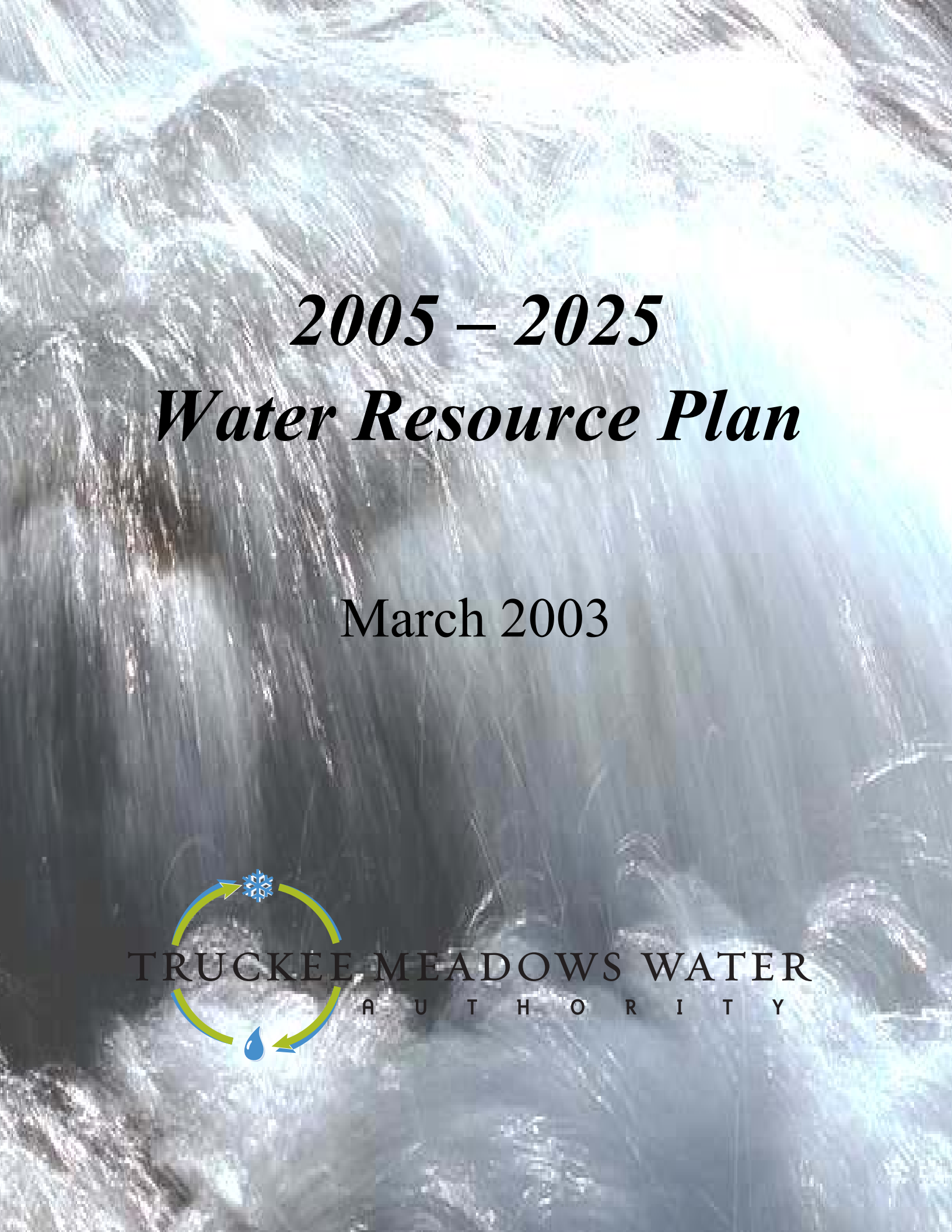

2005 – 2025
Water Resource Plan

March 2003

TRUCKEE MEADOWS WATER
AUTHORITY

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Abbreviations

AF	Acre-feet, equal to 325,851 gallons
AFA	Acre-feet annually, or acre-feet per annum
AF/month	Acre-feet per month
af/yr	acre-feet per year
ASL	Above Sea Level
ASR	Aquifer Storage and recovery
BBER	Bureau of Business and Economic Research, University of Nevada Reno
BCC	Washoe County Board of County Commissioners
Board	Board of Director for Truckee Meadows Water Authority
BOR	U.S. Bureau of Reclamation
cfs	cubic feet per second
CIP	Capital Improvement Program
CTWCD	Carson-Truckee Water Conservation District
CTP	Chalk Bluff Water Treatment Plant
EIR	Environmental Impact Report (California)
EIS	Environmental Impact Statement (U.S.)
EPA	Environmental Protection Agency (U.S.)
GIS	Geographic Information System
GTP	Glendale Water Treatment Plant
gdp	gross domestic product
gpcd	gallons per capita per day
gpm	gallons per minute
ISA	Interim Storage Agreement, 1994
JPA	Joint Powers Authority
µg/l	micrograms per liter or parts per billion (ppb)
MGD	Million gallons per day
M&I	Municipal and Industrial services or customer
NDEP	Nevada Division of Environmental Protection

NDWR	Nevada Division of Water Resources
NRS	Nevada Revised Statutes
NSWTR	Nevada Surface Water Treatment Rule
NTU	nephelometric turbidity unit
OCAP	Operating Criteria and Procedures
PCE	tetrachloroethylene, a volatile organic compound
PLPT	Pyramid Lake Paiute Tribe
POSW	Privately-owned stored water, as defined in Truckee River Agreement
PSA	Preliminary Settlement Agreement
PUCN	Public Utility Commission of Nevada
RSW	City of Reno, City of Sparks, and Washoe County
RWP	Regional Water Plan, 1997
RWPC	Regional Water Planning Commission of Washoe County
RWSQS	Regional Water Supply and Quality Study, 1993, by Washoe County
SDWA	Safe Drinking Water Act
Sierra	Sierra Pacific Power Company
sq. ft.	Square feet
TCID	Truckee-Carson Irrigation District
tds	Total dissolved solids
TMWA	Truckee Meadows Water Authority
TPEM	Truckee Meadows Water Authority Population and Employment Econometric model for Washoe County
TRA	Truckee River Agreement, 1935
TROA	Truckee River Operating Agreement, required under PL 101-618
USBR	United States Bureau of Reclamation
WCWCD	Washoe County Water Conservation District
WCCP	Washoe County Comprehensive Planning Department
WDWR	Washoe County Department of Water Resources
WQSA	Truckee River Water Quality Settlement Agreement, 1996
WRP	Water Resource Plan

Preface

The Truckee Meadows Water Authority ("TMWA") was formed in direct response to a September 2000 announcement by Sierra Pacific Resources ("Sierra") of its intention to sell its water utility business serving water to the greater Reno/Sparks area in Washoe County, Nevada. On October 20, 2000 Reno, Sparks and Washoe County ("RSW") submitted a joint "Proposal to Purchase the Water Utility Assets of Sierra Pacific Resources." RSW indicated intent to form a Joint Powers Authority ("JPA") and to have the JPA in existence upon selection as the successful bidder[1]. On November 13 and 14, 2000, a Cooperative Agreement was executed between RSW forming TMWA. TMWA was officially born by RSW's execution of the "Cooperative Agreement among City of Reno, City of Sparks, and County of Washoe" on December 4, 2000 pursuant to the provisions of Chapter 277 of the Nevada Revised Statutes ("NRS").

Some of the underlying principles RSW sought to achieve through TMWA include:

- Assure that water resources are developed and managed to fulfill the present and future water needs of the greater Truckee Meadows community.
- Acquire and manage the water assets for the benefit of the Truckee Meadows community.
- A need for RSW to act together with respect to such matters as water supply, allocation of water supply, water quality, treatment, and wheeling.
- Secure additional supplies of water and the effective management of existing supplies can best be achieved through the cooperative action of the RSW, operating through TMWA.

After the successful launch of TMWA, RSW subsequently submitted and was awarded the successful bid to acquire Sierra's water utility business. On January 13, 2001, TMWA approved the Asset Purchase Agreement, and Sierra approved it on January 15, 2001. Efforts to transfer the water assets and business from Sierra to TMWA began in earnest early in 2001 following these approvals. On June 5, 2001 TMWA sold $452.3 million in bonds pledged against its revenues and the sale of Sierra's water utility business with the transfer of title to all diversion, treatment, conveyance, water transmission, wells and distribution related facilities was completed. When TMWA opened for business on June 11, 2001, 127 employees, all former water division employees of Sierra, continued managing and operating the water utility business for the greater Truckee Meadows area, and began the process to meet the business objectives established by the JPA, TMWA's Board of Directors and its management team. As of this writing TMWA has grown to a staff of 145.

One specific requirement of the JPA was for TMWA staff to produce a water resource plan as set forth in Article 5 of the JPA, and to address these specific goals:

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[1] Cooperative Agreement, 2000. Complete copy found in Appendix A.

"To establish a water budget and a water resource plan for the Authority which shall reflect, among other things:

(i.) Water Supplies available to the Authority and separately to each Member from all sources,

(ii.) Demand within each Member's jurisdiction within the Authority's retail service area, and

(iii.) The peaking capacity required for delivery of Water Supplies by the Authority to each Purveyor Member, if applicable, and the means by which such requirements shall be met.

Except as provided in article 24 *[option for RSW to become a separate water purveyor]*, such water budget and such water resource plan shall not confer on the Authority the right to regulate or control the use of Water Supplies by any Purveyor Member within its own retail service area…" [2]

The reader will find in the pages following this preface that this water resource plan ("WRP") not only satisfies the specific concerns expressed in the JPA, but encompasses a host of issues that will serve to guide TMWA and the community with respect to the efficient and optimal use of their present water resources, and the acquisition of future resources to meet the growth needs of TMWA's future customers.

2 JPA, Article 5(h). In addition, Article 5(i) requires TMWA "To prepare, update and oversee the implementation of a water conservation plan for the use of municipal, industrial, and domestic Water Supplies within the retail service area of the Authority and to carry out the former Sierra Pacific Power Company role with regard to the Water Conservation Agreements with Members." Satisfaction of this element of water resource management is described in Chapter 4 of the WRP.

Introduction

Having been the water purveyor since before the turn of the century, TMWA's predecessor Sierra planned for and managed its water resources to meet growth requirements for the greater Reno and Sparks metropolitan areas. Evaluation of the Truckee Meadows water supply was conducted by Sierra as early as 1929. Prior to significant population increases beginning in the late 1960's (see Figure 1), the utility was able to rely on the combination of the conversion of irrigation lands with their associated water rights to municipal use and upstream storage.

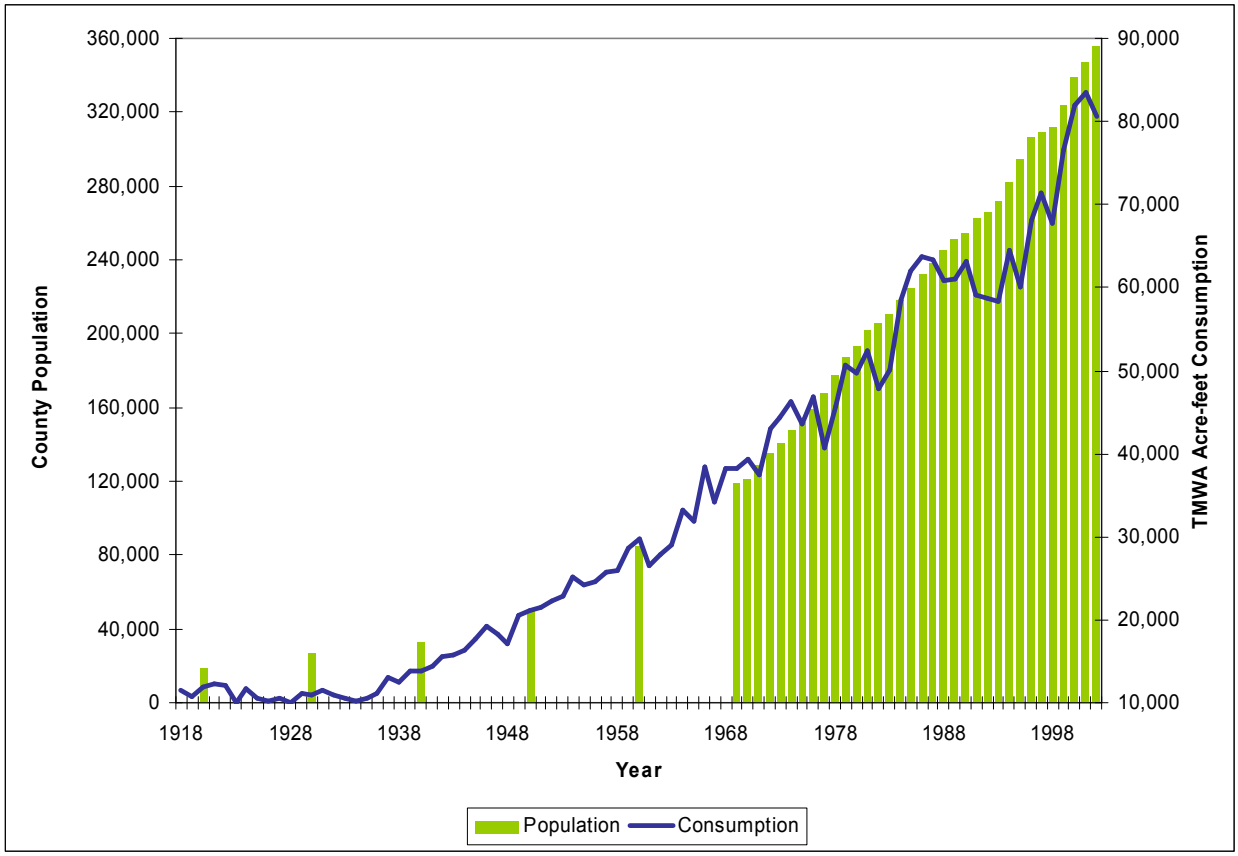

Figure 1: Historic Water Consumption and Washoe County Population

Throughout the history of water delivery in the Truckee Meadows, water demands have grown at a pace that the water purveyor has been able to meet by converting agricultural water rights and augmenting water supplies from privately owned storage water ("POSW") in Independence Lake and Donner Lake in dry years. The use of groundwater supplies came into play in the 1960's to help balance demands within TMWA's widespread and multi-elevation distribution system.

During the late 1960's and early 1970's, as the community began to expand at a rate faster than previously experienced, Sierra planned on the utilization of Stampede Reservoir ("Stampede") to provide future drought supplies necessary to serve growth in the Truckee Meadows. However, with the passage of the Endangered Species Act, storage of water in Stampede reservoir was set aside solely for the conservation of the endangered Cui-ui fish in Pyramid Lake. In 1979, Sierra informed local governments that without the availability of storage space in Stampede, new service commitments would need additional water resources and drought-year supplies. The State Engineer then began requiring new developments to supply sufficient water rights to support each new service commitment. In 1981, Sierra implemented "Rule 17," requiring developers who wanted immediate water service to provide water rights, or in the alternative, be placed on a waiting list until Sierra could make additional commitments through acquisition of new resources. A review of "Rule 17" in 1984 confirmed the earlier findings that additional water resources would be needed. This resource review first occurred in the early 1980's and thus began the formal process of water-resource-planning for the service area then served by Sierra, which has subsequently been assumed by TMWA.

A brief chronology of the significant water-resource-planning efforts for meeting current and future water demands within the Truckee Meadows is presented here:

- In October 1985 Sierra filed its 1985-2005 Water Resource Plan with the Public Utility Commission of Nevada ("PUCN"). The 1985 Water Resource Plan consisted of a detailed description of feasible water-supply projects available at the time with accompanying cost and yield analyses, demand-side programs, discussion of the computer model used to analyze the Truckee system, and material relating to legislation affecting Sierra, local water planning issues, and potential settlement of Pyramid Lake/Truckee River disputes. Based on then existing water resources, it was determined that Sierra could serve a demand of 75,560 acre-feet/year during a critical drought period. In addition, Sierra determined it could serve a demand of 124,000 acre-feet/year with the then-proposed settlement of Truckee River issues and expanded use of reservoir storage in federally operated reservoirs.
- In January 1989, Sierra filed its 1988-2008 Water Resource Plan with the PUCN. It found that Sierra's water supply could support a commitment level of 80,000 acre-feet/year through continued conversion of irrigation rights to municipal use; with the addition of 3,000 acre-feet of groundwater, 83,000 acre-feet/year could be committed; or with a proposed Boca storage contract 86,000 acre-feet/year could be committed. These assessments were based on the 8-year historic drought of 1928-1935.[3]

[3] Selection of a drought-year design is critical for resource planning in the Truckee Meadows since surface water supplies from natural runoff and upstream-reservoir operations during below-average precipitation must be augmented by TMWA's reservoir storage and groundwater reserves. Selecting the appropriate design criteria, as will be described later in this plan, significantly impacts the use of current and future water resources.

- In July 1990, the Regional Water Planning and Advisory Board of Washoe County released the first regional water plan (1990 RWP) covering water resources and demands by hydrographic basins from Washoe Valley to the north valleys (Cold Springs, Lemmon Valley and Spanish Springs), including the Truckee Meadows. The regional plan also analyzed other water-related issues including wastewater and flood control issues.
- In 1992 Washoe County released its Regional Water Supply and Quality Study, which was an expansion of analyses first presented in the 1990 RWP.
- In June 1994, Sierra released its 1995-2015 Water Resource Plan ("1995 WRP"). It found that Sierra's water supply could support a commitment level of 97,400 acre-feet/year through continued conversion of irrigation rights to municipal use, and the 1994 Interim Storage Contract, conjunctive use, and artificial recharge. These assessments were made using the then recommended 10-year drought standard (1987-1994 plus 1987-1988 annual hydrology).
- In 1997, the Regional Water Planning Commission ("RWPC") released its 1997 Regional Water Plan ("1997 RWP").
- The RWPC approved the Spanish Springs Facility Plan in July 2001 and the South Truckee Meadows Facility Plan in August 2002. A draft Facility resource-related plan for Lemmon Valley was released in October 2002.

The findings, results and recommendations of each water resource plan identified above have been incorporated into successive water resource plans produced by Sierra, Washoe County Department of Water Resources ("WDWR") and the RWPC. This plan relies in part on the efforts of prior plans and planners to arrive at the recommendations contained herein.

The primary purpose of water resource planning for the Truckee Meadows is to determine how to supply the water needs of current and future customers with current and future water resources during drought and non-drought years. This plan follows these steps to answer that question:

1. Chapter 1, "Historical Background and Perspective", provides a brief history of water delivery in the Truckee Meadows, the water resources available from the Truckee River and its tributaries, a description of groundwater available for use in the Truckee Meadows, and brief comments pertaining to raw water quality issues.
2. Chapter 2, "Integrated Management of Existing Water Resources and Facilities", describes what water resources and water rights are currently available and how those resources are conjunctively managed to meet TMWA's water service commitments. An estimate is made as to when the current pool of resources will no longer meet the commitments of future growth; if no new resources are added to the current pool (no new supply action is taken).

3. Chapter 3, “Water Demand and Peak Day Projections”, forecasts population and employment, water demands, and factors affecting future demand. Facility requirements to meet peak day projections are also presented.

4. Chapter 4 “Water Conservation Plan”, describes several conservation programs and measures TMWA is employing to reduce annual water use and minimize water waste. Chapter 4 also includes a summary of the Water Meter Retrofit Program.

5. Chapter 5, “Future Water Resources”, identifies potential future water resource options, resource and environmental constraints, and capital, treatment and water rights costs associated with each project.

6. Chapter 6, “Summary”, is a summary of the resource plan.

Key Findings and Recommendations

1. Joint Powers Agreement

Finding:

A specific requirement of the JPA, as set forth in Article 5, was for TMWA staff to produce a water resource plan. This WRP has established a water budget and a water resource plan for TMWA. This WRP has identified what water supplies are available to TMWA from all water sources; has projected demands within TMWA's retail and wholesale service areas as wells as demands within RSW jurisdictions; and has estimated the peaking capacity required for delivery of water supplied by TMWA to its customers. Peaking capacity cannot be meaningfully disaggregated by JPA Member without exposing customers to extensive facility separation costs. The water production facilities necessary to produce and treat water for TMWA's customers have been estimated and consistent with TMWA's 2022 Water Facility Plan approved in December 2001.

Recommendation:

The Board accept this WRP in satisfaction of Article 5 of the JPA.

2. Water Demand Forecast

Finding*:*

Growth on developable land within TMWA's retail service territory is projected to slow after 2025, resulting in slower water demand growth in TMWA's extended forecast. Future demand is anticipated to continue to grow in the Central Truckee Meadows but at a slower than historical rate, while projected demands in Spanish Springs, the North Valleys, and Verdi continue to grow faster than historical rates. Increased use of effluent and other non-potable sources for future large irrigation projects may free-up treatment capacity and/or resources to serve new developments thereby extending TMWA's demands beyond the planning horizon.

Recommendation:

The Board accept the water demand as a reasonable estimate of future water demands to be used for planning purposes.

3. Water Production Facilities

Finding:

Peak day demand is projected to increase from 147.0 MGD in 2002 to 189.5 MGD in 2025. Maximizing treatment plant capacities for non-drought years requires expansion of Chalk Bluff, with the next phase due to be completed sometime in 2004. TMWA will increase well capacity by 8 MGD to meet groundwater production requirements

particularly to meet drought year needs. Maximum benefits are achieved from TMWA's aggregation of facilities and resources while providing the least-cost capital investment. Peaking requirements cannot be meaningfully disaggregated by a JPA Member without exposing customers to extensive facility separation costs.

Recommendation:

The Board acknowledge the efficiencies of a single purveyor and that the water treatment and delivery system be operated in a unified manner; Staff should review and update where necessary the 2002-2022 Facility Plan to incorporate the peak day projections in this WRP; and TMWA should continue its well development program to meet drought supply needs.

