SNWA's Conservation Program

PRESENTATION TO THE OFFICE OF THE NEVADA STATE ENGINEER

Prepared by

SOUTHERN NEVADA
WATER AUTHORITY

May 2011

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SNWA's Conservation Program

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Pertaining to:
Groundwater Applications 54003 through 54021 in
Spring Valley
and
Groundwater Applications 53987 through 53992 in
Cave, Dry Lake, and Delamar Valleys

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ACRONYMS

AMR	automated meter reading
AWWA	American Water Works Association
BOR	Bureau of Reclamation
CFR	Code of Federal Regulations
CY	calendar year
IWPAC	Integrated Water Planning Advisory Committee
LVVWD	Las Vegas Valley Water District
M&I	municipal and industrial
MOU	Memorandum of Understanding
NRS	Nevada Revised Statutes
NRW	non-revenue water
SNWA	Southern Nevada Water Authority
UDACS	Uniform Design and Construction Standards
WCC	Water Conservation Coalition
WET	Water Efficient Technologies
WSC	Water Smart Contractor
WSL	Water Smart Landscapes

ABBREVIATIONS

af	acre-foot
afy	acre-feet per year
ft^2	square feet
gal	gallon
gpcd	gallons per capita per day
gpm	gallons per minute
in.	inch
mi	mile

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EXECUTIVE SUMMARY

The Southern Nevada Water Authority (SNWA) meets the statutory standard set forth in Nevada Revised Statutes 533.370, having developed, adopted and effectively carried out a plan for the conservation of water. The SNWA has established and pursued conservation and water efficiency goals since the agency's inception in 1991. The current five-year Conservation Plan (SNWA, 2009a) has been accepted by both the State of Nevada and the Bureau of Reclamation as meeting or exceeding all regulatory requirements.

The SNWA's conservation efforts have been highly effective, particularly within the past decade. The SNWA has invested substantial resources in the implementation of the plan, with approximately $200 million dollars invested in conservation programming over the past decade. Per capita water use has declined from 315 gpcd in 2000 to 223 gpcd in 2010. The SNWA's current goal is 199 gpcd by 2035.

Conservation program efforts have been most aggressively focused on decreasing consumptive water use, such as landscape irrigation. Historically, 40 percent of water use in Las Vegas serves non-consumptive uses (those which return water to the sanitary sewer for treatment and reuse). Excepting a small amount of conveyance and process loss, nearly 100 percent of southern Nevada's wastewater is directly or indirectly reused. As such, non-consumptive uses have little or no influence on SNWA's water resource allocation.

The Conservation Plan (Plan) is multi-faceted and includes regulatory measures, educational programs, pricing signals and monetary incentives. Among agencies in the western United States, the SNWA has some of the most comprehensive and effective programs. Its Water Smart Landscapes Program is the largest known program of its kind, saving an estimated 26,000 af annually. Development standards adopted in 2003 have dramatically decreased water use in new residential development by nearly 50 percent.

Reaching the target goal of 199 gpcd will require additional conservation measures. In addition to continued pursuit of existing initiatives, the SNWA is committed to developing new initiatives and enhancing existing efforts to achieve the goal.

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1.0 THE SNWA CONSERVATION PLAN

1.1 Overview

The Southern Nevada Water Authority (SNWA) has produced a comprehensive conservation plan at five-year intervals since 1999. The current plan spans the five-year period from 2009 through 2013.

The SNWA Conservation Plan (SNWA, 2009a) has been reviewed and accepted by the State of Nevada in compliance with Nevada Revised Statutes (NRS) 540.121 through 540.151 inclusive, and by the Bureau of Reclamation (BOR) in compliance with Part 417 of Title 43, Code of Federal Regulations (43 CFR 417).

NRS Chapter 540 pertains to the effective management of the State's water resources. NRS 540.011 is the Legislative declaration for the chapter, which states, in part:

> The Legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the State's limited water resources. It is acknowledged that many of the State's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the State the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is the policy of the State to encourage efficient and non-wasteful use of these limited supplies.

NRS 540.131 through 540.151 relate to the requirement to submit a water conservation plan that ensures the submitting agency is compliant with the State's policy of encouraging the efficient, non-wasteful use of water.

In correspondence dated April 22, 2009, Deputy State Engineer Kelvin Hickenbottom affirmed that the Conservation Plan submitted by the SNWA on behalf of its seven member agencies met all statutory requirements of NRS Chapter 540.

At the Federal level, water allocations from the Colorado River are subject to water conservation requirements promulgated and enforced by the BOR. These policies are set forth in Section 210(b) of the Reclamation Reform Act of 1982 and 43 C.F.R. §427.1, which states, in part:

> (a) In general. The Secretary shall encourage the full consideration and incorporation of prudent and responsible water conservation measures in all districts and for the operations by non-Federal recipients of irrigation and municipal and industrial (M&I) water from Federal Reclamation projects.

> (b) Development of a plan. Districts that have entered into repayment contracts or water service contracts according to Federal reclamation law or the Water Supply Act of 1958, as amended (43 U.S.C. 390b), shall develop and submit to the Bureau of Reclamation a water conservation plan which contains definite objectives which are economically feasible and a time schedule for meeting those objectives.

In correspondence dated May 14, 2009, BOR Water Resources Program Manager, Tina Mullis, approved the SNWA five-year plan as meeting the Federal requirements.

The SNWA excels as a regional water agency due, in part, to the extraordinary level of collaboration and alignment between the member agencies. Conservation programs are handled on a regional basis, thus any member agency's customer has access to the same information and services as a customer in a neighboring jurisdiction. Combined with collaboration on regulatory initiatives, this level of collaboration allows the SNWA to utilize regional outreach and mass media messaging.

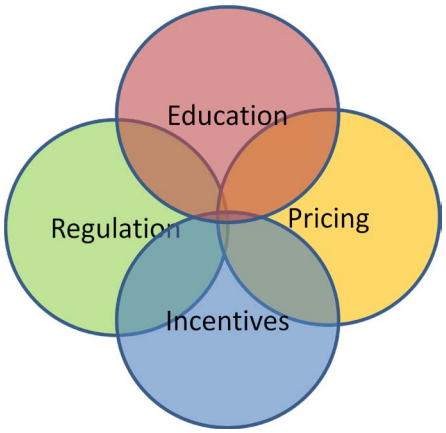
The SNWA established its first conservation goal in the year of its establishment, 1991. At the time, the Las Vegas Valley Water District (LVVWD) was implementing a visible and aggressive conservation program and the SNWA members temporarily adopted the existing goals and initiatives of the LVVWD. The first comprehensive, interagency conservation effort among SNWA member agencies produced a Memorandum of Understanding (MOU) regarding water conservation and efficiency programs in December 1995.

Since that first effort, the MOU has been succeeded by the SNWA Conservation Plan. The current plan has fine-tuned SNWA's conservation efforts to maximize beneficial use of available water resources. To do so, resources have been most heavily allocated to initiatives which the SNWA deems to have the greatest return on investment.

The current plan works in concert with the SNWA's Water Resource Plan (SNWA, 2009b), which is reviewed annually and updated when appropriate. The Water Resource Plan's long-term demand projections include the expectation of achieving conservation goals in full, and on time. The Conservation Plan, in turn, acknowledges the importance of reducing consumptive uses. Consumptive uses are generally those where the water is consumed by evaporation or evapotranspiration after diversion or withdrawal. Examples of consumptive uses include landscape irrigation, evaporation from open water, and losses from cooling and heating systems as steam or vapor.

2.0 CONSERVATION STRATEGIES

The SNWA Conservation Plan (SNWA, 2009a) utilizes a comprehensive suite of strategies to advance water efficiency: Education, Pricing, Regulation and Incentives. These strategic components are synergistic in their effect and their individual influence in conservation progress cannot be fully disaggregated.



An effective conservation plan must acknowledge the policies that govern the agency's water supplies. SNWA agencies have access to both local groundwater (governed by State policy) and Colorado River water (governed by Federal policy). Both State and Federal policies typically assign and measure water rights on the basis of consumptive use.

In all water efficiency arenas, the SNWA emphasizes improved management and conservation of consumptive uses. The SNWA also supports initiatives that reduce non-consumptive use of water. Because nearly all wastewater is treated and reused, efforts such as plumbing retrofits and direct wastewater recycling for landscape irrigation do not extend SNWA's water resources. Still, these efforts are beneficial components of SNWA's sustainability initiatives and effective components of the overall resource management strategy. While the SNWA makes great efforts to educate the community about the relative value of different water efficiency measures, having a multi-faceted conservation program helps bolster the community's conservation ethic by providing more opportunities to embrace water efficiency concepts.

Water measurement is the foundation of water management. SNWA member agencies meter all water customers and bill 12 times annually. Nearly all premises served by SNWA member agencies are equipped with automated meter reading (AMR) devices. The AMR technology not only makes collection of readings more efficient, it also provides opportunities to identify leaks and/or conduct a detailed analysis of water use characteristics on individual properties. This practice provides frequent feedback to customers and allows the agencies to effectively monitor water use and conservation progress for specific properties and customer types. Metered water use data often serves as the basis for evaluating specific conservation programs or supports research projects to evaluate new techniques or technologies.

Metered use information is processed through a database that allows analysis by customer type, meter size and monthly consumption. Metered use information, combined with data from highly-maintained production meters, also allows the agencies to determine the amount of non-revenue water (NRW), both on a regional scale, as well as within each purveyor's jurisdiction.

NRW is water that is produced and accounted for at the point of diversion, but cannot be accounted for at customer meters. SNWA and its member agencies proactively and aggressively control NRW. NRW can be classified as real or apparent. Real losses include leaks in distribution systems and storage tanks. Apparent losses are losses where water may have been beneficially used, but cannot be accounted for. Apparent losses include metering errors, theft, or authorized unmetered uses, such as firefighting.

Water distribution systems have expected levels of losses that are considered unavoidable. No water conveyance system is capable of delivering 100 percent of the water it produces. As such, the goal is not to completely eliminate losses, but to cost-effectively minimize that portion of the loss that is avoidable.

The SNWA regional transmission system contains more than 163 mi of large diameter pipe and two water treatment facilities. On average, the regional transmission system accounts for 98.9 percent of total water production as being delivered to member agencies. Losses from the regional system have averaged just 1.1 percent over the five calendar years 2006 through 2010.

Using the performance indices developed by the International Water Association and the American Water Works Association (AWWA), the SNWA's member agencies typically operate within the top performance tier for managing system losses. These industry-best practices and the techniques for assessing them are described in the AWWA Manual M36 (AWWA, 2009).

The SNWA and its member agencies combat non-revenue water with the following programs.

2.1 Infrastructure Management

All purveyors subscribe to the Las Vegas Valley Uniform Design and Construction Standards (UDACS) for water infrastructure. These standards ensure that systems are appropriately designed and tested to meet quality and durability standards unique to our region.

Efforts are ongoing in all purveyor service areas to identify older infrastructure that has been deemed susceptible to leaks. Through the collection and analysis of data, engineers predict the likelihood of failure and proactively replace susceptible segments of the system. For example, most cast iron mains are being systematically replaced, as are polyethylene service connections that do not appear to be meeting longevity expectations.

Prior to installing facilities, soil testing is conducted to identify potential threats to the distribution system's integrity. For example, where testing indicates that soil chemistry will be destructive to copper piping, plastic sleeves are installed over the service line to prevent corrosion. These measures increase the service life of the materials and reduce failures. Water agencies employ their own inspectors to monitor contractors and ensure use of the appropriate materials and techniques for water mains and service lines.

Production meters are regularly maintained and calibrated.

2.2 Active Leak Detection and Response

The SNWA and its member agencies have a variety of active programs to more effectively account for total production. These ongoing efforts will continue to improve accounting accuracy and minimize loss of unaccounted-for water. The following programs are conducted throughout the region:

- Reservoirs are inspected by divers at regular intervals (typically every five years) to ensure their integrity.

- A substantial portion of purveyor distribution lines have permanent listening devices installed that can identify unseen leaks and assist in accurately determining the leak location for excavation.

- Interagency collaboration speeds leak repairs through fast-tracking line location ("call-before-you-dig") and prompt repair. Records are kept of the estimated system loss for each leak repaired to improve the accuracy of water system accounting.

2.3 Meter Repair and Replacement Programs

All customer meters are monitored for consumption anomalies. Small customer meters are subject to a planned replacement program based upon life expectancy and large meters are regularly maintained and calibrated for accuracy and rebuilt or replaced, as needed.

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3.0 REGULATORY PROGRAMS

Regulatory programs, such as water use regulations and development standards are among the most effective tools for moderating long-term demands. The SNWA, its member agencies and other regulatory jurisdictions have effectively collaborated to develop standardized, regional policies. Each agency is responsible for the adoption and enforcement of mutually-agreed-upon codes within their own jurisdiction.

3.1 Development Codes

Aggressive development codes relating to water efficiency were adopted in 2003 as a mechanism of drought response. These codes have had a substantial influence on reducing community per-capita water use and have since been adopted as permanent measures as follows:

- Clark County Unified Development Code Title 30.64
- Henderson Municipal Code Title 14.14
- North Las Vegas Municipal Code Title 13.08, 13.12, 13.16
- Las Vegas Municipal Code Title 14.08, 14.10, 14.11
- Boulder City Municipal Code 11-1-48 and 11-1-49

3.1.1 Turf Limitations

Research has determined that irrigated turfgrass is the most intensive consumptive use of water. During a five-year study conducted jointly by the SNWA and the BOR, it was found that turfgrass areas were receiving four times as much water as other styles of landscaping (Sovocool, 2005). To dramatically decrease consumptive use in new development, all jurisdictions prohibit the use of irrigated turfgrass in new non-residential construction. In new single-family homes, turfgrass is prohibited in front yards and restricted to 50 percent of the landscapable area in backyards.

Golf course turf acreage is limited to reduce water demand. In general, golf courses are limited to five acres of irrigated turfgrass per regulation playing hole. In most jurisdictions, golf courses are also required to utilize reclaimed water when it is available.

3.1.2 Water Feature Restrictions

Although restrictions on artificial bodies of water were implemented in the mid-1990s, additional measures were implemented in 2003. These policies:

1. Regulate the maximum area for commercial swimming pools.
2. Restrict development of man-made lakes.

3. Regulate the development and operation of ornamental water features.

The Las Vegas Strip continues to feature some of the world's best-known water attractions. While these attractions consume a relatively small amount of water, they are defensible beneficial uses due to the economic benefit they produce. Furthermore, some attractions, such as the Bellagio Fountain, utilize private water rights granted by the State of Nevada. Others, such as the Mirage Volcano and Buccaneer Bay, utilize wastewater reclaimed from the hotel towers.

Most southern Nevada resorts do not have substantial water attractions; however, among those that do, open bodies of water (including water attractions, swimming pools and spas) account for less than 2 percent of the land use. As an example, Figures 3-1 and 3-2 illustrate the relative scale of the Caesar's Palace fountain compared to the developed property. On average, as illustrated in Figure 3-3 just one-fourth of water deliveries to southern Nevada's resorts is consumptively used. As a result, the aggregate consumptive impact to SNWA's water resources from resort hotels is estimated to be less than 3 percent. According to a 2008 report by Applied Analysis (2008), southern Nevada's gaming and tourism industries account for more than one-third of Nevada's gross state product. Thus the relatively small amount of water consumed by Las Vegas resorts and water attractions provides a large boost to the economy of the State as a whole.

Figure 3-1
Caesar's Palace Street View

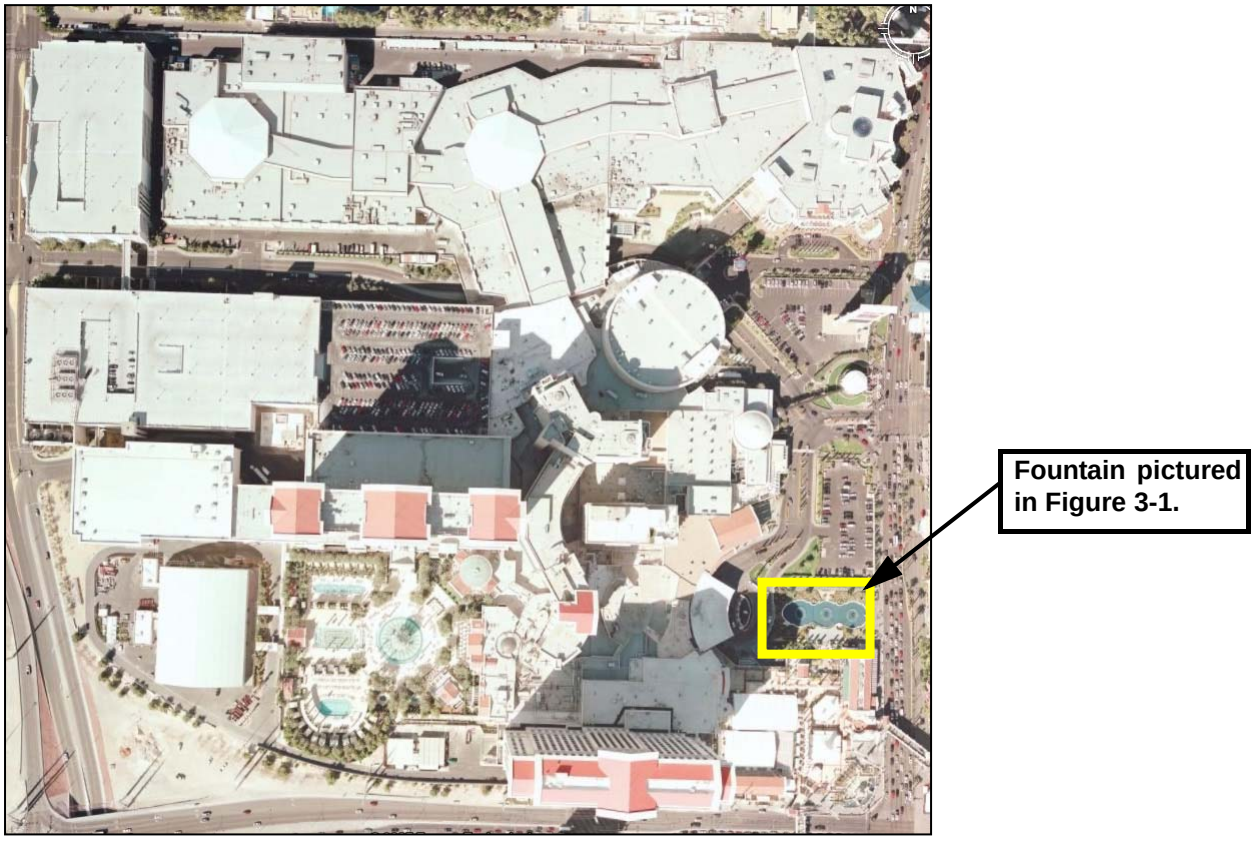

Figure 3-2
Caesar's Palace Aerial View

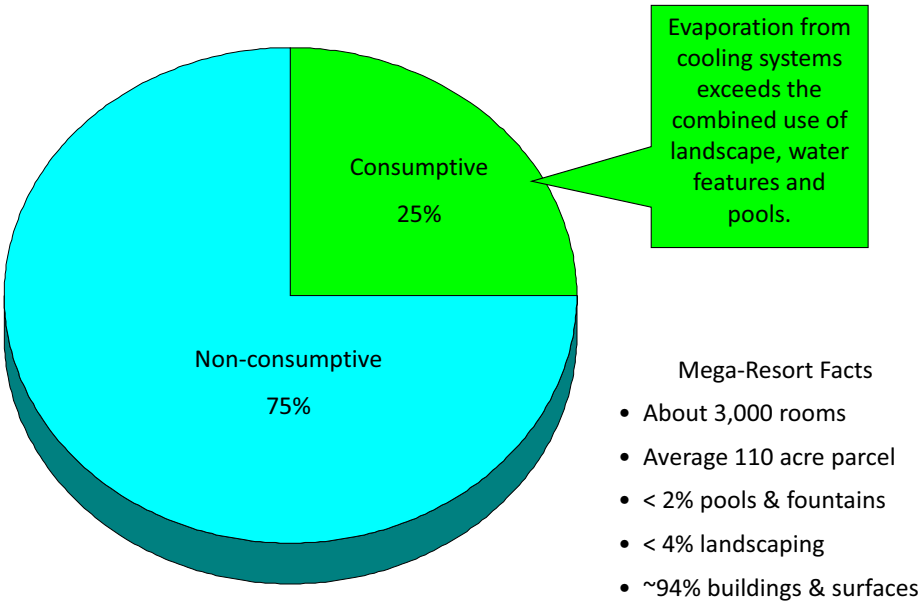

Figure 3-3
Las Vegas Mega-Resort Water Use

3.2 Water Use Policies

Depending upon the jurisdiction, water use policies are promulgated and enforced either through the municipal code, or the service rules of the water agency.

3.2.1 Seasonal Watering Schedules

All SNWA member jurisdictions utilize mandatory seasonal watering restrictions. The restrictions mandate:

1. One assigned watering day per week November through February.
2. Three assigned watering days per week March through April.
3. Mid-day spray irrigation prohibited May through September.
4. Three assigned watering days per week September through October.

3.2.2 Water Budgets for Golf Courses

All agencies have adopted water budgets for golf courses in lieu of mandatory watering schedules. Upon adoption of the policy in 2003, the average golf course was applying approximately 7.1 af of water per irrigated acre annually. The initial water budget was established at 6.5 af per irrigated acre. It has subsequently been reduced to 6.3 af per irrigated acre. Water use above the budget is billed at a punitive rate. Water budgets for golf courses were designed to produce similar sector water savings as assigned watering schedules imposed upon commercial and residential users. An analysis of 34 golf courses subjected to water budgets in 2003 found that they collectively reduced water use by more than 4,400 af by 2009.

The golf industry has responded effectively to water budgeting through improved water management and conversion of out-of-play areas on existing courses from turfgrass to water efficient landscaping. Since implementation of the water budget policy, golf courses have converted more than 38.8 million ft^2 of turfgrass to water efficient landscaping. These conversion areas comprise more than 890 acres, or about the equivalent turf area of nine 18-hole golf courses.

No new golf courses have been constructed since the drought response measures were adopted in 2003.

3.2.3 Water Waste Prohibition

All jurisdictions prohibit waste of water through provisions of the water utility's service rules or their municipal code. In addition to requiring adherence to seasonal watering schedules, the policies also prohibit allowing water to spray or flow from the property. The policies are supported by a comprehensive regional education and awareness plan. The policies are among the most aggressive in the United States. The LVVWD, for example, has assessed fees in excess of $5,000 per violation to chronic violators.

4.0 RATE STRUCTURES

All SNWA member agencies have inclining block rate structures to encourage efficient use of water.

These rate structures are consistent with the intent of the water resource policy of the State of Nevada per NRS 540.011, which states: "It is also the policy of the State to encourage suppliers of water to establish prices for the use of water that maximize water conservation with due consideration to the essential service needs of customers and the economic burdens on businesses, public services and low-income households."

The LVVWD is the largest of the SNWA member agencies, serving approximately 70 percent of the region's customers. Figure 4-1 illustrates the rate structure evolution for the LVVWD, showing the change from a flat rate structure in 1987, to the current four-tiered rate structure. The rate structure has remained very affordable in the first tier, which is intended to meet basic health and sanitation needs. The steepening of the rate structure is most evident after 2003, when the tier pricing was both increased and compressed.

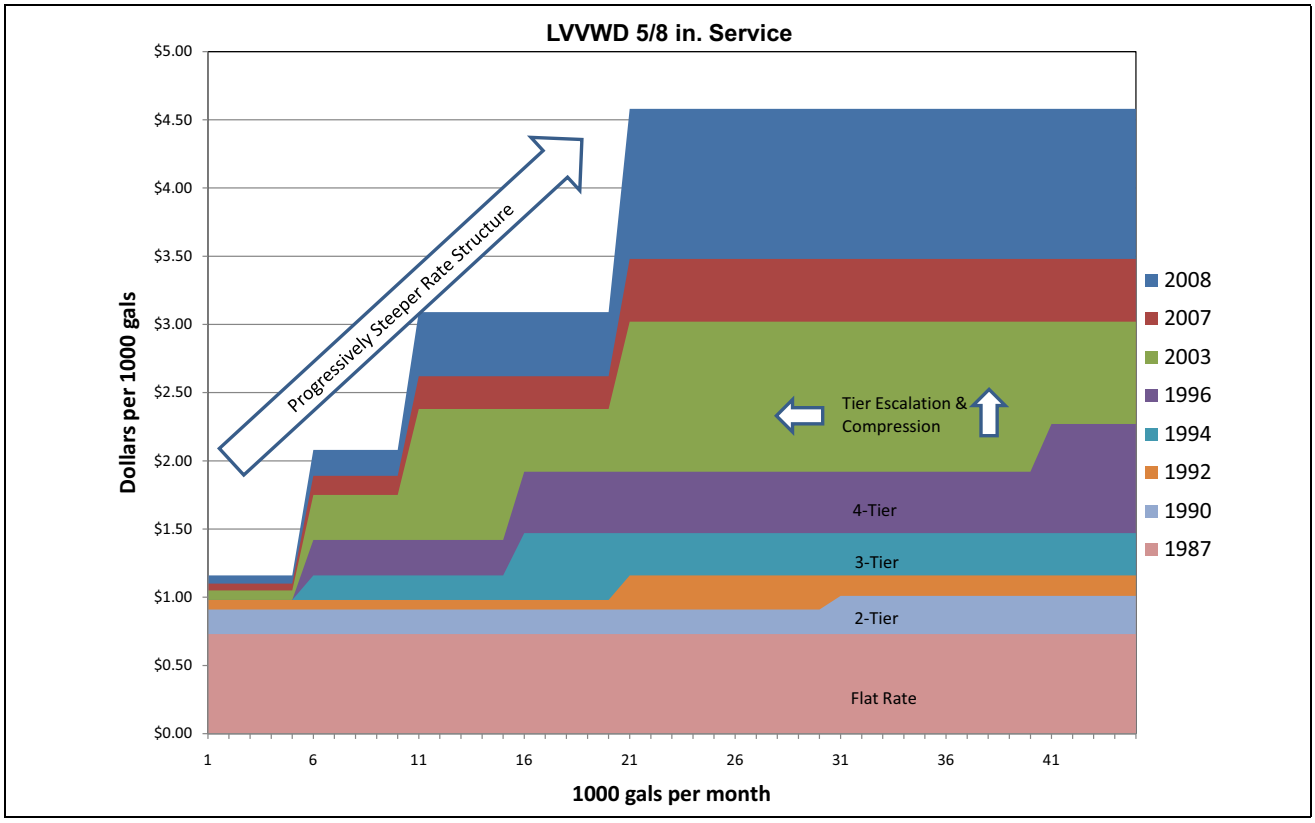

Figure 4-1
Conservation Rate Structure Evolution

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5.0 INCENTIVE PROGRAMS

Although regulatory measures effectively ensure water-efficient development, it is also necessary to effect greater water efficiency from existing properties through both regulation and voluntary measures. By providing products and/or financial incentives to customers, the SNWA has both strengthened its customer relationships and created substantial, long-term water savings on older properties.

Relative to the service population, the SNWA operates one of the largest water conservation incentive programs in the United States. For the 10 fiscal years of 2001 through 2010, an average of $16.44 million dollars per year has been paid directly to property owners for their participation in water efficiency programs.

5.1 Water Smart Landscapes

The Water Smart Landscapes (WSL) program is the flagship incentive program of the SNWA. Consumptive water efficiency is paramount to extending the region's resources, and landscaping accounts for the vast majority of consumptive use. The WSL program is an effective vehicle to encourage existing customers to replace high-water use lawns with water efficient landscaping.

Between 1995 and 2000, the SNWA, in conjunction with the BOR, conducted the nation's most comprehensive long-term research project on water use of urban landscapes. This research demonstrated that conversion of turf areas to water efficient landscape reduced irrigation demands on the converted area by approximately 75 percent (Sovocool, 2005). Based upon these findings, the SNWA initiated an incentive program to encourage property owners to convert lawn areas to water efficient landscapes in late 1999.

Since implementation, more than 43,000 WSL projects have been completed comprising approximately 150 million ft^2 of landscape conversion. The SNWA estimates these conversions reduced demand by more than 26,000 af in 2010. Over the past 10 years, this single program has reduced demand by more than 127,000 af (Figure 5-1).

In 2009, the SNWA identified and surveyed 33 other agencies that offer financial incentives for water efficient landscape conversions to determine typical program participation levels. Twenty-eight agencies responded to a request for the following information:

- Annual average amount of incentive payments
- Annual average number of incentives awarded
- Average square footage of landscape converted
- Average incentive amount paid per square foot converted.

