption during peak usage times of day and year.
- Consider local government adoption of ordinance/code restricting water usage during peak usage times of day and year to enhance enforcement efforts.
- Continue SNWA, Las Vegas Valley Water District and local government adoption of progressive/tiered water pricing structure based on quantity and use.
- Encourage all new golf courses to use recycled water and submit drought tolerant landscape and irrigation plans.
- Encourage Existing golf courses to submit turf conversion/irrigation management plans.

Objective 1.2. Increase water quality and decrease wastewater and dry weather urban runoff while encouraging recycled water reuse strategies.

- Support the Clark County Flood Control District's Stormwater Quality Management Committee's adopted Stormwater Management Plan to promote site design standards in large parking lots such as depressed medians, buffer strips, porous paving, and minimized parking standards.
- Encourage adoption of ordinance/code for new and existing commercial businesses with water intensive uses that regulate/restrict water usage and provide other minimum standards. For example, consider requiring commercial car washes to recycle water onsite or send it to a wastewater treatment facility, where it can be cleaned and returned to the water cycle.
- Promote sustainable water practices among businesses such as dry cleaners, gas stations, hotels, and other similar uses.
- Work toward meeting or surpassing federal, state and local water quality requirements.

Objective 1.3. Reduce transportation related emissions of ozone and carbon monoxide.

- Consider collaborating with state regulatory agencies and the Department of Motor Vehicles (DMV) to strengthen the standard for vehicle emission.
- Reduce vehicle miles traveled to reduce mobile emissions and therefore improve regional air quality (See Transportation component).
- Promote responsible auto use, including refueling motor vehicles after sunset to prevent gasoline fumes from interacting with sunlight and keep vehicle engines finely tuned.

Objective 1.4. Minimize air pollutant emissions from stationary sources to reduce emissions and improve air quality to meet or exceed national ambient air quality standards and reduce greenhouse gas emissions.

- Encourage adoption of ordinance or other code changes to promote the use of Air Quality Impact Analyses for certain types and sizes of land developments, including industrial developments.
- Encourage adoption of ordinance or other code to limit the use of solvents and aerosol sprays for painting and dry cleaning.
- Support and expand programs that incentivize electric-powered lawn equipment instead of mowers with gasoline motors.

- Promote natural spaces, particularly native trees, which are proven to counter poor air quality by absorbing greenhouse gases such as carbon dioxide and other pollutants.
- Support transit and land use improvements and amenities that make walking and biking short distances viable to further reduce carbon emissions.

Objective 1.5. Reduce local and regional energy demand.

- Encourage energy efficient new home construction to meet or exceed energy efficiency standards.
- Promote Combined Heat and Power (CHP) systems, such as MGM's existing CHP system at CityCenter, to increase reliability and decrease regional energy demands of Southern Nevada's resort hotels.
- Establish a regional Property Assessed Clean Energy (C-PACE) program to assist commercial, industrial and multi-family property owner's access affordable, long-term financing for smart energy upgrades to their buildings.
- Promote the use of electric vehicles in local and state government fleets.
- Incentivize the construction of electric vehicle charging stations in local government zoning codes by offering parking reductions and other zoning-related incentives.
- Expand incentive programs to include retrofits for existing commercial and residential structures for both energy efficiency and renewable energy.
- Develop shared renewable energy and energy efficient models for higher density neighborhoods and public spaces, such as solar charging stations and NetZero cooling stations.

Objective 1.6. Increase supply of regionally generated solar energy.

- Encourage solar PV and solar thermal hot water for new homes.
- Encourage all new commercial and residential construction to allow for solar energy connections.
- Develop campaign to educate local governments and HOAs on Nevada Revised Statute 278.0208 which prohibits the unreasonable restricting of systems for obtaining solar energy.
- Implement a green energy program which allows customers, both commercial and residential to opt into purchasing clean energy from the local utility providers.
- Incentivize utility scale renewable energy projects.
- Create a financing program to incentivize solar PV installations.
- Incentivize solar thermal on existing residential buildings measured by existing goals established by Southwest Gas for solar thermal installations.
- Promote the adoption of legislation to allow small distributed generation sale of power and point of sale regulations to allow homeowners the ability to sell power back to their respective service company.

Objective 1.7. Develop guidelines for the preservation of view corridors and restoration of natural resources.