4. Water Conservation

Finding:

TMWA's current conservation programs are designed to achieve 10% water savings annually as part of the conservation goal agreed to in the 1996 Water Conservation Agreement between RSW, TMWA, PLPT and the United States, which agreement satisfies the conservation requirement of the Preliminary Settlement Agreement. Continued levels of spending will be in accordance with that agreement. TMWA continues to work with the RWPC in developing conservation plans for the region, and cooperates with RWPC in implementing its conservation programs. Gallons per capita per day are projected to fall from 264 in 2002 to 250 by 2025. The water conservation activities embodied in this WRP satisfy Article 5(i) of the JPA and the Nevada Division of Water Resources requirements that public water systems have a water conservation plan as set forth in NRS 540.131 through 540.151.

Recommendation:

The Board accept the Water Conservation Plan outlined in this WRP as fulfillment of Article 5(ii) of the JPA; the conservation plan be should submitted to the State of Nevada Division of Water Resources in fulfillment of NRS 540.131-540.151; and the 1996 Water Conservation Agreement between PLPT and TMWA's Members continue to be implemented and funded per the existing agreement.

5. Water Meter Retrofit

Finding:

In 1995, the retrofit of TMWA's 44,651 flat-rate services began. As of June 2002, 26,771 metering facilities have been installed, leaving 17,880 metering facilities to be installed. During the same period, 7,469 customers have converted from flat-rate to metered billing. Facilities installed prior to TMWA managing the program did not include the meter. TMWA installs the meter with the metering facilities, but TMWA

must install 35,012 meters in all facilities previously installed without a meter. Metering the system is estimated to achieve an additional 10% in annual water savings.

Recommendation:

The Board should continue the Meter Retrofit Program in its current form as funding allows.

6. Current Water Resources

Finding:

TMWA has over 129,000 acre-feet of decreed, storage, and irrigation rights, sufficient to generate water supplies for customer demands. TMWA does not use its POSW nor all its groundwater for demands in average or above-average precipitation years since these rights are held in reserve for drought years. Ownership of TMWA water rights are held by TMWA, Reno, Sparks and Washoe County. From 1984 to 1996 water rights were dedicated to Reno, Sparks or Washoe County. Only Washoe County continues to require dedication of water rights for either TMWA's retail customer residing in the County or County retail customers utilizing TMWA for wholesale water service.

Recommendation:

The Board direct TMWA staff to review with Reno, Sparks and Washoe County, the dedication and ownership of water rights to assess whether future water rights transfer applications with the state engineer would be managed more efficiently by one agency.

7. Drought Standard

Finding:

As of June 2002, TMWA's service commitments total 89,660 acre-feet. Through continued acquisition of irrigation water rights, TMWA can achieve 99,000 acre-feet of service commitments using the presently adopted drought design of 10-years, which includes the historic hydrology of 1987 to 1994 plus a repeat of 1987 and 1988. However, present dry-year supplies from surface water reservoirs and groundwater pumping are adequate to support a commitment level of 113,000 acre-feet using actual historic drought hydrology of 1987 to 1994. These findings are based on river modeling studies conducted by TMWA.

In addition, TMWA worked with UNR to develop a second model to analyze drought frequencies, similar to statistical analysis used to estimate flood frequencies. It was found that the likelihood of a 8-, 9- or 10-year event occurring is extremely rare with frequencies ranging from 1 in 230 years, 1 in 375 years, and 1 in 650 years, respectively. The current 10-year drought design is so rare that it imposes an unrealistic burden on the region's resources. Planning for the 8-year event with today's resources is more than adequate to meet expected drought frequencies. The findings support the ability to expand service commitments under an 8-year design to approximately 113,000 acre-feet

which is estimated to occur in 2026 or 2027; however, reducing the level of committable resource to the 9-year drought supply estimate of 110,000 acre-feet annually at this time gives the Board time to reassess the drought design in future water plans and creates flexibility in managing TMWA's resources. Taking this action also preserves the opportunity for the local community to continue to develop in an orderly fashion without necessitating unreasonable and unnecessary interruptions during the next few years before TROA is implemented.

Recommendation:

The Board: (1) shall, for planning purposes, design and manage TMWA's water resources to withstand the length of the worst drought cycle of hydrologic record (1987 to 1994) for the Truckee River, (2) recognize that although commitments could expand from 99,000 acre-feet annually to 113,000 acre-feet annually through the continued conversion of irrigation water rights to municipal use, manage commitments to 110,000 acre-feet; and (3) direct staff to continue review of the performance of this standard and update the Board when future conditions change and/or at the next water resource plan update in 3-5 years.

8. Water Rights Availability

Finding:

A review of available Truckee River water rights shows sufficient water rights exist to meet future TMWA water service commitments through the planning horizon, 2005-2025. However, acquiring and transferring many of these water rights, which are fractionated and have ownership problems, will require additional time and expense before the right can be put to use. Over the past decade, demands for Truckee Meadows water rights have increased in response to using water rights to enhance water quality both in the Lower Truckee River and groundwater aquifers, and for future demand scenarios for the south Truckee Meadows area. TMWA will work with RSW and PLPT to find opportunities that satisfy TMWA's operating requirements and enhance Truckee River flows below Vista to improve lower river water quality. Since the number of Truckee Meadows water rights is limited, close coordination of the various river interests must occur to avoid undo stress to the water rights market.

Recommendation:

The Board direct TMWA staff to: (1) continue to purchase water rights under its Rule 17 and (2) expand its activities in cooperation with Reno, Sparks and Washoe County in identifying and purchasing fractionated Truckee River water rights under the streets within those jurisdictions.

9. Future Water Resources

Finding:

TMWA is an active supporter and participant in the TROA process. TMWA will continue toward TROA implementation because of the numerous benefits it provides: expanded drought storage, water quality, expanded recreation, endangered species mitigation, interstate allocation of Tahoe and Truckee rights, and litigation resolution.

Using the 8-year drought design (even moderated to the 9-year yield of 110,000 acre-feet as recommended) TMWA has sufficient resources to meet future demands through the 2025 planning horizon by continued acquisition of Truckee River irrigation rights, and can focus on TROA completion.

Using a 10-year drought design, TMWA has sufficient resources to support continued addition of new service commitments through the acquisition of Truckee River irrigation rights for the next 4 to 6 years. During those years, TMWA will continue working on TROA but TMWA must also work to prove and permit artificial recharge in the event TROA is delayed. Should TROA not be implemented, permitting and acquisition of other resources options including conjunctive use with Washoe County resources, North Valleys importation, acquisition of TCID share of Donner Lake, or other projects must take place in order to meet future water demands.

Recommendation:

The Board should continue to support the efforts to implement TROA and direct TMWA Staff to investigate, evaluate, and negotiate, where appropriate, other potential water supply projects.

Chapter 1 Historical Background and Perspective

History of the Truckee Meadows Water Authority

The history of TMWA begins with the history of Sierra's history as a water utility history beginning as early as 1861. Utility companies involved in the delivery of natural gas, electricity, and/or water in the latter part of the 1800's and the first part of the 1900's were often directly or indirectly involved in developing water supplies for municipal and industrial use in the Truckee Meadows. Hydraulic mining, milling, irrigation, and power production needing water-delivery services formed the basis of purveying water in and around the Truckee Meadows.

Early companies involved in the water-delivery business in the Truckee Meadows were the Reno Water Company, incorporated 1874, and the Highland Ditch and Water Company, incorporated 1875. The Reno Water, Land and Light Company acquired these two companies in 1889 and 1890, respectively. In 1902, the Nevada Power, Light and Water Company acquired the Reno Water, Land and Light Company, which in 1904 became part of the Reno, Light and Water Company.

By 1923, through numerous acquisitions and mergers, the Truckee River General Electric Company had emerged as the sole provider of gas, electricity, and water for the Truckee Meadows. In becoming the primary provider of utility services, the company had acquired such properties as hydroelectric plants, distribution systems, land, water rights, irrigation ditches, dams, and reservoirs. The Truckee River General Electric Company became Sierra Pacific Power Company in 1928.

Sierra and its predecessor companies continued to acquire water utilities throughout the years. Among these acquisitions were Prospect Hill Water Company in 1951, Stead Air Base water system in 1969, Vaughn Mill water system in 1978, Truckee Meadows Community College water system in 1981, Mogul Water Company in 1989, and Silver Lake Water Distribution Company in 1999.

In September 2000 Sierra announced its intention to sell its water utility business which served the Reno/Sparks area in Washoe County, Nevada. On October 20, 2000, RSW submitted a joint "Proposal to Purchase the Water Utility Assets of Sierra Pacific Resources." In November 2000, a Cooperative Agreement was executed between RSW to form TMWA. TMWA was officially born by RSW's execution of the "Cooperative Agreement Among City of Reno, City of Sparks, and County of Washoe" on December 4, 2000 pursuant to the provisions of Chapter 277 of NRS.

RSW subsequently submitted and was awarded the successful bid to acquire Sierra's water utility business. On January 13, 2001, TMWA approved the Asset Purchase Agreement, and Sierra approved TMWA's APA on January 15, 2001. Efforts to transfer the water assets and business from Sierra to TMWA began in earnest in the early months of 2001 following these approvals. On June 5, 2001 TMWA sold $452.3 million of bonds pledged against its revenues and the sale of Sierra's water utility business with the transfer of title to all diversion, treatment,

conveyance, water transmission, wells and distribution related facilities was completed on June 11, 2001, when TMWA officially opened for business.

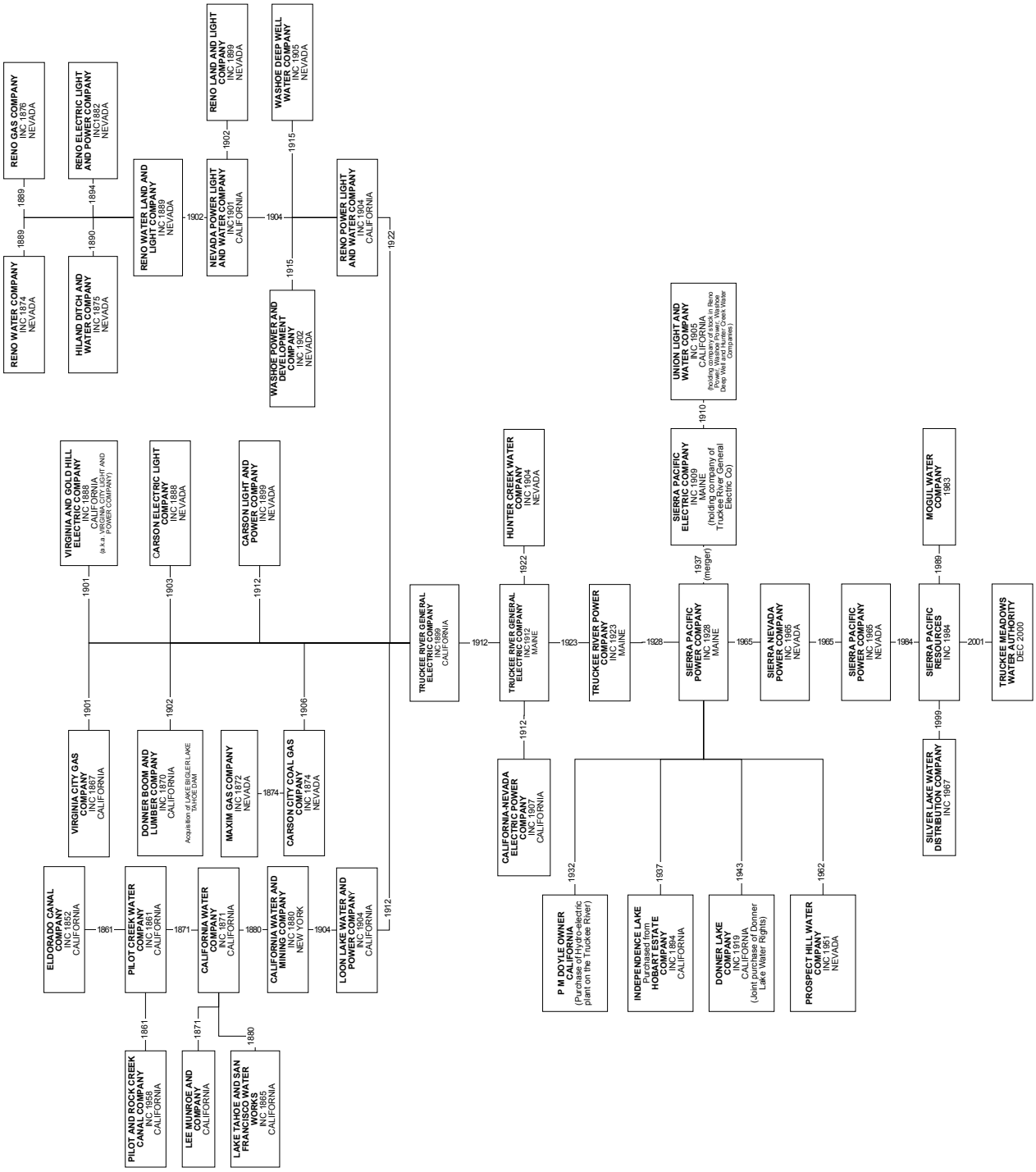

Figure 2: Water Utilities That Were Merged To Form TMWA.

Figure 2 illustrates the various water, gas, and electric utilities that were ultimately acquired and/or merged together before the water business was sold to the Truckee Meadows Water Authority.

Surface Water Resources

The Truckee River is the principal source of water for the Truckee Meadows. The river, approximately 110 miles in length, begins at the outlet of Lake Tahoe in California, flows northerly to the California – Nevada state line, easterly through the Truckee Meadows and the Truckee Canyon to the vicinity of the town of Wadsworth, and then turns northerly terminating in Pyramid Lake (see Figure 3).

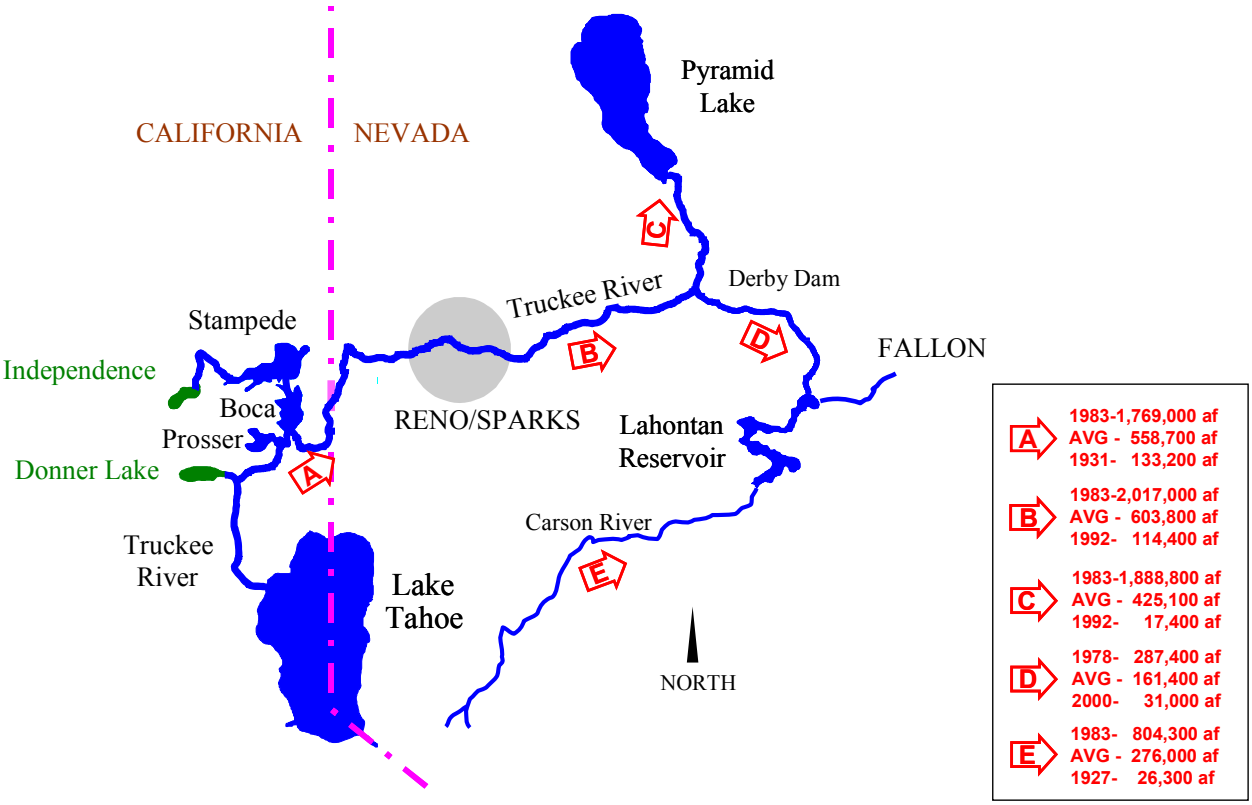

Figure 3: Map of Truckee River System with Historic Flows

Truckee River flows are measured near the California—Nevada state line at a United States Geological Survey (USGS) gauging station located at Farad, approximately two miles downstream from the community of Floriston, California. Flows were originally measured at the Iceland gage upstream of Floriston but this gage was abandoned in 1937.

Mean annual flow for the Truckee River at Farad for the period 1909 through 2000 is 558,700 acre-feet. The annual flow at Farad has varied from 1,769,000 acre-feet in 1983 to 133,200 acre-feet in 1931. The minimum mean daily flow rate is the lowest daily flow of the

calendar year. From 1909 to 2000 the minimum mean daily flow rate has ranged from 37 cfs in 1933 and 1977, to 420 cfs in 1952. The maximum mean daily flow rate is the highest daily flow of the calendar year. For the same time period the highest daily flow rate range is from 594 cfs in 1991 to 13,400 cfs in 1955. Figure 4 shows the historic high, low, and annual mean annual flow rates in cubic feet per second at Farad from 1909 to 2000.

Figure 5 shows the annual volume of water in acre-feet for the years 1909 to 2000. The figures illustrate the tremendous variability of water available on an annual basis from the Truckee River. TMWA, through its planning efforts, has constructed facilities and implemented management strategies to levelize the impact of these variable flows; this strategy is discussed in detail in Chapter 2.

Additional water flows to the Truckee River from streams draining the hills surrounding the Truckee Meadows area. Major tributaries include Dog Creek in Verdi and Hunter, Evans, Thomas, and Whites Creeks in the west and southwest portions of the Truckee Meadows. Water also flows into the Truckee River from Steamboat Creek and its tributaries near the eastern edge of the Truckee Meadows. Washoe Lake and Little Washoe Lake provide some regulation of Steamboat Creek.

Three natural lakes with regulated outlets and three man-made reservoirs, all located in California, control Truckee River flows and provide storage for watershed runoff. On the Carson River, Lahontan Reservoir is a vital element in the operation of the Truckee and Carson River systems, because Truckee River water is diverted at Derby Dam into Lahontan Reservoir for the Newlands Project. A brief description of the lakes and reservoirs used to manage Truckee River flows is presented here:

- *Lake Tahoe*. Lake Tahoe is the most significant and largest controlled body of water in the Truckee River drainage basin. The lake is a natural lake with a drainage area of 503 square miles and its outflow is regulated by the natural rim and a dam at Tahoe City, California. The dam, located 400 feet downstream from the undisturbed natural rim of the Lake, was first constructed in 1870 and rebuilt with completion in 1913. The natural rim is at elevation 6,223.0 above sea level ("ASL"). Decrees and agreements permit the storing of 6.1 feet of water above the natural rim, creating a useable capacity of 744,600 acre-feet. By Federal Court decree of June 4, 1915, the United States obtained the right to maintain, and operate the Lake Tahoe dam and outlet works for the purpose of controlling the release of stored water to maintain Floriston Rates.

- *Donner Lake*. Donner Lake is tributary to the Truckee River via Donner Creek and is located immediately to the west of the town of Truckee, California. The upper 12 feet of Donner Lake is regulated by a control structure in the outlet channel. Donner Lake drains an area of approximately 15 square miles. In 1943 Sierra and TCID jointly purchased the storage rights in Donner Lake from the Donner Lake Company. Under the provisions of the 1943 purchase agreement, Sierra and TCID acquired rights to water stored in Donner Lake by virtue of the construction and operation of the original dam built in the 1877. California Water Law recognizes uses of water that were legally established and exercised prior to 1914 pursuant to a vested water right. Provisions in the deed by which Sierra and TCID acquired the Donner Lake water

require that the Lake not be drawn below 5,932.0 feet ASL (or 6,310 acre-feet) during the months of June, July, and August. The California Department of Water Resources, Division of Safety of Dams, requires that the lake be drawn down so that the outer slidegates are fully open by November 15 of each year and the gates shall not be closed until April 15 unless a waiver is granted for early closure.

These requirements somewhat limit the use of Donner Lake as a municipal and industrial water source. During prior drought periods, Sierra requested and received seasonal approval from the Division of Safety of Dams to begin storage in Donner Lake prior to April 15. This early storage is important to ensure that as much runoff as possible can be stored in Donner Lake and used to augment Truckee River flows during drought periods. TMWA is joint owner with TCID and has rights to store 9,500 acre-feet in Donner. Utilization of these rights is also covered by the privately owned stored water provisions ("POSW") of the Truckee River Agreement.

- *Martis Creek Reservoir*. Martis Creek, with a drainage basin of 40 square miles, is tributary to the Truckee River immediately downstream from Truckee. Martis Creek Dam, with a reservoir capacity of 20,000 acre-feet, was constructed in 1971 by the U.S. Army Corps of Engineers ("USCE") and is operated by the USCE for flood control purposes. This reservoir has been considered for carryover storage in recent years.

- *Prosser Creek Reservoir*. Flows in Prosser Creek are controlled by Prosser Creek Reservoir located almost due north of the city of Truckee, CA. The reservoir, completed in 1962 by the United States Bureau of Reclamation ("USBR") as part of the Washoe Project has a useable capacity of 28,640 acre-feet with a drainage basin of approximately 50 square miles. The reservoir is operated for flood control and for storage of water exchanged with Lake Tahoe to ensure minimum releases from Tahoe under the Tahoe-Prosser Exchange Agreement dated June 15, 1959.