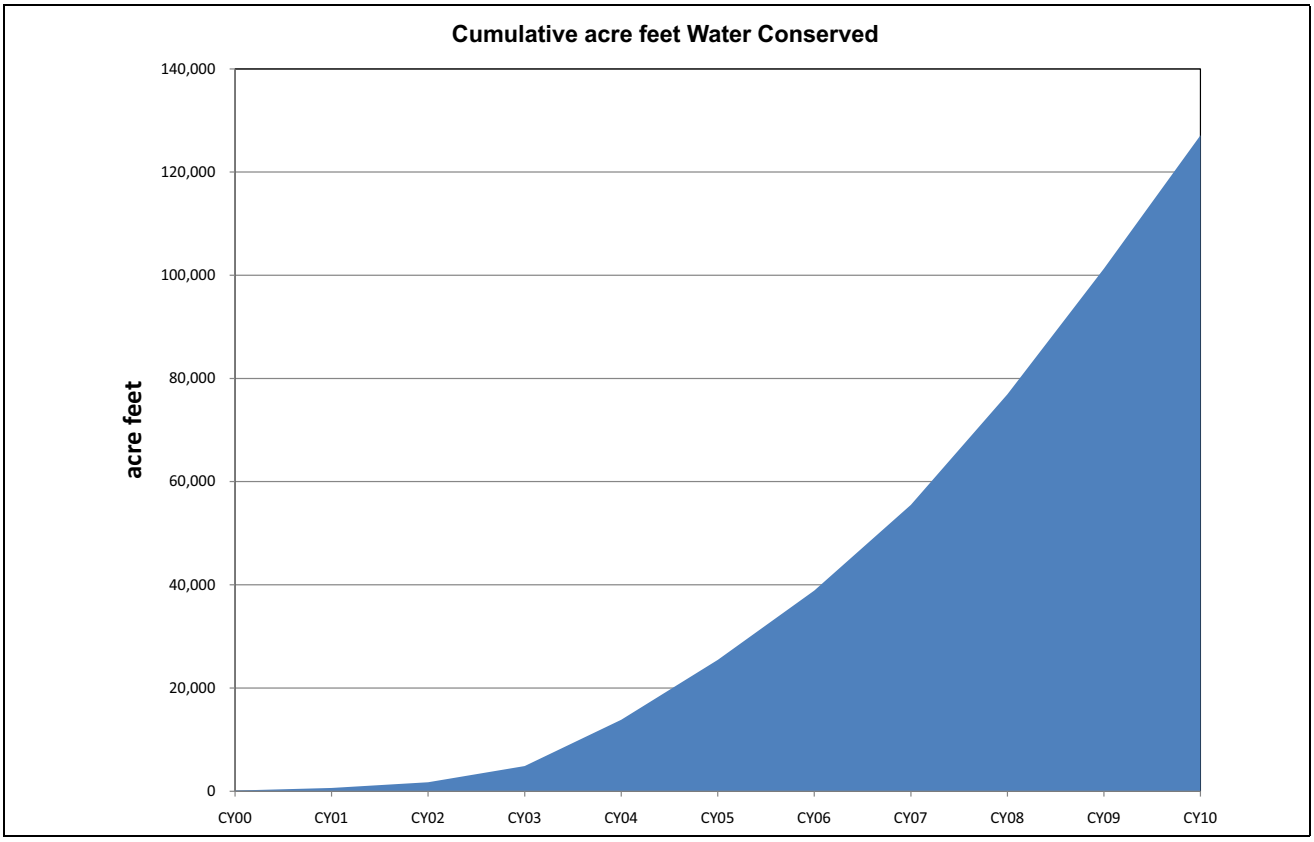

Figure 5-1
Water Smart Landscapes 2000-2010

Due to differences in program design and management, not all agencies were able to provide comparable data; however, 17 programs in California, New Mexico, Arizona, and Colorado provided complete, comparable data (Table 5-1).

According to the survey, the SNWA invests 10 times more in landscape conversion incentives than all 17 similar programs combined.

Beginning in June 2009, the SNWA began requiring WSL applicants to grant a restrictive covenant and easement to ensure that water efficiency gains achieved from the program would run with the land and be sustained by subsequent land owners. Prior to the covenant requirement, the owner was required to sustain the conversion as long as they controlled the property. SNWA conducted annual inspections to confirm continued compliance and determined a long-term compliance rate of 99.5 percent. The SNWA continues to conduct annual inspections to ensure compliance with WSL program requirements.

Table 5-1
Water Efficient Landscape Incentive Programs 2009

Agency	Annual Spending	Approximate Service Population	Square Feet Converted
SNWA Annual Average	**$15,704,756**	**1,950,000**	**14,226,382**
Albuquerque Bernalillo County Water Utility Authority, NM	$307,692	592,000	461,538
Aurora Water, CO	$255,811	310,000	274,162
City of Santa Rosa, CA	$250,000	220,000	250,000
City of Chandler, AZ	$200,000	240,000	288,404
City of Tempe, AZ	$142,857	181,000	142,857
Inland Empire Utilities Agency, CA	$120,953	850,000	87,156
City of Roseville, CA	$85,000	125,000	85,000
Soquel Creek Water District, CA	$80,000	49,000	43,333
City of Scottsdale, AZ	$40,668	240,000	110,345
City of Mesa, AZ	$26,750	440,000	52,134
City of Prescott, AZ	$22,741	60,000	61,687
City of Glendale, AZ	$9,400	180,000	40,920
City of Bullhead City, AZ	$8,607	42,000	16,703
City of Flagstaff, AZ	$6,788	63,000	47,998
Scotts Valley Water District, CA	$4,000	11,000	4,250
Town of Paradise Valley, AZ	$3,405	14,000	13,620
City of Gallup, NM	$2,100	22,000	8,600
Annual Total Other Programs	**$1,566,772**	**3,639,000**	**1,988,707**
SNWA Annual Average	**$15,704,756**	**1,950,000**	**14,226,382**

5.2 Water Efficient Technologies Program

The Water Efficient Technologies (WET) Program is intended to facilitate large scale conservation efforts, primarily for commercial and industrial clients. This voluntary program allows customers to submit applications for any capital improvement that is expected to produce a minimum water savings of 250,000 gal annually. The program issues a one-time incentive of $8.00 per 1,000 gal for reductions of non-consumptive water use and $24 per 1,000 gal for reductions in consumptive water use.

The program offers menu-based options for traditional technologies and a performance-based option for specialized technologies. Incentives are available both for new construction and retrofit projects. Among the menu options are:

- High Efficiency Toilets and Urinals (HET's and HEU's)
- High Efficiency Showerheads
- Artificial sporting surfaces in lieu of turfgrass

- Cooling tower improvements
- Closed loop liquid-cooled and air-cooled ice machines

Since inception of WET in 2001, 83 projects have been rebated for $1.78 million. These projects have been estimated to reduce demand by more than 2,400 af in 2010. Cumulatively, the program has produced a lifetime demand reduction of more than 8,200 af.

WET has undergone substantial modifications to make it more accessible. In 2006, the menu option was added to simplify the application process. Subsequently, in fall 2008, the eligibility threshold was reduced from 500,000 gal annual savings to 250,000 gal to further expand accessibility to smaller facilities. At the same time, the program was modified to allow the submittal of "group" applications where multiple facilities controlled by the same applicant could be aggregated to meet the minimum water savings threshold. Rebate amounts for consumptive water use projects were rescaled to be commensurate with the Water Smart Landscapes Program.

These modifications, combined with targeted marketing outreach to the commercial sector, have been successful in increasing participation. In the two years since the modifications, 34 projects have been rebated, accounting for more than 40 percent of the program's historic participation.

5.3 Voucher Programs

SNWA offers monetary incentives for consumer products, including swimming pool covers, rain sensors and smart irrigation controllers. In each case, the incentive can pay up to half of the cost of the product. These products are all eligible for SNWA's instant rebate vouchers. As a means of simplifying participation, customers may produce their own voucher via SNWA.com and redeem it instantly at a participating retailer. The voucher format is not only appealing to end users, but it also builds strategic relationships with local businesses by demonstrating the market influence of water efficiency products. Since the coupon format was introduced in 2005, more than 22,000 coupons have been redeemed with a combined value of more than $1.16 million.

5.4 Indoor Retrofit Kits

Approximately 70 percent of all plumbing fixtures in the valley are estimated to already meet the most current Federal water efficiency standards. However, the SNWA provides free components for indoor water efficiency retrofits. The kits are mailed upon request and include 1.0 gpm WaterSense faucet aerators, 2.0 gpm WaterSense showerheads, flow testing bag, toilet leak testing tablets and a swiveling, high-efficiency kitchen sink aerator. By providing items that exceed current plumbing standards, the kits achieve savings for homes of all ages. Between July 2007 and December 2010, more than 5,500 kits have been issued.

6.0 EDUCATION AND OUTREACH

The SNWA has one of the nation's most comprehensive education and outreach campaigns. Between 2007 and 2010, the SNWA invested approximately $2.5 million annually in mass marketing campaigns. In addition, the agency has a team of in-house public information specialists that handle a variety of conservation education and outreach initiatives.

The education and outreach program includes:

- Mass media advertising (broadcast, visual, direct mail)
- Bill inserts in collaboration with member agencies
- Speakers' Bureau
- Award-winning website (over 450,000 visits annually)
- Monthly television show (WaterWays)
- Quarterly newsletter (WaterSmart Living, 340,000 distribution)
- Annual calendar (340,000 distribution)
- Spanish language outreach program
- Community events outreach
- Instructional videos
- How-to publications and educational classes
- Community demonstration gardens
- Conservation Helpline telephone support

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7.0 PUBLIC/PRIVATE PARTNERSHIP PROGRAMS

The SNWA partners with the private sector to promote conservation efforts. This includes partnering with local retailers, landscapers, homebuilders, and the business community. Partnerships include:

Water Conservation Coalition (WCC) – Established in 1995, the WCC is comprised of business and community leaders that have partnered to promote water-efficient practices in the Southern Nevada business community. WCC members speak to professional and civic organizations to explain the benefits of increased water efficiency, encourage other businesses within their industries to participate in SNWA incentive programs and identify water conservation projects within the community to organize and sponsor. In 2008, the WCC completed water-efficient upgrades at Boys Town Nevada, a group of homes that provide short-term services for at-risk children. The project is estimated to save 6.75 af of water annually.

Water Upon Request – The Nevada Restaurant Association, WCC and SNWA partner with local restaurants, which agree to serve water only when patrons request it. This program saves participating restaurants water, time and money by eliminating unconsumed glasses of water. For every glass of water not served, as much as 1.5 to 3 gal of water is saved. More than 300 restaurants participate in the program.

Water Smart Contractor (WSC) – Landscape contractors are critical links in promoting, implementing and sustaining water efficient landscapes. The SNWA determined that securing knowledgeable contractors was a potential impediment to customers who were interested in undertaking a water efficient landscape project. In response, the SNWA created the WSC program. The WSC program trains licensed landscape contractors in water-efficient landscape and irrigation design. Classes are offered in both English and Spanish. Contractors who complete the course and pass an exam are designated as Water Smart Contractors and receive promotional marketing assistance from SNWA. To date, more than 100 companies have completed the program.

Water Smart Home – In 2004, the SNWA partnered with the Southern Nevada Home Builders Association to develop a program that certifies new homes as "water smart." This is the nation's largest program for water efficiency in new homes, with more than 7,500 water smart homes constructed. The U.S. Environmental Protection Agency used the SNWA's program as the template for developing the recently launched WaterSense New Home program nationwide.

Water Smart Car Wash – Water Smart Car Washes recover all of their wastewater and reuse it onsite or send their wastewater to municipal facilities for treatment and reuse. This program encourages residents to use Water Smart Car Wash facilities instead of washing their vehicles at home. In addition to educating customers on the environmental benefits, the program offers instant discount coupons for dozens of valley car washes. On average, more than 2,500 visits are recorded for the coupon-producing page of SNWA.com every month.

Lodging Linen Exchange – Nearly two dozen resorts and other lodging properties, comprising approximately 35,000 guest rooms, participate in this voluntary program through which linens are changed only on the third day of a guest's stay, unless otherwise requested. The average savings of washing linens and towels every three days is about 50 gal per room each day. This program is estimated to reduce potable water demand by approximately 1,500 af annually.

8.0 THE SNWA CONSERVATION PLAN IS EFFECTIVELY IMPLEMENTED

8.1 Conservation Goals and Achievements

To track conservation achievements, SNWA calculates water use in terms of gallons per capita per day (gpcd). For purposes of planning, SNWA weather normalizes each year's actual gpcd. For example, if weather is abnormally cool or wet, a portion of the demand reduction observed is known to be caused by weather conditions and not conservation efforts, thus the weather normalized gpcd will be higher than the actual gpcd. Likewise, a year that is hotter or drier than normal would be expected to inflate water use, resulting in a weather adjusted gpcd lower than the actual gpcd. Weather normalization is a recommended practice when gpcd is used as a long-range planning or monitoring metric (Dziegielewski and Kiefer, 2010).

The first SNWA conservation goals were established in 1995. The initial goal was to reduce actual demand 25 percent below a modeled demand by 2010. SNWA eclipsed the goal in 2004, six years ahead of schedule. The agency determined that future water efficiency objectives would be established as gpcd targets to better align with the methodologies and reporting associated with the SNWA Water Resource Plan.

In 2004, the SNWA convened the Integrated Water Planning Advisory Committee (IWPAC) to review SNWA's future water resource options and to make long-term resource recommendations. In early 2005, the IWPAC recommended a conservation target of 250 gpcd by 2010 and further reductions to 245 gpcd by 2035. At the time, the recommendation constituted an 8.8 percent water use reduction over a six year span. The SNWA Board of Directors adopted the recommendation. The SNWA projected that these goals would decrease demand by 107,000 af in the year 2035.

The SNWA again surpassed the 250 gpcd goal in 2008, two years ahead of schedule. It became clear that the IWPAC's recommendation to reach 245 gpcd by 2035 would not only be reachable, but swiftly surpassed. The SNWA convened a committee of water efficiency professionals from each of the member agencies to develop a more aggressive goal for the 2035 planning horizon.

In February 2009, the SNWA Board of Directors adopted the workgroup recommendation to establish 199 gpcd as the water efficiency goal for 2035. The revised goal increased the projected 2035 demand avoidance to 276,000 af (Figure 8-1).

Although SNWA's projected demands assume a linear path from current water use to the 199 gpcd goal, it is unlikely conservation progress will be as precisely consistent. As more waste and discretionary water use is eliminated, attaining remaining conservation potential becomes more challenging. This concept is known as demand hardening. Demand hardening results when water

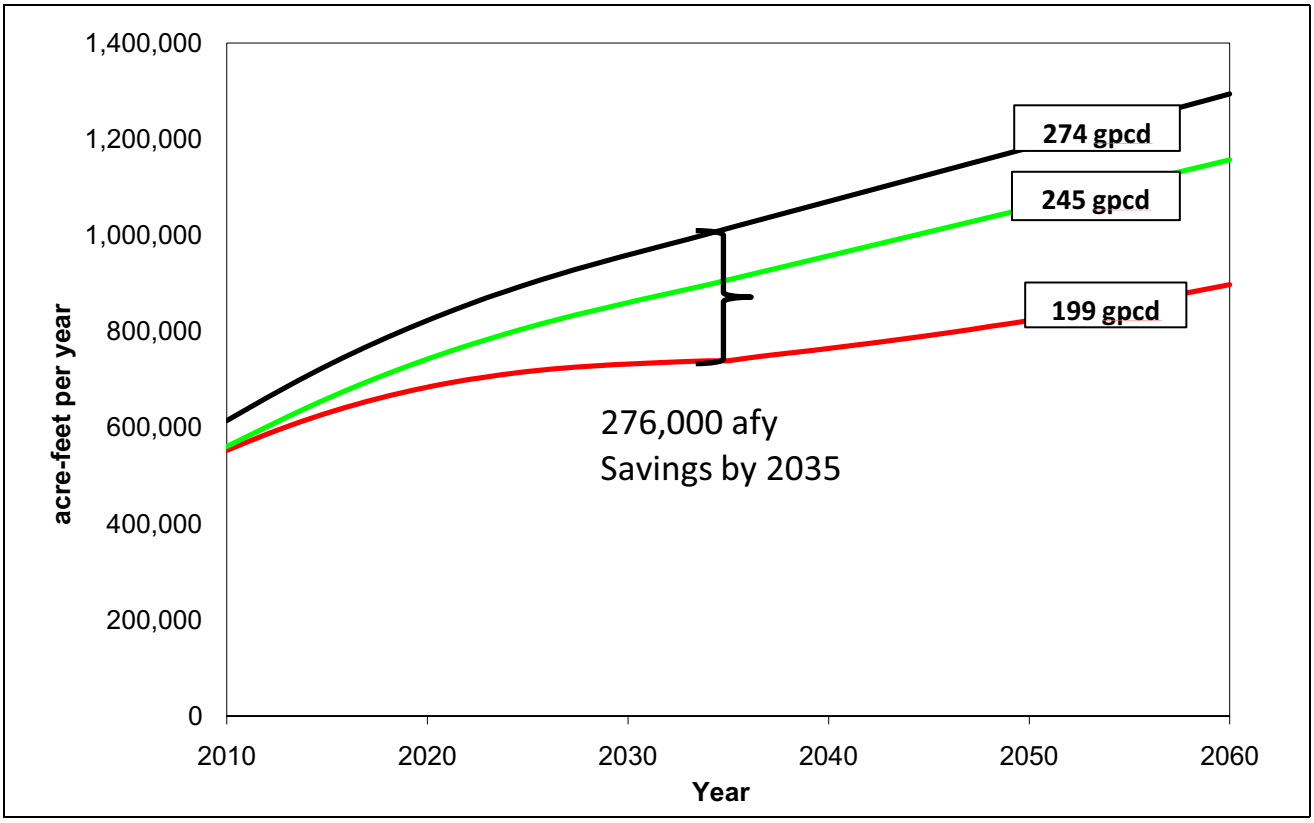

Figure 8-1
Summary of SNWA Water Demands and Conservation

users near the limit of either their ability or their willingness to further reduce water use. In addition to demand hardening, there are likely to be periods where conservation performance exceeds the goal and other periods where progress slows. This is characteristic of the complex group of variables that affect the public's use of water, some of which are beyond the control of the SNWA.

8.2 GPCD as a Metric for Evaluating Goal Advancement

The SNWA has a strong record of conservation achievement. The agency established a conservation goal in its first year, has consistently met or exceeded every goal, and has voluntarily established more stringent goals each time.

Gallons per capita per day is an effective metric for a community to project water resource demands and measure its own efficiency progress. However, it is not a metric that can be used to compare communities with varying climates, economies and demographics. Furthermore, there is no concise industry standard for the calculation of gpcd, thus the gpcd reported by various communities may not be produced by the same formulas.

In a 2003 study, "SMART WATER: A Comparative Study of Urban Water Use Efficiency Across the Southwest" (Western Resource Advocates, 2003), the authors forewarn the reader not to consider gross gpcd comparisons between cities:

> Although the water supply industry commonly uses this demand variable as a system demand indicator, the probability for comparison error in the system-wide per capita variable is relatively high, resulting in an "apples-to-oranges" comparison. Therefore, the displayed values in Figure 3.9 should be considered individually, instead of comparatively, to avoid erroneous conclusions on water consumption.

In the guidance manual produced by the AWWA Water Conservation Division, "Water Conservation Measurement Metrics," (Dziegielewski and Kiefer, 2010) the authors came to similar conclusions about the challenges of inter-agency comparisons of utility-wide gpcd.

In its simplest form, gpcd is derived by taking the average daily water production and dividing it by the number of permanent residents in the agency's service area.

$$\text{gpcd} = \frac{\text{total average daily production}}{\text{permanent residents served}}$$

Dziegielewski and Kiefer (2010) described broad variations in how utilities defined both the numerator and the denominator. Not all utilities include reclaimed water or raw water, for example, as part of their production, even if it was delivered to customers to meet demand.

In most jurisdictions, including SNWA's, other sources of water may be in use that are not part of the utility's production, such as private groundwater wells or landscape irrigation water from surface canals. In the Phoenix region, for example, residential properties have access to water from two different suppliers, one that provides domestic water and another that provides landscape irrigation water. In Australia's coastal cities, homeowners commonly have private wells, or bores, that are used for outdoor irrigation. Such disparities in the quantity and availability of alternate supplies is another confounding variable when trying to establish comparisons between communities. While some have advocated that single family residential use may be the only sector where gpcd comparisons could be drawn, the broad availability of secondary water supplies would give the impression of lower household use.

Dziegielewski and Kiefer (2010) found some utilities use the term "functional population" and convert transient populations such as seasonal workers, commuters and even tourists into "resident equivalents." These variations can have a tremendous effect upon gpcd. For example, in 2010, the Las Vegas region hosted more than 37 million visitors for an average stay of 4.6 days (Las Vegas Convention and Visitors Authority, GLS Research, 2010). These 171.7 million visitor days averaged over one year indicate more than 470,000 visitors are within the water service area every day.

To put the visitor load into perspective, consider that there are more people visiting Las Vegas on any given day than living in Sacramento, California. If the SNWA used "functional population" equivalents that included visitors, the region's per capita water use would be reduced by approximately 43 gallons to 180 gpcd.

In calculating its gpcd, the SNWA includes all water sources in its water production, including groundwater, surface water, raw water and reclaimed water. Only water produced for banking is deducted, since it will be recorded as a demand when it is recalled for use. SNWA's service populations include only bona fide residents estimated to be living in the service area at the mid-year

point. Residents living within the service area, but supplied by private wells are not included in the service population.

Dziegielewski and Kiefer (2010) also found weather and climate significantly influenced the gpcd of the communities they studied. For each inch of evapotranspiration not supplied by precipitation, the authors noted about a 3 gpcd increase in water demand.

Although the water efficiency achievements of other western communities may provide lessons for agencies within the same region, it is not appropriate to assume that the gpcd of one community would adequately meet the needs of another.

Water agencies are expected to take extraordinary measures to avoid situations that jeopardize the people they serve. While people can relate to the absolute need for water for drinking, cooking and sanitation, water is also a vital ingredient for sustaining the urban economy. The SNWA has established gpcd goals with the expectation of continuing to support water uses that contribute to quality of life and environment, such as efficiently-irrigated landscaping, as well as sustaining a viable economy that provides necessary employment and services to the community. A utility that finds itself in a long-term position of curtailing water use in such a way as to jeopardize the economy or human health has failed in their long range and contingency planning.

By its nature, providing water to a community requires conservative planning to avoid unmanageable shortfalls in water supply, water quality or infrastructure. The 199 gpcd goal is considered both prudent and achievable. The problems associated with overestimating future water efficiency achievements would pose an unacceptable risk to the community.

8.3 Water Rates

Designing effective rate structures is a delicate art. It is challenging to predict customer base response to radical changes in rate structures, thus such measures could jeopardize the financial stability of the agency. Instead, most rate setters prefer to make a series of modifications to rate structures with a known track record. It is not uncommon for an agency to design and review more than a dozen variations of rate structures. Many of the agencies also engage citizens' advisory committees in the review of rate philosophies and structures.

Each of SNWA's member agencies are public, not-for-profit utilities. As such, they are obligated to devise rate structures that produce adequate revenue to meet the costs of the agency, but not produce excessive revenue. As use of water decreases, cost per unit typically climbs to cover the operating costs of the agency. In most utilities, fixed costs account for the majority of expenses. This explains why water may be much more costly per unit in a community with low water demands, even if the low demand is the result of a cold or wet climate and not a designed conservation effort.

In an active conservation program it can be expected that water use reductions may result in increasing costs per unit of water, which in turn, effects further conservation. This "volley" between customer water use reductions and agency rate responses is common and can be managed; however, if an agency underestimates the community response to a rate change, the volley becomes amplified and can result in financial instability. This situation can actually threaten the viability of long-term

conservation achievement by eroding the agency's credibility with its customers and negating the effectiveness of non-rate components of the conservation plan. Volatile exchanges in water pricing and customer response are most often the result of radical rate changes.

SNWA member agencies have implemented and strengthened effective water efficiency rate structures. As an example, the LVVWD, which serves approximately 70 percent of the SNWA customer base, has evolved from a two-tier rate structure to a four-tier rate structure. Additionally, the LVVWD has substantially compressed the rate tiers, there by steepening the water rate.

SNWA's Cooperative Agreement establishes principles for the pricing of wholesale water to recover the costs of production. SNWA cannot directly or arbitrarily influence the water rate structures of individual purveyors, however, trends in operating costs have been exceeding increases in the consumer price index. As a result, it is expected that water rates will continue to increase at a rate exceeding inflation.

The suggestion that adopting rate structures of another agency should produce similar water use reductions in another community is misguided. Each agency has unique characteristics that influence both the rate structure and the community reaction to the rate. Among the variables on the utility side are debt load and energy use. On the customer side, per capita income and current levels of discretionary water use influence elasticity of response.

If necessary rate increases combined with ongoing programs do not produce adequate conservation gains, the SNWA agencies will be able to further modify rate structures to stay on goal.

8.4 New Development Efficiency

The cumulative impact of the 2003 development standards will continue to decrease per capita water use as SNWA's service population grows through 2035.

An SNWA analysis indicates that homes built after the 2003 development standards became effective use about half as much water as homes built just prior. The reduction appears to be largely attributable to higher densities and more efficient landscape irrigation.

The analysis included only homes with a continuous pattern of water use, thus avoiding unoccupied homes, and excluded homes built between 2000 and 2003 that had participated in the Water Smart Landscapes Program (Figure 8-2).

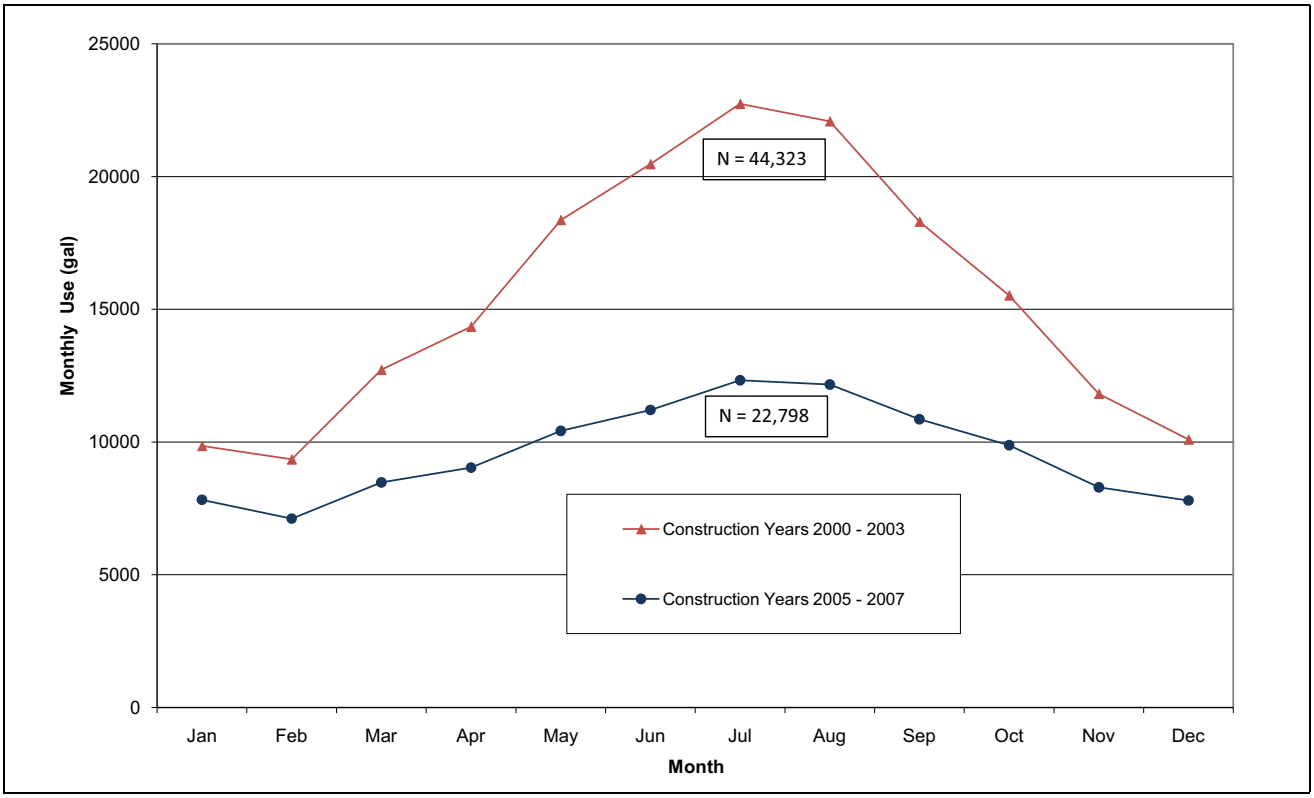

Figure 8-2
Average Home Monthly Consumption 2007-2008

9.0 CONCLUSION

The SNWA has a current conservation plan that has been reviewed and accepted by the State of Nevada in compliance with NRS 540.121 through 540.151 inclusive. Furthermore, the plan has also been reviewed and accepted by the BOR as meeting the requirements of 43 CFR 417.