- Coordinate conservation and development of natural resources by establishing a regional entity that represents the views of the federal, state, and local agencies involved in these efforts, including private and non-profit agencies.
- Develop a publicly available database to showcase the region's network of park, trails, and open space amenities.
- Implement the SNRPC regional open space plan to conserve areas for their value as open spaces and acquire public recreation access to public lands
- Incorporate xeriscaping and native/adaptive landscaping from SNRPC plant list into public agency design standards for trails, roadways, and other public rights of way.
- Create incentives to encourage use of native plant materials in meeting the landscape

code through outreach programs for developers, designers, engineers, and contractors.

Objective 1.8. Increase regional solid waste recovery and reduce landfill contributions.

- Encourage franchise agreements to require single-stream recycling programs throughout the region.
- Encourage franchise agreements to pilot and implement a composting program.
- Introduce regional composting pilot program utilizing the EPA-supported best practices for establishing a composting program.
- Create an incentive-based program to promote regional recycling for both residential and commercial recycling based on case study research.

Goal 2. Improve neighborhood safety and protect residents from the harmful effects of pollution and hazardous materials.

Objective 2.1. Protect community members from the harmful effects of pollution and hazardous materials, hazardous waste, and environmental contamination.

- Reduce or eliminate the use of pesticides and herbicides that negatively impact human health on public properties, especially in parks and publicly accessible open spaces.
- Avoid locating new schools, childcare centers and senior housing in proximity to sources of pollution (e.g., truck routes and busy roadways) or near existing businesses that handle toxic materials. Where such uses are located in proximity to sources of air pollution or toxic materials, use building design, construction safeguards and technology techniques to mitigate the negative impacts of hazardous materials and/or air pollution on indoor air quality.

Objective 2.2. Prioritize the cleanup and reuse of brownfield and grayfield sites

- Remediate EPA/State/locally-identified brownfield sites to prevent further pollution and to utilize land for other uses.
- Develop area-wide plans and specific implementation strategies for integrating the cleanup and reuse of brownfield and grayfield sites into neighborhood revitalization efforts.
- Provide incentives for private sector cooperation to reduce the creation of hazardous wastes, the cleanup of brownfield sites, and the return of land to productive uses.
- Establish appropriate measures for long-term environmental protection of previous brownfield sites.

These goals and strategies will be included in the Regional Plan which is the final deliverable to HUD for the planning grant. The next step after completing the planning grant will be to apply for the HUD Sustainable Community Implementation Grant to implement the goal and strategies outlined above. Only entities that received the planning grant can apply for the implementation grant and the awarded amounts are projected to be fifty to one-hundred million dollars.

Acknowledgements

We would like to acknowledge the many people involved in the creation of the *Southern Nevada Existing Conditions Report:*

Stephanie Garcia-Vause, AICP, Project Director, City of Henderson

Sean Robertson, AICP, Project Manager, City of Henderson

Lisa Corrado, Senior Planner, SNRPC

Richard Rojas, AICP, Planner, SNRPC

Daniel Fazekas, Planner, SNRPC

Andrew Powell, Senior Planner, City of Henderson

Jason Rogers, AICP, Planner, City of Henderson

Andrew Roether, Planner, SNRPC

Brittany Murphy, Public Information Specialist, SNRPC

Robert Lang, Ph.D., Executive Director, The Lincy Institute and Director, Brookings Mountain West, UNLV

Tom Piechota, Ph.D., Interim Vice President for Research and Dean of the Graduate College Division of Research and Graduate Studies

Jon Wardlaw, AICP, Planning Manager, Clark County

Philip Banea, AICP, Principal Planner, RTC of Southern Nevada

Marco Velotta, Planner, City of Las Vegas
James Marshall, Senior Planner, City of Las Vegas
Richard Wassmuth, Analyst, City of Las Vegas
Deborah Williams, Manager, Southern Nevada Health District
Chris Drury, Analyst, Applied Analysis
Marya Shegog, Ph.D., Director of Health Programs, The Lincy Institute, UNLV
Patricia Rowley, Manager, Southern Nevada Health District

Financial Disclosure

The work that provided the basis for this publication was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government. This research was funded in part by the US Department of Housing and Urban Development Sustainable Communities Regional Planning Grant, #FR-5500-N-30FA.

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