- *Independence Lake*. Independence Lake is located on Independence Creek upstream of its confluence with the Little Truckee River, approximately 15 miles due north of Donner Lake. Independence Lake and surrounding lands (2,200 acres) were acquired by Sierra in 1937 by direct purchase from the Hobart Estate Company. Currently, the surrounding lands are owned by Sierra; however, the water rights and the provisions necessary to operate the lake, dam, and outlet works were deeded to TMWA. The outlet works are currently being reconstructed as of this writing. In 1939 the dam and outlet works were reconstructed and enlarged. The dam currently controls the top 28 feet of the lake, which impounds 17,500 acre-feet of usable storage. The lake drains an area of approximately 8 square miles, and the rights to store water are wholly owned by TMWA. Utilization of these rights is also covered by the POSW provisions of the Truckee River Agreement.

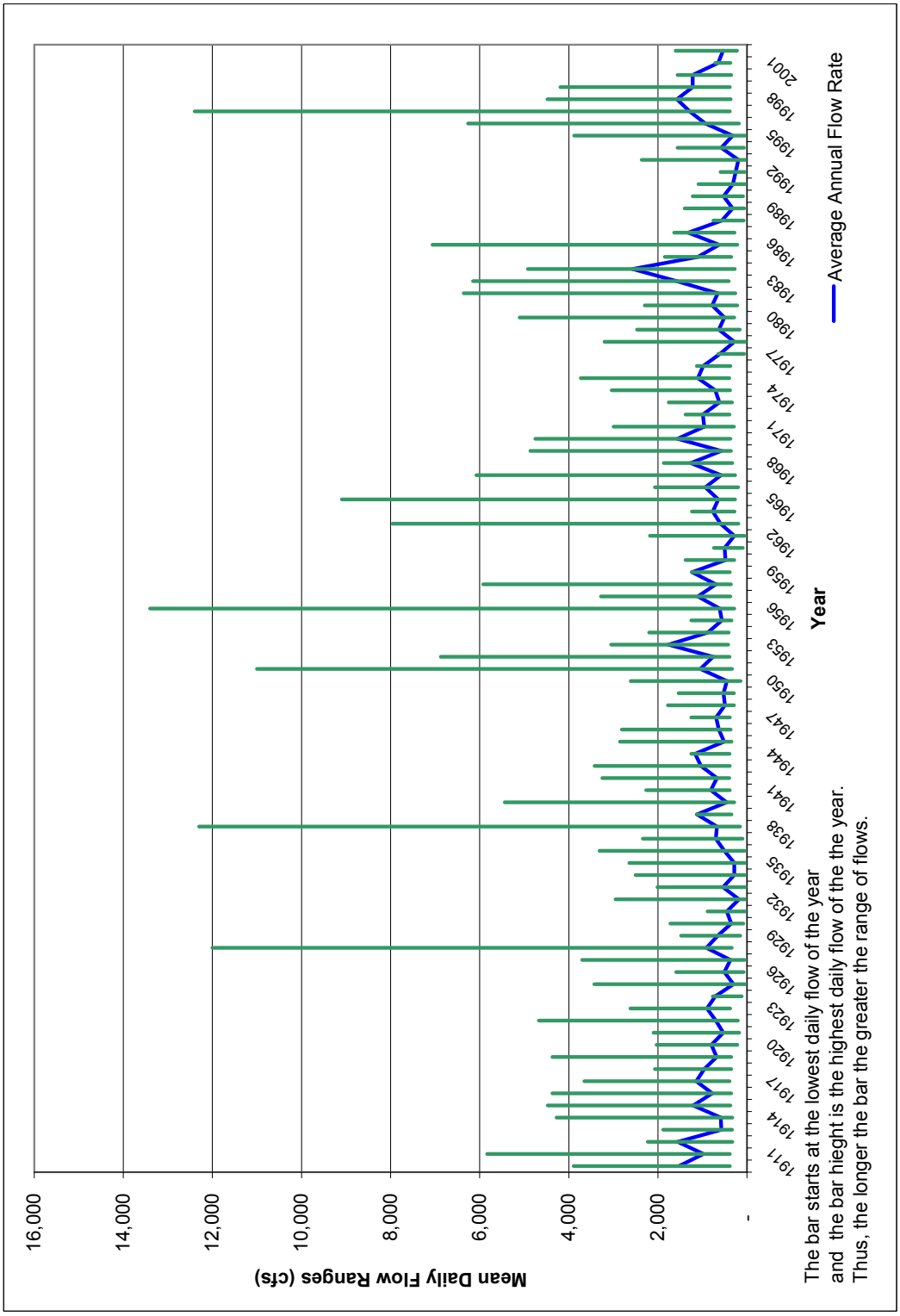

Figure 4: Annual High, Low, and Mean Rates of Flow at Farad

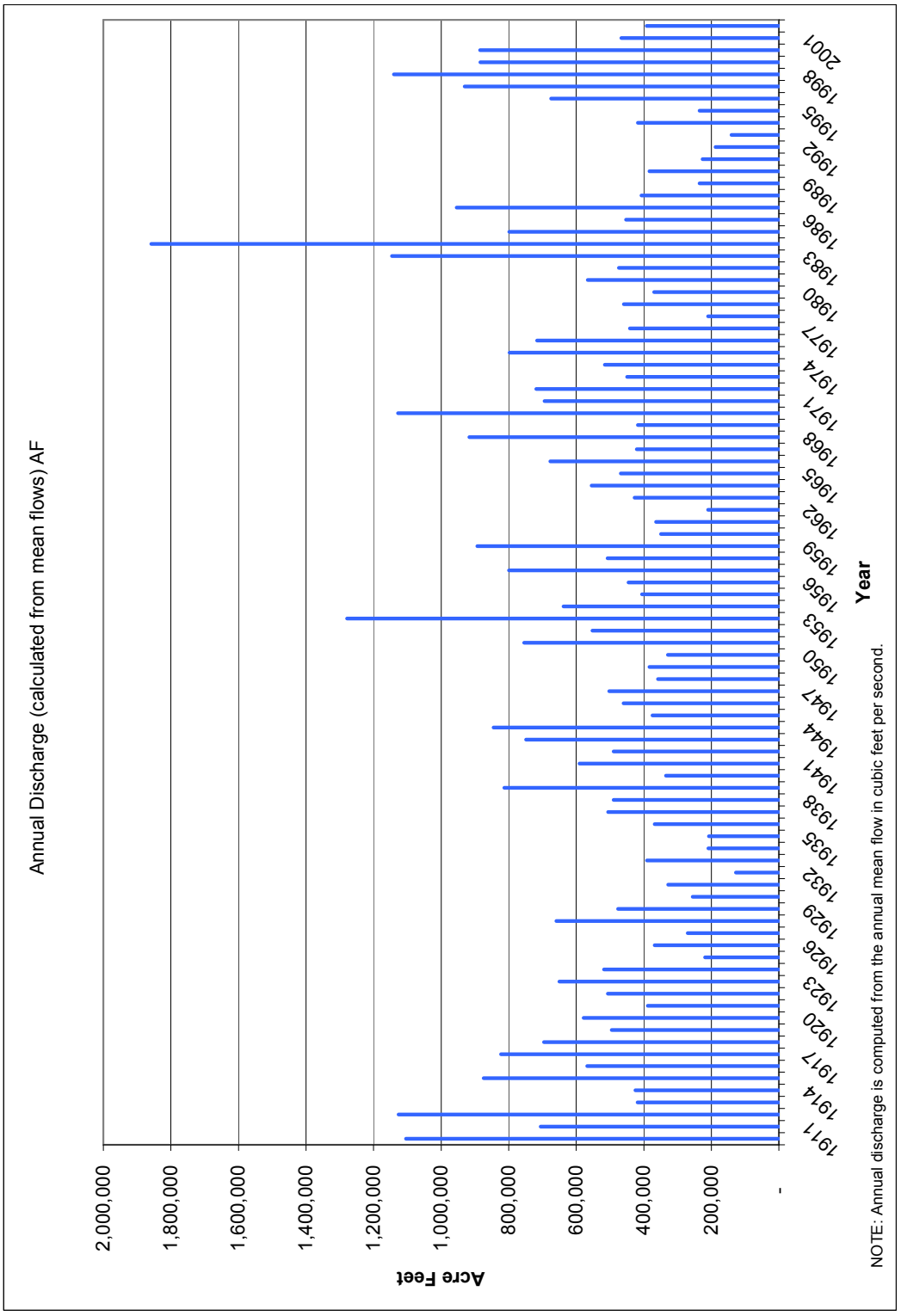

Figure 5: Annual Total Acre-feet Measured at Farad 1909 to 2000

By virtue of the original dam constructed at Independence Lake in 1879, TMWA can store the first 3,000 acre-feet of runoff from Independence Creek. Additional runoff cannot be stored in Independence Lake until Floriston Rates are met and the diversions in the Truckee Canal are being met according to operating procedures and Boca Reservoir has been filled. TMWA has the right to store and use 17,500 acre-feet of water from Independence Lake.

- *Stampede Reservoir*. Stampede Reservoir, also on the Little Truckee River, was completed in 1970 by the USBR as part of the Washoe Project for the purposes of flood control; irrigation; municipal, industrial, and domestic water supply; recreation; and fishery propagation. The Reservoir has a useable storage capacity of 221,490 acre-feet and a permit to store 126,000 acre-feet. The drainage basin of Stampede Reservoir is 136 square miles. Since its completion, the operation of Stampede Reservoir has been the subject of extensive litigation. Even though municipal and industrial use became an authorized purpose of the reservoir by virtue of the Water Supply Act of 1958, the then Secretary of the Interior and his successors have refused to sign a contract for the sale of water from the reservoir to the Carson-Truckee Water Conservancy District ("CTWCD"), a public agency established to be the contracting entity with the United States. The refusal to sign a contract was based on the possible negative impacts the sale of water could have on the endangered species of Pyramid Lake. In 1976 the CTWCD, the State of Nevada, and Sierra filed suit in Federal Court asking that the Secretary be ordered to sign the water sale contract. The Court held that the U.S. had the right to use the yield of Stampede Reservoir for fishery management in the lower river so long as the Cui-ui remains an endangered species. The decision was ultimately appealed to the United States Supreme Court. In 1985, the U.S. Supreme Court refused to consider the appeal and the lower court decision stood.

- *Boca Reservoir*. Boca Reservoir, also located on the Little Truckee River near its confluence with the Truckee River, has a useable capacity of 40,800 acre-feet and was constructed by the United States in 1937. Water released from Boca Reservoir is used along with natural flow and Lake Tahoe releases to meet the Floriston rates. The rights to store are owned and the reservoir is operated by the Washoe County Water Conservation District ("WCWCD"). TMWA shares with WCWCD the annual operation and maintenance costs in proportion to its storage rights which in addition to the irrigation rights supported by this reservoir includes 800 acre-feet of Boca pondage capacity.

- *Lahontan Reservoir*. Lahontan dam and reservoir, constructed by the United States as part of the Newlands Project, was completed in 1915. The dam, located on the Carson River approximately 18 miles west of the city of Fallon, Nevada, has a maximum storage capacity of 317,000 acre-feet (with flashboards) and stores water diverted from the Truckee River at Derby Dam, via the Truckee Canal, along with the natural flow of the Carson River. The drainage basin of Lahontan Reservoir is approximately 1,950 square miles. The capacity of the Truckee Canal which takes water from the Truckee River to Lahontan is 900 cfs.

The first diversion of water in the Truckee Meadows area was some time in 1858, prior to Nevada becoming a state. From then until the turn of the century, numerous canals were constructed to deliver water to agricultural lands within the Truckee Meadows. Water not diverted for irrigation purposes flowed to Pyramid Lake.

A new demand for Truckee River water was created when on July 2, 1902, the United States withdrew from public entry the lands required for the government's first reclamation project, to be known as the Newlands Project located in and around the vicinity of Fallon, Nevada. On May 21, 1903, the United States posted an application to appropriate the water stored in Lake Tahoe. Recognizing that water released for the Newlands Project would be subject to a multitude of upstream diversions with very early priorities, the United States, first brought suit to condemn the operation of the Tahoe Dam and then filed to adjudicate all uses of Truckee River water within the State of Nevada and to establish a firm water supply for the Newlands Project. The final decree in the condemnation lawsuit is known as the 1915 decree and was entered June 4, 1915. The final decree in the water rights adjudication lawsuit is know as the Orr Ditch Decree and was entered in 1944.

In 1973, the Pyramid Lake Paiute Tribe ("PLPT") and the United States filed an action in Federal District court asking that the Orr Ditch Decree be reopened and claiming the first right to 485,000 acre-feet of Truckee River Water per year. In 1976 Sierra and the Carson Truckee Water Conservancy District filed suit to require the use of Stampede Reservoir for municipal purpose. By 1979 Sierra had done sufficient studies to determine that it would quickly be out of water if certain measures were not immediately taken to increase the number of water rights per new service. By 1982 the Federal District court decided that the United States had the authority to use Stampede reservoir for conservation of the endangered species and on June 24, 1983, the United States Supreme court determined that the Orr Ditch Decree was "Res Judicata" and binding on PLPT and the United States in Nevada. The PLPT and the United States also filed suit in California claiming that all the California water rights including TMWA reservoir rights to Donner and Independence should be secondary to the PLPT claim of right. The California courts have agreed that Donner and Independence should not be subject to the PLPT's claims because the rights rely upon the Decree; however other claims are still pending. Essentially, during the late 1980s the community, PLPT and the U.S. were in gridlock. The amount of water rights was assured for each year but sufficient drought reserves for future growth were not secured for the Reno-Sparks community. The PLPT's primary interest was to improve the timing of flows in the lower Truckee River through changing the operations of the Truckee River reservoirs.

The primary focus of negotiations during the 1980's was on issues involving the PLPT and the Newlands Project. Those negotiations failed because PLPT and TCID were not able to agree on how much water could be diverted at Derby Dam for the Newlands Project. Another attempt was made in 1985 to pass the interstate allocation of water in Congress and this attempt also failed. In 1988 when Senator Reid undertook the settlement of water issues, the gridlock was even more pronounced and it appeared the community would be in building moratorium if additional drought reserves could not be found. Sierra had pursued the construction of Dog Creek Reservoir but every opportunity to build a reservoir required an Army Corp 404 permit which in turned required Endangered Species Act consultation. In 1989 when the PLPT and Sierra signed the Preliminary Settlement Agreement, ("PSA") those parties had negotiated the

basic framework of operation of the River system to create the ability to "credit" store seasonal unexercised water rights in the reservoir for drought and/or fishery purposes. In that agreement the parties agreed to provide enhanced drought supplies for the Truckee Meadows community and to changes in the operation of Truckee River reservoirs to improve the timing of inflows to Pyramid Lake. That agreement did not address the issues between the PLPT and the Newlands Project. In wet years the rules favored water for the fishery, and in the dry years the rules favor water for drought supplies. That concept was presented to the Congress and work was begun on PL 101-618. The bill needed to provide for the interstate allocation of water as well as making the U.S. a party to the PSA. In November of 1990 PL 101-618 was passed in the closing hours of the session. Since that time, the cooperation among the parties has improved considerably and many opportunities to the cooperate and coordinate have been undertaken including: a drought contract to use Prosser Creek water if the Truckee Meadows needed it for drought supply (that agreement expired in 1995); an exchange contract for Independence water during the drought which improved drought reserves while protecting the fishery, temporary transfers for water quality; the 1996 Water Quality Settlement Agreement; the Unappropriated Water Agreement; the Interim Storage Agreement (ISA), also known as the "5000 Acre-Feet Agreement"; the conservation agreement; and annual operations to improve releases to meet California objectives and others.

The rights established in the Orr Ditch Decree include irrigation rights for the Pyramid Lake Indian Reservation; for the United States to divert water to the Newlands Project and to store and release water from Lake Tahoe; rights for hydroelectric power generation; rights for municipal, industrial, and domestic use; and rights for the irrigation of private agricultural lands.

Certain parties to that Decree also entered into the Truckee River Agreement, dated June 13, 1935, and adopted by the Court as part of the Decree. By incorporating the Truckee River Agreement in the Decree, specific operating criteria are set forth under which the Truckee River system must be operated. The Agreement provides for specific flow rates that must be maintained in the Truckee River at the Farad gauging station. These flow rates are known as the "Floriston Rates." The Floriston Rates are dependent upon the level of Lake Tahoe and are shown in Table 1 .

The Truckee River Agreement specifies that if the Floriston Rates cannot be met by natural flow, water must be released from Lake Tahoe and/or Boca Reservoir to meet the required rate of flow. Only that quantity of water required to meet Floriston Rates can be released. If the Floriston Rates are being met from natural flow in the Truckee River then water need not be released from Lake Tahoe or Boca Reservoir.

In addition to the criteria specified in the Orr Ditch Decree, there are other constraints that affect the operation of the Truckee River system. The natural rim located some 400 feet upstream from the dam controls the amount of water that can be discharged from Lake Tahoe at its lower elevations. For example, when the water surface elevation of the lake is one foot above the rim (which equals approximately 122,000 acre-feet of water in storage), only 211 cfs can be discharge over the rim into the Truckee River. When the lake elevation is one-half foot above the rim, the maximum rate of outflow is 55 cfs.

Table 1: Truckee River "Floriston Rates" Required at Farad (units in cfs)

Lake Tahoe Elevations	October	November thru February	March	April thru September
Below 6223.00 feet (natural rim)	0	0	0	0
Below 6225.25 feet	400	300	300	500
Between 6225.25 and 6226.00 feet	400	350	350	500
Above 6226.00 feet	400	400	500	500

Other constraints include required flood control reservations during the winter and spring months for Martis Creek, Prosser Creek, Stampede and Boca Reservoirs; water right priorities that establish the sequence in which the storage reservoirs can be filled and required stream flow maintenance releases from upstream reservoirs are shown in Table 2.

The Orr Ditch Decree and the incorporated Truckee River Agreement provides TMWA with its basic water rights for its municipal and industrial water system. Article V of the Truckee River Agreement grants TMWA the right to divert 40 cfs from the Truckee River at all times. This right, equal to 28,958 acre-feet/year, is senior to all other water rights from the Truckee River with the exception of the irrigation rights granted to the United States for the Pyramid Lake Indian Reservation. Because of its priority, this 40 cfs right can be fully exercised in all but the driest of years.

Claim Number 726 of the Orr Ditch Decree granted TMWA the right to divert 13.6 cfs from Hunter Creek for use in its water system. This right equal to 9,847 acre-feet per year, has a priority of 1863. Use of this right is limited by the amount of water available in Hunter Creek. During a critical drought period, such as 1987-1994, this right would provide an estimated annual yield of approximately 3,500 acre-feet.

Table 2: Truckee River System Reservoirs and Required Releases

Reservoir	Owner	Useable Storage Capacity acre-feet	Required Releases Stream Flow MTCE. Cfs	Drainage Area Sq. Miles
Lake Tahoe	USA *	744,600	50 Oct 1 – Mar 31 70 Apr 1 – Sep 30	503
Donner Lake	TMWA TCID	9,500	**	14.6
Martis Creek	USA	19,583		40
Prosser Creek	USA	28,640	5	50.5
Independence Lake	TMWA	17,500	2	8.2
Stampede	USA	221,490	30	136
Boca	USA	40,870***		172
	Total	1,082,183		
Lahontan (Carson River)	USA	290,000 (without flashboards) 317,000 (with flashboards)		1,950

* US acquired storage rights in 1903, and rights to operate Lake Tahoe Dam in 1915.
** 2 cfs if more than 5 cfs in Donner Creek below confluence with Cold Creek.
3 cfs if less than 5 cfs in Donner Creek below confluence with Cold Creek.
*** TMWA owns 800 acre-feet of pondage.

TMWA annually stores runoff at Independence Lake as allowed by its storage rights. TMWA releases approximately 3,000 acre-feet of water in the fall in order to provide storage space for the ensuing year's runoff. Historically that water was stored in Boca Reservoir for a one year period of time. In 1990 as the result of the negotiation of PL 101-618, the Negotiated Settlement, it became clear that the United States would require an extended EIS process on the Truckee River Operating Agreement ("TROA"). Senator Reid put language in the bill that allowed the Secretary of Interior to negotiate an interim storage agreement. The interim storage agreement is essentially a first installment of the TROA that allows the fall release of Independence Lake water, together with the water owned by TMWA from its half of Donner Lake, to be stored in Boca and/or Stampede reservoirs and carried over for use the following spring and summer. If the amount of storage water is over 5,000 acre-feet on August 31, it would be turned over to the U.S. for recovery of endangered species. Table 3 shows a history of POSW balance in Boca on August 31. That agreement between Sierra, the Secretary of Interior, the PLPT and the Washoe County Conservation District was entered into in June of 1994 and has a term of 25 years or until it is replaced with the final effective Truckee River Operating Agreement.

Because of the water right priorities on the Little Truckee River, the first 3,000 acre-feet is TMWA's senior right to store in Independence. During droughts this 3,000 acre-feet per year

can be depended upon to refill Independence Lake, and there has been sufficient runoff in all historic drought years to satisfy this right. After storing the 3,000 acre-feet of first priority rights, other rights on the Little Truckee and Truckee must first be satisfied before additional water can be stored in Independence Lake. The sequence of water right priorities on the Truckee is as follows:

- Deliver water to pre-1870 Irrigation Rights (this is only a separate item if Floriston Rates are not being met)
- Divert up to 60 cfs to Sierra Valley (1870 priority in dry years only)
- Store up to 3,000 acre-feet in Independence Lake and fill Donner
- Provide Floriston Rate flows
- Store up to 25,000 acre-feet in Boca Reservoir
- Provide Truckee Canal diversion (this may be as much as 900 cfs) to TCID in accordance with the Operating Criteria and Procedures ("OCAP")
- Fill Boca Reservoir to capacity of 40,800 acre-feet
- Fill Independence Lake to capacity of 17,500 acre-feet
- Fill Stampede Reservoir to capacity of 225,000 acre-feet
- Fill Prosser Creek Reservoir with 29,800 acre-feet.

During drought periods, TMWA can request seasonal approval from the Division of Safety of Dams in California to begin storage in Donner Lake prior to its April 15 operating criteria. This early storage is important to ensure that as much runoff as possible can be stored in Donner Lake and used to augment Truckee River flows during drought periods.

Table 3:Annual Storage Under Terms of the Interim Storage Agreement (units in acre-feet)

Year	Credit Storage at August 31	Storage Turned over for Fish Recovery
1996	1,576	0
1997	2,144	*
1998	826	*
1999	1,828	0
2000	2,963	0
2001	5,000	621
2002	5,000	3,094

* All credit water in these years spilled due to high precipitation resulting in full reservoirs.