The SNWA has been aggressive in establishing and pursuing meaningful conservation goals since its establishment in 1991. The agency's 20-year history demonstrates progressively-increasing commitment and innovation in water efficiency policy and programming. The current conservation plan and the programs that support it are unrivaled by any community in the State of Nevada and considered a top-tier program nationally.

The efforts of the SNWA and its member agencies have produced meaningful reductions in both gross demand and per capita demand. Without the improvements in water use efficiency achieved since 1991, the SNWA service area would currently demand more than 700,000 af of water annually. In 2010, gross production was approximately 488,000 af, a 30 percent reduction.

The programs implemented in 2003 in response to the unprecedented Colorado River drought demonstrate the capacity of SNWA to swiftly respond to changing conditions and the ability of the community to respond effectively. This demonstrated ability ensures that the agency has the ability to meet water use efficiency goals in the future.

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Southern Nevada
Water Authority

Conservation Plan
2009-2013

May 2009

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OVERVIEW OF THE SOUTHERN NEVADA WATER AUTHORITY

The Southern Nevada Water Authority (SNWA) was formed in 1991 by a cooperative agreement among seven water and wastewater agencies in Southern Nevada:

- Big Bend Water District
- City of Boulder City
- City of Henderson
- City of Las Vegas
- City of North Las Vegas
- Clark County Water Reclamation District
- Las Vegas Valley Water District

Collectively, these agencies provide water and wastewater services to nearly 2 million citizens in Las Vegas, North Las Vegas, Henderson, Boulder City, Laughlin and portions of unincorporated Clark County.

As the wholesale-water provider to Southern Nevada's municipal water agencies, the SNWA is responsible for managing the region's current and future water resources. This includes managing all water supplies available to Southern Nevada through an approved water budget; managing regional water resources and conservation programs; ensuring regional water quality meets or exceeds state and federal standards; water-resource planning; and building and operating regional facilities.

Although the SNWA plays a critical role in managing water, it does not regulate water use by end users or establish customer rates. Such policies, codes and regulations are implemented through its member agencies. In terms of regulatory issues, the SNWA's role is to facilitate information sharing and collaboration. In recent years, this has resulted in the creation of successful community-wide water-efficiency policies, such as permanent mandatory watering restrictions and limitations on lawn installation in new construction. Education, outreach and incentive programs are largely managed by the SNWA through committed involvement from its member agencies, community stakeholders and the public.

THE ROLE OF CONSERVATION IN RESOURCE PLANNING

Water conservation plays a critical role in water-resource planning and management. The ability to increase efficient water use and reduce water waste has a direct impact on the amount of resources that will be needed in the future. The more successful a community's conservation, the lower the community's projected demand for water (relative to levels that would have occurred in the absence of conservation) becomes.

To support its water planning and management responsibilities, the SNWA developed and maintains a Water Resource Plan. The 2009 Water Resource Plan (Plan) projects demands and identifies a portfolio of existing and planned water supply options available to meet those demands over time. The Plan, first developed in 1996, is reviewed annually and updated as needed. As demonstrated in past revisions, adjustments to the Plan are made to account for various uncertainties such as drought, conservation achievements, resource availability and changes in population and demand projections.

The SNWA has worked to develop and manage a flexible portfolio of diverse water resource options. This approach is commonly used in the field of resource planning and is essential in responding to future conditions that may result from drought or other conditions that may limit the availability of resources. The portfolio approach allows the SNWA to assess its overall resource options and make appropriate decisions regarding what resources to bring on-line when necessary. The 2009 Water Resource Plan includes water conservation, water recycling, Colorado River water and groundwater in its portfolio of current and future resources that will be used to meet demands as needed.

Water conservation is a key resource in the SNWA Water Resource Plan, helping to lower projected demands and extend the availability of current and future water resources. The 2009 Plan projects an estimated saving of 276,000 acre-feet of water in 2035 by achieving its current water conservation goal. Gradual savings increases are estimated to occur in following years.

While conservation is an important water management tool, the more aggressive and responsive a community is to calls for conservation, the more difficult it becomes to realize additional conservation gains. This phenomenon of diminishing returns is referred to as “demand hardening.” For communities where a majority of the water supply comes from one source (such as Southern Nevada), the prospect of demand hardening requires development of additional alternative water supplies regardless of conservation levels achieved.

This concept has become increasingly important in recent years. The Colorado River, which provides approximately 90 percent of Southern Nevada’s water supply, continues to experience serious and sustained drought conditions. As a result, Lake Mead’s water levels have dropped more than 100 feet in the past ten years, and Lake Mead is at about half of capacity in early 2009. Mandatory water shortages and critical infrastructure outages are possible should these conditions persist. As a result, the SNWA continues to aggressively pursue development of non-Colorado River resources, work with the Colorado River Basin States on management strategies and initiate construction of a new Lake Mead intake to preserve system capacity.

CONSERVATION ACHIEVEMENTS

Since 1991, the SNWA has developed and implemented one of the most progressive and comprehensive water conservation programs in the nation. Success is measured through the implementation and achievement of regional conversation goals. Over time, these goals have been adjusted to induce higher levels of conservation. An overview of past SNWA conservation efforts is outlined below.

In the mid-1990s and using 1990 as a base year, the SNWA established a goal of 25 percent conservation by 2010. This is equivalent to roughly 280 gallons per capita per day (GPCD).

During the mid-1990s, the SNWA purveyor members also agreed to follow a series of conservation "best management practices" published by the Bureau of Reclamation. The agreement was an important first step in implementing more consistent conservation measures across the service boundaries of SNWA purveyor member agencies. The agreement was updated in 1999 and a comprehensive five-year conservation plan was approved by the SNWA Board of Directors. An update to the conservation plan was submitted to and approved by the Bureau of Reclamation in 2004.

Southern Nevada made consistent progress towards its conservation goal throughout the 1990s. However, beginning in 2000, levels of conservation began to decline, falling short of the interim goals needed to reach a 25 percent conservation goal by 2010. In response, the SNWA and its member agencies launched a conservation strategic planning process in 2001. In 2002, as drought conditions in the Colorado River Basin became more severe, the SNWA member agencies recognized that a more immediate and actionable community response was necessary. As a result, the conservation strategic planning effort evolved to address drought conditions and ultimately set the stage for development of the SNWA Drought Plan. The Drought Plan was approved by the SNWA Board of Directors in February 2003 and implemented thereafter by SNWA's member agencies.

Following the implementation of the Drought Plan in 2003, conservation and drought savings rebounded with a 23.1 percent savings for that year. A year later, the community surpassed the 25 percent conservation goal set in 1996 – six years ahead of schedule.

What is GPCD? GPCD is a metric used by some communities to measure water consumption. For the SNWA, it provides a general means of monitoring water-use trends and for tracking conservation progress. A variety of factors influence GPCD including climate, demographics, water-use accounting practices and economic conditions. SNWA calculates total system GPCD by first totaling water use for its member agencies, adjusting that water use to account for weather variations, and then dividing by the estimated SNWA population within the SNWA's member agencies' jurisdictions. That number is then divided by the days in a year (weather adjusted total use/total population/365 days).

In an effort to maintain and build upon this success, a citizens advisory committee recommended that the SNWA pursue a strategy to decrease total water demand from 2004 levels to 250 GPCD by 2010 and to 245 GPCD by 2035. The SNWA Board of Directors adopted this goal in 2005.

The following years witnessed extraordinary conservation achievements. Participation in the SNWA's rebate programs realized record-breaking results, including peak participation levels in almost every area. A summary of key SNWA conservation accomplishments is provided in **Appendix A**.

These efforts resulted in a reduction of Southern Nevada's annual water consumption by nearly 21 billion gallons (between 2002 and 2008), despite a population increase of 400,000 people during that span. Available data indicate that in 2008 the SNWA achieved its 2005 conservation goal of 250 GPCD – two years ahead of schedule.

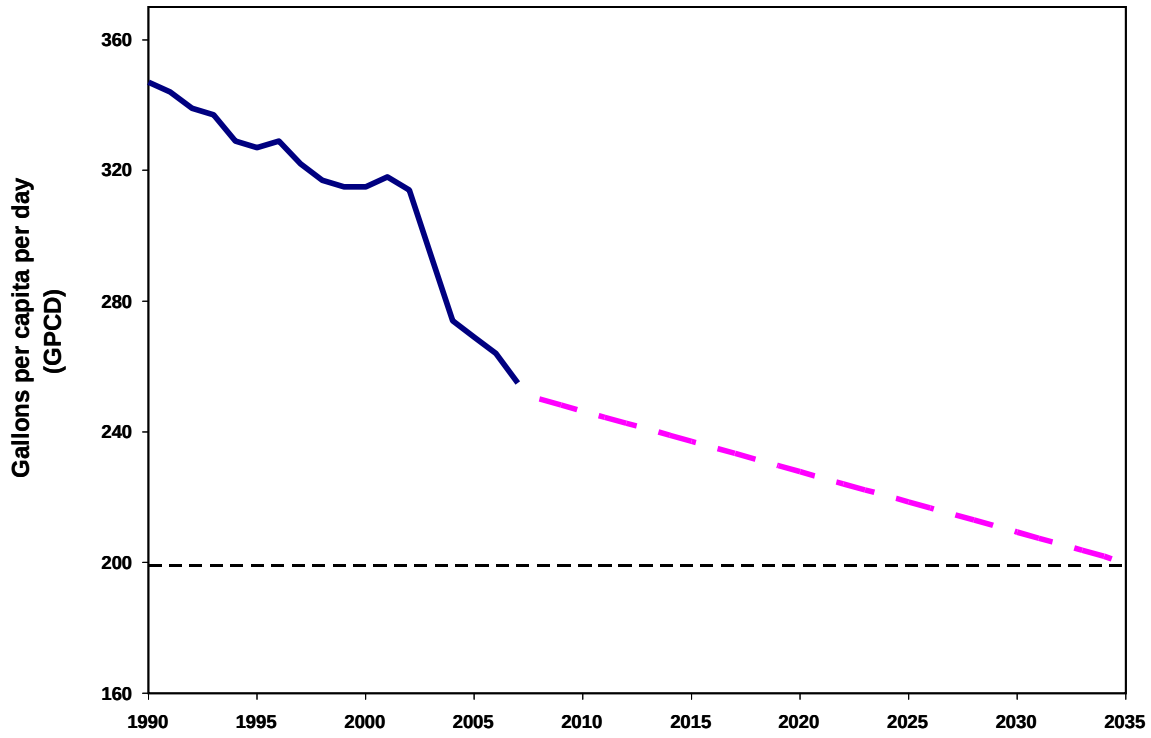
These past achievements provide the basis for current efforts. The following sections provide an overview of the SNWA's current conservation goal and a description of how the SNWA will make progress toward this goal during the 5-year planning period. A table with discussion and analysis also is provided in **Appendix B**.

The 2009-2014 Conservation Plan will be submitted to the U.S. Bureau of Reclamation in fulfillment of the requirements for Section 210(b) of the Reclamation Reform Act of 1982 and to the State of Nevada Department of Conservation and Natural Resources, Division of Water Resources in fulfillment of the requirements for Nevada Revised Statutes Chapter 540.

CONSERVATION GOALS

Building upon previous success, the SNWA Board of Directors in 2009 adopted a new conservation goal of 199 GPCD by 2035 for the community. Figure 1 outlines the SNWA's previous conservation achievements (described above) and provides projected achievements through the year 2035.

Figure 1 – Conservation Achievements (1990-2007) and Projections (2008-2035)



The SNWA estimates that more aggressive conservation outreach and education, and continuance of incentive programs, rate setting and regulation will yield these additional GPCD savings. Figures 2 and 3 compare the estimated volume of water that would be saved by conservation pre- and post-adoption of the SNWA's current conservation goal. A table with projected annual GPCD reductions for the 2009-2014 planning period is provided in **Appendix C**.

FIGURE 2 – SNWA Water Demands and Conservation (250 GPCD by 2010 and 245 GPCD by 2035 Conservation Goals)

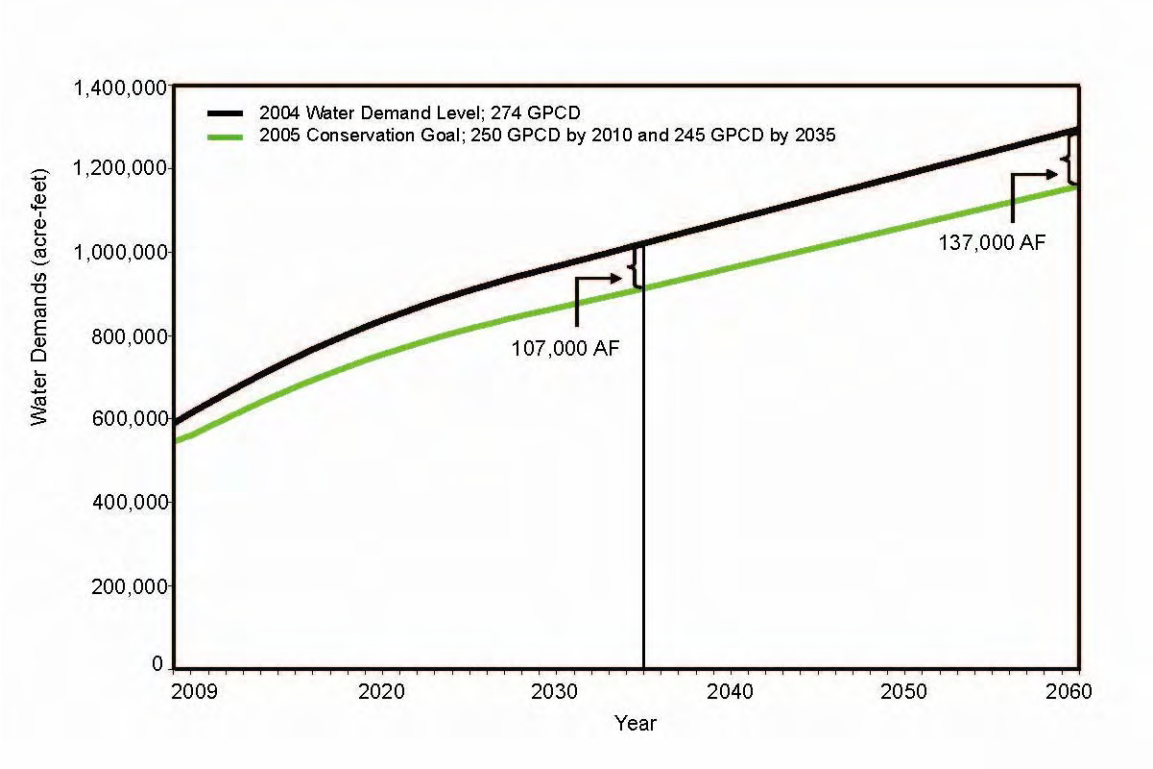
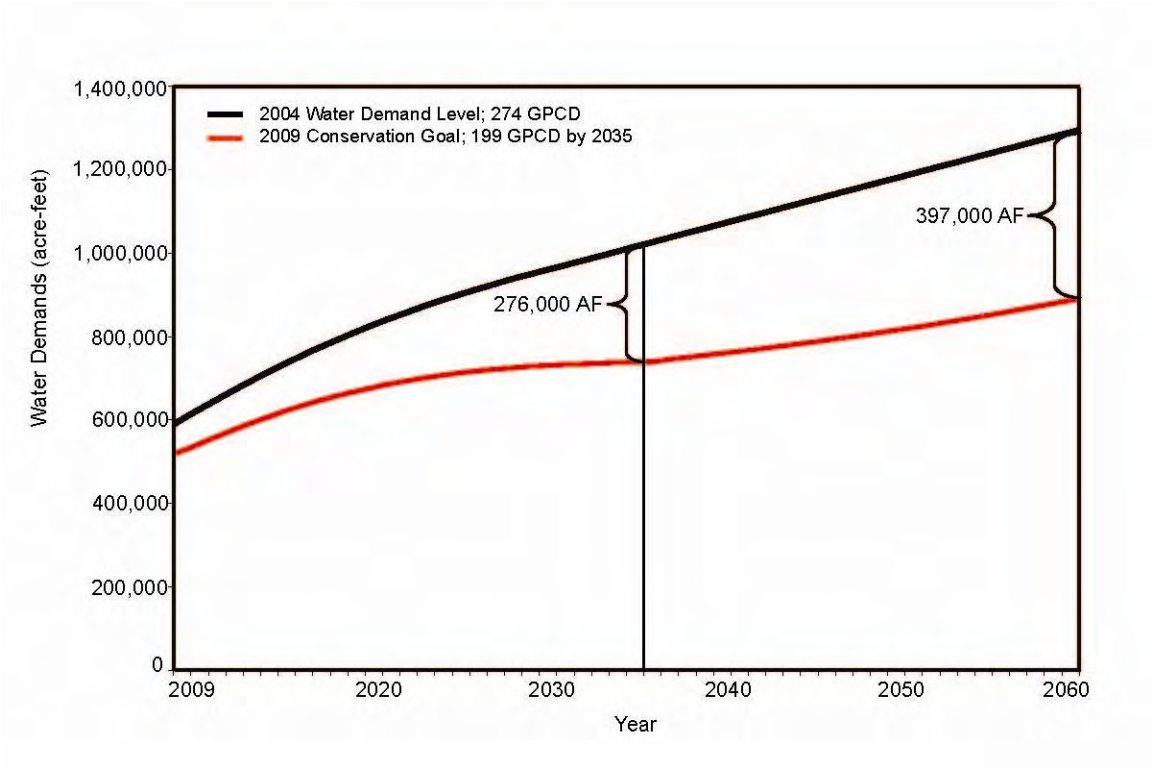


FIGURE 3 – SNWA Water Demands and Conservation (199 GPCD by 2035 Conservation Goal)

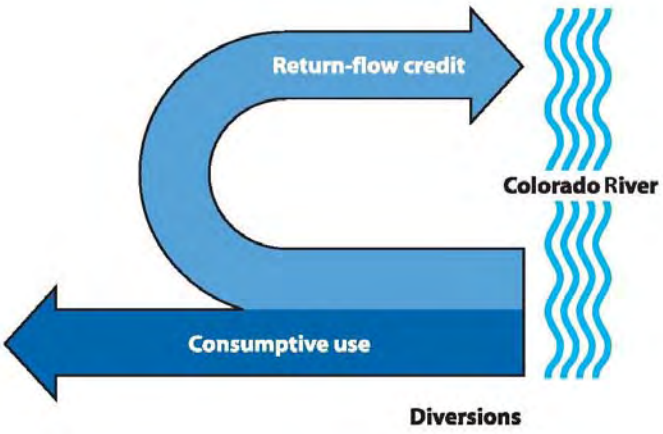


CONSERVATION STRATEGIES

Although the SNWA supports and promotes water conservation both indoors and outdoors, significant effort goes into promoting more efficient water use outdoors. Approximately 60 percent of the water delivered to customers is used consumptively, meaning it can be used just once. For example, landscape irrigation is collectively the single largest consumptive water use.

In Southern Nevada, all indoor water use that reaches the sanitary sewer is reclaimed. It is either returned to the Colorado River, or delivered to other municipal uses, such as golf course irrigation or power plant use. In accordance with Bureau of Reclamation policy, the SNWA receives credit to withdraw one acre-foot of water from the Colorado River for every acre-foot of Colorado River water that is treated and returned (figure 4). As a result, additional local reuse and indoor conservation does not enlarge the SNWA's resource portfolio.

Figure 4 – Return-Flow Credits



The SNWA's conservation success is partly dependent upon the water management and business practices of its individual member agencies. There are three key areas related to demand management that are within the purview of the member agencies: metering, managing unaccounted-for water and tiered water rates. The SNWA and its member agencies will continue to use these base water management practices to sustain previous GPCD reductions and achieve future gains.

Metering – Metering is the foundation of sound demand-management programs. SNWA member agencies will continue to meter all customer connections for all classes of water in accordance with American Water Works Association standards.

All purveyors operate on-going meter maintenance and replacement programs. Meters are read monthly and data is classified and retrievable on the basis of customer class, meter size, land use and other relevant variables. Purveyors have the ability to identify unusual water use patterns, such as spikes in consumption due to leaks, and to notify customers of unusual account activity. In addition, the three largest purveyors, Las Vegas Valley Water District (LVVWD), City of Henderson and City of North Las Vegas have all expanded their automated meter reading (AMR) systems, which record water usage data at each meter and transmit the information through radio waves to specialized receiving units. AMR systems eliminate the need for individual manual reads, improve meter-reading efficiency and provide customers with improved billing processes.

Unaccounted-for Water – All water delivery systems experience losses. In the water industry, these losses are known as unaccounted-for water. Unaccounted-for water is the difference between an agency's total water production and the sum of all metered uses. Such losses are predominantly associated with leaks, variations in meter accuracy and theft.

The SNWA and its member agencies have a variety of active programs to more effectively account for total production. While these ongoing efforts will continue to improve accounting accuracy for and

minimize loss of unaccounted-for water, measurable GPCD savings are not attributed to this management tool. The following programs are conducted throughout the region:

- Working together, the SNWA's member agencies have created and adopted the Uniform Design and Construction Standards. These detailed construction standards assure that delivery systems meet or exceed industry standards, including water-distribution systems pressure zones, main sizes and service lateral installations.
- Efforts are ongoing in all service areas to identify older infrastructure that has been deemed susceptible to leaks. For example, most cast iron mains are being systematically replaced, as are polyethylene service connections that do not appear to be meeting longevity expectations.
- Prior to installing facilities, soil testing is conducted to identify potential threats to the distribution system's integrity. For example, where testing indicates that soil chemistry will be destructive to copper piping, plastic sleeves are installed over the service line to prevent corrosion.
- Reservoirs are thoroughly inspected at regular intervals to assure their integrity; special monitoring devices beneath each reservoir detect and report leakage.
- Production meters are regularly maintained and calibrated.
- All customer meters are monitored for consumption anomalies. Small customer meters are subject to a planned replacement program based upon life expectancy and large meters are regularly maintained and calibrated.
- A substantial portion of purveyor distribution lines have permanent listening devices installed that can signal patrolling employees of leaks that fail to surface and assist in accurately determining the leak location for excavation.
- Interagency collaboration speeds leak repairs through fast-tracking line location ("call-before-you-dig") and prompt repair. Records are kept of the estimated system loss for each leak repaired.

Water Rate Setting – All potable water purveyors will continue to utilize multi-tier increasing block rate structures. These pricing structures provide financial incentive for all water users to implement and participate in conservation measures.

In the past several years, local purveyors have implemented major rate restructuring and increases specifically for the purpose of accelerating conservation. This restructuring involves significant price increases in the higher tiers and a compression of tier thresholds. The impact of water rates on GPCD reductions is discussed in detail below.

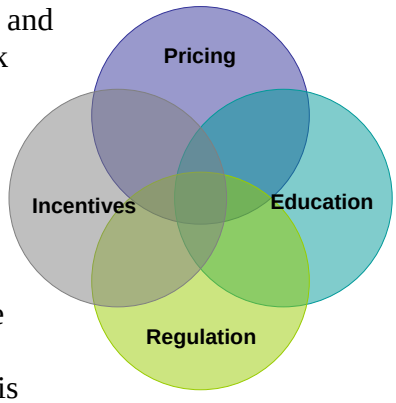
CONSERVATION MEASURES

In addition to municipal water management practices discussed in the preceding section, the SNWA and its member agencies will continue to utilize a variety of demand-management measures to promote conservation and reduce overall water use. These include a combination of the following:

- Water Pricing: tiered-rate structures charge higher rates as water use increases. These rate structures encourage efficiency, while ensuring the affordability of water for essential uses.
- Incentives: incentives are flexible tools that invite the community to participate in the conservation effort. The SNWA has a number of "water smart" programs that are critical to achieving its conservation goals.

- Regulation: city and county governments have adopted a variety of land-use codes and water-use ordinances to promote the efficient use of Southern Nevada's water resources.
- Education: the SNWA's public-education programs are designed to elicit buy-in from the community and help residents understand that responsible water use is a critical part of living in a desert environment.

These measures, discussed in detail in the latter portion of this section, work in conjunction with one another to promote efficient water use. For example, water pricing (including water rates and water-waste fees) provides a financial signal for customers to reduce water use, which in turn, may lead some customers to seek out ways to improve their efficiency. Through passive and active education, customers learn about regulations (such as day-of-week watering restrictions) and incentive programs, which, when acted upon, will help the customer to save water, and therefore reduce the impact of rates. Ideally, these measures all drive customers to higher levels of efficiency.



The complex and inter-related nature of these conservation measures makes it difficult to attribute specific GPCD reductions to any one single measure. A table of the estimated GPCD reduction, and the amount of water estimated to be saved each year over the 5-year planning horizon, is included in **Appendix B**.

The following sections detail how the SNWA will utilize each of these conservation measures to achieve its conservation targets throughout the 5-year planning horizon.

Water Pricing

Price can be an effective instrument for reducing water demand. Research has consistently shown that water users respond in an inverse manner to changes in the price of water – in general, as the price of water increases, water use decreases. This principle, however, may only hold true for discretionary water use, the portion of a person's water use beyond what is necessary to meet their perceived basic needs.

Economists measure the relationship between pricing and demand as Price Elasticity of Demand (PED). Water PED measures the degree of customer water demand responsiveness due to changes in water rates, holding all other factors constant. Mathematically, PED is the percent change in water demand divided by the percent change in water rates. Water is typically considered relatively inelastic; that is, the response to a change in price is less than the degree of the price change. PED can only be estimated in retrospect and can be substantially influenced by economic conditions in the community, including income levels and other factors.

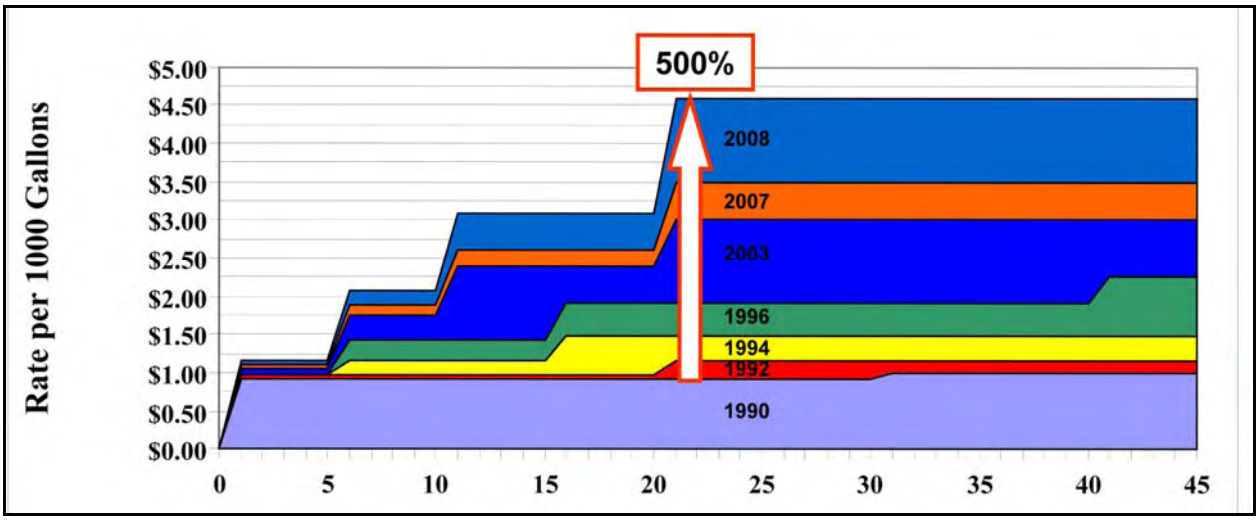
Water users respond to changes in water rates by changing water use practices and implementing available water conservation measures. In the short-run, water users may respond by reducing car washing or their showering time. This short-run response is difficult to quantify and may not be permanent as customer water-use patterns change over time. For the longer term, water users respond to rates by taking advantage of water conservation measures. These measures may include replacing fixtures and appliances with more efficient devices or participating in incentive programs, such as the

SNWA's Water Smart Landscapes Rebate Program. In fact, research shows that water bills are a principal reason for customer participation in incentive programs.

A common strategy for managing demand through pricing is the use of increasing block rates. Increasing block rates encourage water conservation by charging water users higher rates for higher volume use. Since 1995, SNWA member agencies have subscribed to a Memorandum of Understanding in which they agree to utilize progressive rate structures to manage demand. All SNWA member agencies currently use increasing block rates to encourage water conservation among high water users, while maintaining overall affordability. In 2005, the SNWA adopted the recommendations of a citizens advisory committee to promote water rates that sustain and advance conservation achievements by ensuring water rates keep pace with inflation.

While each of the SNWA's member agencies set water rates independently, all utilize similar rate principles to manage demand. For example, the Las Vegas Valley Water District (LVVWD), which delivers nearly 70 percent of the public water supply in Southern Nevada, has a long history of encouraging conservation through water rates. Figure 5 illustrates successive modifications to the tiered rates. These include expanding from two tiers to four, increasing the rate for upper tier water and compressing upper tier thresholds. Since 1990, the rate at the 20,000 gallon threshold has increased by 500 percent. During the same time period (1990-2008), the Consumer Price Index increased 64 percent. While rates are an important conservation measure, public water agencies also have an obligation to the well being and vitality of the communities they serve.

FIGURE 5 – LVVWD Rate History (1990-2008)



The SNWA's conservation goal of 199 GPCD by 2035 is predicated upon continued performance in all conservation measures. Whereas SNWA and its member agencies operate some of the nation's most aggressive regulatory, education and incentive programs, these programs may approach their practical limitations over the planning period. Rates, on the other hand, have long-term potential to continue to influence demand as needed. As such, SNWA member agencies are committed to periodically adjusting rates to a level necessary to meet its conservation goals.

Incentives

The SNWA recognizes that long-range demand management requires not only implementing progressive conservation strategies for new customers (such as landscape codes for new development), but also creating incentives for existing customers to improve their water efficiency. The SNWA is nationally-renowned for its customer-incentive programs. The following incentives will continue to play a significant role over the next five years in helping the community meet its water conservation goal.

Water Smart Landscapes Rebate Program **–** The Water Smart Landscapes (WSL) Rebate Program offers financial incentives to residents who replace water-thirsty lawn with water-efficient landscaping. Since the majority of Southern Nevada's water is used outdoors on landscaping, the WSL program targets one of the largest consumptive water uses. The current program rebate amount is $1.50 for the first 5,000 square feet of lawn removed and $1 for additional lawn removed, up to $300,000. Based on prior achievements and a community-wide turf assessment, the WSL program is projected to remain a major demand-reduction tool as the SNWA works toward its new conservation goal.

Rebate Coupons – The SNWA offers a variety of instant rebate coupons for single-family, residential property owners, including Pool Cover Instant Rebate Coupon, Rain Sensor Instant Rebate Coupon and Smart Irrigation Controller Rebate Coupon. These rebates are expected to contribute to significant GPCD reductions in the future, based on past program involvement and current research initiatives.

An exposed pool can lose approximately 50 gallons of water per square foot per year to evaporation. Pool covers reduce evaporation by 90 percent, limit windblown debris and conserve energy. Southern Nevada pool owners are encouraged to cover their pools to conserve water and save money on their water bills. The SNWA Pool Cover Instant Rebate Coupon value is $50 or 50 percent off the purchase price of a pool cover, whichever is less, or $200 or 50 percent off the purchase of a permanent, mechanical pool cover.

Water Efficient Technologies – The Water Efficient Technologies (WET) Program was initiated in 2001 and offers financial incentives to commercial and multi-family property owners who install water-efficient devices that save at least 250,000 gallons annually. The SNWA plans to continue to offer a menu of pre-approved water-saving technologies with predictable savings and a defined monetary incentive, including high-efficiency toilets, showerheads, and urinals; converting a grass sports field to an artificial surface; converting from old water cooled ice machines to air-cooled machines; and retrofitting standard cooling towers with high-efficiency drift elimination technologies. Additionally, businesses can work directly with the SNWA to implement a custom technology that meets their needs. Currently, the SNWA offers a rebate of up to $8 per 1,000 gallons conserved annually for reducing nonconsumptive-use water or $25 per 1,000 gallons conserved annually for reducing consumptive-use water through technology improvements. Commercial and multi-family property owners are encouraged to apply to the WET program to receive financial and conservation incentives.

Regulation

The SNWA works collaboratively with its member agencies to develop and implement regulations that promote water conservation.

Development Codes and Policies – Member agencies adopted landscape and plumbing codes in the mid-1990s to limit water use. Under the 2003 drought plan, all agencies adopted more stringent policies for landscape watering, vehicle washing, lawn installation, mist systems and golf course water budgets during declared drought. In 2005, a citizens advisory committee recommended permanent adoption of these drought restrictions as a way to help meet long-term resource needs for the community. To this end, the SNWA and its member agencies have agreed to and will work to adopt the drought response measures as permanent conservation measures for the community as part of the overall conservation effort. These policies and previously adopted development codes, which are among the most stringent in the United States, include:

- Landscape watering: watering groups are mandatory and limit watering to one day a week in winter, three days a week in spring and fall, and prohibit watering from 11 a.m. to 7 p.m. in summer.
- Vehicle washing: a positive shutoff nozzle is required for residential vehicle washing. Commercial vehicle washing is prohibited unless water is captured to the sanitary sewer where that water can be treated and reused.
- Lawn installation: turf installation is prohibited in new residential front yards and is limited to a maximum of 50 percent the landscapeable area in new residential backyards.
- Mist systems: use of commercial mist systems is limited to summer months.
- Golf course water budgets: golf courses are subject to mandatory water budgets (6.3 acre feet of water per year per irrigated acre).
- Fountains and ornamental water features: these features are prohibited except as allowed by jurisdiction policy.
- Resort water efficiency plans: a hotel/resort water efficiency plan must be submitted and approved by an appropriate water purveyor, prior to the issuance of associated permits.
- Water waste: ordinances and service rules prohibit water waste (allowing water to runoff into streets and/or into adjoining property). It also is considered water waste to violate policies that limit the time of day or assigned days of the week when watering may occur. If wasteful behavior isn't corrected, property owners are assessed citations and fees. Fees double with additional violations and are assessed consecutively based upon the previous 18-month history for the account.
- Plumbing fixtures: each new, remodel or replacement of plumbing fixtures in residential or commercial buildings shall incorporate minimal standards for plumbing fixtures, including water-use standards for toilets, faucets, showerheads and urinals.

Education

In addition to extensive conservation and incentive programs, the SNWA will continue to maintain an education and public outreach campaign to assist residents and businesses with conservation efforts. Currently, the campaign utilizes a variety of media to educate customers on the need for conservation, to provide practical tips on how to conserve, and to put customers in touch with SNWA experts who can help them reduce water use at their properties. The efforts include advertising, community events, publications, an interactive Web site, public-private partnerships, and demonstration gardens to inspire water-efficient landscape designs. Education is an ongoing initiative for the SNWA that will contribute to GPCD reductions during the 5-year planning period.

The SNWA believes that education and outreach help to drive the community towards its incentive programs (for example to the WSL program) where specific reductions are measurable. Without education and promotion, these programs are not likely to have realized the level of conservation gains achieved to date or that are projected in future years.

The following section describes current education and public outreach initiatives employed by the SNWA. While actual products and services may vary, the SNWA expects to continue to provide this type and level of service throughout the 5-year planning horizon.

Demonstration Gardens **–** Through the combined efforts of the SNWA and its member agencies, there is a demonstration garden in every part of the valley. The SNWA also promotes visits to the Springs Preserve, a 180-acre facility that offers hundreds of examples of water-efficient landscaping, as well as classes by master gardeners and horticulturists. Advice from the facility's staff is available seven days a week. Free tours also are available for area students.

The SNWA supports the development of smaller demonstration projects throughout the Las Vegas Valley to show the public that water-smart landscaping is attractive and the most water-efficient choice for Southern Nevada. Currently, schools may apply annually for SNWA funded conservation grants of up to $5,000 to develop demonstration projects for their own campuses. Grants also are available for conservation-related curriculum programs or other approved activities.

Public Outreach Efforts and Events **–** The SNWA employs a variety of community outreach efforts to educate customers on the need for conservation and on the programs and services that are available. Customers can easily access this information through the Conservation Helpline, a phone center that connects customers to rebate and conservation program information, free landscape publications, landscape watering schedules, and a place to report water waste. The same information is available online at **snwa.com**. The SNWA's Web site includes interactive features that allow customers to enter their address and receive a customized landscape watering schedule based on their assigned watering days, online rebate program applications, landscape sample designs, and landscape care tips. In addition, the SNWA produces a variety of collateral materials to educate consumers. These include:

- Landscape Watering Schedule: This schedule explains the SNWA's mandatory watering restrictions, illustrates which day(s) of the week each watering group may water, and offers practical tips for irrigating efficiently. The schedule has been included with customer water bills, published in SNWA newsletters and is available at member agency locations valley-wide.

- Water Smart Living: This quarterly publication is mailed to more than 675,000 residents in Southern Nevada. It includes drought updates, information on conservation programs and incentives, and tips for landscape care and using water more efficiently outdoors.

- Simply Beautiful Book and CD: These free tools help homeowners to plan water-smart landscapes. The user-friendly book and interactive CD include step-by-step planning instructions, a searchable plant database and sample designs.

- Sample Designs: The SNWA teamed with the American Society of Landscape Architects to produce five sample landscape designs. The designs include a variety of water-efficient plants

to help homeowners convert their existing landscape or to install the right landscape from the start.

- Water Smart Calendar: This annual publication enables the SNWA to provide information on water-smart plants and conservation tips, and keeps that information in front of customers year-round. The twelve-month calendar is sent to single-family homeowners and includes landscape watering restrictions and water-smart landscape inspiration.

- Water Ways: This monthly television program airs on local government cable channels and includes segments focusing on water conservation. The program airs daily.

- Videos: Instructional videos are available free of charge to customers. These include "Detecting and Silencing Leaks," a video to help customers find and fix leaks in and around their property, and "Lawn to Lush," a video to walk customers through the steps of converting lawn to water-smart landscaping.

The SNWA also attends a variety of community events to educate customers on conservation issues. In addition, SNWA and member agency representatives provide valuable landscape and irrigation expertise through classes taught at several venues in Southern Nevada.

Advertising Campaigns – A long-term commitment to water conservation includes an aggressive advertising campaign that utilizes television, radio and print advertisements to reach target audiences. New community advertising campaigns challenge homeowners, businesses and community associations to take conservation to the next level by taking control of their irrigation clocks and replacing more grass with water-smart landscaping.

The SNWA also created a bicultural campaign, which includes television, radio, and print ads designed specifically for the Spanish-speaking audience. This allows the SNWA to effectively communicate the need for conservation as well as inform residents of the rebate programs available to them.

Youth Education Programs – The valley's youth play an important role in SNWA outreach efforts and the SNWA is committed to educating the next generation on the importance of water resources and conservation. The SNWA has partnered with the Springs Preserve to develop a comprehensive education program known as H2O University for teachers in the Clark County School District. One innovative component of the program is the Youth Advisory Council, which allows select high-school students to pursue an interest in water-related issues and further develop leadership skills. Previous Youth Advisory Council projects include planting a demonstration garden at a local elementary school, helping to restore wetlands in the Las Vegas Wash and creating the first water-smart home with a local homebuilder.

In addition, the SNWA offers the Water Education Institute, a continuing education program for teachers. Elementary and secondary teachers attend a two-day workshop and take with them lesson plans and activities they can use in the classroom. Nearly 600 teachers have participated in the program.

Public-Private Partnerships – The SNWA partners with the private sector to promote conservation efforts. These include partnering with local retailers, landscapers, homebuilders, and the business community. Partnerships include:

- Water Conservation Coalition (WCC): Established in 1995, the WCC is a group of local business and community leaders that have partnered to promote water-efficient practices in the Southern Nevada business community. WCC members speak to professional and civic organizations to explain the benefits of increased water efficiency, encourage other businesses within their industries to participate in SNWA incentive programs and identify water conservation projects within the community to organize and sponsor. In 2008, the WCC completed water-efficient upgrades at Boys Town Nevada, a group of homes that provide short-term residential services for at-risk children. The project is estimated to save 2.2 million gallons of water each year.

- Water Upon Request: The Nevada Restaurant Association, WCC and SNWA partner with local restaurants, which agree to serve water only when patrons request it. This program saves participating restaurants water, time and money by eliminating unconsumed glasses of water. For every glass of water not served, as much as 1.5 to more than 3 gallons of water is saved. There are currently more than 300 restaurants participating in the program.

- Water Smart Contractor: The key to preventing many water waste problems is efficient landscape design. The SNWA provides a course in water-efficient landscape and irrigation design and installation for licensed landscape contractors. Contractors who complete the course and pass an exam are certified as Water Smart Contractors. Classes are offered in both English and Spanish. To date, more than 100 companies have completed the program.

- Water Smart Home: The SNWA has partnered with the Southern Nevada Home Builders Association to develop a program that certifies new homes as water smart. Homeowners purchasing a water-smart home can save as much as 75,000 gallons of water per year. This is the nation's largest program for water efficiency in new homes, with more than 7,000 water smart homes constructed so far.

  In addition, the SNWA consistently engages with the Environmental Protection Agency (EPA) in developing new national standards for WaterSense, a partnership program that provides information on products to save water and protect the environment. The SNWA's Water Smart Home program is the principal model for the WaterSense New Homes Program. In 2006, the SNWA was the first water agency to receive the EPA's Water Efficiency Leadership Award for its comprehensive suite of progressive water efficiency programs.

- Water Smart Car Wash: This program encourages residents to use commercial car wash facilities instead of washing their vehicles at home by offering residents instant coupons for dozens of valley car washes. Water Smart Car Washes recover all of their wastewater for treatment and reuse. Water used at these facilities is either reused on site, or treated and returned to Lake Mead for return-flow credits.

- Linen Exchange: Nearly two dozen resorts and other leading properties participate in this voluntary program through which linens are changed only on the third day of a guest's stay,

unless otherwise requested. The average savings of washing linens and towels every three days is about 50 gallons per room each day.

RESEARCH

In addition to existing demand-management tools, ongoing research enables the SNWA to make informed decisions regarding water policy and programs. The SNWA recognizes the value and necessity for research and innovation in water conservation and has developed a number of research initiatives to foster cutting edge techniques and technologies. These research initiatives are expected to continue during the 5-year planning horizon.

The following section outlines present research initiatives and their impacts to the community's water conservation efforts. A listing of completed research initiatives is included in **Appendix D**.

Current Research Initiatives

EPA New Homes Water Efficiency Benchmarking **–** SNWA is one of several utilities participating in a nationwide study of water efficiency in new homes. The research includes comparisons of water consumption in new and older homes, as well as construction and monitoring of new homes with high-efficiency fixtures and appliances. To date, the SNWA has secured Pulte Homes as a participating builder and developed relationships with product representatives. While the current housing market has negatively impacted study recruitment, the first resident has moved into a study home.

Watering Group Assistant Study **–** SNWA is pioneering a research project to test a new water-saving device that eliminates the need for residents to change their watering clock to comply with mandatory seasonal day-of-week and time-of-day watering restrictions. The Watering Group Assistant automatically adjusts an irrigation clock to a property's assigned watering group throughout the year. SNWA is providing approximately 600 units made from four different manufacturers for test purposes.

Smart Controls Exemption Study **–** SNWA is testing whether residents using smart irrigation controllers that receive an exemption from day-of-week watering restrictions can save more water than conventional controls subjected to landscape watering restrictions.

Leak Detection Research **–** Using Automated Meter Reading (AMR) technology, SNWA assisted the Las Vegas Valley Water District in identifying persistent leaks. Coupled with forthcoming automated messaging being developed, such a leak detection program could save hundreds of millions of gallons each year.

School Audits **–** SNWA facilitated water efficiency audits of 30 Clark County School District (CCSD) schools, which included review and accounting of all indoor and outdoor uses. The research will be used to further develop custom conservation programming for this unique and largest of customer groups served by local purveyors.

Turf Assessment Project – SNWA has been pioneering the use of aerial imagery to find and estimate the amount of lawn at local properties. While technical challenges and overlying tree canopy have thus far prevented a valley-wide accounting of the amount of lawn in Southern Nevada, the data collected has proven very valuable for targeted direct-mail outreach to residents with significant amounts of

grass. This has helped boost enrollment in the SNWA's Water Smart Landscapes Rebate Program, as well as assist with various studies.

Smart Sprinklers Study – SNWA is planning to begin research in 2009 on a variety of possible improvements to distribution uniformity of popup sprayheads. Such improvements should theoretically facilitate water savings in lawn areas.

CONCLUSION

The SNWA has one of the most dynamic and comprehensive water conservation programs in the nation. While the general strategies employed will continue to yield results, the SNWA constantly pursues refinement and innovation.

The 2004-2009 planning period witnessed significant conservation results that helped to safeguard Southern Nevada's resources during evolving global, national and regional circumstances.

It is anticipated that the next five years are likely to reveal even greater challenges and opportunities. The SNWA supports continual cycles of program planning, implementation and evaluation. This on-going process allows the agency to succeed in meeting community needs under a diverse set of circumstances. These efforts are expected to yield new opportunities that may result in further improvement of this five-year plan.

Appendix A
Conservation Achievements

The SNWA witnessed substantial conservation gains during the 2004-2009 planning period, contributing to the following noteworthy accomplishments:

- Now in its tenth year, the Water Smart Landscape (WSL) Rebate Program has helped the community to upgrade more than 125 million square feet of lawn to water-efficient landscaping, saving the community more than 25 billion gallons of water.

- More than 14,000 coupons have been distributed to participants in the Pool Cover Instant Rebate Coupon Program, contributing to a total of 480 million gallons of water saved.

- The Irrigation Clock Rebate Program, which provided financial assistance for customers to upgrade landscape irrigation controllers to models that can increase water efficiency, facilitated replacement of nearly 2,000 controllers for residential and commercial properties, saving the community more than 150 million gallons of water.

- Since 2001, participating businesses in the Water Efficient Technologies (WET) Program have saved more than 1.75 billion gallons of water.

- In 2008, the SNWA, in partnership with the U.S. Environmental Protection Agency's WaterSense program, hosted the inaugural WaterSmart Innovations Conference & Expo. Roughly 1,200 participants from across the U.S. and 17 foreign nations came together to share information about conservation programs and water-efficient technologies.

Appendix B
2009-2014 Conservation Plan Measures, Estimated Savings and Implementation Schedule

2009

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.34	40%	0.34	20%	0.17	0.85	1829
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	351
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	134
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1571
Landscape Development Codes*	0%	0	0%	0	0%	0	0	0
Other	40%	0.02	40%	0.02	20%	0.01	0.05	100
TOTAL	N/A	0.63	N/A	0.59	N/A	0.63	1.85	3985

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

*****Based on estimated population projections, the SNWA does not anticipate Landscape Development Codes contributing to GPCD reductions in 2009. Savings are represented for 2010 through 2014 (see pages 21-25), as population increases are expected.

Appendix B continued

2010

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.176	40%	0.176	20%	0.088	0.44	977
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	366
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	140
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1638
Landscape Development Codes	0%	0	0%	0	100%	0.45	0.45	1006
Other	40%	0.004	40%	0.004	20%	0.002	0.01	23
TOTAL	N/A	0.45	N/A	0.41	N/A	0.99	1.85	4150

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

Appendix B continued

2011

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.168	40%	0.168	20%	0.084	0.42	977
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	380
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	146
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1701
Landscape Development Codes	0%	0	0%	0	100%	0.42	0.42	968
Other	40%	0.024	40%	0.024	20%	0.012	0.06	144
TOTAL	N/A	0.46	N/A	0.43	N/A	0.96	1.85	4316

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

2012

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.16	40%	0.16	20%	0.08	0.40	977
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	394
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	151
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1764
Landscape Development Codes	0%	0	0%	0	100%	0.40	0.40	950
Other	40%	0.04	40%	0.04	20%	0.02	0.10	240
TOTAL	N/A	0.47	N/A	0.43	N/A	0.95	1.85	4475

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

2013

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.156	40%	0.156	20%	0.078	0.39	977
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	408
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	156
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1825
Landscape Development Codes	0%	0	0%	0	100%	0.37	0.37	927
Other	40%	0.056	40%	0.056	20%	0.028	0.14	338
TOTAL	N/A	0.48	N/A	0.45	N/A	0.92	1.85	4631

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

Appendix B continued

2014

	Water Pricing Influence Coefficient	Water Pricing Influence GPCD	Education & Ethic Influence Coefficient	Education & Ethic Influence GPCD	Other Influence Coefficient	Other Influence GPCD	TOTAL REDUCTION (GPCD)	TOTAL REDUCTION (ACRE-FEET)
Water Smart Landscapes Program	40%	0.152	40%	0.152	20%	0.076	0.38	977
Water Efficient Technologies Program	40%	0.064	20%	0.032	40%	0.064	0.16	421
Coupon Programs	40%	0.024	30%	0.018	30%	0.018	0.06	161
Adoption of improved equipment, appliances and fixtures	25%	0.1825	25%	0.1825	50%	0.365	0.73	1885
Landscape Development Codes	0%	0	0%	0	100%	0.35	0.35	899
Other	40%	0.068	40%	0.068	20%	0.034	0.17	438
TOTAL	N/A	0.49	N/A	0.45	N/A	0.91	1.85	4781

Note: Calculations assume a linear annual decrease in total GPCD consistent with achieving a 199 GPCD by 2035 conservation goal. Actual savings may be higher or lower in a given year.

As discussed on page 10, these figures represent estimated savings based on SNWA demand-management measures. Water Pricing and Education & Ethic achievements are embedded in the total GPCD reduction. For the purposes of this plan, those estimated contributions have been outlined in the table above.

Appendix C
Historical and Projected SNWA Total Water Use
GPCD Estimates

YEAR	Estimated and Projected SNWA Population	SNWA Total Usage (acre-feet)	Historical SNWA GPCD	Projected SNWA GPCD
1989	708,704	276,407	348	
1990	750,621	291,760	347	
1991	790,099	304,435	344	
1992	839,295	318,650	339	
1993	886,207	334,282	337	
1994	954,106	352,107	329	
1995	1,002,411	367,244	327	
1996	1,075,331	395,908	329	
1997	1,123,316	404,626	322	
1998	1,193,489	423,182	317	
1999	1,265,475	445,853	315	
2000	1,364,248	481,798	315	
2001	1,439,973	513,580	318	
2002	1,517,885	533,154	314	
2003	1,577,737	519,376	294	
2004	1,679,845	515,025	274	
2005	1,747,536	526,995	269	
2006	1,846,561	546,516	264	
2007	1,930,414	550,955	255	
2008	1,921,352	538,048		250
2009	1,921,352	534,062		248
2010	2,002,629	552,500		246
2011	2,080,818	569,755		244
2012	2,157,517	586,281		243
2013	2,232,364	601,989		241
2014	2,304,996	616,794		239

Note: The SNWA considers weather adjusted water use in tracking water conservation and in long-term planning to account for variations in weather among years. Weather-adjusted GPCD of 250 in 2008 is a rough estimate used as a starting point for long-term planning purposes; weather-adjusted GPCD for 2008 will be reported at a later date upon completion of 2008 data collection and verification process.

Estimated population was projected using forecasts from the Center for Business and Economic Research at the University of Nevada, Las Vegas and adjusted based on short-term population trends.

Appendix D
Completed Research Initiatives

Xeriscape Conversion Study (XCS) **–** This partnership study between the SNWA and Bureau of Reclamation (BOR) identified several objectives to determine the potential water savings from upgrading lawn to water-smart landscaping (xeriscape). The objectives included:

- Identifying candidates for participation and monitoring their water use by submetering xeriscape and lawn irrigation use separately for comparison purposes.
- Measuring the average reduction in water use among study participants.
- Measuring the variability of water savings over time and across seasons.
- Assessing the variability of water use among participants and to identify what factors contribute to that variability.
- Measuring the capital costs and maintenance costs of landscaping among participants.
- Estimating incentive levels necessary to induce desired changes in landscaping.

The objectives of this study were completed in 2005. The study demonstrated that in Southern Nevada average savings obtainable from lawn to water-smart landscape conversions is 55.8 gallons per square foot annually and reanalysis of subsequent data continues to support this significant savings figure. The results of the XCS have supported the basis for the SNWA's Water Smart Landscapes Rebate Program and helped guide local conservation policies. The study along with subsequent analyses of landscape conversions has been published in the *Journal of the American Water Works Association* and the work is commonly recognized as the nation's largest, most complete investigation of the conservation potential of conversion projects. In recognition of the work performed on the XCS, the BOR awarded SNWA the Water Conservation Field Services Program Regional Director's Award. The study is available online at **snwa.com/assets/pdf/xeri_study_final.pdf**.

Construction Water Use Study **–** This University of Nevada, Las Vegas (UNLV) study was funded by the SNWA and Bureau of Reclamation and completed in 2005. The study presented objectives related to construction activities and water-use practices, including:

- Benchmarking existing practices and efficiencies.
- Determining opportunities to improve water efficiency for construction water users.
- Creating practical recommendations and/or tools for construction professionals to improve water efficiency without compromising quality of work, regulatory compliance needs or cost efficiency.
- Providing credible information to allow the SNWA to evaluate opportunities for incentive and educational programs for construction water users.

The results demonstrated that relatively simple and inexpensive improvements to construction water trucks could reduce consumption by approximately 20 percent. Other findings and recommendations pertain to ideal soil surface wetting to achieve dust control while avoiding track-out of mud onto right-of-ways. These findings have been presented in several forums and at least one construction company

locally is following the study's recommendations. The study is available from SNWA upon request.

National Multiple Family Submetering and Allocation Billing Study **–** The SNWA agreed to participate in this national study to determine the benefits of submetering at multi-family housing units, such as apartment complexes. Multi-family water billing is traditionally done with one or just a few meters on site, which means that individual apartment dwellers typically do not receive a price signal corresponding to their individual levels of consumption and thus have little or no financial incentive to conserve. The study objectives included:

- Determining the water savings potential in the multi-family sector resulting from both direct metering and allocation programs.
- Understanding the current regulatory framework governing billing conversion programs across the U.S.
- Assessing the current business practices in the sub-billing industry.
- Making recommendations that offer consumer protection, provide ethical business practices for the industry and capture cost-effective water savings.

Completed in 2004, the study demonstrates that submetered units save about 15 percent in annual indoor water use relative to properties with "in-rent" water charges. The study is available from Aquacraft, Inc. by visiting **aquacraft.com**.

Automated Irrigation Controllers **–** This study funded by SNWA and administered by UNLV was completed in 2006. The study explored the possible savings that might be associated locally with the use of smart irrigation controllers, which mediate irrigation based on calculated landscape needs as revealed by analysis of environmental data. The objectives of the study included:

- Recruiting and selecting appropriate sites for controller evaluation.
- Installing controllers at treatment sites.
- Monitoring study sites by recording detailed consumption data and responding to customer inquiries.
- Performing analyses to determine the potential water savings achievable from the technology.

The results demonstrated smart controllers reduce outdoor consumption by 15-25 percent locally and advanced the SNWA's decision to offer a rebate program for smart controllers. Information on papers covering various aspects of the research is available from the SNWA. Alongside local research, the SNWA has provided leadership on national initiatives to develop standardized protocols for efficient irrigation system components. Additional information on this progress is available online at **irrigation.org/SWAT/Industry**.

Additional Research Results **–** In the previous five-year planning period, the following research also was completed:

Appendix D continued

- SNWA hosted an investigation by Utah State University that revealed that statistically significant water savings are being obtained by local water waste enforcement efforts.
- Water budgeting policies implemented by SNWA purveyors were found to be helping to facilitate conservation efforts in the golf sector that are saving approximately 1 billion gallons annually.
- While SNWA cooling tower research is ongoing, a major cover article on cooling towers was completed in 2008 and published in *HPAC Engineering*. The article found that facilities partnering with SNWA on cooling-tower retrofits are saving on average 17.7 million gallons of water annually. Total savings from SNWA's cooling tower efforts have exceeded 1 billion gallons.