Groundwater Resources

The principal source of groundwater in the Truckee River basin in Nevada is the Truckee Meadows. Groundwater occurs beneath Truckee Meadows and has been pumped from the groundwater reservoir for over fifty years. Large quantities of groundwater are available from that part of the reservoir containing unconsolidated rocks of alluvial origin. Groundwater also is available from consolidated rocks, generally in the foothills surrounding Truckee Meadows.

The groundwater reservoir is essentially full in much of the Truckee Meadows, with water moving from areas of recharge to areas or points of discharge. The natural groundwater discharge supports vegetation principally in the eastern portion of the Truckee Meadows and provides water directly to drains and creeks passing through the Meadows. Groundwater discharge also occurs when wells are pumped to provide water for various uses in the Truckee Meadows.

The water-bearing materials in the Truckee Meadows are recharged from infiltration of precipitation which falls in the mountains and on the land surface, seepage from streams entering or crossing the Meadows, underflow from tributary valleys, seepage from irrigation ditches, deep percolation of water applied for irrigation of pasture, row crops, lawns and other greenscape areas, and from waste water discharged from septic tanks, and from the injection of treated surface water into public supply wells used for artificial recharge. On the eastern slopes of the Sierra, where recharge occurs, precipitation ranges from 8 to 16 inches per year. A significant amount of recharge to the water-bearing materials in Truckee Meadows is due to seepage from irrigation canals and deep percolation of water applied for irrigation. In the past, it has been estimated that approximately 25% of water applied for irrigation percolates into the groundwater reservoir. It has been assumed that as land is converted from irrigated pasture or row crops to lawns or other types of water consumptive landscaping, the recharge from the land would be reduced.

TMWA has 28 production wells in the Truckee Meadows basin and 2 production wells in the west Lemmon Valley basin used for potable water. In addition there are 3 wells, Peckham, Stanford and Stead that are unsuitable for drinking purposes but are used for non-potable applications such as construction water. Two other wells in west Lemmon Valley are in the process of rehabilitation for use as recharge wells.

TMWA's wells are located throughout the distribution system as illustrated in Figure 6. The map also identifies some of the low water quality and low production areas in portions of the Truckee Meadows hydrographic basin.

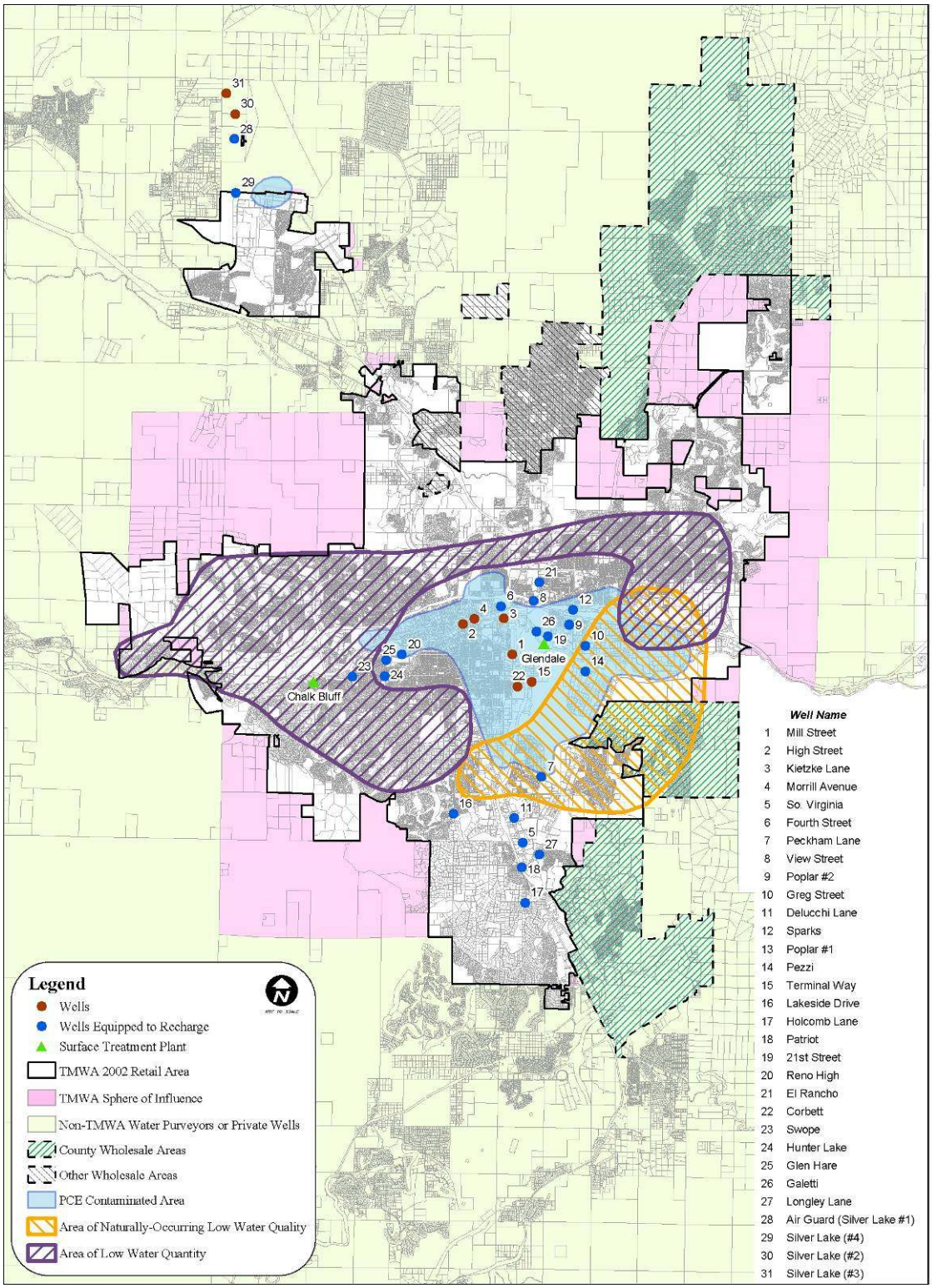

Figure 6: Production Wells, Water Quality, Water Quantity and PCE Plumes/or Sites

Water Quality

Surface Water Quality Surface water originates as runoff from the Sierra Nevada Mountains and is obtained from Lake Tahoe and the Truckee River Basin. Surface water is of exceptional quality because base flows are composed of Sierra Nevada Mountain snowpack runoff and seepage or spring flow. Typical water quality data are shown in Table 4. Mineral concentrations are very low, and turbidity levels are typically less than five nephalometric turbidity units (NTU). However, water in the Truckee River can have higher turbidity because of storm runoff and/or algae growth associated with low flows and warm temperatures in summer. All surface water is treated at one of two water treatment plants, described in Chapter 2, before distribution to customers.

Table 4: Typical Mineral Concentrations of Surface Water

Constituent	Minimum	Average	Maximum
Total dissolved solids, mg/l	34	86	132
Total suspended solids, mg/l	1	13	20,000*
PH	6.8	7.7	9.6
Temperature, C	0.5	0.0	20.0

* High turbidity events only, such as the July 1992 flash flood on Grey Creek.

Subsurface Water Quality Groundwater quality varies throughout the Truckee Meadows hydrographic basin as highlighted in Figure 6. In 1987, several of TMWA's wells began testing positive for trace amounts of an organic solvent known as perchloroethylene, tetrachloroethylene, and PCE. This solvent is used in a variety of commercial/industrial operations such as commercial dry cleaning, paint manufacturing and distribution, and auto repair. Figure 6 illustrates the extent of the PCE contamination that was initially found in groundwater within the limits of the city of Reno. Subsequent groundwater investigations have identified widespread occurrences of PCE and other volatile organic compounds (VOC's) in groundwater.

To address the presence of PCE in groundwater, which impacts both the drinking water supply and future construction projects that penetrate the water table, Senate Bill 489 was developed by a consortium of shared water and business interests and was passed in the 1995 legislature Session. This bill required the Washoe County Board of Commissioners ("BCC") to create a "Remediation District" once either the Nevada Division of Environmental Protection ("NDEP") administrator or the district health officer or both certified a groundwater

contamination problem existed. BCC received certification letters from both NDEP and the Washoe County Health District ("WCHD") in August 1995.

Funding for the Central Truckee Meadows Remediation District ("Remediation District") is calculated based on the program's budget needs and is prorated to customers proportionate to their annual water bills. Funding requirements for the ensuing year are placed on the tax roll for collection from every parcel within TMWA's wholesale and retail service areas. These funds are to be used for the design, construction, and operation of groundwater treatment facilities to treat groundwater. The funds have paid for three air-stripping-treatment facilities that remove PCE from five of TMWA's wells: Kietkze Lane, Mill Street, High Street, Morrill Avenue, and Corbett School.

The funding pays for ongoing environmental sampling, annual operation of the treatment facilities, and long-term, mitigation plans for the Remediation District. Over the last 4 years, environmental sampling of specified surface water locations and groundwater wells, as well as development of a comprehensive listing and mapping of historic land use throughout the Central Truckee Meadows, has been performed by the County. The primary goals of the remediation plan are to:

- Define the extent of the contamination.
- Recommend mitigation actions.
- Identify the costs associated with mitigation implementation.
- Develop proposals for the equitable allocation of costs among mitigation beneficiaries.

The Remediation District has achieved some success as a result of the daily pumping of TMWA's wells affected by PCE. The boundary of the contamination plume does not appear to be growing. TMWA is an active participant with the Remediation District in planning for and implementing mitigation of PCE.

In the west Lemmon Valley basin, a smaller PCE plume was identified in 1994. This plume, known as the Stead Solvent Site ("SSS") was identified as a result of an environmental survey conducted during a sale of property. The source of the PCE is linked to Air Force activities at the Stead Air Base when the base was active. The plume is confined to the unconfined aquifer (averaging 50 feet in depth) and is much smaller in extent due to the fact there is little horizontal groundwater movement in the aquifer except that related to well production near the plume. TMWA's Silver Lake Well is over 2,500 feet due west of the SSS, and PCE has not been detected in the well. TMWA is activity pursuing injection of treated surface water to abate the westward migration of the plume toward its well. Results thus far are very favorable. The injection program is described more fully in Chapter 2.

Because of the sovereign immunity of the United States, it was necessary for NDEP to file the lawsuit to secure the State of Nevada's jurisdiction over federal parties and to ensure long term federal participation in funding of cleanup activities. The parties (NDEP, Dermody, Moya Olsen Lear, Lear Family Trust (B), Leareno Development, Inc., City of Reno, United States of America (United States) and Airport Authority of Washoe County) to that litigation have entered into the Stead Consent Decree ("Consent Decree") to facilitate cleanup of pollution that may be located within certain areas of the former Stead Air Force Base, and to set forth the procedures

and rules for determining which parties are responsible for the cleanup of such contamination. The Consent Decree is designed to eliminate financial liability of new purchasers of property for existing contamination. All cleanup plans will be developed under the direction of NDEP.

The parties have been engaged in cooperative investigations at the former Stead Air Force Base since 1994 under the guidance of the NDEP. These cooperative investigations were initiated by Silver Lake water utility, NDEP, major property owners, and the USACE after contaminants were discovered in groundwater underlying portions of the former base. Much of the study areas have been carefully investigated and found to be free of environmental concerns.

The procedures in the Consent Decree apply only to contamination that exists as of the effective date of the Consent Decree. The Consent Decree requires the parties to adhere to strict guidelines in developing cleanup alternatives. To date, these parties have spent in excess of a million dollars in delineating this contamination and in investigating possible remedial alternatives.

Attaining allowable arsenic levels from groundwater sources is a significant issue for TMWA's well operations. The USEPA has finalized the maximum contaminant level (MCL) for arsenic. The proposed regulation is 10 part per billion (ppb), down from the current regulation of 50 ppb. At 10 ppb, 11 of TMWA's 30 wells are affected. Three of the wells that exceed the 10 ppb MCL (Poplar #1, Pezzi, and Terminal) are already piped to Glendale Treatment Plant ("GTP") for treatment and/or blending with treated surface water. Five other wells may be piped to GTP in the future (High Street, Morrill, Keitzke, Mill Street, and Corbett) while three other wells (View Street, Poplar #2, and Greg Street), though not close enough to a treatment plant, may require special mitigation. TMWA is in the process of evaluating mitigation strategies to address the arsenic compliance.

Summary

This chapter described the history of water delivery in the Truckee Meadows, including the formation of the Truckee Meadows Water Authority. Purveyance of Truckee River water for irrigation and drinking purposes began in the 1850's. For over 150 years the communities of the Truckee Meadows have relied on the Truckee River for at least a portion of their annual supplies.

The lake and reservoirs upstream of the Truckee Meadows are managed to provide flood protection and regulate river supplies in accord with numerous decrees, agreements, rights, State and Federal regulations and laws. It has been said that the Truckee River is the most litigated river in the United States. As the population in the Truckee Meadows has grown, particularly in the latter half of the twentieth century, more groundwater supplies have been developed to augment river supplies.

Water quality of TMWA's surface and groundwater sources are excellent with the exception of naturally occurring minerals in groundwater sources such as arsenic, and human-caused contaminants that affect a small part of the supply. TMWA is analyzing potential mitigation processes to meet the various Nevada Safe Water Treatment Rules ("NSWTR") administered by NDEP and Safe Drinking Water Act rules promulgated by EPA.

The next chapter will examine how the various resources described in this chapter are integrated with TMWA's surface water treatment facilities and groundwater production wells. The successful coordination of TMWA's current resources and facilities also provides the basis to determine the current and future level of water service commitments.

References

1985-2005 Water Resources Plan, Sierra Pacific Power Company,

1988-2008 Water Resources Plan, Sierra Pacific Power Company, January 1989.

1995-2015 Water Resources Plan, Sierra Pacific Power Company, June 1994.

1997 Regional Water Plan, Regional Water Planning Commission of Washoe County

Chapter 2 Integrated Management of Water Resources and Water Production Facilities

This chapter examines the relationship of water resources, and water rights associated with those resources, to TMWA's surface and groundwater production facilities. Water resources described in Chapter 1 include the rights to flows in the Truckee River, storage or contract rights in upstream reservoirs, and groundwater rights. The conjunctive management of the various rights along with its production facilities makes it possible for TMWA to meet its service commitments in drought and non-drought years. A review of water rights and water production facilities is followed by a discussion on water service commitments.

Water Rights

TMWA's accumulation of Orr Ditch Decree irrigation rights was begun by Sierra in the 1940's. After acquisition, the points of diversion, place of use, and manner of use are changed through application process with the Nevada State Engineer. TMWA's primary diversion points of surface water include the Highland Ditch ("Highland") and the Orr Ditch Pump Station ("Orr Pump") for the Chalk Bluff Treatment Plant ("CTP") and the Glendale Diversion Dam for the Glendale Treatment Plant ("GTP"). To date, TMWA has acquired and committed to service over 51,610 acre-feet of these irrigation rights that are used to create its water supply. The priorities of the acquired rights vary from very early priority, e.g., 1861, to later priorities of the early 1900's.

Until August of 1979, water service to applicants for new water service was supported using originally decreed water rights, groundwater resources, and the irrigation water rights acquired by that date. In that year, as the result of an extensive study by Sierra Pacific Power Company, the Washoe Council of Governments was informed of water supply problems resulting from the inability of the community to acquire use of Stampede Reservoir for municipal and industrial purposes. The State Engineer subsequently ordered that will-serve commitments for subdivisions could not be issued until a water budget showed that sufficient water was available for new projects. At this same time, RSW were approving commercial projects whether or not a "will serve" letter had been issued. To address this situation, Sierra sought approval of "Rule 17" with the PUCN. After extensive hearings in late 1981, the PUCN issued its Opinion and Order on February 8, 1982. The order provided that applicants for new water service had the option of transferring sufficient water rights to the utility or be placed on a waiting list until the utility had acquired water rights to serve the project. If the applicant chose to be placed on the waiting list, the applicant was required to reimburse the costs incurred in acquiring the necessary water rights. The rule not only served to treat all applicants equally and ensure that supply would match demand, but it allowed applicants a choice as to purchasing water rights on the open market or waiting for the utility to acquire the necessary water rights.

As a result of a 1984 hearing, the PUCN reviewed and reaffirmed the policies and procedures contained in Rule 17. RSW enacted ordinances and/or resolutions requiring that all new developments transfer the necessary water rights to the city or county prior to the issuance

of a building permit. In 1986 the Tax Act was changed to require tax on this contribution of water rights. Since water rights acquired for the project were owned by the cities or county and then leased to the utility so that that a will-serve letter could be issued it was determined a tax would not be required. This process continued until 1996 when Federal tax laws were changed eliminating a tax contribution associated with the dedication of water facilities and water rights to private utilities. Since that time, the acquisition and dedication of water rights for the issuance of a will-serve commitment for projects within the cities of Reno and Sparks have been to TMWA, only Washoe County continues to require dedication of water rights to the County for projects in its jurisdiction.

Table 5 summarizes TMWA's inventory of water rights acquired or leased through June 2002.

Table 5: Water Rights Inventory (units in acre-feet)

	Reno	Sparks	Washoe County	TMWA	Totals
Decree rights					
Truckee (40 cfs)				28,959	28,959
Hunter (13.6 cfs)				9,847	9,847
Subtotal Decree Rights	-	-	-	38,806	38,806
Irrigation Rights	11,261	5,006	3,229	32,119	51,615
Storage Rights					
Independence Lake				17,500	17,500
Donner Lake				4,750	4,750
Subtotal Storage Rights	-	-	-	22,250	22,250
Groundwater Rights					
Truckee Meadows Basin [1]				15,950	15,950
Lemmon Valley Basin				755	755
	-	-	-	16,705	16,705
Total Rights All Sources	11,261	5,006	3,229	109,881	129,376

[1] Groundwater diversion rights total 41,811 acre-feet annually, which rights are limted to average year pumping of 15,950 acre-feet annually and drought year pumping of 22,000 acre-feet annually.

TMWA has, as shown in Table 5, over 129,000 acre-feet of decreed, storage, and irrigation rights, sufficient to generate water supplies for customer demands. TMWA does not use its POSW nor all its groundwater for demands in average or above-average precipitation years since these rights are held in reserve for drought years. At the present time, TMWA holds certificated groundwater diversion rights totaling 41,811 acre-feet. In 1983, the State Engineer limited diversions against these permits to an annual groundwater pumpage of 12,000 acre-feet plus 1,340 acre-feet of rights acquired above the certificated amounts. This administrative cap made it difficult for the purveyor to integrate and maximize the operation of its groundwater and surface water resource in order to expand water service to new customers. This constraint was

alleviated somewhat as new surface production facilities were constructed in the 1990's. These improvements are discussed in the following section.

Water Production Facilities

Hydroelectric Facilities. Though not used in the production of treated water, TMWA operates four hydroelectric power-generating facilities located on the Truckee River above Reno. These hydroelectric plants are valuable assets, because of the historic diversion rights[4] associated with hydroelectric generation, and the power that they generate helps to offset up to 94% of TMWA's annual power costs. The hydroelectric facilities are run-of-the-river plants; with no storage reservoirs at their intakes. Water is diverted from the river at a weir and flows to the plant's forebay through a series of wooden flumes and earthen canals. Water flows from the forebay through penstock pipelines to the hydroelectric turbine generators, and then returns to the river. The plants were constructed between 1900 and 1912 and provide rights to river flows that are used for hydroelectric generation, as well as water supply. Full Floriston Rates allow the hydroelectric plants to be operated at full capacity. The total generation capacity of the four hydroelectric plants is 10.1 megawatts. The hydroelectric facilities are not subject to Federal Energy Regulatory Commission ("FERC") jurisdiction as currently operated since the plants existed prior to FERC. Details of the plants are shown in Table 6.

Table 6: Hydroelectric Facilities

Plant Name	Generating Capacity (megawatts)	Year of Construction	Year of Generator Rehab	Comments
Farad	2.8	1900	1993	Out of service due to wash out of diversion weir in January 1997 flood
Fleish	2.7	1905	1955	Operating
Verdi	2.4	1912	1987	Operating
Washoe	2.2	1908	1993	Operating
Total	10.1			

4 The hydroelectric water rights were confirmed in the 1915 Truckee River General Electric Decree and Claims 4 through 9, under the Orr Ditch Decree.

Chalk Bluff Treatment Plant. CTP is the largest surface water treatment plant, with a current capability of producing approximately 69 MGD of finished treated water. Phase I of this facility was completed in 1994 at 20 MGD nominal capacity and Phase II of this facility was completed in 1996 with a treatment capacity of 55 MGD.

The plant sits on Chalk Bluff overlooking the Truckee River on the west side of Reno. Untreated (raw) water is delivered to the plant via Highland Ditch by gravity or from the Orr Pump station. Highland Ditch has a nominal capacity of 48 MGD, is approximately 5.85 miles in length, and includes structures such as siphons, flumes, and highway and railroad crossings. Due to ice formation, the ditch is typically shut down in favor of the Orr Pump in the winter time. The Orr Pump diversion on the Truckee River is located approximately 1,000 feet due south of CTP. The pump station was built in conjunction with CTP construction and was expanded to a capacity of 72 MGD in 2001. The pump station structure is designed for expansion to approximately 80 MGD firm pumping capacity.

CTP treats raw water through settling of heavy solids, screening, flocculation and sedimentation, filtration, and chlorination. The plant is designed for modular expansions to an ultimate treatment capacity of 120 MGD. The next expansion of 15 MGD treatment capacity (13.8 MGD finished water capacity due to 8% backwashing requirements) will be accomplished primarily through the addition of mechanical equipment to existing structures. The 15 MGD capacity expansion, identified in TMWA's Water 2002-2022 Facility Plan, is tentatively planned for 2004 at the approximate cost of $9 million. The plant currently has 12 million gallons (MG) of finished water reservoir capacity with the ability to add another 4 MG reservoir.