Rebuttal Report on Water Conservation and Efficiency in Southern Nevada

PRESENTATION TO THE OFFICE OF THE NEVADA STATE ENGINEER

Prepared by

SOUTHERN NEVADA WATER AUTHORITY

August 2011

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Rebuttal Report on Water Conservation and Efficiency in Southern Nevada

Submitted to:
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Carson City, Nevada 89701

Pertaining to:
Groundwater Applications 54003 through 54021 in
Spring Valley
and
Groundwater Applications 53987 through 53992 in
Cave, Dry Lake, and Delamar Valleys

August 2011

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17 Aug 2011
Date

Rebuttal Report on Water Conservation and Efficiency in Southern Nevada

In 2007, the Pacific Institute, in partnership with Western Resource Advocates (WRA), released a report titled "*Hidden Oasis: Water Conservation and Efficiency in Las Vegas*" (Hidden Oasis). The report assessed conservation efforts of the Southern Nevada Water Authority (Authority) in Las Vegas, Nevada. The report was commissioned at the request of the Progressive Leadership Alliance of Nevada, an opponent of the Authority's efforts to expand and diversify its water resource portfolio.

Subsequently, Peter Gleick and Heather Cooley of the Pacific Institute submitted to the Nevada State Engineer a follow-up report titled "Report on Water Use Efficiency and Conservation in the Las Vegas Valley," dated June 29, 2011. This rebuttal report addresses content from both Hidden Oasis and the Gleick and Cooley documents.

Hidden Oasis was largely based upon the Authority's responses to a pre-defined set of survey questions and documents available to the authors upon request or via the internet. The Authority was allowed to review and comment on the final draft of the document approximately one week prior to its release. Some, but not all, of the Authority's corrections and comments were integrated into the final report.

The report contends that "a serious effort at water conservation and efficiency improvements can reduce water demand for the single-family residential sector, hotels and casinos by more than 86 KAFY (86,000 acre feet per year)."[1] The Authority is committed to furthering water efficiency in southern Nevada, but considers the Pacific Institute's estimates to have been derived using inflated baselines and unrealistic assumptions about market penetration and cost efficiency of water-efficiency programs. Furthermore, the data presented in the report is now almost seven years old, during which time the Authority has continued to advance water efficiency.

Gleick and Cooley (2011) designate outdoor conservation "especially important because of the consumptive use aspects of outdoor water use, and especially valuable for reducing the need for new sources of supply[2]." The Authority concurs and has made outdoor water efficiency the primary target for our conservation programs. Although indoor conservation does not extend the region's resources, the Authority also has effectively pursued indoor conservation as a component of a comprehensive, multi-faceted conservation program.

Furthermore, all indoor water collected by the Authority's member agencies' regional wastewater treatment plants is already directly or indirectly reused. In fact, more than seven billion gallons of wastewater are directly recycled annually for use at parks, golf courses, and power plants. Gleick and Cooley (2011) suggest that "expanding indoor efficiency efforts and improving implementation of

1. Pacific Institute, *Hidden Oasis* (2007), page 36.
2. Gleick and Cooley (2011) page 3.

water treatment and recycling would provide substantial water savings by providing water that can be reused for a wide range of uses, without finding new supplies.[3]" Gleick and Cooley fail to acknowledge that direct reuse does not provide a water resource benefit to southern Nevada, since all wastewater is currently directly or indirectly reused. In addition, research conducted by Dr. Dale Devitt of the University of Nevada Las Vegas[4] indicates that irrigating with reuse water, which is higher in salinity than potable water, actually increases demand due to the increased leaching fractions required to maintain plant health.

Graywater reuse is another technique that is often promoted with the expectation of reducing potable water demand. Graywater is untreated wastewater from bathroom sinks, showers, baths and laundering machines. While graywater reuse has been successful in many cases, it has also produced unintended consequences. When the Water Corporation of Western Australia (Perth) provided incentives to 64 households to install a graywater reuse system, the average annual potable water use increased by more than 16,000 gallons per household.[5] Since graywater's secondary use is typically landscape irrigation, reuse projects have the potential to increase southern Nevada's consumptive demand.

The Authority contends that the efficiency potential suggested by Hidden Oasis is grossly inflated and that substantial errors were incurred in the report's assumptions and calculations:

1. The 165 gallons per single family residential (SFR) occupant per day shown in the report was reasonably comparable to the Authority's calculation of 162 gallons per SFR occupant per day for the year 2004. By 2009, the most recent year assessed by the Authority, SFR use decreased to 146 gallons per single family resident per day[6].

2. Although the report contains a city-by-city graphical comparison of single family homes' indoor water use, Hidden Oasis's estimate of the Authority's current per capita residential indoor water use was not derived from actual data. In acknowledging that the study used by Hidden Oasis is fairly dated, the report estimates that demand may be lower, stating: "*we assume that indoor demand is between 60 and 70 GPCD, or about 65 GPCD.*[7]"

   In 2007, the Authority collected metered water use data from 214 single family homes using datalogging devices. The study home population was selected to represent the construction age structure of the total SFR sector in the region. Through collection and analysis of water use data, the Authority is able to differentiate outdoor irrigation by identifying recurring cycles of use consistent with the operation of an automated irrigation controller. Once outdoor use was disaggregated, remaining water use was attributed to indoor uses. Using a population of 2.97 persons per household,[8] the analysis estimated SFR indoor per person use to be approximately 55.2 gallons per day.

3. Gleick and Cooley (2011), pages 4 and 700.
4. D.A. Devitt et al. (2007), Agronomy Journal 99:692-700.
5. Waterwise rebate scheme review 2007 (2008). Data Analysis Australia Pty Ltd.
6. Total SFR metered demand for all agencies/estimated SFR residents/365 (from T. Maher, July 26, 2011).
7. Pacific Institute, *Hidden Oasis*, (2007), page 37.
8. Clark County Comprehensive planning – Single family population divided by occupied SFR units (2007).

3. In addition to using an inflated baseline (65 gpcd instead of 55.2 gpcd) for indoor water use, the estimate of potential indoor residential water savings assumes every existing household and business purchases, installs, uses and maintains the highest performing appliances and fixtures currently available in the market. *"Replacing all water-using appliances and fixtures with more efficient models would reduce current SFR indoor demand from 78 KAFY to 46 KAFY, or from 65 GPCD to 39 GPCD. Using this approach, we estimate that Las Vegas' current SFR indoor conservation potential is 31 KAFY."*[9]

   A scenario of replacing 100 percent of existing appliances and fixtures is unachievable by any agency under any circumstance, therefore, it cannot be utilized as a scenario for demand planning due to the significant risk of experiencing a water supply shortage if conservation goals are not met due to less than 100 percent compliance.

   The report offers two different projections of efficient per person indoor use in single family homes: 43 gpcd (Figure 7) which is derived from research studies, and 39 gpcd, which is used in calculating southern Nevada's water efficiency potential. While per person indoor use values in the 40 gpcd range have been proven achievable in individual households,[10] no major American city has yet shown a consistent ability for their entire single family customer base to meet such a target except as a response to a short-term water-supply crisis. The recently completed California Single Family Home Water Efficiency Study (Aquacraft, 2011) found average per person per day indoor use to be approximately 58 gallons in California communities, with the lowest per person indoor use of 53.5 gpd reported for the City of San Diego.

   The Authority's goal to achieve 199 gpcd calls for indoor demand reductions and projects residential indoor water use may decline by approximately 20 percent by 2035 through adoption of more efficient appliances and plumbing fixtures. While these reductions will increase efficiency of energy and infrastructure use, indoor water conservation does not extend southern Nevada's water resources because Las Vegas already recycles all water used non-consumptively indoors. Only reductions in consumptive water uses extend southern Nevada's water resources by allowing the conserved water to be diverted to another use.

4. Hidden Oasis' baseline estimates for specific uses are also incorrect. For example, Table 9 suggests 12 KAF of demand reduction could be achieved by equipping homes with 1.6 gallon per flush (gpf) toilets. As demonstrated by Table 8 (page 38) and Appendix D, the baseline scenario incorrectly assumes <u>all</u> Las Vegas homes are currently equipped with 3.5 gpf toilets. (Table 8 estimates that each resident in a single family home uses 17.8 gallons per day for toilet flushing. Appendix D applies an average of 5.04 flushes per person per day. These figures demonstrate that the report estimated an average flush volume of 3.53 gallons in calculating the baseline.)

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9. Pacific Institute, *Hidden Oasis* (2007), pages 21 and 39.
10. Estimate derived by applying fixture replacement rates found in the California Single Family Home Water Efficiency Study (Aquacraft, 2011) to Las Vegas region homes built prior to 1994.

The federal Energy Policy Act of 1992 (EPACT) required all new homes to be equipped with 1.6 gpf toilets. Since EPACT allowed depletion of remaining inventories, it is estimated that all homes built in 1994 or later were equipped with 1.6 gpf toilets. Sixty-one percent of homes in Las Vegas were built since 1994 and already equipped with 1.6 gpf or 1.28 gpf toilets. Of the 172,000 homes built in 1993 and earlier, 60 percent are estimated to have one or more 1.6 or 1.28 gpf toilets.[11] As a result, the Authority estimates the average flush volume in single family homes to be just over 2 gpf, not the 3.5 gpf estimated in Hidden Oasis.

5. Hidden Oasis' estimates of baseline resort water use and efficiency potential are not based upon any study or analysis of data and, therefore, cannot be considered credible. As an example, the report assumes 2.4 gallons of water use for each pound of resort linens laundered. All resorts in the region use industrial scale laundering facilities that utilize state-of-the art equipment that typically uses from 0.4 gallons to 1.5 gallons per pound. The Authority has worked closely with all industrial launderers on water-efficiency improvements. Based upon metered water use and regulatory reports submitted to Clark County, the Authority has determined approximately 25 percent of resort water use is consumptive and 75 percent is non-consumptive use, making it available for subsequent direct or indirect reuse. As such, the resort industry is estimated to consume less than 3 percent of southern Nevada's water resources while generating the bulk of the community's economy.

6. The report suggests reductions of approximately 48 KAFY of outdoor water savings are achievable in the SFR sector through landscape conversion (page 39), but this estimate is devoid of any actual data on existing quantities of landscape styles and their water use. The Authority currently operates the world's largest known landscape conversion program. As of July 1, 2011, the Water Smart Landscapes Program has incentivized conversion of more than 3,500 acres of lawn and paid incentives of $172 million. This program, now in its eleventh year, has reduced southern Nevada's consumptive demand by an estimated 26,361 AFY. Achieving the additional landscape demand reductions suggested by the Pacific Institute would be equivalent to converting an additional 6,500 acres of SFR turfgrass to water-efficient landscape. A 2010 Authority analysis of aerial multi-spectral images estimated a total of 3,100 acres of turfgrass are on SFR properties. As such, even the conversion of all SFR grass, including functional turf areas, would be insufficient to yield even half of the water savings suggested by the Pacific Institute report. There simply is not enough turfgrass left in Las Vegas to meed Hidden Oasis's estimates.

The report made 12 recommendations for water-efficiency programming. Many accomplishments and programs of the Authority were not mentioned in the report or were relegated to Appendix A, which was not distributed with the printed report.

11. Penetration rates from California Single Family Home Water Efficiency Study. Aquacraft (2011).

Following are the 12 major recommendations of the Pacific Institute, accompanied by facts and statistics about the Authority's efforts and accomplishments related to the issue.

1. **<u>Pacific Institute Recommendation</u>: Expand efforts to reduce outdoor water demand, using incentives for conservation and penalties for excessive water use.**

   - Since 2000, the Authority has operated the largest incentive program in the nation. Over 154 million square feet of lawn have been converted to desert-adapted landscape on more than 40,000 individual projects. Over $172 million dollars invested. Water savings of 8.6 billion gallons annually.

   - The Authority's per capita investment in water-efficiency programming over the past decade is the highest of any comparable water agency in the United States.

   - The Authority initiated the national effort to expand the marketplace for "smart" irrigation controllers and was among the first agencies in the nation to offer incentives for these devices. (Smart controllers can adjust irrigation rates based on climate or soil moisture conditions).

   - The Authority has redeemed more than 39,000 instant rebate coupons for pool covers, rain sensors and smart irrigation controllers at a cost of $1.16 million.

   - The Authority's Water Efficient Technologies Program provides financial support for capital improvements with large users and has produced a cumulative savings of over 2 billion gallons.

   - Authority member agencies operate the most aggressive water waste enforcement programs in the nation, conducting up to 40,000 field inspections and assessing over $400,000 in water waste fees annually. The largest Authority member agency has the nation's most aggressive fees for water waste, assessing as much as $5,120 per violation.

   - Authority member agencies use four water rate tiers with top tier rates typically more than three times of first tier rates. The volumes of water allowed in each tier have been compressed, such that users incur the higher rates at lower volumes of use.

   - Golf courses have specifically calculated water budgets with overuse penalties of up to 9 times of upper tier water costs.

2. **<u>Pacific Institute Recommendation</u>: Implement indoor water-efficiency programs targeting older homes and high users.**

   - More than two thirds of southern Nevada's existing buildings were constructed with fixtures and appliances that meet or exceed the most current national water-efficiency

standards. The majority of structures older than 1994 have replaced fixtures with models that meet current federal standards for water efficiency.

- As part of a market transformation initiative, the Authority issued incentives for the installation of 3,441 high-efficiency toilets in new single family homes.

- A cost-benefit analysis comparing SFR toilet retrofit programs to Water Smart Landscapes found:

  - Landscape retrofits produce 41 percent more water savings per dollar invested.

  - Landscape retrofit creates 117 acre feet of consumptive water demand reduction per $1 million. Toilet programs produce none.

  - Landscape retrofit creates 3.3 times more jobs per unit of investment than toilet retrofit programs.

  - Water savings from landscape retrofit produce 25 percent more energy savings in water treatment and delivery than toilet retrofit programs. These energy savings also reduce CO_2 discharge commensurately.

- The Authority audited use of a representative group of older public schools and then paid to retrofit fixtures in 30 public school facilities identified to have the greatest water efficiency potential.

- The Authority operated fixture retrofit programs for older buildings until slowing demand indicated market saturation in the late 1990s. Over 20,000 households received indoor retrofit products, which constitutes more than one of every ten homes built prior to the most current water-efficiency standards.

- Retrofit products have been continuously available without charge to all customers for over a decade. Any customer may request a kit.

- Kits offered by the Authority include EPA WaterSense components which exceed current efficiency standards for such devices.

- The Authority issued 5,747 rebates for high-efficiency washing machines from 1999 to 2003. Customer research conducted in 2002 showed that these appliances were successful in the marketplace without subsidies. Over 85 percent of rebate recipients surveyed disclosed that the rebate was not a major influence in their purchasing decision. Rebate programs are intended to stimulate and accelerate market acceptance of new technology. The Authority determined that high-efficiency washers had gained broad acceptance in the local market. As a result of this positive finding, the program was discontinued in 2003 and the program resources were diverted to the Water Smart Landscapes Program.

- In terms of cost efficiency, programs that target outdoor, consumptive water use produce greater returns than indoor water use. This holds true in terms of water resources, energy conservation and infrastructure costs.

- One hundred percent of wastewater received at regional treatment plants is treated and directly or indirectly reused. Five to eight percent of all wastewater is treated at satellite facilities at higher elevations and reused directly for irrigation.

3. **<u>Pacific Institute Recommendation</u>: Develop tiered block rate structure with low fixed costs, low rates for water sufficient to meet basic indoor needs, and a sharply increasing rate for higher-volume outdoor uses.**

   - All Authority member agencies use tiered rate structures. Top tier rates may be 350 percent more costly than the first tier. Tier ranges have been aggressively abbreviated for greater conservation effect.

   - First tier water rates are structured to meet a family's basic needs at a low (or even subsidized) rate. First tier rates are typically around $1.00 per Kgal.

   - Agencies have committed to review and adjust rates frequently to assure not only that revenue needs are met, but also that the conservation effect is sustained.

4. **<u>Pacific Institute Recommendation</u>: Adopt ordinances that target indoor water use, such as retrofit-on-resale ordinances.**

   - Retrofit on resale is a controversial regulatory method with broad impact on commerce. Considering the majority of homes have efficient fixtures and the high natural replacement rate of older fixtures, such a regulatory measure would be burdensome and costly. In lieu of this strategy, the Authority is promoting marketplace transformation for highest efficiency fixtures, both through the development of national-level standards and through local efforts such as the Water Smart Home Program.

5. **<u>Pacific Institute Recommendation</u>: Expand efforts to work with resorts and other businesses to improve efficiency.**

   - Major resort corporations have made efficiency improvements for both indoor and outdoor use, including showers, toilets, landscaping and cooling. The Past President of the Nevada Professional Facility Managers Association, Peter Ricardo, estimates that more than 95 percent of resort fixtures meet or exceed current EPACT requirements as a result of frequent rehabilitation of hotel properties.

   - The Authority has conducted efficiency projects with every major resort management corporation operating in southern Nevada.

   - Las Vegas resorts are among the most efficiently-operated and best-maintained facilities in the nation. Less than two percent of the land use of a Las Vegas "mega-resort" is

dedicated to water (spas, swimming pools, and fountains). Less than four percent of a mega-resort parcel is irrigated landscape.

- Southern Nevada is one of the only cities with an active business-to-business conservation organization, the Water Conservation Coalition.

- The Authority influenced electric power producers in the region to develop dry-cooled generation facilities.

6. **Pacific Institute Recommendation: Develop more aggressive ordinances to further limit turf area in new developments.**

- Turf limitations have been in use since 1995. Current restrictions are among the most aggressive of any western city.

- Lawns are prohibited in all commercial/industrial development.

- Lawns are prohibited in front yards of new residential development. Backyard turf is limited to 50 percent of total landscape area.

7. **Pacific Institute Recommendation: Provide better incentives to developers who install water-efficient landscapes and devices that exceed current-efficiency standards.**

- More than 8,800 new homes have been built through the Water Smart Home Program, the nation's largest water-efficiency program for new homes. Water Smart Homes exceed all national and local codes for efficiency of appliances, fixtures, landscape and cooling.

- Authority research has shown that WaterSmart Homes use about half as much water as the standing stock built prior to 2003, largely as a result of smaller and more efficient landscapes.

- The Authority Water Smart Home Program is integrated with the Southern Nevada Green Building standards and compliant with the Draft LEED standards for new homes.

- The Authority's Water Smart Home Program served as the principal program model for EPA's WaterSense New Home Program.

8. **Pacific Institute Recommendation: Encourage developers to install community pools rather than private pools.**

- The compactness of new development has dramatically reduced the potential of new residential pools. Currently, 22 percent of all homes, of all ages, have a swimming pool. Pool ownership as a percentage of housing units is most pronounced in homes built from 1965 to 1980, with one of every three such homes having a swimming pool. Among the 122,000 homes built since 2004, just 12 percent have a swimming pool.

- More than 25,000 Authority incentives have been issued for swimming pool covers.

- The Water Smart Home Program restricts the maximum surface area of pools in private backyards and encourages appropriately-sized community pools in lieu of private pools at individual residences.

9. **<u>Pacific Institute Recommendation</u>: Create a culture of conservation by developing a consistent message about the importance of indoor and outdoor conservation.**

   - Southern Nevada has one of the largest and most aggressive public outreach programs in the nation.

   - A full suite of commercial partnership programs assures that citizens are exposed to water-efficiency messaging from multiple sources.

   - Marketing research conducted by the Authority determined that specific messaging targeted at the most vital issue (landscape water use) was more effective than generalized messaging or multiple messages.

10. **<u>Pacific Institute Recommendation</u>: Offer public awards for innovative conservation programs.**

    - The Authority has long-standing annual awards programs to recognize outstanding conservation efforts. The Authority operates both Water Hero awards and the Authority Landscape Awards. The Landscape Awards are now entering their 14th year.

11. **<u>Pacific Institute Recommendation</u>: Institute a market-based system by which private groundwater can be conserved and sold to the Authority.**

    - Such opportunity already exists and is managed through the Nevada Division of Water Resources. Transferring ownership of local groundwater rights, however, typically produces no net gain in regional water resources. All groundwater in the Las Vegas Valley has already been allocated for existing beneficial uses. As such, any ongoing demand currently met with private groundwater would have to be substituted with water from a municipality if the groundwater rights were sold.

    - The Authority provides water-efficiency incentives for conservation of privately-held groundwater rights.

12. **<u>Pacific Institute Recommendation</u>: Evaluate opportunities to utilize shallow groundwater and manage urban runoff and floodwaters so as to improve groundwater infiltration and recharge.**

    - The Authority continually evaluates the potential of all potential water resources, including shallow groundwater, desalination, condensate recovery, rainwater harvesting and other innovative concepts. Currently, the Las Vegas Valley groundwater aquifer is near practical capacity as a result of storage and recovery operations.

- Many proposals for recovery of rainwater are not cost-effective due to the sporadic nature of rain events. In 2009, for example, the Las Vegas Valley received just one inch of rainfall. Rainfall which does not infiltrate into the soil is conveyed to the Colorado River.

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Hard times don't stop Las Vegas influx

Updated 3/1/2011 5:50:26 PM |

By **Haya El Nasser**, USA TODAY

Despite being hammered by the recession and housing bust that created record unemployment and foreclosures, the Las Vegas area continues to gain people at a phenomenal rate.

By Ethan Miller, Getty ImagesLas Vegas grew 22% in the last decade, despite being hit hard by foreclosures, new Census data show.Enlarge

By Ethan Miller, Getty Images

Las Vegas grew 22% in the last decade, despite being hit hard by foreclosures, new Census data show.

Clark, the state's largest county and home to Las Vegas and booming suburban cities, grew 42% to 1.95 million since 2000, according to 2010 Census data released Thursday.

Almost three of four Nevadans live in the Greater Las Vegas area, in Clark and Nye counties.

NEVADA: Local county, city Census data

CENSUS NUMBERS: Interactive map shows your state, county, locality

Sin City itself grew 22% to 583,756. With almost 258,000 people, Henderson has surpassed Reno as the state's second-largest city. North Las Vegas, fourth-largest at 216,961, is on the verge of passing Reno (pop. 225,221).

"Despite all the pronouncements of Las Vegas' demise, it has retained most of its population growth from the decade and ensured that the state of Nevada will gain a congressional seat," says Robert Lang, an urban expert at the University of Nevada-Las V egas.

Census counts are used to allocate seats in the U.S. House of Representatives and to redraw state and local political districts.

Nevada is on the cusp of becoming a "majority-minority" state because whites who are not Hispanic make up 54% of the population, compared with 65% in 2000. The

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state's child population is dominated by minorities, according to analysis by William Frey, demographer at the Brookings Institution.

Nevada's Hispanic population grew 82% to almost 717,000. Hispanics make up 27% of the population, up from 20% in 2000. Non-Hispanic Asians more than doubled to about 191,000 and make up more than 7% of the population. Non-Hispanic blacks grew 58% to more than 208,000.

Lang says Nevada held on to its population gains largely because the recession "was so large and universal that it froze people in place even if there were no jobs."

State unemployment is above 14%, the highest in the country — even higher than industry-battered Michigan.

"The national economy hasn't picked up enough yet to draw people out," says Jeff Hardcastle, the state demographer. "There's no place to go for work."

The flood of people coming into the state has slowed.

"In the '90s, our population growth was driven by migration, accounting for 72%. Since 2000, it's about 57%.

"Fewer people are coming in, but more people are being born," Hardcastle says.

More than a quarter of Nevada's growth came from births, up from 19% the previous decade. The state attracted many young families seeking jobs and affordable housing.

"Henderson is one of the epicenters of the housing collapse," Lang says. "Yet Henderson grew tremendously."

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Population Forecasts: Long-Term Projections for Clark County, Nevada 2011-2050

2011

Prepared by

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Prepared for

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May 27, 2011

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Population Forecasts: Long-Term Projections for Clark County, Nevada 2011-2050

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Executive Summary

Each year, the Regional Transportation Commission (RTC), the Southern Nevada Water Authority (SNWA), the Southern Nevada Regional Planning Coalition (SNRPC), the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas, and a group of community demographers and analysts work together to provide a long-term forecast of economic and demographic variables influencing Clark County's population growth. The primary goal is to develop a long-term forecast of the Clark County population that is consistent with the structural economic characteristics of the county. Toward this end, we employ a general-equilibrium demographic and economic model developed by Regional Economic Models, Inc. (REMI), specifically for Clark County.

The model recalibration incorporates the most recent available information regarding the national gross domestic product forecast, local employment growth, local transit investment, and an amenity factor representing negative externalities from local growth. The resulting long-term forecast predicts positive population growth throughout the range of the forecast without attempting to capture short-term economic uncertainty. By 2035, we predict that Clark County's population will reach approximately 3 million. By 2050, we predict that it will reach nearly 3.6 million.

Table 1 summarizes the population forecast. The population in Clark County is predicted to grow at a rate of 2.3 percent in 2011. Though seemingly optimistic, our growth-rate forecast is consistent with the beginning recovery of the Clark County economy in 2011, as predicted by the CBER at its 2011 Southern Nevada Economic Outlook Conference. Despite short-term economic uncertainties and model difficulties, we note that this forecast is intended for medium- to long-term planning purposes. In the

medium term, the population growth rate vacillates around 2.5 percent as the Southern Nevada economy continues to recover. In the long term, population growth begins to taper off as the maturing economy attracts fewer economic migrants. By 2020, population growth has declined to 1.7 percent. By 2050, the growth reaches 1.2 percent, just above the estimated long-term national population growth rate of 1 percent. This represents a long-term convergence to the national average annual population growth rate, which is projected to stabilize at around 1 percent after 2020.

As is typical of any forecast, there are potential risks which could lead to either over- or underestimated population growth in the short run. The principal risk to our forecast is the recovery of the Southern Nevada economy in the short term. The assumption underlying this forecast is that the local economy will begin to show signs of recovery in 2011. To the extent that the short-term economic outlook differs, the short-run forecasts will differ. We believe, however, that these risks tend to arise from short-run uncertainty; whereas, our forecasts are primarily meant to be long-run planning tools.

Table 1: Clark County Final Population Forecast 2000 - 2050			
Year	**Population Forecast**	**Change in Population Forecast**	**Growth in Population (Percent)**
2000	1,428,689*	107,513	8.1%
2001	1,498,278*	69,589	4.9%
2002	1,578,332*	80,054	5.3%
2003	1,641,529*	63,197	4.0%
2004	1,747,025*	105,496	6.4%
2005	1,815,700*	68,675	3.9%
2006	1,912,654*	96,954	5.3%
2007	1,996,542*	83,888	4.4%
2008	1,986,145*	-10,397	-0.5%
2009	2,006,347*	20,202	1.0%
2010	1,951,269**	-55,078	-2.7%
2011	1,997,000	45,731	2.3%
2012	2,047,000	50,000	2.4%
2013	2,097,000	50,000	2.4%
2014	2,147,000	50,000	2.3%
2015	2,195,000	48,000	2.2%
2016	2,242,000	47,000	2.1%
2017	2,286,000	44,000	1.9%
2018	2,329,000	43,000	1.8%
2019	2,369,000	40,000	1.7%
2020	2,409,000	40,000	1.7%
2021	2,449,000	40,000	1.6%
2022	2,487,000	38,000	1.5%
2023	2,525,000	38,000	1.5%
2024	2,563,000	38,000	1.5%
2025	2,600,000	37,000	1.4%
2026	2,638,000	38,000	1.4%
2027	2,675,000	37,000	1.4%
2028	2,712,000	37,000	1.4%
2029	2,749,000	37,000	1.3%
2030	2,786,000	37,000	1.3%
2031	2,822,000	36,000	1.3%
2032	2,858,000	36,000	1.3%
2033	2,894,000	36,000	1.2%
2034	2,930,000	36,000	1.2%
2035	2,967,000	37,000	1.2%
2040	3,153,000	38,000	1.2%
2045	3,352,000	41,000	1.2%
2050	3,559,000	41,000	1.2%

*2000-2009 are historical estimates from Clark County Comprehensive Planning.
** 2010 U.S. Census.

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I. Introduction

Each year, the Regional Transportation Commission (RTC), the Southern Nevada Water Authority (SNWA), the Southern Nevada Regional Planning Coalition (SNRPC), the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas, and a group of community demographers and analysts work together to provide a long-term forecast of economic and demographic variables influencing Clark County. The primary goal is to develop a long-term forecast of the Clark County population that is consistent with the structural economic characteristics of the county. Toward this end, we employ a general-equilibrium demographic and economic model developed by Regional Economic Models, Inc. (REMI), specifically for Clark County.