Glendale Treatment Plant. GTP is the smaller of TMWA's surface treatment plants and is located just east of the Hilton Hotel in Sparks. The plant borders the north side of the Truckee River and diverts raw water from the river directly at the plant. The plant was originally built in 1976 and upgraded in 1996. It employs the same treatment processes as CTP thereby satisfying Nevada Safe Water Treatment Rule ("NSWTR") and also is authorized to filter at the same filtration rate (7.5 gpm/square foot) as CTP. Although the plant is rated at 37.5 MGD, plant output is currently limited to 25 MGD because of limitations of the raw water diversion and distribution system. GTP houses TMWA's pilot treatment plant, which is used to test chemicals and operational enhancements prior to full-scale implementation at the treatment plants.

The capacities of the two surface water treatments plants are summarized here:

	Treatment Capacity	Production/Nominal Capacity
Chalk Bluff	75 MGD	69 MGD
Glendale	37.5 MGD	25 MGD

Wells. TMWA has 28 production wells in the Truckee Meadows basin and 2 production wells in the west Lemmon Valley basin. Well capacities are noted in Table 7. The wells are spread throughout the distribution system (see Figure 6) and pump water directly into the distribution system after chlorination. However, water from five wells (Morrill, Kietzke, High, Mill and Corbett) receives air-stripping treatment for PCE removal, and water from three wells (Terminal, Pezzi and Poplar #1) is pumped to GTP for arsenic removal and/or blending. The Peckham Well is not used due to a high arsenic concentration. The Stanford Way Well and the original Air Force well in Stead are used for non-potable purposes only (e.g., construction uses).

There are also two wells north of the Air Guard Well that will be rehabilitated 2002/2003 and prepped for service, however, new distribution facilities are needed to get water to and from these wells.

TMWA's production wells have a rated capacity of approximately 58.5 MGD and are relied on in the summer to handle peak water demands. The wells typically have supplied between 15 and 20 percent of annual, net water production. Table 8 summarizes water production by source since 1990.

In the winter season, many of the wells are used to inject or artificially recharge treated surface water into the groundwater aquifer for storage and future drought year use. Those wells are identified in Figure 6. The injection of treated water for TMWA's aquifer storage and recovery program ("ASR") has increased since the pilot program began in 1993. TMWA's ASR program has grown from 81 acre-feet of treated surface water in 1993 to over 3,000 acre-feet in 2001 as shown in Table 9. The total amount of water injected in the Truckee Meadows hydrographic basin's aquifer since 1993 is 8,296 acre-feet, while 773 acre-feet has been injected into the west Lemmon Valley hydrographic basin since 2000.

TMWA's injection of treated water is governed by quantity permits issued by Nevada Division of Water Resources ("NDWR"), and quality permits issued by Nevada Department of Environmental Protection ("NDEP"). Permit R-016 was approved by the State Engineer in 2001; this permit consolidated the Truckee Meadows wells that were used under 1992 permits R-010 and R-013, which were subsequently cancelled into one permit. Recharge of 7,000 acre-feet annually is permitted under R-016. Coincident with issuance of R-016, on October 16, 2001 NDEP reissued Permit No. UNEV92200 authorizing TMWA to inject treated water into twenty-three wells within the Truckee Meadows hydrographic basin No. 87. The permit expires on October 16, 2006. Reports are issued every January and July to both agencies summarizing injection activities including water quality[5].

[5] A copy of the January 2003 NDEP report is found in Appendix C.

Table 7: Production Well Capacities (units in MGD)

Groundwater Facilities	Year Placed in Service	Rated Capacity	Cumulative Rated Capacity
Hunter Lake	1995	3.1	3.1
Reno High	1991	3.3	6.4
Swope	1993	0.8	7.2
Galletti	2000	2.5	9.7
Greg st	1967	2.1	11.8
Pop 2	1967	1.5	13.3
Sparks Ave.	1967	0.6	13.9
21st st	1991	2.0	15.9
Glen Hare	1999	1.6	17.5
Fourth St	1971	2.7	20.2
View St	1969	2.6	22.8
El Rancho	1992	1.7	24.5
S. Virginia	1969	1.6	26.1
Lakeside	1985	1.1	27.2
Delucchi	1972	0.8	28.0
Holcomb	1988	1.0	29.0
Patriot	1990	1.8	30.8
Longley Lane	2000	2.1	32.9
Silver Lake	1973	1.8	34.7
Air Guard	1968	1.8	36.5
Sierra Plaza	2002	1.4	37.9
Mendive	2003	0.4	38.3
Arsenic-Treated			
Pop 1	1963	3.2	41.5
Pezzi	1974	1.6	43.1
Terminal	1961	1.8	44.9
PCE - Treated			
Kietzke	1972	3.4	48.3
Mill	1960	3.4	51.7
Corbett	1993	2.0	53.7
Morrill	1963	2.1	55.8
High St	1961	2.7	58.5

Table 8: Annual Water Production (units in acre-feet)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PLANTS													
Chalk Bluff					12,134	17,662	38,425	51,827	50,011	50,675	56,423	58,333	55,231
Glendale	11,987	11,389	12,775	13,508	13,666	12,098	14,021	11,726	10,066	13,704	13,234	10,925	13,087
Highland	19,221	16,513	15,999	17,005	12,494	11,899	3,047						
Hunter Creek	10,977	10,559	11,051	14,636	9,372	3,607							
Idlewild	6,397	6,277	3,138	3,723	1,143								
TOTAL SURFACE WATER	48,582	44,738	42,963	48,871	48,808	45,265	55,492	63,553	60,076	64,379	69,656	69,257	68,318
WELLS													
Mill Street	1,651	1,370	1,596	1,035	1,679	17	0	8	0	601	850	1,224	1,196
High Street	1,081	1,340	716	16	86	132	1,287	840	551	1,319	722	1,600	1,596
Kietzke Lane	1,142	848	1,150	629	1,676	557	0	0	247	1,072	1,045	1,450	1,480
Morrill Avenue	1,213	1,171	539	20	69	0	1,113	1,422	1,385	855	840	1,351	1,419
So. Virginia	1,063	1,018	784	527	483	388	452	475	243	269	264	303	210
Fourth Street	1,184	1,033	974	292	721	867	738	559	389	602	432	784	309
Peckham Lane	441	488	620	261	218	201	0	0	0	0	19	0	0
View Street	1,321	1,483	1,691	943	1,841	1,719	1,199	521	396	660	481	669	328
Poplar #2	1,684	1,071	903	373	594	506	341	502	341	660	590	720	393
Greg Street	1,417	875	819	640	685	1,024	879	525	587	736	735	857	612
Delucchi Lane	390	355	292	219	0	51	106	152	125	157	89	122	111
Sparks	833	428	355	157	106	77	77	76	71	108	132	174	71
Poplar #1	0	0	277	526	828	1,166	669	328	253	379	949	682	342
Pezzi	31	21	264	178	488	685	235	19	14	113	454	375	207
Terminal Way	39	58	212	67	556	412	303	129	134	20	274	439	286
Lakeside Drive	555	632	560	166	188	192	276	358	171	262	137	182	86
Holcomb Lane	486	623	150	23	200	111	169	193	425	184	21	137	139
Patriot	24	531	986	847	853	679	553	323	292	408	197	280	255
21st Street	0	549	954	728	1,124	1,189	822	474	390	615	710	757	664
Reno High	0	567	1,854	1,757	1,997	2,226	1,481	293	366	758	429	707	437
El Rancho	0	0	0	88	522	361	485	257	798	335	297	185	232
Corbett	0	0	0	0	454	81	0	0	155	682	590	1,068	1,039
Swope	0	0	0	0	358	803	298	69	81	121	66	115	62
Hunter Lake	0	0	0	0	0	1,273	1,148	334	327	836	463	762	1,209
Glen Hare	0	0	0	0	0	0	0	0	0	0	376	407	295
Galetti	0	0	0	0	0	0	0	0	0	0	526	857	783
Longley	0	0	0	0	0	0	0	0	0	0	213	375	358
Sierra Plaza	0	0	0	0	0	0	0	0	0	0	0	0	159
Mendive	0	0	0	0	0	0	0	0	0	0	0	0	0
Air Guard (Silver Lake #1)	0	0	0	0	0	0	0	0	0	188	159	412	236
Silver Lake (#4)	0	0	0	0	0	0	0	0	0	308	228	246	308
TOTAL GROUNDWATER	14,557	14,461	15,696	9,490	15,728	14,718	12,629	7,857	7,744	12,249	12,290	17,239	14,821
ANNUAL TOTAL	63,139	59,199	58,658	58,362	64,536	59,983	68,121	71,410	67,821	76,628	81,946	86,496	83,139
Retail Gallons per Capita per Day	**291**	**266**	**260**	**253**	**269**	**239**	**260**	**270**	**252**	**270**	**275**	**280**	**264**
Percent Surface Water	77%	76%	73%	84%	76%	75%	81%	89%	89%	84%	85%	80%	82%
Percent Ground Water	23%	24%	27%	16%	24%	25%	19%	11%	11%	16%	15%	20%	18%
*Surface water produced for recharge	0	0	0	81	9	116	132	133	550	778	1,717	3,084	2,469
*PCE pumping	0	0	0	0	0	0	0	0	0	2,024	2,090	3,871	4,164

Table 9: Artificial Recharge History (units in acre-feet)

Well Name	Year Equipped for Recharge	1993 to 95	1996	1997	1998	1999	2000	2001	2002	Total
Lakeside Drive	1993	128	132	111	377	194	246	258	218	1,664
Hunter Lake	1998/99					196	290	332	175	993
View Street	1998				173	327	486	433	260	1,679
Reno High	1998/99					61	190	216	142	609
Poplar #1	1993			22						22
Poplar #2	1999						68	46	70	184
Kietzke Lane	1993	26								26
Morrill Avenue	1993	27								27
Fourth Street	1993	25					39	452	309	825
Mill Street	1993									
Glenn Hare	1999						36	117	62	215
Greg Street	1999						76	135	137	348
Sparks	1999									
Terminal Way	1999						2			2
El Rancho	1999						121	216	178	515
Holcomb Lane	2000						21	39	187	247
21st Street	2000						61	202	193	456
Galletti Way	2000						81	239	234	554
Longley Lane	2000							10	14	24
Total - Truckee Meadows		116	132	133	550	778	1,717	2,693	2,177	8,296

Subsequent to acquiring the Silver Lake Water Distribution Company in 1999, Sierra filed applications in the fall of 1999 with NDWR and NDEP to treat and inject 2,500 acre-feet water through its newly acquired wells in west Lemmon Valley. A concern arose between Sierra and the parties involved in the Stead Solvent Site ("SSS") mitigation plans as to the potential effects of recharge in the basin.

TMWA began a series of injection tests in 2000 to evaluate recharge potential in the basin. Tests were performed to:

1. Test the aquifer's response to annual increase in volumes of injected water to assess the maximum injection rate;

2. Test maximum injection rates, feasibility and characteristics at TMWA's Lemmon Valley wells.
3. Evaluate the SSS response to injection of potable water in the basin.

TMWA injected a total of 35 acre-feet of water into its Silver Lake Well ("SLW") between February and May 2000. TMWA conducted a second injection test between February and April 2001 of 170.8 acre-feet in TMWA's Silver Lake Well ("SLW") and Army Air Guard ("AAG") wells. A third temporary permit was issued in 2001 that allowed TMWA to inject up to 600 acre-feet between November 1, 2001 and April 30, 2002. TMWA injected 166.3 acre-feet in SLW and 298.3 acre-feet in AAG for a total of 464.6 acre-feet before April 2002.

Conclusions from these 3 tests showed that (1) injection into the West Lemmon Valley basin has little to no impact on the contamination in the shallow aquifer (<50 ft); (2) injection rates averaged approximately 400 gpm at each well; and (3) injection in this basin will not adversely affect the contaminant clean up efforts of the SSS; on the contrary, injection has shown to be a positive benefit to the SSS clean-up efforts such that anticipated expenditures for the agreed upon mitigation plan may be reduced. TMWA was issued a 5-yr permit in November 2002 to inject up to 2,500 Acre-feet in the West Lemmon Valley basin.

ASR will become an integral part of developing additional reserves for drought year requirements should other future resources not be available in a timely manner. To accomplish this TMWA is investigating additional sites for artificial recharge development with plans to equip if possible its remaining and new production wells for recharge. By achieving its annual injection targets, TMWA's ASR program aims at enhancing drought supplies, provide opportunity to expand water supply service and improve subsurface-water quality of the groundwater in the Truckee Meadows and Lemmon Valley hydrographic basins.

Water Service Commitments

The primary purpose of water resource planning for the Truckee Meadows is to determine how to supply the water needs of current and future customers with current and future water resources during drought and non-drought years. Since only minimum surface water deliveries may be available during drought years, a review of the most recent drought experience is instructive on how the water supplies were successfully managed to meet customer demands.

Drought of 1987 to 1994. During the 1987/1988 winter, it became apparent that runoff from the snowpack would be significantly below normal. By August 20 of 1988, the Floriston Rates could not be met and Sierra's POSW was needed by late August to meet customer demands. By the end of August, emergency steps were taken by local government to curb water use to maintain carryover storage for 1989. Outside water use was limited to one-day-a-week in late August. A comparison of water use during the months of August through October 1987 to

water use during the same period in 1988, revealed that drought actions reduced consumption by about 4,150 acre-feet.

Precipitation through the 1988/1989 winter produced a 100 percent of average snowpack for the Truckee River basin. [6] Floriston rates were met throughout the 1989 irrigation season. The area remained under Stage 1 which called for voluntary water conservation and encouraged compliance with the "*Yard Fitness Program"* (voluntary twice weekly watering)[7].

Water supply conditions returned to below average in 1990, prompting the Cities to enact Stage 2 drought ordinances on June 4, 1990.[8] Stage 2 drought ordinances are the mandatory two-day-a-week lawn watering restrictions enforced during the watering season. Local irrigation ditches were cut off in late August due to low flows in the Truckee River. The largest and most important reservoir on the Truckee system, Lake Tahoe, dropped below its natural rim in September 1990, resulting in no flow into the Truckee River from the Lake.

The Stage 2 ordinances are designed to keep lawns healthy and viable but not use any more water than is needed by the plants. Since this period of time the Stage 2 practices have become a normal year practice because of the Conservation Agreement between TMWA, the Cities of Reno and Sparks, and Washoe County. The Drought Plan and Conservation Agreement are described in detail in Chapter 4.

The winter of 1990/1991 was one of the lowest precipitation periods on record prior to March of 1991. Even with the unusually heavy March precipitation, the snowpack in the Truckee River basin only measured 60 percent of average on April 1, 1991. Twice weekly watering limits under Stage 2 continued in effect during the spring of 1991, and on June 1 Stage 3 became effective in the cities and county, limiting watering to once-weekly after August 15. Local irrigation ditches were cut-off July 26 when Floriston Rates could not be met. By August, conservation results indicated that the communities' response was so effective that reversion to Stage 2 would not severely diminish water supplies. In 1990 Sierra delivered 63,138 acre-feet; in 1991 59,200 acre-feet were delivered. The difference in water delivered is largely attributable to the communities' response to and support for drought actions.

During 1992, Floriston Rates could not be met after June 5, the earliest date on record (U.S. District Court Water Master records). 1992 was the worst year of the drought with snowpack less than 50% of average and no outflow from Lake Tahoe. Throughout 1992, Stage 2 was in effect. Sierra continued to implement and fund its "*Water Watcher Program"* as well as funding city employees with authority to issue misdemeanor citations for water use violations. The cities did not declare Stage 3, but did direct their staffs to increase enforcement of water wasting regulations. By year-end, Reno had issued 165 notices of violations and 36 citations and Sparks had issued 39 citations. Overall there were more than 5,000 documented field responses

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6 Snowpack is reported by the U.S. Soil Conservation Service as a percent of average of data from 1961 to 2002.

7 The Drought Plan, comprising several stages of conservation is presented in Chapter 4.

8 The Board can recommend appropriate drought stages, but only the Cities and County can enact the necessary ordinances.

to possible water waste violations. Although there were some impacts to vegetation and landscaping, there was never a lack of water for drinking and sanitary purposes. After utilizing 9,000 AF of Independence Lake water (POSW), 8,500 AF remained in storage at the end of 1992. Since Sierra is able to impound 3,000 acre-feet in each year, the net depletion of Independence was 6,000 AF during 1992.

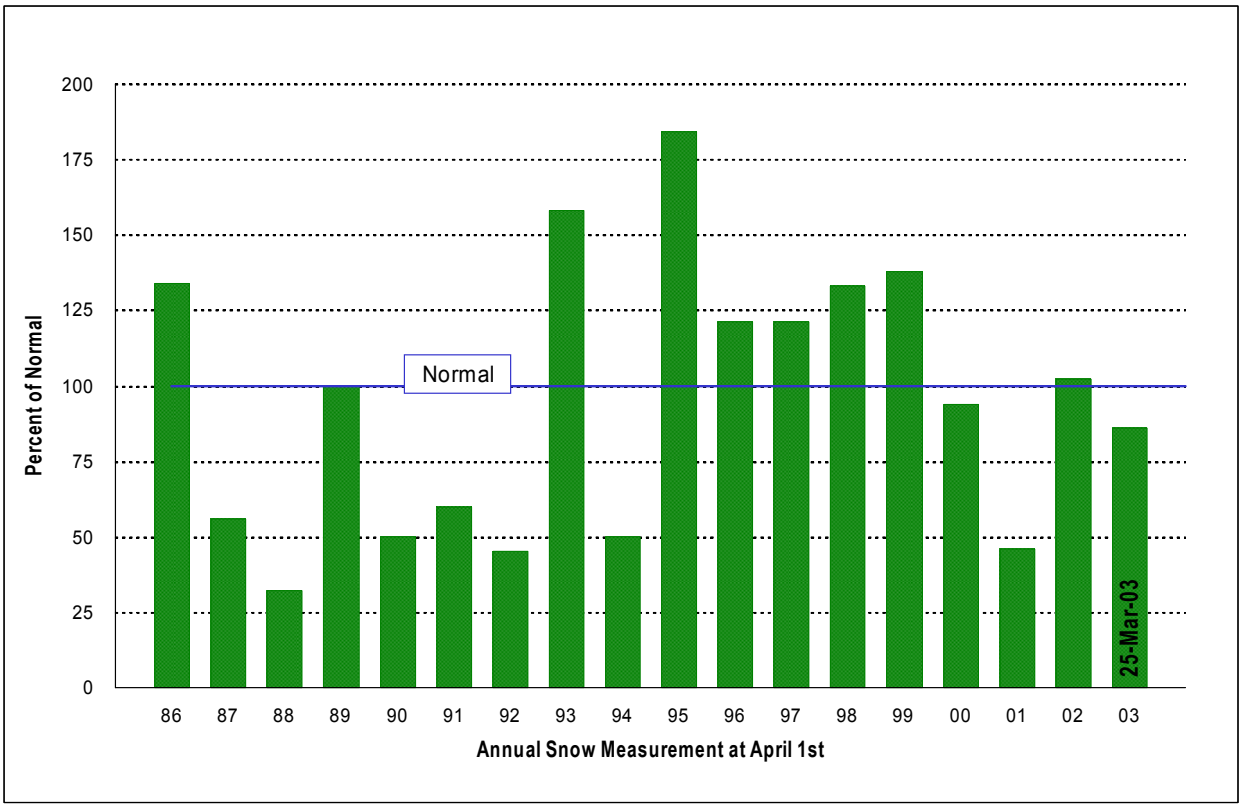

Figure 7: Snowpack for the Truckee River Basin

The snowpack in 1993 was over 150 percent of average. As a result of the heavy snowpack during the 1992/1993 winter, the Lake refilled in 1993. Although 1993 was a significant improvement over 1991 and 1992, the Truckee's primary reservoir, Lake Tahoe, was not high enough to significantly help sustain Floriston rates. The two cities decided to remain in Stage 2 throughout 1993. Sierra again funded its "*Water Watcher Program"* and water demand closely resembled 1992 levels. Floriston Rates were met until September 26, 1993.

The 1994 snowpack in the Truckee Basin was 50% of average on April 1. It was predicted that Lake Tahoe would not rise to the elevation of its rim, so no flow from it was expected to discharge to the Truckee River. The Cities of Reno and Sparks remained under the Stage 2 watering constraints from prior years.

The abundant snowfall of 1995, reinforced by above-average snowfalls from 1996 to 2000, ended the 1987-1994 drought. Lake Tahoe and all other reservoirs filled to the point that water had to be released to avoid excessive storage in 1996, 1997 and 1998. As shown in Figure

8, total natural flows from the 1987 to 1994 water years were 93% of the total natural flows from 1929 to 1936 water years and thus, more severe than the previous design drought period of 1928-1935.

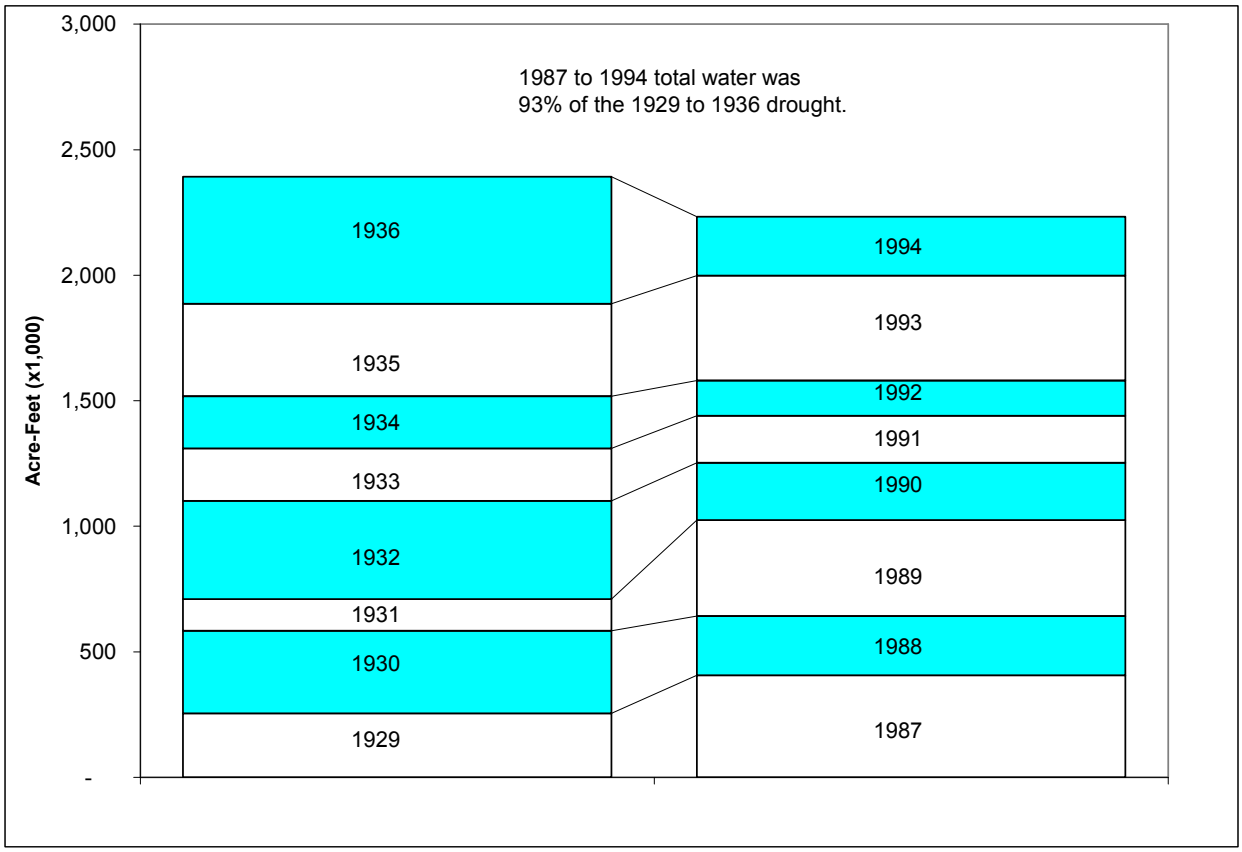

Figure 8: Comparison of Drought Years 1929-1936 and 1987 to 1994 Cumulative Flows

The severity of the drought is also illustrated by Lake Tahoe elevations in Figure 9. Month-end elevations of Lake Tahoe during the 1928 to 1935 Drought are compared with the 1987 to 1994 Drought and the elevation beginning 1998 through September 2002. On November 30, 1992, Tahoe reached an historic low elevation of 6220.2, or 2.8 feet below its rim. The current trend in the data suggests the area has completed its third year of another drought-year cycle. The graph also illustrates that reservoir operations cause reservoir depletions to extend over a period of 5 to 6 years, whereas the reservoirs refill completely within 2 to 3 years of non-drought year precipitation. Figure 7 compares the April 1 snowpack beginning in 1987 through 2002 as a percent of average (average being 100%) for the Truckee River basin.

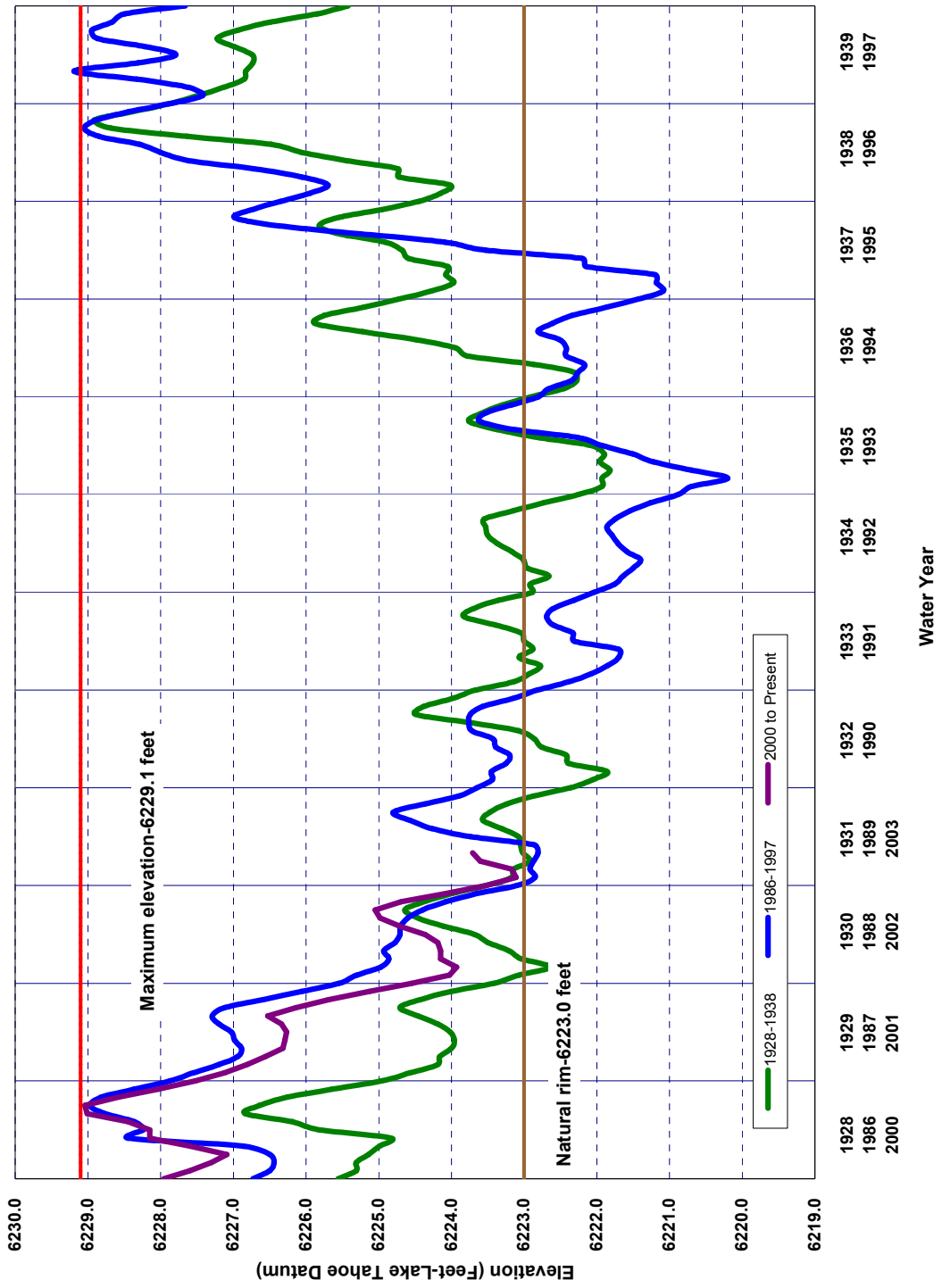

Figure 9: Lake Tahoe Elevations During Drought Cycles

Figure 10 shows a 10-year history of daily river flows measured at Farad compared to TMWA's daily diversion of surface water and groundwater (and POSW during the driest years). In the summer months of the dry years groundwater and/or POSW is used be meet demands that can not be supplied by the river. The reader should note that in all years the river is able to meet the majority of TMWA's needs.

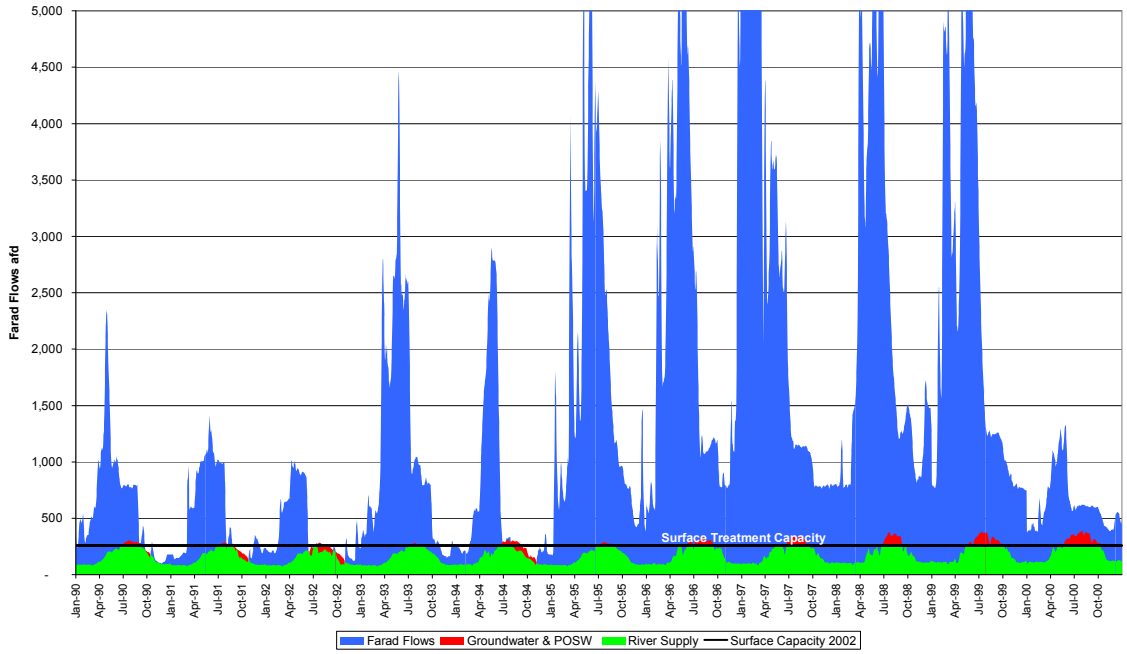

Figure 10: 1990 to 2000 Daily Water Sources

Under current operations, and as illustrated in Figure 12 for the year 2000, river water is diverted up to the capacity of the surface treatment plants, after this point the peak water demand is met using groundwater. During the summer months of drought years, groundwater, TMWA's pondage rights in Boca Reservoir, Independence Lake, and Donner Lake are used to augment customer demands. Independence Lake is TMWA's largest drought backup water supply. The extent to which it is utilized reflects the severity of the drought. Sierra used 12,100 acre-feet of POSW from Independence Lake during the 1987/1994 drought. The use of POSW in 1992 is illustrated in Figure 11 and is compared to Figure 12 source of water supply in 2000.

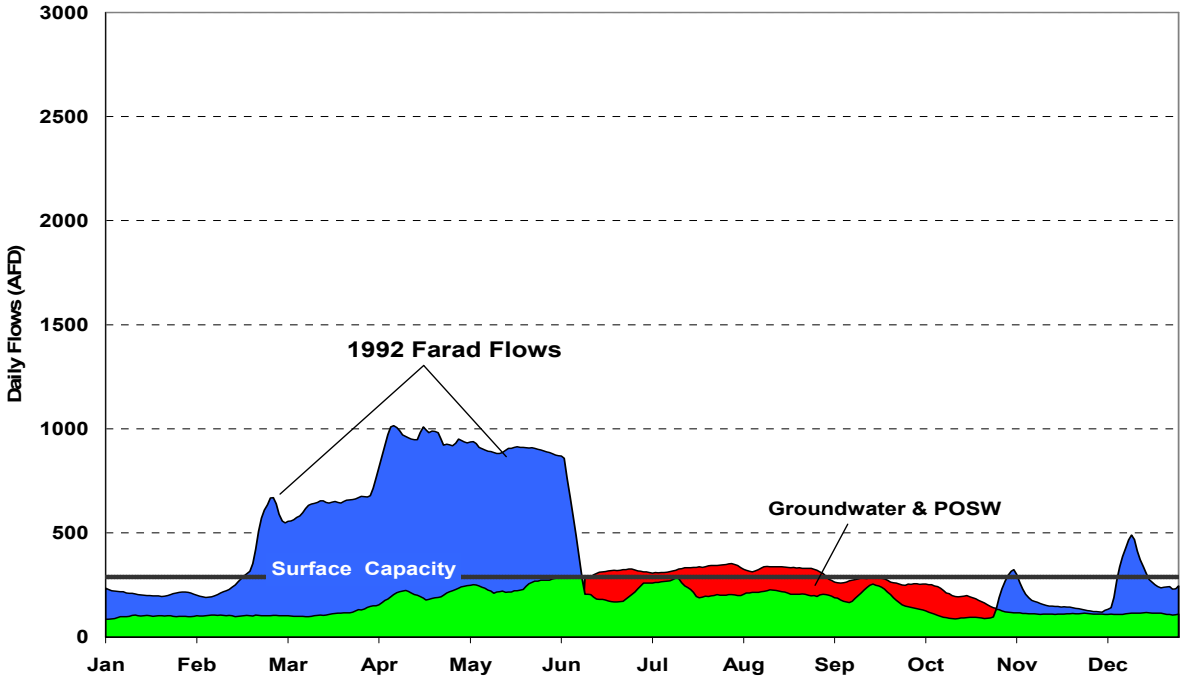

Figure 11: 1992 Daily Sources of Supply

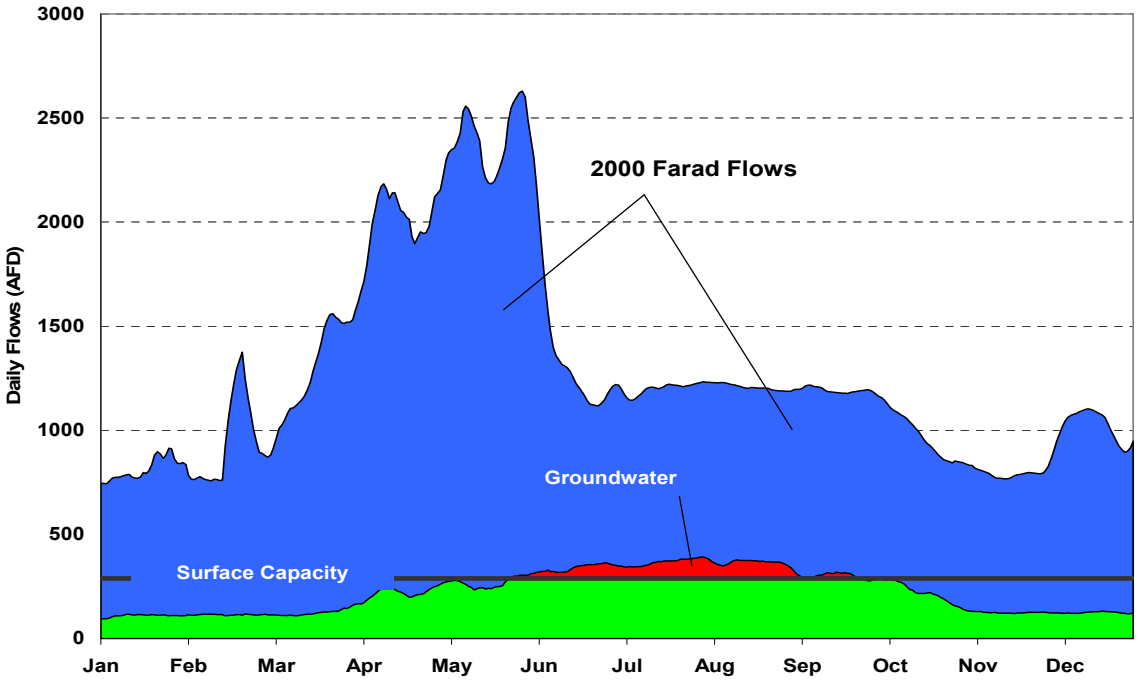

Figure 12: 2000 Daily Sources of Supply

These two figures illustrate the sources of water used by TMWA during an extreme dry-year (1992) and non-drought year (2000). By comparing these figures, it can be seen that even in the driest of years (1992 was the lowest water year of record), use of groundwater or POSW is only required in the summer to early fall months. During the rest of the year the river is able deliver sufficient water for municipal demands. And, as described earlier in this chapter, the replenishment of POSW in upstream reservoirs is sufficient to replace TMWA's drought reserves in the event of successive dry years.

Experiences during the 1987-1994 drought demonstrated the area's ability to manage its water resources during a drought. Important observations to be drawn from reviewing the recent drought experience include:

- Truckee River water supply provided by normal operation for Floriston Rates diminishes early in the summer of dry years.
- Maximizing groundwater use during the months of June through October results in reduction of POSW and any other TMWA storage in surface water reservoirs.
- Use of POSW can be limited to the months of June through October.
- Through conservation efforts, water consumption can be dramatically reduced. As much as 17% reduction on peak days was achieved during the 1987-1994 Drought.
- Average water use per service during the drought declined and has remained relatively constant.
- Water levels in the reservoirs are gradually depleted but refill rapidly following a drought.
- Even during a drought period, wet years are typically experienced, helping replenish supplies.

Drought Criterion for Setting Resource Yield. Until the mid-1990's water resource planning conducted by Sierra had been based upon the historic drought of 1928-1935 with a provision for a modest reserve water supply at the end of that historic period. The recent 1987-1994 drought was more severe than the 1928-1935 drought and, as a consequence, the 1987-1994 drought experience provided an incentive for modifying water resource planning criteria.

During the last few years of the 1987-1994 drought, it was apparent to local and state entities that water resource planning drought based criteria should be investigated and that criteria should be based upon something more severe than the 1928-1935 drought. During 1994, the Nevada Public Service Commission directed Sierra to base its water resource planning upon the 1987-1993 period followed by a repeat of the dry water years 1987 and 1988. Later, and at the urging of the Nevada Public Service Commission, RSW and Sierra agreed to adopt a 10-year drought period comprised of the historic drought years of 1987-1994 followed by a repeat of the 1987 and 1988 dry years for Sierra's water resource planning.

In consideration of the following benefits, that were not developed when the present 10-year drought criterion was established, the eight year drought period appears desirable for use in TMWA's water resource planning:

- TMWA is implementing an effective program to meter all water customers thereby providing a valuable tool for implementing measures that restrict water use during critical water supply periods.
- Water conservation is actively promoted in the local community as evidenced during the 1990's drought.
- Additional surface water storage provided by the Interim Storage Agreement and additional summer and dry year groundwater supply provide resources that can be conserved and held in reserve for use during an extended drought.
- TMWA and the community have demonstrated (during the 1987-1994 drought) an ability to manage water demand and supply during drought periods.
- The statistical analysis described later in this section estimates the frequency of an eight year drought event occurring 1 in 230 years.

During dry years, the local community can operate to take advantage of the above measures through the following:

- The community can have an expectation that should dry conditions continue and the subsequent drought becomes more severe than the design drought, the community and TMWA have tools with which they can manage water supplies to avoid extreme consequences and to assure necessary water supplies during such unexpected drought conditions.
- During later years of a sequence of dry years the community can set target conservation amounts that are greater than the design level of conservation and thereby maintain some surface water and groundwater storage for use during subsequent dry years should they occur.

At this time, there is a particular incentive for considering the above discussion and revising the drought period used for water resource planning. It is reasonable to expect that negotiations and environmental review of TROA will be completed within the next two years, and several years later TROA will be implemented. When TROA is implemented, the drought period water supply will be adequate to support a non-drought year demand of 119,000 acre-feet. However, present dry year supplies from surface water reservoirs and groundwater pumping are not adequate to support commitment beyond 95,000 acre-feet if the current 10-year drought period criterion is applied to evaluation of water supply. This characteristic could cause a hiatus in development within the local community between the time that TMWA's commitment level reaches 95,000 acre-feet and the time when TROA is implemented.

In accordance with the above discussion, it is recommended that TMWA's current water resource planning be based upon the historic 1987-1994 drought period. This will provide the opportunity for the local community to continue to develop in an orderly fashion without necessitating unreasonable and unnecessary interruptions during the next few years before TROA is implemented. And, this will assure that TMWA can continue to acquire and convert irrigation water rights and improve its surface water treatment and groundwater facilities thereby enhancing its operational flexibility and its ability to supply water during both non-drought and dry years. In the event TROA is not implemented the ability exists to expand new service commitments.

TMWA researched the possibility of global warming affecting the water demand results and water supplies. In research of studies, as well as surveying other water purveyors in the Western United States to determine if global warming were considerations in their resource planning, the following results were found:[9]

(1) scientific evidence remains inconclusive

(2) there is no evidence or local studies indicating that global warming is a factor affecting regional water resources;

(3) historic data is the best data available for future planning;

(4) there is no consensus among the water planners in the western United States to factor climate change in their forecasts; and

(5) TMWA's reservoirs operations above 5,500ft elevation would not be affected.

For these reasons, TMWA did not artificially constrain its resource yield calculations for this 20-yr plan. This issue will be monitored and included as necessary in future updates.

Drought-Year Resource Yield. The significance of the two year-round surface treatment plant operations cannot be overstated. Prior to CTP and the improvements at GTP, the now obsolete and dismantled surface treatment plants at Idlewild, Hunter Creek and Highland were not able to operate during winter months and TMWA had to rely heavily on its wells to meet demands through the winter months (late October through mid-April). CTP and GTP make it possible for TMWA to operate a surface water treatment plant year-round thereby eliminating the need for winter groundwater pumping. TMWA manages its plants to maximize surface water production and limit or compress its groundwater pumping to meet summer and fall months demands.

This conjunctive operation of surface and groundwater supplies presents the opportunity for TMWA to increase its ability to meet drought-year supplies since more permitted groundwater would be available in dry years during the summer months. Not only does this operational procedure reduce facility use and overall cost of water production, it creates the opportunity to aggressively pursue an aquifer storage and recovery program ("ASR"). During the winter months, TMWA is able to use and treat its surface water resources to meet demands and

[9] Memo regarding global warming with results of research can be found in Appendix J.

to inject treated surface water through existing production wells into the aquifer for later extraction during a drought or as other operating conditions dictate.

After many years of data collection, analysis, and discussion with the State Engineer, the benefits of conjunctive management of TMWA's surface water and groundwater resources were recognized and resulted in the issuance by the State Engineer of "Groundwater Management Order 1161" ("the Order") on May 15, 2000[10]. The order resolved several issues with respect to TMWA's ability to exercise its groundwater permits and provides the opportunity for improving the Truckee Meadows aquifer. The Order establishes:

- The conjunctive management of surface and groundwater resources reduces, over the long-term, the average-annual pumping of the Truckee Meadows aquifer;
- That maximizing the use of TMWA's surface resources allows reduction in annual groundwater extraction;
- That by a combination of minimizing groundwater extractions over an average period, groundwater recharge, conjunctive use and use of additional capped permits, TMWA can build up a credit of underground banked surface water for later extractions during droughts;
- Increased groundwater extraction during droughts increases the ability of TMWA to meet its drought-year demands without extreme stress on the Truckee Meadows aquifer;
- Average year pumping is 15,950 acre-feet; pumping less than this amount in a year is credited for future drought-year pumping;
- Up to 22,000 acre-feet may be pumped for 3 consecutive years if sufficient credit has been accumulated during non-drought (credit is accumulated through a combination of groundwater recharge and conjunctive use below-average year pumping and use of the capped water rights).