The REMI model is a state-of-the-art econometric forecasting model that accounts for dynamic feedbacks between economic and demographic variables. Special features allow the user to update the model to include the most current economic information. CBER calibrates the model using information on recent local employment levels, the most recent national Gross Domestic Product (GDP) forecast, spending on local capital projects, and adjustments for amenities related to local population growth.

The model employed divides Nevada into five regions: Clark County; Nye County; Lincoln County; Washoe County; and the remaining counties, which are combined to form a fifth region. These regions are modeled using the U.S. economy as a backdrop. The model contains over 100 economic and demographic relationships that are carefully constructed to concisely represent the Clark County economy. The model includes equations to account for migration and trade between Nevada counties and other states and counties in the country.

The demographic and economic data used to construct the model begin in 1990, the most important of which include the aggregate totals of employment, labor force, and population. The economic data for the most recent version of the model (REMI PI+ v1.2) are consistent with the North American Industry Classification System (NAICS). The most recent data for REMI PI+ v1.2 are from 2008 because the Bureau of Labor Statistics (BLS) personal-income data are reported with a two-year lag. Over the years, the availability of the income data has been the key in setting the last year of history in the model.

The REMI model is the best model available for describing how economies interact geographically.[1] These interactions may take place within a single economy (such as the interaction between house-price growth and employment growth in Clark County) or between two economies (such as the interaction between Southern Nevada and Southern California). These and over 100 other interactions contained within the model are too complex to consider modeling on our own. Rather, we turn to the REMI model because it has a solid foundation in economic theory and the principles of general-equilibrium-based growth distribution, yet it still offers the flexibility required to model a regional economy like Clark County.

To guarantee that the most current data are used in the forecast, we make a series of adjustments to the model. In this way, we ensure that the forecast model includes the best available information at the time the forecast is made. First, the model's national GDP forecast is updated using the latest available national forecast from the University of Michigan's Research Seminar in Quantitative Economics (RSQE). The second adjustment updates the model with the employment figures from the Nevada Department

[1] See Schwer, R. K. and D. Rickman (1995), "A comparison of the multipliers of IMPLAN, REMI and RIMS II: Benchmarking ready-made models for comparison," *The Annals of Regional Science*.

of Employment, Training, and Rehabilitation (DETR). Next, we include planned new investment in public infrastructure using information from RTC. The fourth adjustment accounts for the potential secondary effects of population growth on the quality of life in Clark County. Lastly, we rebase the population forecast to the most recent population count for Clark County available from the U.S. Census.

In the following section, we first examine the changes in the REMI model from last year's model. Following that, in Section III, we present sequentially the changes we make to update the model and tailor it to local information. In Section IV, we present the population forecast and give a brief discussion of the economic environment surrounding the forecast. In Section V, we compare the population growth forecast with previous years' forecasts. We conclude with a discussion of the risks to the forecast.

II. Comparison of REMI Models: Current and Previous Year

Over the years, we have compared the most recent out-of-the-box REMI models, that is, the current forecast before any model recalibration are made, with corresponding out-of-the-box forecasts from the previous models. This gives us the opportunity to examine how the new model differs from the previous versions and to explore the basis of these differences.

The most recent data used to develop this year's model are from 2008. Thus, we refer to the current model as last historical year 2008 (LHY2008) and the previous model as last historical year 2007 (LHY2007).

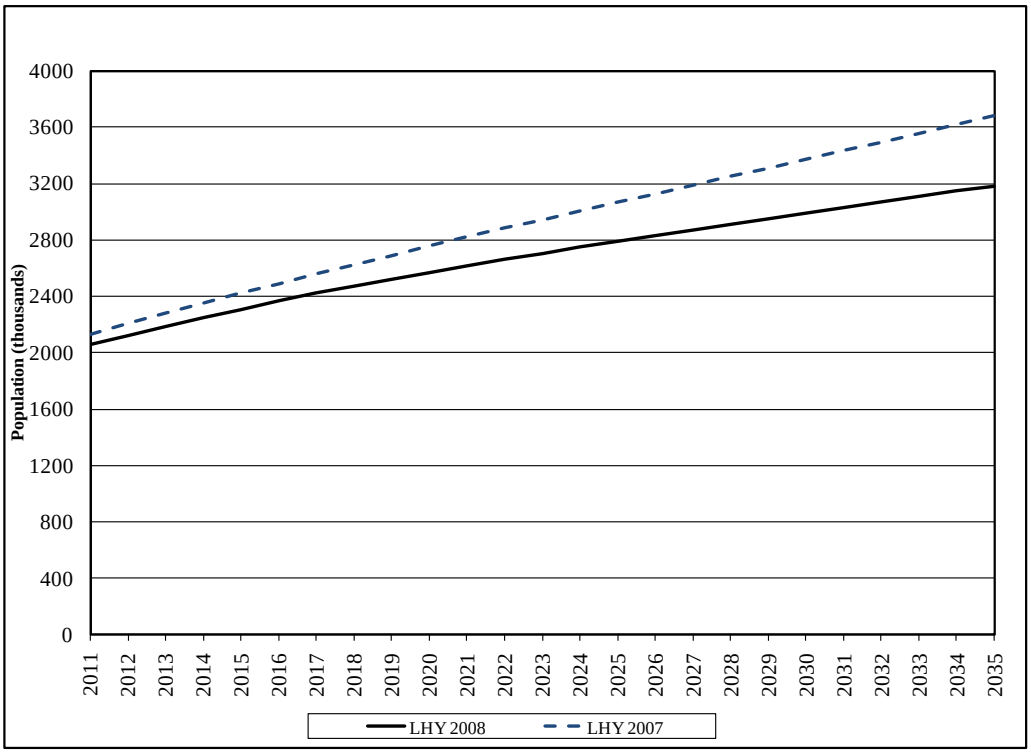
Each year the REMI staff and users discuss the workings of the model and propose changes for improvement. Based on research findings, each year's model incorporates improvements in addition to the inclusion of more recent data. The new model, identified as PI+ version 1.2, offers one major improvement. The model includes

a new long-run national economic forecast for the period 2019 through 2050. The REMI model's national forecast through 2018 combines the June 2010 RSQE forecast through 2012 and the November 2009 BLS long-run forecast, which runs through 2018. The new long-run national forecast for the years 2019 and beyond calculates a new labor productivity trend for each industry. In addition, the new REMI model contains some minor updates which include new estimates of trade flow parameters and a new data suppression procedure. These model updates and the new data history for 2008 lead to the differences in the out-of-the-box population forecast between the LHY2008 model and the LHY2007 model.

Figures 1 and 2 compare the LHY2007 and LHY2008 population forecasts from the out-of-the-box models, i.e., without any updating for migration, employment, infrastructure projects, the amenity factor, or the national GDP forecast.[2] The out-of-the-box population forecast arising from the LHY2008 model predicts lower population levels and growth rates for 2011 through 2035. With regards to population levels, the difference between the two forecasts is relatively small in 2010 but gets larger in the later years of the forecast. By 2035, the out-of-the-box forecasted population in the LHY2008 model is 500,000 people lower than the LHY2007 model.

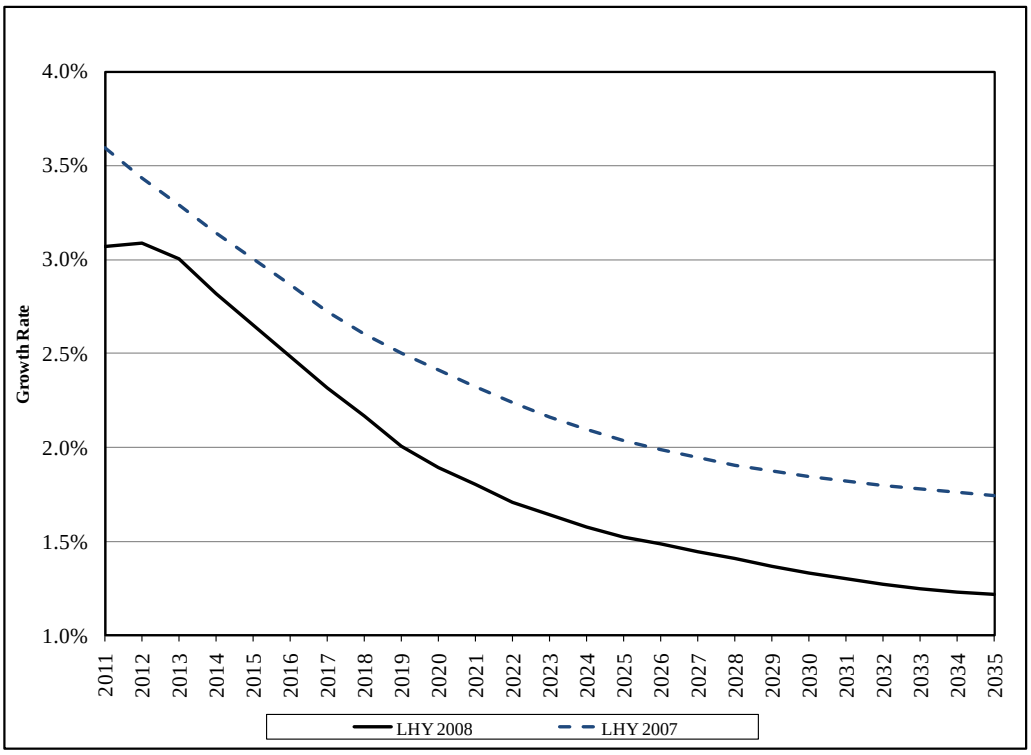
[2] The detailed out-of-the-box results through 2050 appear in Table A1 of the Appendix.

Figure 1: Clark County Population Forecasts: REMI Out-of-the-Box LHY2007 and LHY2006: 2011-2035



Note: Out-of-the-box refers to the model prior to recalibration. These numbers are not the final forecast.

Figure 2: Clark County Population-Growth-Rate Forecasts: REMI Out-of-the-Box LHY2007 and LHY2006: 2011-2035



Note: Out-of-the-box refers to the model prior to recalibration. These numbers are not the final forecast.

The significant difference in the out-of-the-box forecasted population from the LHY2008 and LHY2007 models is due to a larger number of predicted economic migrants in the LHY2007 model. The larger number of economic migrants is due to an increased real relative wage rate in 2007, which was caused by housing prices falling significantly in Clark County, in 2007, relative to the nation. The addition of the 2008 economic history in the LHY2008 model addressed this issue. Hence, patterns which emerge from the LHY2008 out-of-the-box population forecast are more consistent with all the models prior to LHY2007. Those patterns also become evident in Section V when we compare the population growth forecast with previous years' forecasts.

III. Recalibrating the Model

County-level personal income is only available with a two-year lag. As a result, the REMI model also has a two-year lag with the most recent historical data from 2008 for the current model, PI+ version 1.2, released in 2010. To bring the model up to date, we update available pertinent model information, including the most recent national GDP forecast, more recent employment figures, spending on capital projects, and adjustments for disamenities related to population growth to reflect local information in the forecast. We describe each update in turn.

In previous years, we made an adjustment to future hotel employment based on local expectations of hotel rooms that will be added in the near future. This ensures that the model includes a good short-term forecast of new hotel investment and employment. This year, the Las Vegas Convention and Visitors Authority (LVCVA) projects that 1,455 new hotel/motel rooms will be added to the local room stock by the end of 2011. However, the closing of the 1,720-room Sahara hotel, in May 2011, will offset the hotel room additions predicted by LVCVA in 2011. As a result, we did not make an adjustment

for new hotel construction. This, however, does not imply that the forecast does not allow for the possibility of employment growth in the accommodation sector. In fact, we may see additional hiring in sales and management positions as visitor numbers pick up. The current forecast relies on the REMI model's growth forecast for the accommodation sector in the near term. The REMI model's baseline employment growth forecast for the accommodation industry is roughly 1 percent in the year 2011, 2012 and 2013, respectively.

Last year we made an adjustment to the number of domestic and international migrants to correct for the unrealistic migration patterns in the model LHY2007. In 2007, housing prices in Clark County declined faster relative to the rest of the nation. Hence, adjusted for housing prices, the relative wage rate in Clark County was higher than in the rest of the nation. This led the REMI model to allocate a large number of economic migrants to Clark County in the 2008 and 2009 baseline forecasts. The issue has been addressed in the new model LHY2008. As a result, this forecast does not incorporate an adjustment to the number of economic migrants in Clark County.

A. Adjustment of the national GDP forecast

The REMI model relies on a baseline national GDP forecast from the University of Michigan's Research Seminar in Quantitative Economics (RSQE). The current REMI model, PI+ version 1.2, utilizes the June 2010 GDP forecast from RSQE. We adjust the model's national GDP forecast using the March 2011 national GDP forecast from RSQE. Overall, we adjust the national GDP components upward by about $200 billion in 2010 and $300 billion in 2011. The adjusted national forecast is used to generate a new baseline forecast for Clark County. The baseline forecast is then used for the subsequent adjustments.

B. Employment adjustment

One of the most noteworthy updates we make to the REMI model is the employment adjustment. The industry-level employment data used by REMI are the sum of the BLS wage and salary estimates for Clark County and REMI's BLS-based estimate of the number of proprietors. The most recent historical year in the model data is 2008. However, more recent wage and salary employment data are available from the Nevada DETR for 2009 and 2010. Thus, we update the model to account for the more recent information.

The latest growth rates for the out-of-the-box REMI-model forecasts and recent DETR estimates are shown in Table 2 for 2009 and 2010. The actual growth rates from DETR differ substantially from the REMI out-of-the-box forecasts, suggesting a clear need for adjustments. The employment update is as follows: We calculate the annual percentage change using DETR data and apply the percentage changes to generate new estimates for 2009 and 2010. The underlying assumption of this procedure is that the proportion of self-employed in each industry classification grows at the same rate as does the ratio between full- and part-time workers.

Table 2: Employment Growth Rates for Clark County Before Adjustment				
	REMI Baseline Forecast		DETR Estimates	
Industrial Classification	**2009**	**2010**	**2009**	**2010**
Construction	-14.68%	-5.24%	-29.98%	-23.95%
Wholesale trade	-8.10%	-0.87%	-9.92%	0.84%
Retail trade	-6.23%	0.02%	-8.07%	-2.09%
Transit, ground pass transportation	-1.32%	-0.24%	-4.50%	-1.78%
Monetary authorities, et al.	-4.05%	-1.46%	-8.96%	-8.45%
Ins carriers, related activities	-1.46%	-0.92%	-7.20%	-5.14%
Real estate	-1.10%	0.47%	-12.36%	-4.46%
Prof, technical services	-3.94%	1.26%	-9.77%	-6.31%
Management of companies	-5.16%	0.42%	-2.76%	6.97%
Administrative, support services	-2.88%	-0.48%	-12.97%	4.07%
Ambulatory health care services	-2.30%	-1.44%	1.31%	1.80%
Hospitals	-0.48%	-0.46%	0.80%	1.86%
Amusement, gambling, and rec	-1.47%	-0.59%	-10.63%	-7.59%
Accommodation	-2.10%	-1.00%	-7.78%	-2.53%
Food services, drinking places	-0.51%	1.21%	-6.03%	0.12%
Total	**-3.94%**	**-0.58%**	**-9.11%**	**-3.01%**

Table 3 reports the updated employment data by category for the model. The Clark County job growth numbers in 2009 and 2010 are consistent with the continued economic downturn experienced by the Las Vegas area. In 2010, the local economy shed fewer jobs in all sectors compared to 2009. In addition, some positive job growth took place in 2010 in sectors such as management of companies, and administrative services. Hence, it appears that the economic recession in Southern Nevada reached its bottom in 2009. The region lost fewer jobs in 2010 compared to 2009. The Las Vegas area's struggle in 2009 and 2010 is evidenced by the negative job growth in construction, retail trade, and accommodation, the three largest sectors of the economy. The strong negative growth in the construction sector is indicative of the slowdown in the local housing market, whereas the negative growth in the accommodation sector correlates with the slow recovery from the national economic recession which began in 2008. Overall,

Southern Nevada's economy experienced a loss of about 100,000 jobs in 2009, while in 2010, the local economy lost roughly 30,000 jobs.

Table 3: Model Job Adjustments (in 000s) for 2009 and 2010

	Baseline	DETR Growth Rates		Adjusted Job Levels	
Industrial Classification	**History 2008**	**2009**	**2010**	**2009**	**2010**
Forestry et al.	0.01	-100.00%	0.00%	0.00	0.00
Agriculture	0.32	-3.64%	-0.40%	0.31	0.31
Oil, gas extraction	0.04	-100.00%	0.00%	0.00	0.00
Mining (except oil, gas)	2.12	-14.57%	-1.85%	1.81	1.78
Support activities for mining	0.08	-21.28%	-16.34%	0.06	0.05
Utilities	3.19	-3.47%	-2.24%	3.08	3.01
Construction	106.63	-29.98%	-23.95%	74.66	56.78
Wood product mfg	0.82	-13.72%	-3.30%	0.71	0.69
Nonmetallic mineral prod mfg	3.61	-12.33%	-2.19%	3.16	3.09
Primary metal mfg	0.66	22.12%	12.19%	0.81	0.90
Fabricated metal prod mfg	2.62	-11.89%	-3.38%	2.31	2.23
Machinery mfg	0.64	-15.83%	2.05%	0.54	0.55
Computer, electronic prod mfg	0.56	-20.65%	3.07%	0.44	0.45
Electrical equip, appliance mfg	0.57	-12.79%	-3.16%	0.49	0.48
Motor vehicle mfg	0.30	-21.43%	-1.24%	0.23	0.23
Transp equip mfg exc motor veh	0.10	-5.52%	4.71%	0.09	0.09
Furniture, related prod mfg	1.48	-12.96%	3.37%	1.29	1.33
Miscellaneous mfg	6.24	-10.57%	5.49%	5.58	5.88
Food mfg	3.30	-3.44%	-0.42%	3.18	3.17
Beverage, tobacco prod mfg	0.14	1.01%	0.92%	0.14	0.14
Textile mills	0.23	-1.88%	-6.87%	0.23	0.21
Textile prod mills	0.33	-15.33%	-11.44%	0.28	0.25
Apparel mfg	0.33	-9.14%	0.95%	0.30	0.30
Leather, allied prod mfg	0.06	-10.84%	0.41%	0.06	0.06
Paper mfg	0.40	-5.98%	-2.19%	0.37	0.37
Printing, rel supp act	2.31	-5.74%	-2.64%	2.18	2.12
Petroleum, coal prod mfg	0.05	-8.30%	-5.45%	0.05	0.05
Chemical mfg	0.85	-10.23%	-3.61%	0.76	0.73
Plastics, rubber prod mfg	2.33	-9.75%	-1.85%	2.10	2.06
Wholesale trade	28.55	-9.92%	0.84%	25.72	25.93
Retail trade	118.22	-8.07%	-2.09%	108.68	106.41
Air transportation	6.44	-3.80%	-0.71%	6.19	6.15
Rail transportation	0.05	-7.25%	-1.44%	0.04	0.04
Water transportation	0.08	-7.75%	0.87%	0.07	0.07
Truck transp; Couriers, msngrs	9.43	-7.31%	0.17%	8.74	8.76
Transit, ground pass transp	14.23	-4.50%	-1.78%	13.59	13.35
Pipeline transportation	0.02	-5.22%	-1.82%	0.02	0.02
Scenic, sightseeing transp; supp	5.96	-5.36%	1.42%	5.64	5.72
Warehousing, storage	4.14	-4.50%	1.04%	3.95	3.99

Table 3 Continued:	Baseline	DETR Growth Rates		Adjusted Job Levels	
Industrial Classification	**History 2008**	**2009**	**2010**	**2009**	**2010**
Publishing, exc Internet	2.86	-17.65%	-5.90%	2.36	2.22
Motion picture, sound rec	3.00	-7.82%	0.81%	2.76	2.79
Internet serv, data proc, other	1.85	-3.67%	1.12%	1.78	1.80
Broadcasting, exc Int; Telecomm	6.96	-7.14%	-3.31%	6.46	6.25
Monetary authorities, et al.	29.12	-8.96%	-8.45%	26.51	24.27
Sec, comm contracts, inv	20.90	-7.06%	-3.24%	19.42	18.79
Ins carriers, rel act	12.38	-7.20%	-5.14%	11.49	10.90
Real estate	66.96	-12.36%	-4.46%	58.69	56.07
Rental, leasing services	7.28	-8.52%	-1.73%	6.66	6.54
Prof, tech services	61.07	-9.77%	-6.31%	55.10	51.63
Mgmt of companies, enterprises	15.50	-2.76%	6.97%	15.08	16.13
Administrative, support services	75.01	-12.97%	4.07%	65.28	67.93
Waste mgmt, remed services	2.24	-0.40%	0.61%	2.24	2.25
Educational services	8.38	2.99%	2.73%	8.63	8.86
Ambulatory health care services	34.62	1.31%	1.80%	35.08	35.71
Hospitals	15.10	0.80%	1.86%	15.22	15.51
Nursing, residential care facilities	6.45	1.80%	1.64%	6.56	6.67
Social assistance	14.84	0.12%	0.20%	14.86	14.89
Performing arts, spectator sports	19.21	-1.74%	0.30%	18.88	18.93
Museums et al.	0.29	0.78%	1.28%	0.29	0.29
Amusement, gambling, recreation	14.94	-10.63%	-7.59%	13.35	12.34
Accommodation	175.50	-7.78%	-2.53%	161.84	157.75
Food services, drinking places	81.30	-6.03%	0.12%	76.40	76.49
Repair, maintenance	11.41	-2.99%	-1.00%	11.07	10.96
Personal, laundry services	15.97	-2.10%	-0.94%	15.63	15.49
Membership assoc, organ	8.15	-1.00%	0.49%	8.06	8.10
Private households	13.71	-1.80%	-0.84%	13.47	13.35
State & local gov	85.91	0.59%	0.05%	86.42	86.46
Federal civilian	11.24	1.81%	5.58%	11.44	12.08
Federal military	12.18	4.39%	-0.74%	12.71	12.62
Farm	0.32	-0.83%	-1.18%	0.32	0.31
Total	**1,162.05**	**-9.11%**	**-3.01%**	**1,061.90**	**1,032.12**

C. Transportation and infrastructure improvements

Clark County has continued to invest in transportation infrastructure such as roads, highways, and mass transit. The model assumes that public-infrastructure investment will continue at a pace consistent with the model history. Thus, some local spending on public infrastructure, such as road building and additional services, is built into the model. However, one-time monies tend to come from outside the region (for example, federal

transportation funding). These large, special projects need to be accounted for in the forecast.

Whereas some of the planned expenditures are "new money," the remaining would have been spent for other purposes. Thus, in order to avoid double-counting and retain a balanced budget, the expenditures are entered in the REMI model as translator policy variables. The model then computes the actual new expenditures over and above what is already included and returns them as policy variables.

The estimated federal funding in transportation-infrastructure investment expenditures is about $217 million in 2011, $90 million in 2012, $607 million between 2013 and 2020, and $1.01 billion between 2021 and 2030.[3] These expenditures are annualized and included in the REMI model as new construction projects.

D. Amenity adjustments

For over a decade, the Las Vegas metropolitan area has been one of the fastest-growing communities in the United States. This has helped maintain a vibrant economy, but research has shown that rapid urban expansion is frequently correlated with a diminishing quality of life as congestion, deteriorating air quality, and a shortage of public services take their toll on local populations. These "negative externalities" arising from rapid growth impose costs on local residents, making the county less attractive to those living here and potential in-migrants. As a result, people are more likely to relocate to areas with a higher quality of life, all else being equal.

To account for the rising social costs of negative externalities from growth, we include an amenity factor in the model. We assume that the social costs of growth rise by 0.033 percent each year. The amenity factor is introduced in the model through the wage

[3] Source: Regional Transportation Commission.

equations, effectively causing real wages to fall relative to other regions. Falling wages means less economic migration, and population growth slows as the desirability of Clark County falls.

E. Rebasing the population forecast

We traditionally rebase the population forecast by adding the forecasted annual changes in population to the most recent population count. The most recent information available for use in rebasing this forecast is the 2010 Census' April 1, 2010, count of 1,951,269 people. Hence, we adjust the population forecasts downward by 22,245, and forecast that population will grow from roughly 2 million in 2010 to about 3.56 million in 2050 when rebased.

In previous years, we rebased the population forecast using the population estimate from Clark County Comprehensive Planning (CCCP). The CCCP population estimate for Clark County in 2010 is 2.03 million. Because CCCP benchmarks its population estimation process to the U.S. Census it made sense, for this year, to use the U.S. 2010 Census Clark County population count instead of the CCCP estimate.

IV. Analysis of the Economic and Demographic Forecast

The forecast predicts steady population growth for Southern Nevada over the forecast period extending out to 2050. However, the rate of growth, which has been decidedly greater than the national average over the past fifty years, is beginning to moderate and move toward the national rate of growth. The economic forecast calls for the beginning of the economic recovery in 2011 and steady employment growth through 2015. Tables 4 through 6, respectively, report the population, employment, and Gross Regional Product (GRP) predictions for Clark County from the calibrated model.

A. Population

The current forecast predicts an end of the recent declining population trend and a return of long-term population growth in Southern Nevada. The population in Clark County is predicted to grow at a rate of 2.3 percent in 2011. The population growth rate remains near 2 percent in the medium term as the Clark County economy continues to recover. By 2020, population growth is at 1.7 percent. By 2023, the population growth rate falls to 1.5 percent as the Clark County economy is expected to mature; and it reaches 1.2 percent, just above the estimated long-term national population growth rate of 1 percent, by 2050. This type of long-term growth pattern is expected as our economy matures and is very similar to previous forecasts.

Clark County is forecasted to add roughly 45,000 new residents in 2011. This prediction is consistent with CBER's forecast of a beginning economic recovery for Southern Nevada in 2011. However, the 2011 forecasted population growth rate of 2.3 percent may turn out optimistic as the predictions of economic recovery are for the second half of 2011. The population forecast predicts that the Clark County population will be roughly 3.6 million by 2050.

Table 4: Population History, REMI Forecast, and Rebased Forecast[4]				
Year	**Population REMI Forecast***	**Population Rebased Forecast**	**Change in Population Rebased Forecast**	**Growth in Population Rebased Forecast**
2010	1,974,000	1,951,000**		
2011	2,019,000	1,997,000	45,000	2.3%
2012	2,069,000	2,047,000	50,000	2.5%
2013	2,119,000	2,097,000	50,000	2.5%
2014	2,169,000	2,147,000	49,000	2.4%
2015	2,217,000	2,195,000	48,000	2.3%
2016	2,264,000	2,242,000	47,000	2.1%
2017	2,309,000	2,286,000	45,000	2.0%
2018	2,351,000	2,329,000	42,000	1.9%
2019	2,392,000	2,369,000	41,000	1.7%
2020	2,432,000	2,409,000	40,000	1.7%
2021	2,471,000	2,449,000	39,000	1.6%
2022	2,509,000	2,487,000	39,000	1.6%
2023	2,547,000	2,525,000	38,000	1.5%
2024	2,585,000	2,563,000	38,000	1.5%
2025	2,623,000	2,600,000	37,000	1.5%
2026	2,660,000	2,638,000	37,000	1.4%
2027	2,697,000	2,675,000	37,000	1.4%
2028	2,734,000	2,712,000	37,000	1.4%
2029	2,771,000	2,749,000	37,000	1.4%
2030	2,808,000	2,786,000	37,000	1.3%
2031	2,844,000	2,822,000	36,000	1.3%
2032	2,880,000	2,858,000	36,000	1.3%
2033	2,917,000	2,894,000	36,000	1.3%
2034	2,953,000	2,930,000	36,000	1.2%
2035	2,989,000	2,967,000	36,000	1.2%
2040	3,175,000	3,153,000	38,000	1.2%
2045	3,375,000	3,352,000	41,000	1.2%
2050	3,582,000	3,559,000	41,000	1.2%

*This forecast incorporates all the adjustments except rebasing.
**2010 U.S. Census

[4] A table detailing the rebased population forecast appears in the Appendix – Table A2.