By extracting as much groundwater as possible in the critical months of a drought year, the reliance on surface water released from POSW in those months is reduced which: (1) delays the use of limited reservoir storage, (2) improves drought year supply capability, and (3) increases the yield of TMWA's combined resources.

The Truckee River operations model is used to analyze the effects of various drought design criteria. This model has been developed in cooperation with the U.S. Bureau of Reclamation, the Pyramid Lake Tribe, and others and is used by all parties involved in Truckee River settlement negotiations. The model simulates operation of the major Truckee and Carson River facilities -- Lake Tahoe; Prosser, Stampede, Boca, Donner, Independence and Lahontan Reservoirs; Derby Dam and Truckee Canal. The model operates reservoirs over the historic period of record in accordance with flood control criteria, Floriston Rate criteria, the Prosser Exchange Agreement, Orr Ditch Decree and the Truckee River Agreement; it releases water

[10] A copy of Order 1161 is found in Appendix B.

from Stampede storage in accordance with criteria for maintaining endangered species fishery flows in the lower Truckee River; and it diverts Truckee River flows to TCID through the Truckee Canal in accordance with specified OCAP.

River and reservoir operations can be analyzed with TMWA demands set at various levels under specified hydrologic conditions. Model results show whether a given demand can be delivered with available resources during the most critical water supply situation. Data required for the model, in addition to river and reservoir constraints include:

- Monthly groundwater pumping volumes.
- Quantity of irrigation rights acquired for customer use.
- Irrigation water demands in Truckee Meadows.
- Quantity of wastewater return flows.
- Monthly customer demands less conservation[11] of up to a 10 percent maximum monthly reduction in water use in summer months during droughts versus non-droughts.

The model performs a monthly accounting of all water in the system and operates the reservoirs to deliver selected user demands in accordance with the established procedures and criteria. By testing various demand levels, the model can determine the maximum amount of water delivery achievable under a given set of hydrologic conservation and resource assumptions, and indicate how much water TMWA can commit to deliver through a drought using its present resources.

The investigations are based upon maintaining ability to supply water equal to 90 percent or more of non-drought year demands. This implies that the community reduces its non-drought year summer demands at least 10%, however, during the last drought water reduction as high as 17% were experienced on peak days therefore the anticipated reductions should be achievable and are incorporated into the planning process.

To further test its drought planning criteria TMWA developed a drought frequency model in a joint effort with University of Nevada, Reno faculty[12]. Two datasets were tested: the 91-year hydrologic record for the Truckee River and a 350-year tree-ring dataset. The analyses confirm TMWA's previous work of designing its resources to withstand the worst drought of hydrologic record of the Truckee River: 1987 to 1994. The new model demonstrates that drought year cycles

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[11] A water conservation agreement between RSW, TMWA, PLPT, and the US, has been in place since 1996, and was extended to December 2009 by the same parties in December 2001. Among other things, the agreement provides for non-drought year water conservation measures to be implemented so as to waive the 10 percent drought-year conservation requirement in the Preliminary Settlement Agreement. In addition to the non-drought year conservation measures, the local governments have adopted ordinances providing a mechanism to implement incremental levels of drought conservation measures, including placing various predefined limits on outdoor irrigation. Chapter 4 outlines the elements of TMWA's conservation plans.

[12] A complete description of this model and accompanying analyses are presented in Appendix J.

are rare events, similar to flood events. The analyses establish that appropriate drought design criterion should reflect conditions that impact the ability of TMWA to divert surface water and require TMWA to use its upstream reserves: the only time this happens is during the irrigation months and only during consecutive dry summer months. The effect of one summer month when Floriston rates are not met does not necessarily impact upstream reserves; only consecutive months during the irrigation season can significantly impact upstream reserves.

When considering the 8-, 9- or 10-year event, the likelihood of any of those events occurring is estimated to be a rare occurrence with frequencies of 1 in 230 years, 1 in 375 years, and 1 in 650 years, respectively. The current 10-year drought design is so rare that it imposes unrealistic burden on the region's resources. The model was also used to estimate the frequency of the 10-year drought. It was found that the 10-year drought frequency is approximately 1 in 650 years; a 100-year flood is 6.5 times more likely than the 10 year drought!

The drought frequency model estimates that the worst drought on record has an estimated frequency of approximately 1 in 230 years. As a comparison the 100-year flood is twice as likely as the 8-year drought. This can be clearly seen in the hydrologic record of the Truckee River shown in Figure 4. Four 100-year flood events, including the flood of 1997, appear in the record. Over this same period there were two eight year drought events. Based on comparable methods to flood planning and the statistical methods developed for this plan, planning for the 8-year event with today's resources is more than adequate to meet expected drought frequencies.

The modeling results estimate the following resource yields:

- An eight-year design drought is the drought corresponding to the historic drought that began in 1987 and continued through 1994. TMWA's resources will support commitments up to 113,000 acre-feet with an additional conservation of 6,700 acre-feet required between June and October during the critical year of the drought period.
- A nine-year design drought is the drought corresponding to the historic 1987-1994 drought followed by an additional dry year, which corresponds to the historic year of 1987. TMWA's resources will support commitments up to 110,500 acre-feet with 5,600 acre-feet of additional conservation required between June and October in a critical year of the drought period.
- A ten-year design drought is the drought corresponding to the historic 1987-1994 drought followed by two additional dry years, which correspond to the historic 1987-1988 sequence. This ten-year design drought is the condition that was used in the 1995 WRP and the 1997 RWP plans. TMWA's resources will support commitments up to 99,000 acre-feet with 4,900 acre-feet of additional conservation required between June and October in a critical year of the drought period.

By way of comparison, the Sierra's 1988 WRP demonstrated an ability to serve 86,000 acre-feet per year based on the 1928-1935 drought with the continued conversion of irrigation rights, the construction of additional groundwater wells and a Boca storage contract. In its 1995 WRP Sierra demonstrated an ability to serve 107,500 acre-feet per year based on the 1928-1935 Drought. This was reduced to 97,400 acre-feet per year when the 10-year drought criterion was ordered by the PUCN for planning purposes.

As of June 2002, TMWA has issued will-serve commitments of 89,660 acre-feet. Depending on the recommended drought criterion, TMWA has the ability to continue to acquire irrigation rights and extend its water service commitments as shown below:

Drought Design	Committable Yield	TMWA 2002 Commitments	Increase
8	113,000	89,660	23,340
9	110,500	89,660	20,840
10	99,000	89,660	9,340

The following two graphs illustrate the estimated use of POSW during under the 10-year and 8-year drought designs at the level of the respective committable yields. Figure 13 depicts the amount of reserve water available in upstream reservoirs during the hypothetical 10-year drought design (1987 to 1994 plus a repeat of 1987 and 1988). Figure 14 depicts the amount of reserve water available in upstream reservoirs during the 8-year drought design (1987 to 1994 extended with 1995 and 1996 actual hydrology). Both figures show annual declines in all reservoir storage, particularly evident with Donner Lake, which is due to annual Fall releases required by state and federal agencies to ensure there is sufficient flood storage capacity to capture excess runoff from winter storms.

Both figures show that: (1) the system is designed to never run out of water and (2) there is always an amount of water held in reserve in the event the drought goes beyond either planning horizon.

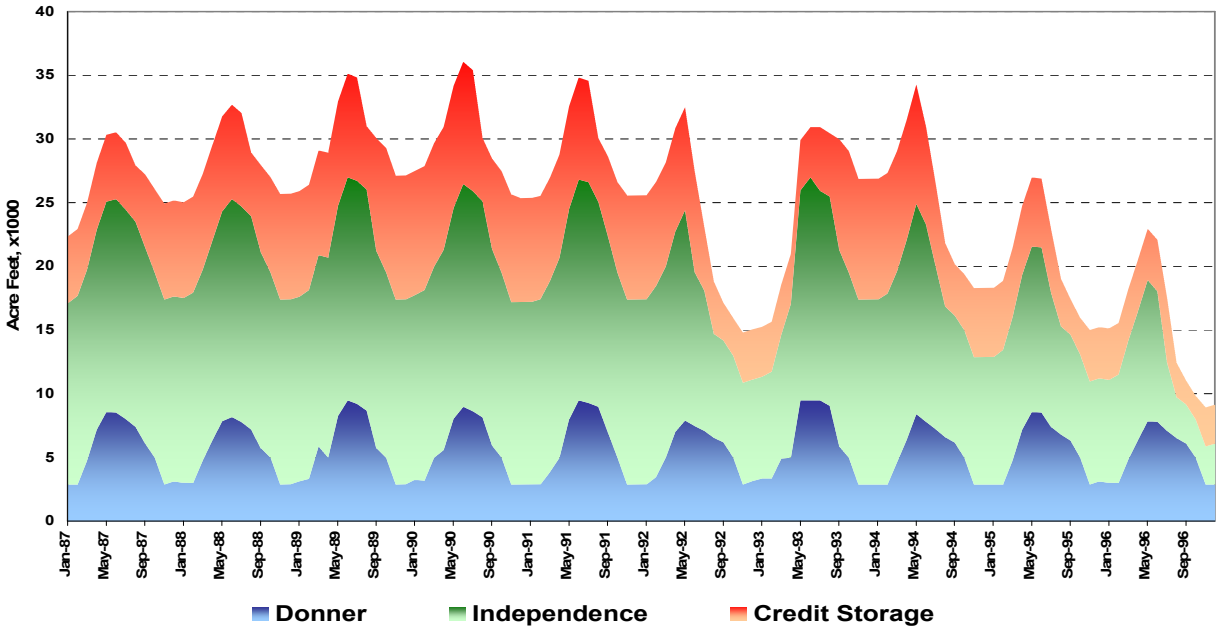

Figure 13: Use of Drought Reserves During the Hypothetical 10-Year Drought Design that Yields 99,000 Acre-Feet

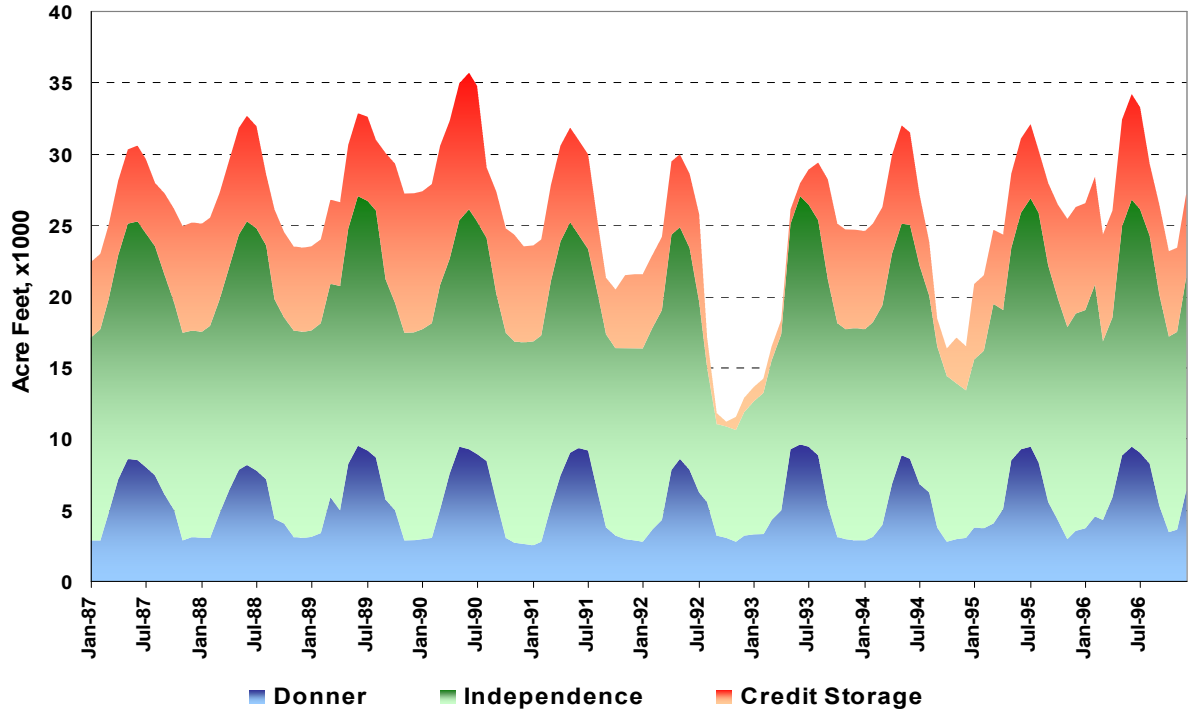

Figure 14: Use of Drought Reserves During the Actual Hydrology of the 8-Year Drought Design that Yields 113,000 Acre-Feet

Summary

This chapter has described TMWA's existing water rights and water production facilities. The key points of the analysis derived from conjunctively managing surface rights, groundwater rights, and water production facilities are:

1. Available water rights include:
    - "40 cfs" right (28,959 acre-feet)
    - Hunter Creek (9,847 acre-feet)
    - Independence Lake (17,500 acre-feet)
    - Half of Donner Lake storage (4,750 acre-feet)
    - The Interim Storage Agreement ("ISA") for storage in Stampede and Boca (up to 14,000 AF)
    - The Truckee Meadows Groundwater Banking Order (allows variable pumping up to 22,000 acre-feet in a drought-year, and 15,950 acre-feet average year pumping)
    - Approximately 51,610 acre-feet of acquired irrigation rights.
2. Current water service commitments as of June 2002 are 89,660 acre-feet annually.
3. Current production capacities are:

Chalk Bluff	69.0 MGD
Glendale	25.0 MGD
Subtotal Surface	94.0 MGD
Groundwater	58.5 MGD
Total	152.5 MGD

Note: 2002 peak day was 147.0 MGD

4. Drought year cycles are rare events, similar to flood events. The estimated drought frequencies are:

8-year	1 in 230 years
9-year	1 in 375 years
10-year	1 in 650 years

5. Drought year yield of TMWA's resources is a function of available resources and drought-year design. By continuing to acquire Truckee River irrigation rights, drought-year yield studies conclude TMWA has the ability to continue to extend its water service commitments by:

   23,340 acre-feet with 8-year drought design

   20,840 acre-feet with 9-year drought design

   9,340 acre-feet with 10-year drought design

6. Additional drought-year conservation needed during the peak irrigation season (June through October) over and above the annual savings achieved through existing conservation activities is identified for each drought design option:

   6,700 acre-feet, or 6% of committable yield with 8 year drought design

   5,600 acre-feet, or 5% of committable yield with 9 year drought design

   4,900 acre-feet, or 5% of committable yield with 10 year drought design

References

1985-2005 Water Resources Plan, Sierra Pacific Power Company,

1988-2008 Water Resources Plan, Sierra Pacific Power Company, January 1989.

1995-2015 Water Resources Plan, Sierra Pacific Power Company, June 1994.

1997 Regional Water Plan, Regional Water Planning Commission of Washoe County

Engineer's Report, CDM 2001

Chapter 3 Water Demand and Peak Day Projections

Prior to selecting water supplies for the future, forecasts of population, employment, growth, and water demands are needed. Steps outlined in this chapter include how TMWA forecasts population and employment, and water consumption (demand). Factors affecting future demand results are also described.

In addition, this chapter forecasts peak day demand and facility requirements to meet future demands. Specifically, Article 5.h (ii) and (iii) of the JPA are presented in this chapter. They are:

> "To establish a water budget and a water resource plan for the Authority which shall reflect, among other things…
>
> (ii) demand within each Member's jurisdiction within the Authority's retail service area, and
>
> (iii) the peaking capacity required for delivery of water supplies by the Authority to each Purveyor Member, if applicable, and the means by which such requirements shall be met..."

Demand Forecast

TMWA demand comprises retail and wholesale demand, and losses/ unaccounted for water. There are three components of retail demand, (1) Residential, (2) Commercial, and (3) Irrigation. An illustration of the step-wise process to project these demands is shown in Figure 15 and described in this section. Wholesale demand and losses/unaccounted for water are added to the TMWA retail demand to project TMWA system demand.

The first step in developing the water demand forecast was to establish a forecast of population and employment by major industrial sector. TMWA projects water demand based on an econometric model forecast of Washoe County population and employment, in combination with a geographic information system (GIS) techniques.

TMWA developed its *"Truckee Meadows Water Authority Population and Employment Econometric Model for Washoe County" ("TPEM") in 2002*. TPEM is a time-series model that simultaneously forecasts population and employment in Washoe County using historical employment and population data from 1969 through 2000[13].

[13] TPEM methodology and results are presented in Appendix D.

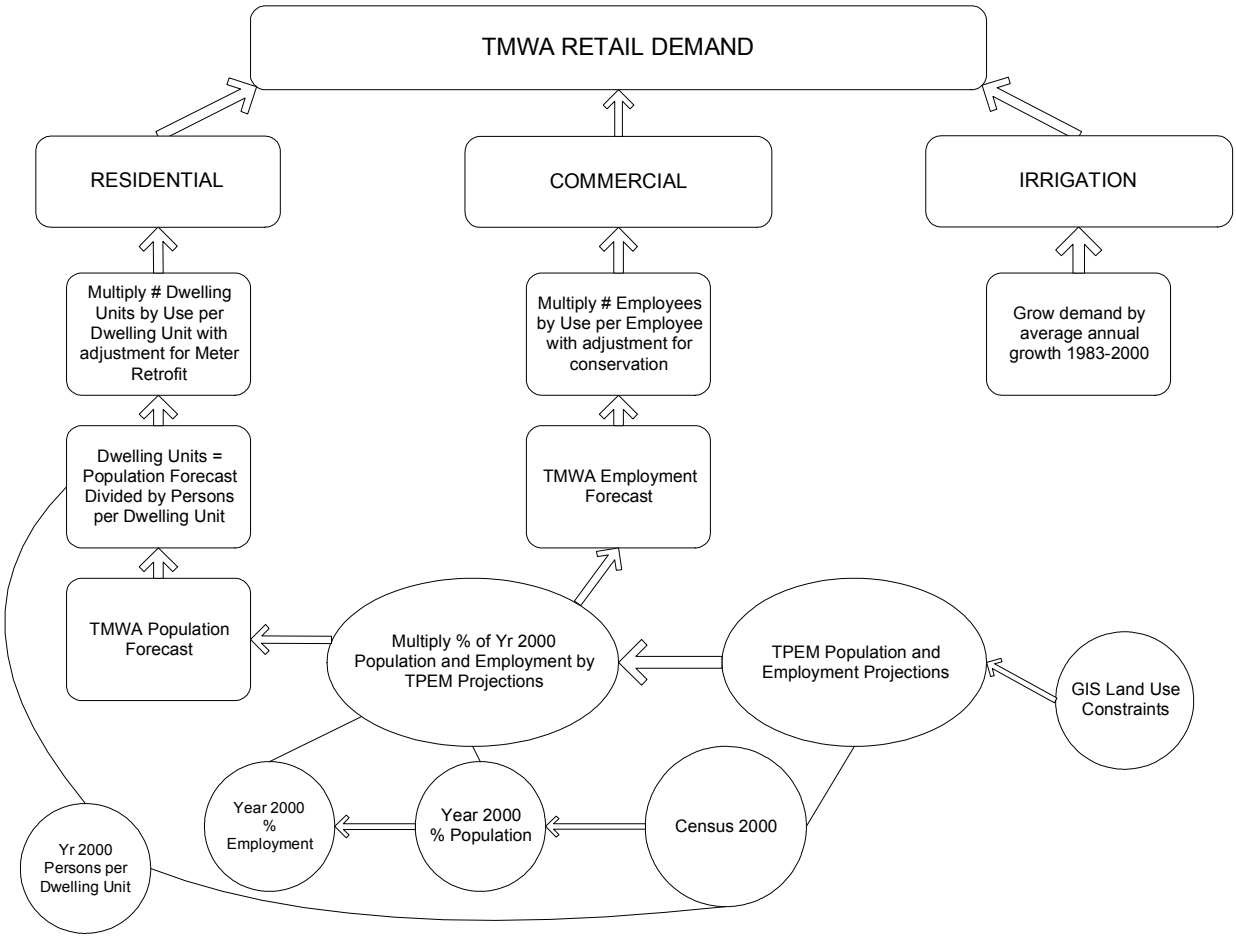

Figure 15: TMWA Retail Demand Forecast Process

A major conclusion from development of TPEM was that construction employment growth is the most significant variable driving population and employment growth in our local economy. Coupled with this finding, remaining buildable land is considered to be a constraint to future growth that was analyzed and incorporated into the TPEM model[14]. Land is considered to be a constraint to future growth as larger parcels are developed first, leaving more expensive and difficult land to develop (redeveloped properties and smaller underdeveloped properties are not incorporated into this analysis). An inventory of annually developed land was gathered from 1996 to 2001 for each County planning area and a historical average-annual-growth-rate was established for each area. The historical-average-annual-growth-rate was then applied to total-available-developable land to project total land developed per year through 2025.

Total-available-developable land was estimated using the Washoe County Assessor's database. Additional criteria were added, specifically those properties located above 6,000 foot elevation where, as a rule of thumb, future development is impractical due to land slope, land

[14] Memo regarding development of GIS technique is presented in Appendix E.

ownership, and extensive and expensive facilities upgrades to treat, pump and store water for delivery to these properties. Lands owned by the US Forest Service were also identified as un-developable (79% of the US Forest Service land is also located above 6,000 foot elevation level). Remaining vacant land that can be developed was further reduced by 20% to allow for major improvements and setbacks.

By imposing these constraints during the forecast process, the amount of available land within TMWA's current retail and expansion areas that can actually be developed and served by TMWA was diminished. Figure 16 shows the water purveyors' territories, and the impact of the US Forest Service land ownership and 6,000 foot elevation development constraints.