B. Employment

The forecast predicts an end to the economic recession in Southern Nevada in 2011. The Las Vegas economy is forecasted to add an additional 30,000 jobs in 2011, which represents a 2.8 percent growth in employment over 2010. Employment growth is predicted to be stronger in 2012 as the economy is predicted to add 40,000 new jobs. The forecast also predicts a continuation of steady employment growth in the near term. It is predicted that the Las Vegas economy will return to the 2007 peak employment level (1.18 million jobs) by 2015. Employment growth reaches a peak of 3.8 percent in 2012 and then eventually stabilizes at around 1 percent as the Southern Nevada economy reaches maturity. The employment growth rate then declines in the last ten years of the forecast until 2050 when the forecasted employment growth rate is 0.45 percent. See Table 5.[5]

The decline in the employment-population ratio over time can be attributed to three factors. First, employment growth slows as the economy and the gaming industry mature; whereas, the population base continues to grow. Second, the employment-population ratio is expected to fall as the baby boomers begin retiring in the coming two decades. Third, the increase in the Hispanic-only population over the last decade has led to an increase in the number of children in Clark County. The increase in the children population raises the population base and lowers the employment-population ratio.

[5] Unadjusted employment forecasts are shown in the Appendix.

Table 5: Employment History and Forecasts				
Year	**Employment Forecast**	**Change in Employment Forecast**	**Growth in Employment Forecast**	**Employment-Population Ratio Forecast****
2008	1,161,300*			0.58*
2009	1,065,000	-96,000	-8.3%	0.55
2010	1,036,000	-30,000	-2.8%	0.52
2011	1,065,000	30,000	2.8%	0.53
2012	1,105,000	40,000	3.8%	0.53
2013	1,134,000	28,000	2.5%	0.53
2014	1,156,000	22,000	2.0%	0.53
2015	1,176,000	20,000	1.7%	0.53
2016	1,191,000	15,000	1.3%	0.53
2017	1,203,000	12,000	1.0%	0.52
2018	1,215,000	12,000	1.0%	0.52
2019	1,228,000	13,000	1.0%	0.51
2020	1,241,000	13,000	1.1%	0.51
2021	1,254,000	13,000	1.1%	0.51
2022	1,267,000	12,000	1.0%	0.50
2023	1,279,000	13,000	1.0%	0.50
2024	1,292,000	13,000	1.0%	0.50
2025	1,304,000	12,000	1.0%	0.50
2026	1,317,000	12,000	1.0%	0.50
2027	1,330,000	13,000	1.0%	0.49
2028	1,343,000	14,000	1.0%	0.49
2029	1,357,000	13,000	1.0%	0.49
2030	1,371,000	14,000	1.1%	0.49
2031	1,386,000	15,000	1.1%	0.49
2032	1,401,000	15,000	1.1%	0.49
2033	1,417,000	15,000	1.1%	0.49
2034	1,432,000	15,000	1.1%	0.48
2035	1,447,000	15,000	1.0%	0.48
2040	1,522,000	14,000	0.9%	0.48
2045	1,587,000	12,000	0.7%	0.47
2050	1,628,000	6,000	0.4%	0.45

*Actual employment.
**The unrebased population forecast was used for consistency.

C. Gross regional product

Gross regional product (GRP) is defined as the dollar value of all final goods and services for sale in a regional economy. As such, it reflects the output of a local economy and avoids double-counting initial and intermediate goods. The forecast for growth in the Clark County GRP, shown in Table 6, basically mirrors the growth pattern of local employment, but also reflects continued growth in productivity throughout the majority of the forecast. The GRP growth forecast starts at 4.1 percent in 2011, and climbs up to 5.0 percent in 2012. The GRP forecast then cycles through a low of 2.1 percent and finally stabilizes at around 2.4 percent.

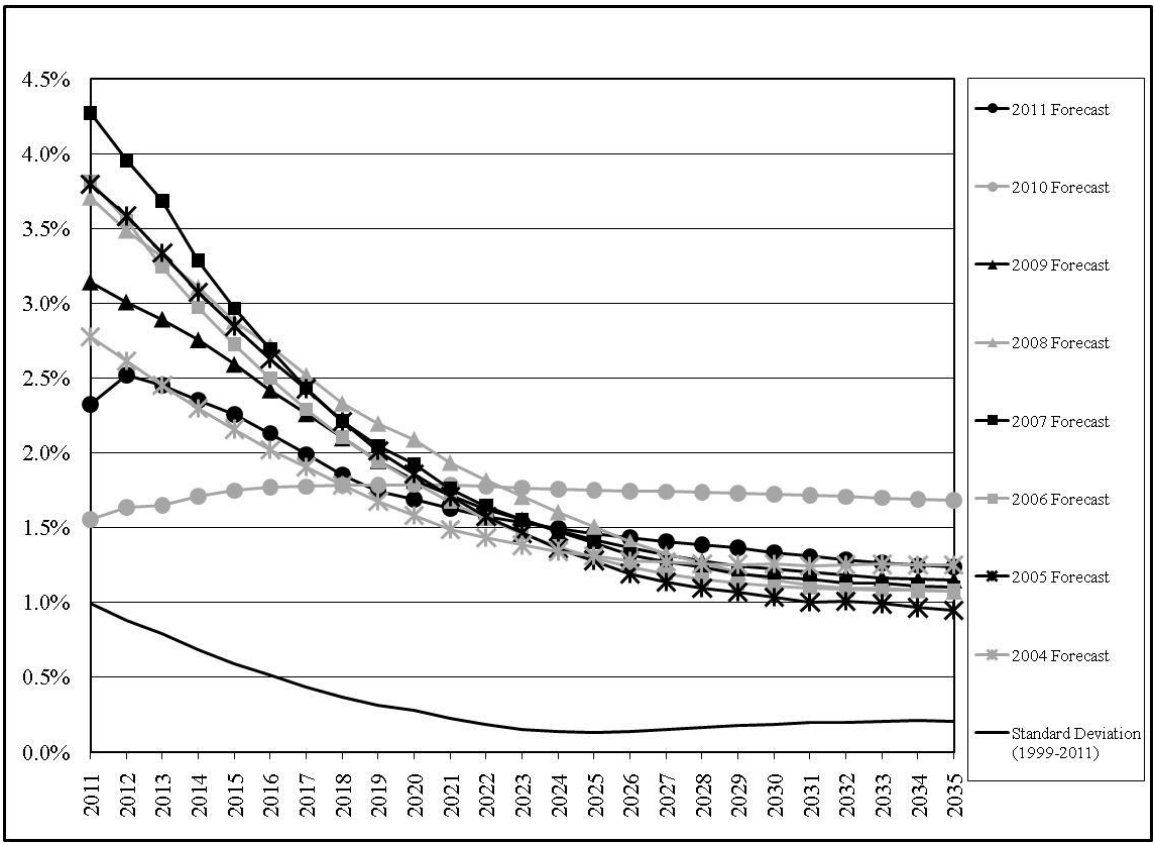
Table 6: Gross Regional Product History and Forecasts				
Year	**GRP (Billions of Chained 2005$) REMI Forecast**	**Change in GRP (Billions of Chained 2005$) REMI Forecast**	**Growth in GRP (Billions of Chained 2005$) REMI Forecast**	**GRP per Capita (Chained 2005$) REMI Forecast**
2008	88.040*			44,327*
2009	81.478	-6.56	-7.5%	40,610
2010	81.012	-0.47	-0.6%	41,518
2011	84.364	3.35	4.1%	42,253
2012	88.574	4.21	5.0%	43,272
2013	92.087	3.51	4.0%	43,910
2014	95.547	3.46	3.8%	44,513
2015	99.107	3.56	3.7%	45,153
2016	102.768	3.66	3.7%	45,844
2017	106.473	3.71	3.6%	46,570
2018	110.337	3.86	3.6%	47,382
2019	113.311	2.97	2.7%	47,824
2020	115.729	2.42	2.1%	48,033
2021	118.236	2.51	2.2%	48,287
2022	120.732	2.50	2.1%	48,543
2023	123.313	2.58	2.1%	48,833
2024	125.940	2.63	2.1%	49,138
2025	128.605	2.67	2.1%	49,455
2026	131.354	2.75	2.1%	49,799
2027	134.252	2.90	2.2%	50,191
2028	137.269	3.02	2.2%	50,617
2029	140.324	3.05	2.2%	51,046
2030	143.553	3.23	2.3%	51,533
2031	146.932	3.38	2.4%	52,065
2032	150.442	3.51	2.4%	52,635
2033	154.093	3.65	2.4%	53,240
2034	157.835	3.74	2.4%	53,861
2035	161.649	3.81	2.4%	54,489
2040	182.651	4.33	2.4%	57,927
2045	205.866	4.83	2.4%	61,408
2050	230.320	4.96	2.2%	64,706
*Actual GRP.				

V. Comparing Current Forecast with Previous Years of the Forecast

This section compares this year's final population growth forecasts with the final population growth forecasts from previous years. This exercise allows us to assess the consistency of the forecast methodology and to assess the variability in the population growth forecasts over the last ten years. Figure 3 shows the population-growth-rate forecasts obtained from 2004 to 2011. Figure 3 also shows the standard deviation of the population-growth-rate forecast in the last 13 years (1999-2011).[6] The population-growth-rate forecasts exhibit a high level of variability in the near term. The standard deviation of the population-growth-rate forecast for the year 2011 is roughly 1 percent. This reflects a high degree of uncertainty in the short-term forecast (see Section VI). The variability among the population-growth-rate forecasts falls dramatically in the long term. By 2025, the forecasted growth rates converge to about 1.5 percent, with a standard deviation of 0.25 percent. Hence, there is a large degree of consistency in the long-term growth predictions obtained during the last 13 years, as evidenced by the low standard deviation among the forecasts. This observation further confirms the fact that our forecasts are primarily meant to be long-run planning tools.

[6] The standard deviation is a measure of the variability among data points. For data that follow a normal distribution, 99.7 percent of data points will fall within approximately 3 standard deviations of the mean.

Figure 3: Clark County Historic Population-Growth-Rate Forecasts: 2011-2035



VI. Risks to the Forecast

Our Southern Nevada population forecasts rest on economic and demographic models set in the context of a structured framework. This structure keeps our long-term forecasts consistent with our objectives. We have separated the long-term trend from the noise that one finds in time-series data. These noise factors include the business cycle and seasonal and irregular events.

The main risks to the short-term population forecast arise from short-term fluctuations in both U.S. and Southern Nevada economic conditions. The major assumption of the short-term forecast is that the Southern Nevada economy will begin to recover in the second half of 2011. This also assumes that the recovery of the U.S.

economy, which began in 2010, continues on pace. However, it is still unclear how the recent crisis which hit Japan, the third largest economy in the world, will affect the economic recovery in the United States. In addition, growing uncertainty in the U.S. financial sector could pose a serious threat to national economic growth in the short term. To the extent that any of these factors cause a slowdown of the national economy in the second half of 2011, the economic recovery of Southern Nevada will be delayed.

The reliability of the long-term forecast hinges on the new growth path that will emerge from the current economic recession. As we discussed in previous forecasts, we see a recovery from the current recession following a similar pattern as the national economy, an L-shaped recovery except with a longer phase in the base of the L. In other words, we see a slower recovery. This shape largely shows the greater difficulty of the Las Vegas housing market to recover. At mid-year 2011, we still see a large oversupply of housing units with more foreclosures in sight. Overcoming these difficulties will take more time in Nevada than elsewhere in the United States, except for the housing bubble states of Arizona, California, and Florida. The current recession is also likely to result in a structural change in consumer spending habits. As a result, the spending for each visitor may remain at a lower level than during the boom period, and it may be some time before consumers return to earlier spending levels.

The long-term path, as shown in the trend estimates, arises from the regional economy's maturity. This maturation, under way for some time, has spread casino gambling throughout the United States, even though visitor growth has continued in Las Vegas. Many argued that more gamblers in outlying venues created a larger base for Las Vegas to attract. Others foresaw cannibalization and direct competition that would cut into Las Vegas' economic well-being. The Las Vegas market has enjoyed continued

success, but the region no longer has a monopoly with few impediments to success. Competitive markets for casino visitors will constrain growth, to be sure, but it need not prove a fatal flaw so long as the Las Vegas market remains quick to change and answer challenges and opens up to new ideas that will grow the market. Last, the availability of capital, long a factor in the growth of Las Vegas, became abundant during the past few years, contributing to investments that might not otherwise have happened.

The current recession affects population growth. A severe recession drives up unemployment rates and places people at economic risk. During such periods, one might expect slower rates of migration as people tend to be less sure of their economic environment in locations with which they are not as familiar. For economies such as Clark County, where there is a fairly higher percentage of the work force in construction than the national economy, the stoppage of construction of big projects is likely to result in out-migration because workers in this industry are accustomed to moving to find work. Again, these recent events are natural swings of a couple years' duration and fluctuations of this nature should be fully expected over the forecast range, but these types of events are not captured in a long-term forecast of this nature.

Therefore, although we feel the population forecasts are sound, there are significant risks to the forecasts which could lead to either over- or underestimated growth. We say again, however, that these risks tend to arise from short-run uncertainty; whereas, our forecasts are primarily meant to be long-run planning tools.

VII. Conclusion

The latest REMI model projects long-term population growth patterns that are consistent with previous population forecasts. Overall, the population growth forecast is less than last year's forecast. This is a reflection of the new data incorporated into the model that takes into account the current economic recession. We note that, despite short-term economic uncertainties and model difficulties, the long-term population forecast, which is the main focus of this forecasting exercise, remains consistent with past forecasts. By 2035, we predict that Clark County's population will be about 3 million. In 2050, Clark County is expected to have nearly 3.6 million residents. The model continues to predict changes in the economy as the county grows and matures. Thus, the breakneck percentage annual growth rates seen in the past two decades are expected to moderate over the long term.

Appendix:

Detailed Report Tables

Table A1: Out-of-the-Box Clark County Population and Population Growth Forecasts from REMI Models LHY 2008 and LHY 2007

Year	LHY2008 Population (Thousands)	LHY2007 Population (Thousands)	LHY2008 Population Growth	LHY2007 Population Growth
2009	1,941	1,985		
2010	1,999	2,059	3.0%	3.7%
2011	2,060	2,133	3.1%	3.6%
2012	2,124	2,206	3.1%	3.4%
2013	2,187	2,279	3.0%	3.3%
2014	2,249	2,351	2.8%	3.1%
2015	2,308	2,421	2.6%	3.0%
2016	2,365	2,491	2.5%	2.9%
2017	2,420	2,558	2.3%	2.7%
2018	2,472	2,625	2.2%	2.6%
2019	2,522	2,691	2.0%	2.5%
2020	2,569	2,756	1.9%	2.4%
2021	2,615	2,820	1.8%	2.3%
2022	2,660	2,883	1.7%	2.2%
2023	2,703	2,945	1.6%	2.2%
2024	2,746	3,007	1.6%	2.1%
2025	2,788	3,068	1.5%	2.0%
2026	2,829	3,129	1.5%	2.0%
2027	2,870	3,190	1.4%	1.9%
2028	2,911	3,251	1.4%	1.9%
2029	2,950	3,312	1.4%	1.9%
2030	2,990	3,373	1.3%	1.8%
2031	3,029	3,434	1.3%	1.8%
2032	3,067	3,496	1.3%	1.8%
2033	3,106	3,558	1.2%	1.8%
2034	3,144	3,621	1.2%	1.8%
2035	3,182	3,684	1.2%	1.7%
2040	3,378	4,010	1.2%	1.7%
2045	3,585	4,348	1.2%	1.6%
2050	3,801	4,677	1.1%	1.4%

Note: Out-of-the-box refers to the model prior to recalibration. These numbers are not the final forecast.

Table A2: Detailed Final Population Forecast: 2000 – 2050			
Year	**Population Forecast**	**Change in Population Forecast**	**Growth in Population (Percent)**
2000	1,428,689*	107,513	8.1%
2001	1,498,278*	69,589	4.9%
2002	1,578,332*	80,054	5.3%
2003	1,641,529*	63,197	4.0%
2004	1,747,025*	105,496	6.4%
2005	1,815,700*	68,675	3.9%
2006	1,912,654*	96,954	5.3%
2007	1,996,542*	83,888	4.4%
2008	1,986,145*	-10,397	-0.5%
2009	2,006,347*	20,202	1.0%
2010	1,951,269**	-55,078	-2.7%
2011	1,997,000	45,731	2.3%
2012	2,047,000	50,000	2.4%
2013	2,097,000	50,000	2.4%
2014	2,147,000	50,000	2.3%
2015	2,195,000	48,000	2.2%
2016	2,242,000	47,000	2.1%
2017	2,286,000	44,000	1.9%
2018	2,329,000	43,000	1.8%
2019	2,369,000	40,000	1.7%
2020	2,409,000	40,000	1.7%
2021	2,449,000	40,000	1.6%
2022	2,487,000	38,000	1.5%
2023	2,525,000	38,000	1.5%
2024	2,563,000	38,000	1.5%
2025	2,600,000	37,000	1.4%
2026	2,638,000	38,000	1.4%
2027	2,675,000	37,000	1.4%
2028	2,712,000	37,000	1.4%
2029	2,749,000	37,000	1.3%
2030	2,786,000	37,000	1.3%
2031	2,822,000	36,000	1.3%
2032	2,858,000	36,000	1.3%
2033	2,894,000	36,000	1.2%
2034	2,930,000	36,000	1.2%
2035	2,967,000	37,000	1.2%
2036	3,003,000	36,000	1.2%
2037	3,040,000	37,000	1.2%
2038	3,077,000	37,000	1.2%
2039	3,115,000	38,000	1.2%
2040	3,153,000	38,000	1.2%
2041	3,192,000	39,000	1.2%
2042	3,231,000	39,000	1.2%
2043	3,271,000	40,000	1.2%
2044	3,311,000	40,000	1.2%
2045	3,352,000	41,000	1.2%
2046	3,394,000	42,000	1.3%
2047	3,435,000	41,000	1.2%
2048	3,477,000	42,000	1.2%
2049	3,518,000	41,000	1.2%
2050	3,559,000	41,000	1.2%

*2000-2009 are historical estimates from Clark County Comprehensive Planning.
** 2010 U.S. Census.
Note: The average annual forecasted growth rate is 1.7 percent.

Table A3: Economic Forecast After Employment, Hotel, Amenity, and Transit Adjustments									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total Employment	1065.149	1105.490	1133.587	1155.782	1175.807	1191.238	1203.333	1215.402	1228.061
Total Employment as % of Nation	0.614	0.626	0.630	0.633	0.636	0.637	0.636	0.635	0.636
Private Non-Farm Employment	951.155	990.783	1018.408	1040.153	1059.776	1074.927	1086.817	1098.687	1110.992
Private Non-Farm Employment as % of Nation	0.652	0.664	0.669	0.672	0.676	0.678	0.678	0.677	0.678
Gross Domestic Product	84.364	88.574	92.087	95.547	99.107	102.768	106.473	110.337	113.311
Personal Income	77.728	83.616	89.257	95.579	102.293	109.465	116.950	124.896	132.251
Personal Income as % of Nation	0.617	0.631	0.639	0.646	0.652	0.656	0.659	0.661	0.663
Disposable Personal Income	71.096	76.167	80.500	86.021	91.855	98.054	104.487	111.275	117.850
PCE-Price Index	108.547	110.346	113.085	115.974	118.939	122.081	125.313	128.642	132.110
Real Disposable Personal Income	65.498	69.026	71.185	74.172	77.228	80.319	83.381	86.500	89.206
Real Disposable Personal Income as % of Nation	0.644	0.660	0.669	0.676	0.683	0.687	0.691	0.693	0.696
Population (unrebased forecast)	2018.886	2069.176	2119.413	2168.760	2217.159	2263.938	2308.544	2350.919	2391.576
Population as % of Nation	0.646	0.656	0.665	0.675	0.683	0.691	0.698	0.704	0.709

Table A3: Economic Forecast After Employment, Hotel, Amenity, and Transit Adjustments continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Total Employment	1241.068	1254.201	1266.649	1279.369	1291.954	1304.265	1316.711	1329.753	1343.314
Total Employment as % of Nation	0.638	0.640	0.643	0.645	0.648	0.650	0.652	0.654	0.657
Private Non-Farm Employment	1123.598	1136.531	1148.693	1161.166	1173.461	1185.423	1197.571	1210.222	1223.348
Private Non-Farm Employment as % of Nation	0.681	0.684	0.687	0.689	0.692	0.695	0.698	0.700	0.703
Gross Domestic Product	115.729	118.236	120.732	123.313	125.940	128.605	131.354	134.252	137.269
Personal Income	139.217	146.564	154.342	162.561	171.153	180.199	189.844	200.129	211.051
Personal Income as % of Nation	0.666	0.669	0.672	0.675	0.678	0.681	0.685	0.688	0.691
Disposable Personal Income	124.075	130.637	137.581	144.920	152.591	160.665	169.277	178.464	188.221
PCE-Price Index	135.638	139.253	143.122	147.073	151.107	155.315	159.696	164.249	168.886
Real Disposable Personal Income	91.475	93.812	96.129	98.536	100.982	103.445	106.000	108.655	111.448
Real Disposable Personal Income as % of Nation	0.699	0.703	0.706	0.709	0.713	0.716	0.719	0.723	0.726
Population (unrebased forecast)	2431.599	2470.865	2509.370	2547.473	2585.221	2622.665	2659.946	2697.063	2734.162
Population as % of Nation	0.714	0.719	0.723	0.727	0.731	0.735	0.739	0.743	0.746

Table A3: Economic Forecast After Employment, Hotel, Amenity, and Transit Adjustments continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Total Employment	1356.765	1371.016	1446.803	1522.110	1586.796	1628.287
Total Employment as % of Nation	0.658	0.660	0.667	0.676	0.685	0.688
Private Non-Farm Employment	1236.322	1250.032	1322.641	1394.334	1455.605	1494.968
Private Non-Farm Employment as % of Nation	0.705	0.706	0.715	0.724	0.734	0.737
Gross Domestic Product	140.324	143.553	161.649	182.651	205.866	230.320
Personal Income	222.731	235.356	313.010	420.184	566.274	756.049
Personal Income as % of Nation	0.694	0.698	0.716	0.736	0.759	0.773
Disposable Personal Income	198.657	209.942	279.377	375.271	506.061	675.915
PCE-Price Index	173.698	178.688	206.559	239.467	278.418	324.416
Real Disposable Personal Income	114.369	117.491	135.253	156.711	181.763	208.348
Real Disposable Personal Income as % of Nation	0.730	0.733	0.752	0.773	0.796	0.810
Population (unrebased forecast)	2771.198	2807.873	2988.897	3175.349	3374.687	3581.708
Population as % of Nation	0.749	0.753	0.767	0.780	0.795	0.809

Table A4: Employment									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total Employment	1065.149	1105.490	1133.587	1155.782	1175.807	1191.238	1203.333	1215.402	1228.061
Total Employment as % of Nation	0.614	0.626	0.630	0.633	0.636	0.637	0.636	0.635	0.636
Private Non-Farm	951.155	990.783	1018.408	1040.153	1059.776	1074.927	1086.817	1098.687	1110.992
Forestry, Fishing, Other	0.310	0.316	0.322	0.326	0.329	0.331	0.331	0.332	0.341
Mining	1.863	1.921	1.925	1.917	1.903	1.884	1.859	1.835	1.844
Utilities	3.032	3.073	3.090	3.085	3.072	3.046	3.009	2.966	2.927
Construction	63.607	72.818	76.284	79.267	81.977	84.277	86.241	88.121	89.639
Manufacturing	25.861	26.868	27.345	27.643	27.848	27.918	27.946	27.975	27.806
Wholesale Trade	26.581	27.721	28.163	28.433	28.655	28.757	28.778	28.805	28.938
Retail Trade	109.292	113.653	116.200	117.923	119.477	120.530	121.208	121.946	122.745
Transportation and Warehousing	38.899	40.092	40.822	41.380	41.837	42.138	42.339	42.551	42.897
Information	13.114	13.337	13.633	13.891	14.158	14.403	14.644	14.903	15.011
Finance and Insurance	54.799	56.047	57.366	58.375	59.296	59.989	60.538	61.123	61.767
Real Estate and Rental and Leasing	65.391	68.708	70.966	72.806	74.498	75.837	76.892	77.907	79.029
Professional and Technical Services	54.498	57.848	60.408	62.676	64.829	66.746	68.495	70.260	71.260
Mngmt of Companies and Enterprises	16.275	16.605	16.754	16.824	16.840	16.803	16.738	16.671	16.606
Admin and Waste Services	72.262	74.827	76.879	78.507	79.945	81.040	81.884	82.711	83.825
Educational Services	9.359	9.902	10.396	10.833	11.232	11.575	11.866	12.142	12.476
Health Care and Social Assistance	75.423	78.288	82.577	86.390	90.182	93.680	96.922	100.255	103.143
Arts, Entertainment, and Recreation	32.431	33.466	34.300	34.933	35.482	35.859	36.100	36.326	36.723
Accommodation and Food Services	238.045	242.788	246.695	249.357	251.402	252.370	252.584	252.724	254.135
Other Services, except Govt	50.111	52.506	54.283	55.586	56.813	57.745	58.443	59.131	59.880
Government	113.758	114.473	114.948	115.402	115.808	116.091	116.299	116.502	116.858
State and Local	88.092	89.020	89.756	90.484	91.172	91.759	92.271	92.748	93.324
Federal Civilian	12.589	12.552	12.489	12.417	12.338	12.247	12.153	12.077	12.029
Federal Military	13.077	12.901	12.703	12.501	12.297	12.085	11.875	11.676	11.505
Farm	0.236	0.233	0.230	0.227	0.224	0.220	0.217	0.214	0.211

Table A4: Employment continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Total Employment	1241.068	1254.201	1266.649	1279.369	1291.954	1304.265	1316.711	1329.753	1343.314
Total Employment as % of Nation	0.638	0.640	0.643	0.645	0.648	0.650	0.652	0.654	0.657
Private Non-Farm	1123.598	1136.531	1148.693	1161.166	1173.461	1185.423	1197.571	1210.222	1223.348
Forestry, Fishing, Other	0.349	0.356	0.363	0.371	0.377	0.384	0.391	0.398	0.404
Mining	1.865	1.888	1.907	1.928	1.944	1.961	1.982	2.001	2.019
Utilities	2.881	2.841	2.797	2.759	2.720	2.680	2.642	2.606	2.571
Construction	91.282	92.953	94.574	96.238	97.903	99.554	101.246	102.955	104.638
Manufacturing	27.571	27.410	27.247	27.111	27.001	26.884	26.802	26.771	26.728
Wholesale Trade	29.072	29.223	29.354	29.492	29.623	29.746	29.871	30.007	30.144
Retail Trade	124.053	125.294	126.374	127.435	128.434	129.361	130.272	131.202	132.174
Transportation and Warehousing	43.310	43.787	44.268	44.784	45.312	45.847	46.402	47.004	47.621
Information	15.027	15.031	15.013	14.990	14.952	14.907	14.855	14.804	14.764
Finance and Insurance	62.459	63.057	63.540	63.970	64.341	64.650	64.947	65.247	65.549
Real Estate and Rental and Leasing	79.826	80.626	81.364	82.098	82.805	83.487	84.166	84.878	85.622
Professional and Technical Services	72.097	73.050	74.032	75.076	76.163	77.277	78.448	79.680	80.963
Mngmt of Companies and Enterprises	16.654	16.738	16.831	16.937	17.047	17.158	17.276	17.420	17.564
Admin and Waste Services	84.777	85.774	86.729	87.714	88.686	89.620	90.577	91.567	92.610
Educational Services	12.623	12.765	12.890	13.014	13.134	13.248	13.353	13.439	13.534
Health Care and Social Assistance	105.711	108.300	110.764	113.305	115.832	118.331	120.837	123.373	126.004
Arts, Entertainment, and Recreation	37.106	37.513	37.910	38.328	38.746	39.177	39.625	40.117	40.646
Accommodation and Food Services	256.473	258.890	261.176	263.524	265.841	268.058	270.263	272.532	274.935
Other Services, except Govt	60.461	61.035	61.559	62.093	62.598	63.094	63.618	64.221	64.858
Government	117.263	117.467	117.755	118.005	118.299	118.651	118.953	119.347	119.785
State and Local	93.927	94.357	94.844	95.294	95.771	96.295	96.773	97.322	97.910
Federal Civilian	11.992	11.939	11.899	11.858	11.824	11.795	11.763	11.740	11.720
Federal Military	11.344	11.170	11.012	10.853	10.704	10.561	10.418	10.284	10.155
Farm	0.207	0.204	0.200	0.197	0.194	0.190	0.187	0.184	0.181

Table A4: Employment continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Total Employment	1356.765	1371.0161	1446.8027	1522.1102	1586.7963	1628.2866
Total Employment as % of Nation	0.6584294	0.6598585	0.6674553	0.6757936	0.6846014	0.6883408
Private Non-Farm	1236.322	1250.032	1322.641	1394.334	1455.605	1494.968
Forestry, Fishing, Other	0.411	0.418	0.45	0.48	0.499	0.501
Mining	2.032	2.041	2.083	2.1	2.056	1.956
Utilities	2.541	2.509	2.376	2.244	2.091	1.911
Construction	105.508	106.37	111.115	115.874	119.72	121.37
Manufacturing	26.705	26.729	26.943	27.143	27.017	26.588
Wholesale Trade	30.27	30.436	31.261	31.94	32.263	32.002
Retail Trade	133.248	134.653	141.787	148.527	155.423	162.215
Transportation and Warehousing	48.258	48.935	52.562	56.268	59.441	61.788
Information	14.718	14.716	14.759	14.744	14.552	14.173
Finance and Insurance	65.855	66.181	67.829	69.257	69.827	69.037
Real Estate and Rental and Leasing	86.367	87.131	91.178	95.113	98.222	99.469
Professional and Technical Services	82.21	83.494	90.54	97.969	104.639	109.504
Mngmt of Companies and Enterprises	17.704	17.852	18.564	19.076	19.147	18.77
Admin and Waste Services	93.619	94.668	100.099	105.052	108.049	107.704
Educational Services	13.639	13.739	14.183	14.662	15.103	15.31
Health Care and Social Assistance	128.842	131.695	146.828	163.069	180.344	197.223
Arts, Entertainment, and Recreation	41.216	41.825	45.26	49.106	52.923	56.308
Accommodation and Food Services	277.629	280.344	294.102	306.216	313.973	315.439
Other Services, except Govt	65.548	66.295	70.722	75.493	80.317	83.701
Government	120.265	120.809	124	127.627	131.052	133.191
State and Local	98.529	99.199	102.947	107.051	110.941	113.57
Federal Civilian	11.705	11.695	11.676	11.685	11.684	11.653
Federal Military	10.032	9.915	9.377	8.891	8.427	7.968
Farm	0.178	0.175	0.162	0.15	0.138	0.127

Table A5: Employment II									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Private Non-Farm	951.155	990.783	1018.408	1040.153	1059.776	1074.927	1086.817	1098.687	1110.992
Intermediate Demand	200.725	208.593	213.754	217.564	220.714	222.774	224.058	225.193	226.479
Local Consumption Demand	348.747	362.496	374.503	383.897	392.815	399.846	405.377	410.883	417.177
Government Demand	6.436	6.635	6.826	6.984	7.113	7.194	7.245	7.286	7.294
Investment Activity Demand	42.113	50.252	54.058	57.632	61.053	64.176	67.042	69.827	71.744
Exports to Multiregions	4.679	4.849	4.986	5.087	5.177	5.245	5.298	5.353	5.411
Exports to Rest of Nation	323.061	331.117	336.775	340.94	344.221	346.468	348.125	350.016	352.382
Exports to Rest of World	24.727	26.563	27.226	27.876	28.522	29.031	29.49	29.957	30.341
Exogenous Industry Sales	0	0	0	0	0	0	0	0	0
Exogenous Industry Demand	0.931	0.379	0.38	0.236	0.222	0.267	0.252	0.237	0.227

Table A5: Employment II continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Private Non-Farm	1123.598	1136.531	1148.693	1161.166	1173.461	1185.423	1197.571	1210.222	1223.348
Intermediate Demand	229.17	231.89	234.478	237.114	239.7	242.2	244.713	247.273	249.84
Local Consumption Demand	422.272	427.346	431.967	436.654	441.196	445.607	450.079	454.821	459.931
Government Demand	7.297	7.294	7.288	7.283	7.276	7.272	7.278	7.282	7.287
Investment Activity Demand	73.569	75.49	77.483	79.576	81.707	83.751	85.841	87.932	90.04
Exports to Multiregions	5.47	5.531	5.584	5.637	5.692	5.747	5.801	5.861	5.919
Exports to Rest of Nation	354.988	357.616	360.061	362.579	365.046	367.475	370.018	372.657	375.332
Exports to Rest of World	30.673	31.127	31.604	32.106	32.636	33.171	33.714	34.275	34.883
Exogenous Industry Sales	0	0	0	0	0	0	0	0	0
Exogenous Industry Demand	0.218	0.328	0.315	0.302	0.29	0.278	0.176	0.169	0.162

Table A5: Employment II continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Private Non-Farm	1236.322	1250.032	1322.641	1394.334	1455.605	1494.968
Intermediate Demand	252.162	254.486	265.148	271.731	272.251	263.765
Local Consumption Demand	465.701	472.054	507.493	547.348	588.441	623.985
Government Demand	7.287	7.283	7.316	7.375	7.423	7.417
Investment Activity Demand	91.612	93.15	101.634	110.987	120.661	129.085
Exports to Multiregions	5.978	6.036	6.337	6.616	6.846	7.029
Exports to Rest of Nation	377.945	380.748	394.787	405.635	409.517	406.288
Exports to Rest of World	35.525	36.169	39.926	44.642	50.466	57.399
Exogenous Industry Sales	0	0	0	0	0	0
Exogenous Industry Demand	0.155	0.148	0	0	0	0

Table A6: Gross Regional Product												
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Personal Consumption Expenditures	70.18	73.988	77.955	81.935	86.178	90.43	94.687	99.123	102.19	104.662	107.17	109.597
Vehicle & parts	3.318	3.846	4.065	4.299	4.554	4.784	4.981	5.162	5.319	5.465	5.616	5.766
Computers & furniture	7.898	8.422	9.331	10.332	11.487	12.718	14.097	15.654	16.238	16.571	16.911	17.242
Other durables	0.975	1.098	1.133	1.161	1.189	1.21	1.227	1.242	1.282	1.323	1.365	1.407
Food & beverages	11.197	11.626	11.975	12.298	12.614	12.907	13.164	13.404	13.789	14.062	14.334	14.591
Clothing & shoes	2.164	2.299	2.401	2.506	2.607	2.706	2.801	2.894	2.993	3.088	3.183	3.275
Gasoline & oil	2.213	2.324	2.391	2.454	2.514	2.569	2.616	2.658	2.714	2.756	2.798	2.837
Fuel oil & coal	0.082	0.083	0.081	0.078	0.076	0.073	0.07	0.067	0.067	0.066	0.065	0.064
Other non-durables	4.896	5.181	5.41	5.636	5.87	6.092	6.298	6.503	6.7	6.924	7.153	7.38
Housing	10.283	10.7	11.107	11.494	11.892	12.279	12.644	13.005	13.312	13.581	13.844	14.092
Household operation	2.656	2.773	2.903	3.028	3.156	3.281	3.4	3.517	3.605	3.678	3.75	3.818
Transportation	2.245	2.341	2.424	2.502	2.582	2.656	2.723	2.786	2.848	2.899	2.95	2.998
Medical care	12.613	13.19	14.098	15.002	15.961	16.957	17.97	19.03	19.753	20.401	21.068	21.72
Other services	9.64	10.104	10.636	11.145	11.676	12.197	12.697	13.203	13.569	13.849	14.134	14.409
Gross Private Domestic Fixed Investment	15.642	18.254	19.913	21.691	23.565	25.386	27.233	29.089	30.423	31.668	32.984	34.351
Residential	2.504	3.4	3.665	3.915	4.146	4.356	4.543	4.712	4.889	5.061	5.236	5.415
Nonresidential structures	2.996	3.334	3.592	3.854	4.124	4.395	4.664	4.933	5.133	5.339	5.568	5.816
Nonresidential equipment	10.141	11.52	12.656	13.922	15.295	16.635	18.026	19.445	20.402	21.268	22.18	23.12
Change in Private Inventories	0.043	0.037	0.044	0.053	0.066	0.083	0.108	0.147	0.151	0.155	0.157	0.159
Exogenous Final Demand	0.156	0.064	0.064	0.04	0.038	0.047	0.045	0.043	0.042	0.041	0.062	0.061
Government Consumption Expenditures	12.566	12.666	12.883	13.111	13.323	13.455	13.576	13.677	13.816	13.928	14.024	14.122
Federal Military	4.524	4.416	4.524	4.635	4.741	4.809	4.875	4.931	4.976	5.004	5.031	5.054
Federal Civilian	1.366	1.378	1.372	1.366	1.357	1.34	1.322	1.302	1.322	1.339	1.355	1.371
State and Local Government	6.676	6.872	6.987	7.11	7.225	7.306	7.379	7.445	7.517	7.585	7.638	7.697
Total Exports	53.109	55.364	57.167	59.023	60.889	62.827	64.785	66.811	68.261	69.629	71.067	72.517
Total Imports	67.332	71.797	75.94	80.305	84.952	89.461	93.961	98.553	101.572	104.353	107.23	110.076

Table A6: Gross Regional Product continued												
Variable	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Personal Consumption Expenditures	112.081	114.569	117.049	119.578	122.201	124.997	128.011	131.284	149.763	171.772	196.715	219.738
Vehicle & parts	5.92	6.077	6.235	6.397	6.56	6.746	6.903	7.056	7.998	9.326	11.006	10.536
Computers & furniture	17.582	17.926	18.264	18.609	18.962	19.34	19.793	20.499	24.484	29.285	34.867	40.652
Other durables	1.452	1.497	1.542	1.59	1.64	1.694	1.751	1.809	2.148	2.558	3.026	3.474
Food & beverages	14.848	15.1	15.349	15.6	15.861	16.136	16.429	16.716	18.27	19.984	21.779	23.414
Clothing & shoes	3.367	3.459	3.55	3.643	3.739	3.843	3.947	4.05	4.612	5.243	5.927	6.618
Gasoline & oil	2.875	2.912	2.948	2.984	3.02	3.059	3.1	3.138	3.344	3.566	3.797	3.999
Fuel oil & coal	0.063	0.061	0.06	0.059	0.058	0.057	0.056	0.055	0.051	0.046	0.043	0.039
Other non-durables	7.616	7.855	8.098	8.348	8.609	8.887	9.183	9.462	11.074	13.018	15.252	17.504
Housing	14.335	14.571	14.804	15.039	15.29	15.554	15.84	16.132	17.753	19.607	21.657	23.719
Household operation	3.887	3.954	4.021	4.088	4.159	4.235	4.318	4.403	4.882	5.444	6.076	6.711
Transportation	3.046	3.093	3.14	3.186	3.235	3.287	3.345	3.402	3.721	4.085	4.485	4.873
Medical care	22.398	23.085	23.777	24.483	25.21	25.972	26.798	27.641	32.351	37.886	44.015	50.475
Other services	14.694	14.977	15.26	15.55	15.856	16.186	16.548	16.919	19.076	21.725	24.783	27.725
Gross Private Domestic Fixed Investment	35.793	37.29	38.796	40.351	41.946	43.602	45.149	46.699	55.417	65.751	77.57	87.826
Residential	5.602	5.795	5.996	6.211	6.435	6.668	6.846	7.029	8.093	9.386	10.88	12.237
Nonresidential structures	6.081	6.354	6.607	6.859	7.109	7.363	7.546	7.726	8.723	9.86	11.08	12.223
Nonresidential equipment	24.11	25.141	26.193	27.281	28.402	29.571	30.758	31.944	38.601	46.506	55.61	63.366
Change in Private Inventories	0.161	0.163	0.164	0.164	0.165	0.165	0.164	0.164	0.158	0.149	0.137	0.12
Exogenous Final Demand	0.059	0.057	0.056	0.036	0.035	0.034	0.033	0.032	0	0	0	0
Government Consumption Expenditures	14.219	14.317	14.425	14.541	14.661	14.788	14.909	15.029	15.761	16.632	17.578	18.245
Federal Military	5.078	5.1	5.122	5.145	5.172	5.2	5.225	5.249	5.402	5.572	5.73	5.842
Federal Civilian	1.386	1.402	1.417	1.434	1.451	1.469	1.486	1.504	1.602	1.711	1.823	1.912
State and Local Government	7.754	7.815	7.885	7.961	8.038	8.119	8.198	8.276	8.757	9.349	10.026	10.492
Total Exports	74.021	75.553	77.112	78.721	80.401	82.14	83.855	85.627	95.209	105.395	115.344	124.263
Total Imports	113.022	116.01	118.996	122.036	125.156	128.456	131.799	135.282	154.658	177.049	201.478	219.873

Table A7: Income									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Personal income	77.728	83.616	89.257	95.579	102.293	109.465	116.950	124.896	132.251
Personal income as % of nation	0.617	0.631	0.639	0.646	0.652	0.656	0.659	0.661	0.663
Total earnings by place of work	54.695	58.515	62.077	65.812	69.770	73.955	78.277	82.850	87.292
Total wage and salary disbursements	40.200	43.026	45.735	48.555	51.544	54.706	57.973	61.430	64.708
Supplements to wages and salaries	9.176	9.832	10.693	11.277	11.893	12.538	13.200	13.895	14.673
Employer contributions for employee pension and insurance funds	6.282	6.731	7.321	7.721	8.142	8.584	9.037	9.513	10.045
Employer contributions for government social insurance	2.894	3.101	3.373	3.557	3.751	3.954	4.163	4.382	4.628
Proprietors' income with inventory valuation and capital consumption adjustments	5.319	5.657	5.648	5.980	6.333	6.711	7.104	7.524	7.910
Less: Contributions for government social insurance	5.717	6.193	6.865	7.264	7.685	8.127	8.581	9.058	9.553
Employee and self-employed contributions for government social insurance	2.823	3.092	3.493	3.707	3.934	4.173	4.418	4.676	4.926
Employer contributions for government social insurance	2.894	3.101	3.373	3.557	3.751	3.954	4.163	4.382	4.628
Plus: Adjustment for residence	-0.787	-0.856	-0.907	-0.965	-1.025	-1.086	-1.147	-1.209	-1.271
Gross in	0.693	0.725	0.761	0.805	0.851	0.903	0.959	1.021	1.078
Gross out	1.480	1.581	1.668	1.769	1.876	1.989	2.106	2.230	2.349
Equals: Net earnings by place of residence	48.191	51.466	54.304	57.583	61.060	64.742	68.549	72.583	76.467
Plus: Rental, personal interest, and personal dividend income	17.683	19.876	21.780	23.861	26.106	28.551	31.164	33.976	36.188
Plus: Personal current transfer receipts	11.854	12.274	13.173	14.134	15.127	16.171	17.237	18.337	19.595
Equals: Personal income	77.728	83.616	89.257	95.579	102.293	109.465	116.950	124.896	132.251
Less: Personal current taxes	6.632	7.449	8.757	9.558	10.438	11.411	12.463	13.621	14.400
Equals: disposable personal income	71.096	76.167	80.500	86.021	91.855	98.054	104.487	111.275	117.850
Real personal income	71.608	75.776	78.929	82.414	86.005	89.666	93.326	97.089	100.107
Real disposable personal income	65.498	69.026	71.185	74.172	77.228	80.319	83.381	86.500	89.206
PCE-price index	108.547	110.346	113.085	115.974	118.939	122.081	125.313	128.642	132.110
Real personal income with housing price	71.337	75.431	78.494	81.901	85.417	89.002	92.591	96.287	99.242
Real Disposable personal income with housing price	65.250	68.711	70.794	73.711	76.700	79.725	82.724	85.786	88.436
PCE-price index with housing price	108.959	110.851	113.711	116.701	119.758	122.991	126.307	129.713	133.261
Relative housing price	0.996	1.008	1.017	1.025	1.032	1.038	1.043	1.047	1.051

Table A7: Income continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Personal income	139.217	146.564	154.342	162.561	171.153	180.199	189.844	200.129	211.051
Personal income as % of nation	0.666	0.669	0.672	0.675	0.678	0.681	0.685	0.688	0.691
Total earnings by place of work	91.576	96.138	101.016	106.167	111.574	117.29	123.35	129.754	136.553
Total wage and salary disbursements	67.871	71.241	74.848	78.659	82.661	86.894	91.384	96.136	101.186
Supplements to wages and salaries	15.43	16.231	17.089	17.993	18.942	19.945	21.006	22.131	23.325
Employer contributions for employee pension and insurance funds	10.564	11.112	11.7	12.318	12.968	13.655	14.381	15.151	15.968
Employer contributions for government social insurance	4.866	5.119	5.39	5.675	5.974	6.29	6.625	6.98	7.356
Proprietors' income with inventory valuation and capital consumption adjustments	8.275	8.665	9.079	9.515	9.972	10.451	10.959	11.487	12.042
Less: Contributions for government social insurance	10.033	10.542	11.087	11.662	12.266	12.905	13.581	14.297	15.058
Employee and self-employed contributions for government social insurance	5.166	5.423	5.697	5.987	6.292	6.614	6.956	7.318	7.702
Employer contributions for government social insurance	4.866	5.119	5.39	5.675	5.974	6.29	6.625	6.98	7.356
Plus: Adjustment for residence	-1.336	-1.405	-1.48	-1.559	-1.643	-1.731	-1.825	-1.923	-2.029
Gross in	1.128	1.181	1.237	1.296	1.358	1.423	1.492	1.566	1.643
Gross out	2.464	2.586	2.717	2.856	3.001	3.154	3.317	3.489	3.671
Equals: Net earnings by place of residence	80.207	84.19	88.449	92.945	97.665	102.654	107.944	113.533	119.466
Plus: Rental, personal interest, and personal dividend income	38.252	40.408	42.671	45.06	47.547	50.157	52.95	55.954	59.142
Plus: Personal current transfer receipts	20.758	21.965	23.222	24.555	25.94	27.388	28.949	30.642	32.444
Equals: Personal income	139.217	146.564	154.342	162.561	171.153	180.199	189.844	200.129	211.051
Less: Personal current taxes	15.142	15.927	16.761	17.641	18.562	19.533	20.567	21.665	22.831
Equals: disposable personal income	124.075	130.637	137.581	144.92	152.591	160.665	169.277	178.464	188.221
Real personal income	102.639	105.25	107.84	110.531	113.266	116.021	118.878	121.845	124.966
Real disposable personal income	91.475	93.812	96.129	98.536	100.982	103.445	106	108.655	111.448
PCE-price index	135.638	139.253	143.122	147.073	151.107	155.315	159.696	164.249	168.886
Real personal income with housing price	101.714	104.263	106.792	109.423	112.097	114.791	117.587	120.491	123.547
Real Disposable personal income with housing price	90.651	92.933	95.195	97.549	99.94	102.348	104.848	107.447	110.183
PCE-price index with housing price	136.87	140.571	144.525	148.562	152.683	156.98	161.45	166.094	170.826
Relative housing price	1.055	1.059	1.063	1.067	1.07	1.073	1.077	1.08	1.083

Table A7: Income continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Personal income	222.731	235.356	313.010	420.184	566.274	756.049
Personal income as % of nation	0.694	0.698	0.716	0.736	0.759	0.773
Total earnings by place of work	143.763	151.5	198.76	263.094	349.618	462.268
Total wage and salary disbursements	106.536	112.275	147.328	195.057	259.277	342.883
Supplements to wages and salaries	24.59	25.948	34.214	45.427	60.524	80.323
Employer contributions for employee pension and insurance funds	16.835	17.764	23.423	31.1	41.436	54.99
Employer contributions for government social insurance	7.755	8.184	10.791	14.327	19.088	25.333
Proprietors' income with inventory valuation and capital consumption adjustments	12.637	13.278	17.219	22.611	29.817	39.062
Less: Contributions for government social insurance	15.865	16.73	22.005	29.174	38.824	51.432
Employee and self-employed contributions for government social insurance	8.109	8.546	11.214	14.847	19.736	26.1
Employer contributions for government social insurance	7.755	8.184	10.791	14.327	19.088	25.333
Plus: Adjustment for residence	-2.14	-2.258	-2.986	-3.992	-5.363	-7.125
Gross in	1.725	1.814	2.355	3.077	4.028	5.289
Gross out	3.865	4.072	5.341	7.068	9.391	12.414
Equals: Net earnings by place of residence	125.759	132.512	173.769	229.928	305.431	403.71
Plus: Rental, personal interest, and personal dividend income	62.574	66.308	89.348	121.427	165.621	223.186
Plus: Personal current transfer receipts	34.397	36.536	49.893	68.828	95.222	129.153
Equals: Personal income	222.731	235.356	313.01	420.184	566.274	756.049
Less: Personal current taxes	24.074	25.415	33.633	44.913	60.213	80.134
Equals: disposable personal income	198.657	209.942	279.377	375.271	506.061	675.915
Real personal income	128.229	131.714	151.535	175.466	203.39	233.049
Real disposable personal income	114.369	117.491	135.253	156.711	181.763	208.348
PCE-price index	173.698	178.688	206.559	239.467	278.418	324.416
Real personal income with housing price	126.742	130.157	149.595	173.073	200.458	229.563
Real Disposable personal income with housing price	113.043	116.102	133.521	154.574	179.143	205.231
PCE-price index with housing price	175.735	180.825	209.238	242.778	282.49	329.343
Relative housing price	1.086	1.089	1.104	1.119	1.136	1.148

Table A8: Population and Labor Force									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total population (unrebased forecast)	2018.886	2069.176	2119.413	2168.76	2217.159	2263.938	2308.544	2350.919	2391.576
Population as % of nation	0.646	0.656	0.665	0.675	0.683	0.691	0.698	0.704	0.709
By race and ethnicity									
White	994.801	1008.513	1021.492	1033.323	1044.007	1053.235	1060.757	1066.596	1071.234
Black	189.346	192.879	196.317	199.582	202.655	205.483	208.017	210.247	212.258
Other	224.727	231.653	238.613	245.515	252.359	259.055	265.543	271.81	277.859
Hispanic	610.012	636.132	662.992	690.339	718.138	746.165	774.227	802.266	830.224
By age									
Ages 0-14	450.383	461.726	473.724	484.842	495.316	504.126	511.711	518.692	524.526
Ages 15-24	248.878	255.885	262.467	270.915	275.296	280.929	286.284	291.526	297.56
Ages 25-64	1087.434	1104.116	1120.926	1136.226	1155.183	1173.601	1191.623	1208.038	1222.243
Ages 65 & older	232.191	247.449	262.296	276.777	291.364	305.282	318.927	332.663	347.247
Labor force	995.083	1015.015	1035.203	1054.816	1074.128	1092.385	1109.172	1124.398	1139.142
Participation rates by gender									
Male (16 & older)	0.726	0.722	0.719	0.715	0.711	0.707	0.703	0.697	0.693
Female (16 & older)	0.581	0.578	0.576	0.574	0.573	0.571	0.569	0.566	0.563

Table A8: Population and Labor Force continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Total population (unrebased forecast)	2431.599	2470.865	2509.37	2547.473	2585.221	2622.665	2659.946	2697.063	2734.162
Population as % of nation	0.714	0.719	0.723	0.727	0.731	0.735	0.739	0.743	0.746
By race and ethnicity									
White	1075.198	1078.426	1080.942	1082.906	1084.359	1085.331	1085.843	1085.909	1085.609
Black	214.144	215.887	217.492	218.992	220.396	221.721	222.974	224.158	225.282
Other	283.822	289.688	295.446	301.147	306.794	312.407	317.987	323.55	329.109
Hispanic	858.435	886.865	915.49	944.429	973.671	1003.206	1033.143	1063.445	1094.163
By age									
Ages 0-14	529.74	534.016	538.279	542.913	547.178	551.428	555.833	560.363	565.086
Ages 15-24	304.048	311.389	318.708	326.236	333.423	340.207	345.765	350.706	355.695
Ages 25-64	1235.433	1248.709	1260.856	1271.593	1283.146	1293.983	1305.9	1318.17	1330.44
Ages 65 & older	362.378	376.751	391.527	406.73	421.474	437.047	452.449	467.824	482.941
Labor force	1153.442	1166.151	1178.99	1191.622	1204.212	1216.575	1229.287	1242.263	1255.343
Participation rates by gender									
Male (16 & older)	0.687	0.683	0.679	0.675	0.672	0.668	0.665	0.662	0.659
Female (16 & older)	0.561	0.556	0.552	0.548	0.544	0.54	0.536	0.533	0.53

Table A8: Population and Labor Force continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Total population (unrebased forecast)	2771.198	2807.873	2988.897	3175.349	3374.687	3581.708
Population as % of nation	0.749	0.753	0.767	0.78	0.795	0.809
By race and ethnicity						
White	1084.93	1083.757	1071.903	1054.271	1034.248	1011.957
Black	226.344	227.324	231.222	233.99	235.934	236.8
Other	334.667	340.189	367.597	395.676	424.894	453.978
Hispanic	1125.257	1156.602	1318.175	1491.412	1679.611	1878.973
By age						
Ages 0-14	570.05	575.208	605.934	644.114	685.885	727.26
Ages 15-24	359.997	363.743	377.643	391.84	414.081	442.639
Ages 25-64	1342.677	1354.684	1421.832	1490.874	1557.318	1629.575
Ages 65 & older	498.473	514.238	583.488	648.52	717.403	782.233
Labor force	1268.199	1280.742	1345.595	1411.866	1482.012	1552.973
Participation rates by gender						
Male (16 & older)	0.656	0.654	0.645	0.639	0.633	0.626
Female (16 & older)	0.527	0.525	0.514	0.506	0.498	0.489

Table A9: Demographics									
Variable	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Starting population	1973.513	2018.886	2069.176	2119.413	2168.76	2217.159	2263.938	2308.544	2350.919
Births	31.859	32.395	32.969	33.508	34.002	34.408	34.767	35.041	35.318
Deaths	14.011	14.522	15.045	15.571	16.099	16.634	17.171	17.711	18.251
Natural growth	17.849	17.873	17.924	17.937	17.904	17.774	17.596	17.33	17.067
Population before migrants	1991.362	2036.759	2087.1	2137.35	2186.663	2234.932	2281.534	2325.874	2367.986
Total migrants	27.524	32.417	32.313	31.41	30.496	29.005	27.011	25.045	23.59
Economic migrants	13.75	17.311	16.377	14.609	12.817	10.464	7.606	4.751	2.871
Retired migrants	3.948	4.148	4.311	4.476	4.651	4.821	4.975	5.133	5.308
International migrants	10.583	11.29	11.997	12.705	13.412	14.119	14.827	15.534	15.735
Special pops migrants	-0.757	-0.332	-0.372	-0.381	-0.384	-0.399	-0.397	-0.374	-0.324
Total population (unrebased forecast)	2018.886	2069.176	2119.413	2168.759	2217.159	2263.938	2308.544	2350.919	2391.576

Table A9: Demographics continued									
Variable	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Starting population	2391.576	2431.599	2470.865	2509.37	2547.473	2585.221	2622.665	2659.946	2697.063
Births	35.642	36.014	36.374	36.754	37.142	37.566	38.133	38.68	39.203
Deaths	18.802	19.368	19.941	20.519	21.109	21.704	22.317	22.938	23.564
Natural growth	16.84	16.646	16.433	16.235	16.032	15.861	15.816	15.743	15.638
Population before migrants	2408.416	2448.244	2487.299	2525.604	2563.505	2601.083	2638.481	2675.689	2712.701
Total migrants	23.183	22.621	22.071	21.868	21.716	21.582	21.465	21.374	21.461
Economic migrants	2.054	1.135	0.193	-0.377	-0.907	-1.425	-1.898	-2.339	-2.581
Retired migrants	5.496	5.677	5.841	6.007	6.167	6.339	6.496	6.626	6.748
International migrants	15.935	16.136	16.336	16.537	16.738	16.938	17.138	17.338	17.538
Special pops migrants	-0.303	-0.327	-0.299	-0.298	-0.281	-0.269	-0.271	-0.251	-0.243
Total population (unrebased forecast)	2431.599	2470.865	2509.37	2547.473	2585.221	2622.665	2659.946	2697.063	2734.162

Table A9: Demographics continued						
Variable	**2029**	**2030**	**2035**	**2040**	**2045**	**2050**
Starting population	2734.162	2771.198	2952.655	3137.072	3333.638	3540.286
Births	39.756	40.295	42.899	45.404	48.001	50.704
Deaths	24.193	24.824	28.012	31.045	33.753	36.085
Natural growth	15.563	15.471	14.887	14.358	14.248	14.618
Population before migrants	2749.725	2786.668	2967.542	3151.43	3347.886	3554.904
Total migrants	21.473	21.204	21.354	23.919	26.801	26.804
Economic migrants	-2.899	-3.475	-4.582	-3.139	-1.488	-2.967
Retired migrants	6.865	6.961	7.186	7.294	7.517	7.998
International migrants	17.739	17.939	18.941	19.942	20.943	21.944
Special pops migrants	-0.232	-0.221	-0.191	-0.178	-0.171	-0.17
Total population (unrebased forecast)	2771.198	2807.873	2988.896	3175.349	3374.687	3581.708

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