Due to an accelerated pace of growth in the Truckee Meadows during the latter half of the 1990's and the United States Census 2000 reporting greater population in Washoe County than had previously been estimated, the forecast for total County population is higher in TPEM's results compared to the 1999 Washoe County Consensus Forecast ("the Consensus"). By 2020, TPEM forecasts 15,400 more people residing in Washoe County than the 1999 Consensus. Total population growth in TMWA's final forecast adds 148,000 people between 2000 and 2025 (approximately 44 percent increase). A comparison of population forecasts is shown:

	2005	2010	2015	2020	2025
1999 Consensus Forecast	356,500	385,300	416,500	448,400	n.a.
2002 TMWA	377,000	409,200	438,200	463,800	487,500

Previous water demand forecasts prepared by Sierra and RWPC used the Consensus population and employment projections to estimate future water demand. The Consensus includes 4 independent population forecasts, one of which was provided by Sierra. In lieu of an updated Consensus Forecast, and the need to complete TMWA's water demand projection through 2025, this WRP uses the projections from TPEM. The TPEM forecast is now being incorporated into the updated Consensus Forecast. TMWA is able to compare water demand results using the updated Consensus Forecast once the revised consensus is approved by local governments for planning purposes.

Once County population and employment were forecast, the second step in developing TMWA's future demand was to use GIS techniques to determine year-2000 share of Washoe County population that resides in TMWA's retail area and wholesale areas. This was accomplished using United States Census 2000 data. Percentage of County population within TMWA's retail area in the year 2000 was applied to the County population forecast to obtain TMWA's retail population forecast. The population forecast is used to estimate residential water demands. The number of employees in TMWA's retail area was determined using the Bureau of Business and Economic Research at UNR 2001 report and TMWA's own GIS database. The employment forecast is used to estimate commercial water demands.

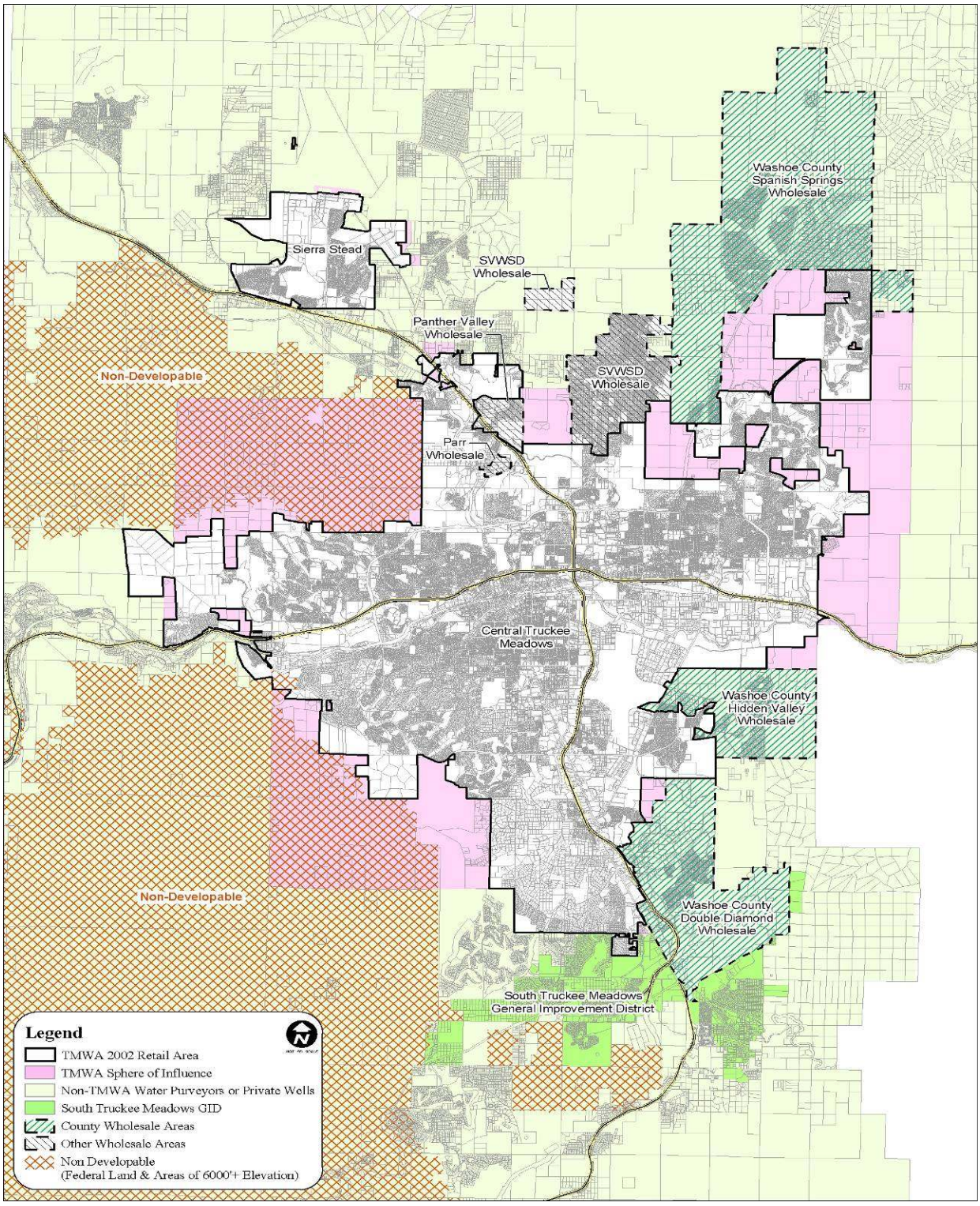

Figure 16: Effects of Elevation and U.S. Forest Service Lands on TMWA's Retail and Wholesale Growth Areas.

Table 10: TMWA Service Area Populations

Year	Washoe County Total Population	Percent Change	TMWA *Retail* Territory Population	less Domestic Well owners in TMWA	Net TMWA Retail Territory Population	TMWA *Wholesale* Service Population Served	Truckee Meadows Water Authority Wholesale Areas: Spanish Springs	Hidden Valley	Double Diamond	Sun Valley	Subtotal County Population Served by TMWA
			73.9%	***0.7%***	***73.2%***		*3.0%*	*1.1%*	*1.0%*	*4.6%*	***86.0%***
2000	339,486		250,873	2,458	248,415	33,274	10,342	3,706	3,517	15,709	281,689
2001	347,391	2.33%	256,714	2,491	254,224	36,120	11,650	3,861	3,982	16,628	292,835
2002	355,390	2.30%	262,626	2,513	260,113	38,125	12,716	4,026	4,506	16,877	300,751
2003	363,385	2.25%	268,534	2,535	265,999	40,131	13,785	4,183	5,045	17,119	308,665
2004	370,443	1.94%	273,750	2,554	271,196	41,903	14,731	4,314	5,532	17,326	315,653
2005	377,049	1.78%	278,631	2,572	276,059	43,562	15,618	4,430	6,000	17,514	322,193
2006	383,618	1.74%	283,485	2,589	280,896	45,213	16,501	4,539	6,478	17,695	328,699
2007	390,067	1.68%	288,251	2,606	285,645	46,824	17,530	4,660	6,733	17,900	335,075
2008	396,486	1.65%	292,994	2,622	290,372	48,414	18,751	4,795	6,733	18,135	341,409
2009	402,872	1.61%	297,714	2,638	295,076	49,997	19,978	4,923	6,733	18,363	347,712
2010	409,152	1.56%	302,355	2,654	299,701	51,555	21,195	5,044	6,733	18,582	353,909
2011	415,291	1.50%	306,891	2,669	304,222	53,078	22,396	5,156	6,733	18,792	359,969
2012	421,266	1.44%	311,307	2,684	308,623	54,561	23,576	5,261	6,733	18,991	365,868
2013	427,075	1.38%	315,600	2,698	312,902	56,025	24,750	5,359	6,733	19,183	371,624
2014	432,730	1.32%	319,779	2,711	317,068	57,238	24,989	5,363	6,733	20,153	377,017
2015	438,233	1.27%	323,845	2,723	321,122	58,265	24,989	5,363	6,733	21,180	382,110
2016	443,581	1.22%	327,797	2,733	325,064	58,265	24,989	5,363	6,733	21,180	386,062
2017	448,767	1.17%	331,629	2,742	328,888	58,265	24,989	5,363	6,733	21,180	389,894
2018	453,862	1.14%	335,395	2,750	332,644	58,265	24,989	5,363	6,733	21,180	393,660
2019	458,885	1.11%	339,106	2,759	336,347	58,265	24,989	5,363	6,733	21,180	397,371
2020	463,838	1.08%	342,766	2,768	339,999	58,265	24,989	5,363	6,733	21,180	401,032
2021	468,724	1.05%	346,377	2,776	343,601	58,265	24,989	5,363	6,733	21,180	404,642
2022	473,540	1.03%	349,936	2,784	347,152	58,265	24,989	5,363	6,733	21,180	408,201
2023	478,280	1.00%	353,439	2,792	350,647	58,265	24,989	5,363	6,733	21,180	411,704
2024	482,939	0.97%	356,882	2,800	354,082	58,265	24,989	5,363	6,733	21,180	415,147
2025	487,515	0.95%	360,263	2,807	357,456	58,265	24,989	5,363	6,733	21,180	418,528
Change	**148,029**		**109,390**	**349**	**109,041**	**24,991**	**14,647**	**1,657**	**3,216**	**5,471**	**136,839**
Percent Change	**44%**		**44%**	**14%**	**44%**	**75%**	**142%**	**45%**	**91%**	**35%**	**49%**

Table 11: TMWA Population by Jurisdiction and Hydrographic Basins

Year	TMWA Retail Population by Jurisdiction				TMWA Retail Population by Hydrobasin					Total TMWA Retail Area
	City of Reno	City of Sparks	Unincorporated Washoe County	Total TMWA Retail Area	Spanish Springs	Sun Valley	Truckee Meadows [1]	Verdi	Lemmon Valley	
2000	173,839	65,670	11,364	250,873	8,323	4,378	223,857	1,881	12,434	250,873
2001	177,038	67,560	12,117	256,714	9,320	4,403	227,445	1,941	13,605	256,714
2002	180,544	69,778	12,304	262,626	10,651	4,444	231,309	2,012	14,210	262,626
2003	184,023	72,023	12,488	268,534	12,136	4,483	235,027	2,081	14,807	268,534
2004	187,070	74,031	12,649	273,750	13,396	4,511	238,454	2,131	15,257	273,750
2005	189,899	75,935	12,798	278,631	14,902	4,540	241,274	2,183	15,732	278,631
2006	192,689	77,854	12,943	283,485	16,552	4,567	243,941	2,232	16,194	283,485
2007	195,404	79,763	13,084	288,251	18,331	4,592	246,417	2,277	16,635	288,251
2008	198,082	81,690	13,222	292,994	20,263	4,615	248,739	2,319	17,059	292,994
2009	200,722	83,635	13,357	297,714	21,247	4,645	251,812	2,375	17,636	297,714
2010	203,293	85,575	13,487	302,355	21,247	4,682	255,613	2,444	18,370	302,355
2011	205,780	87,498	13,613	306,891	21,247	4,717	259,313	2,511	19,103	306,891
2012	208,175	89,398	13,733	311,307	21,247	4,751	262,899	2,576	19,834	311,307
2013	210,478	91,273	13,848	315,600	21,247	4,784	266,370	2,638	20,560	315,600
2014	213,638	92,136	14,005	319,779	21,247	4,815	269,734	2,699	21,284	319,779
2015	216,871	92,810	14,164	323,845	21,247	4,845	272,992	2,758	22,003	323,845
2016	219,971	93,511	14,315	327,797	21,247	4,874	276,143	2,814	22,718	327,797
2017	222,934	94,236	14,459	331,629	21,247	4,902	279,184	2,869	23,427	331,629
2018	225,801	94,996	14,597	335,395	21,247	4,928	282,176	2,923	24,121	335,395
2019	228,582	95,794	14,730	339,106	21,247	4,961	285,791	2,987	24,121	339,106
2020	230,086	97,664	15,016	342,766	21,247	4,992	289,356	3,051	24,121	342,766
2021	231,073	99,966	15,339	346,377	21,247	5,555	291,247	4,207	24,121	346,377
2022	231,300	102,917	15,718	349,936	21,247	6,501	291,900	6,168	24,121	349,936
2023	231,300	106,051	16,088	353,439	21,247	7,426	292,543	8,102	24,121	353,439
2024	231,300	108,408	17,174	356,882	21,247	8,330	293,177	10,007	24,121	356,882
2025	231,300	108,408	20,555	360,263	21,247	9,212	293,801	11,882	24,121	360,263
							-			
Change	57,461	42,738	9,191	109,390	12,924	4,834	69,944	10,001	11,687	109,390
% Change	33%	65%	81%	44%	155%	110%	31%	532%	94%	44%

[1] Includes TMWA servicing 3,325 people (retail or wholesale) in the Tracy hydrographic basin by 2025.

To obtain TMWA's retail population forecast by jurisdiction and hydrographic basin, the GIS land use analysis was used to determine percentage share of population in each area by year. Total number of employees in the County that work within in TMWA's retail area was multiplied by percentage share of population by area to obtain TMWA's retail area employees by jurisdiction and hydrographic basin.

Population and Employment Results Table 10 shows County, wholesale areas and retail area population projections. Wholesale water demands are not estimated using these population projections; these numbers reflect only the population that would reside in these areas if year 2000 percentage of total County population in each wholesale area remains constant. Demands by wholesale areas (South Truckee Meadows, Hidden Valley, and Spanish Springs) are not projected through 2025 because TMWA is relying on future demands estimated by the County in their facilities plans. Table 11 shows TMWA retail population by jurisdiction and hydrographic basin.

Approximately 74% of Washoe County population resided within TMWA's retail service boundary in 2000. It is interesting to note that this is the same result Sierra reached in its 1995-2015 Water Resources Plan. The share of Washoe County employees working in TMWA's service boundary is estimated to be 88.5% in 2001. Population residing within TMWA wholesale areas as of year 2000 was approximately 9.8%, of which 4.6% was in Sun Valley, 3.0% in Spanish Springs, 1.1% in Hidden Valley, and 1.0% in South East Truckee Meadows.

Domestic well owners constitute less than 1% of TMWA's retail service area population. These well owners are excluded from total population used to estimate TMWA water demand.

Figure 17 shows year 2000 and year 2025 population projections for retail and wholesale areas. Figure 18 shows year 2000 and 2025 population projections in TMWA's retail area by jurisdiction, and Figure 19 shows this information by hydrographic basin[15].

[15] Due to scale limitations and for clarity of the maps, not all public lands, such as BLM lands are shown on these figures.

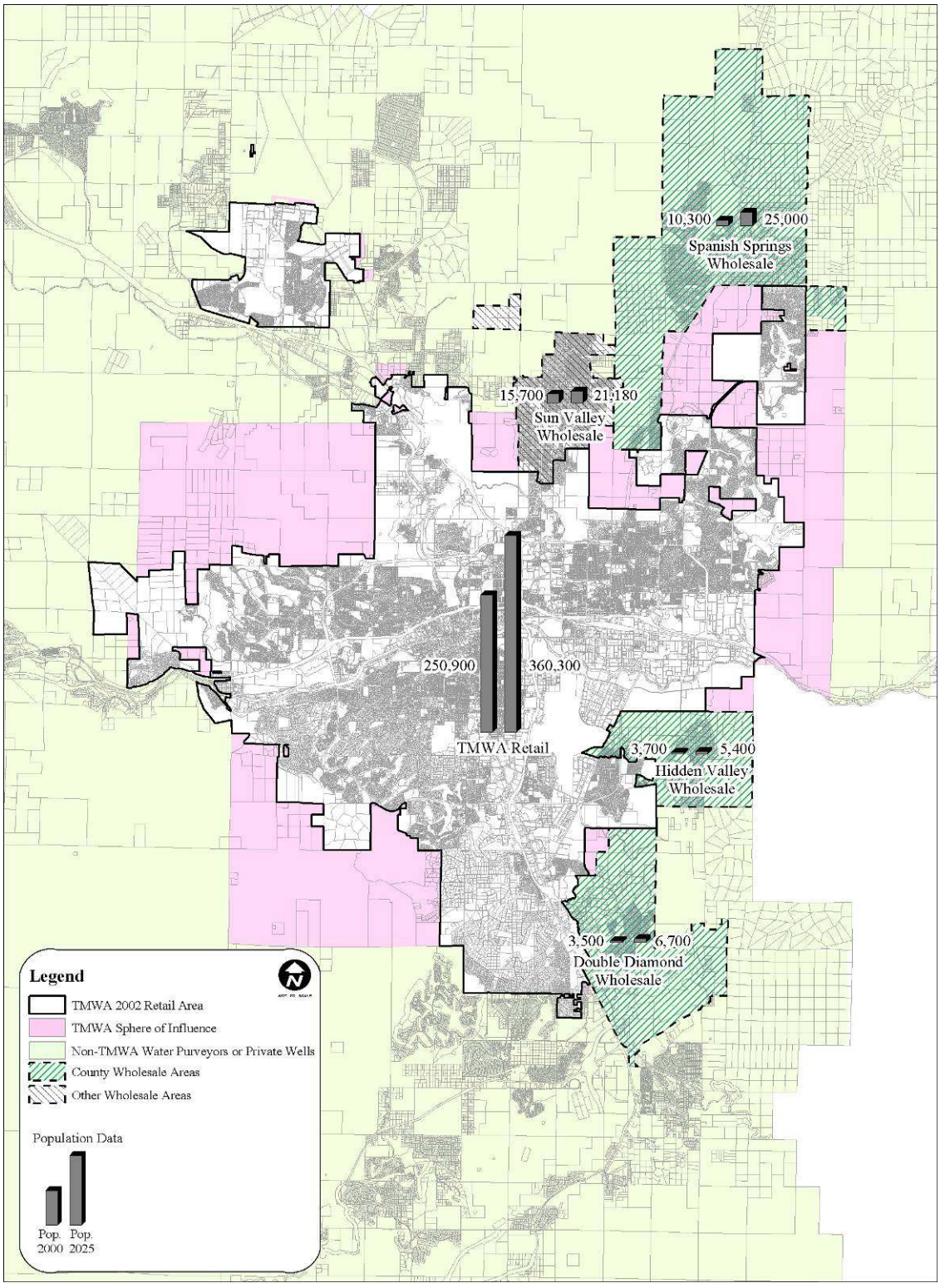

Figure 17: Comparison of 2000 and 2025 TMWA Retail and Wholesale Populations

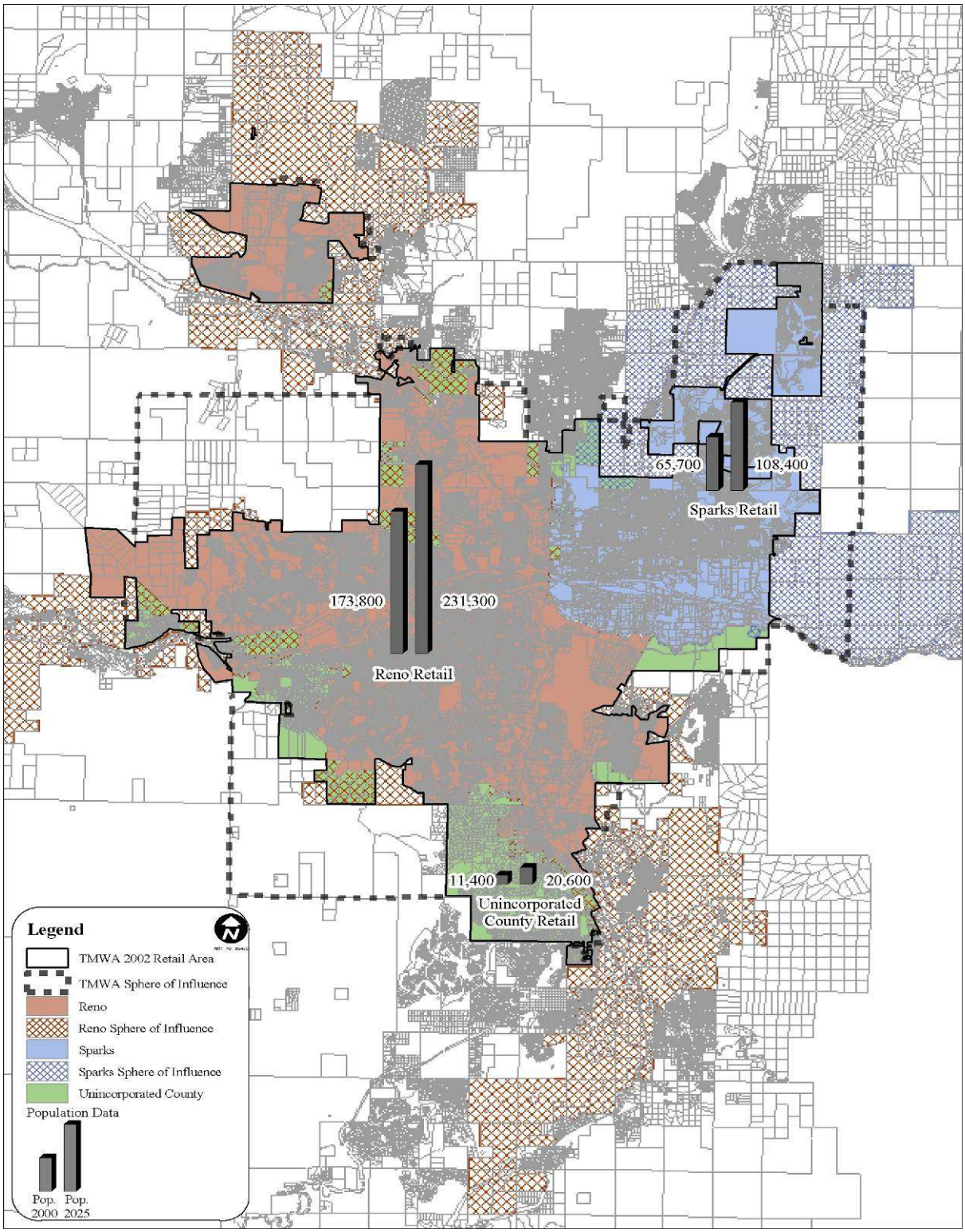

Figure 18: Comparison of 2000 and 2025 TMWA Retail Population by Jurisdiction

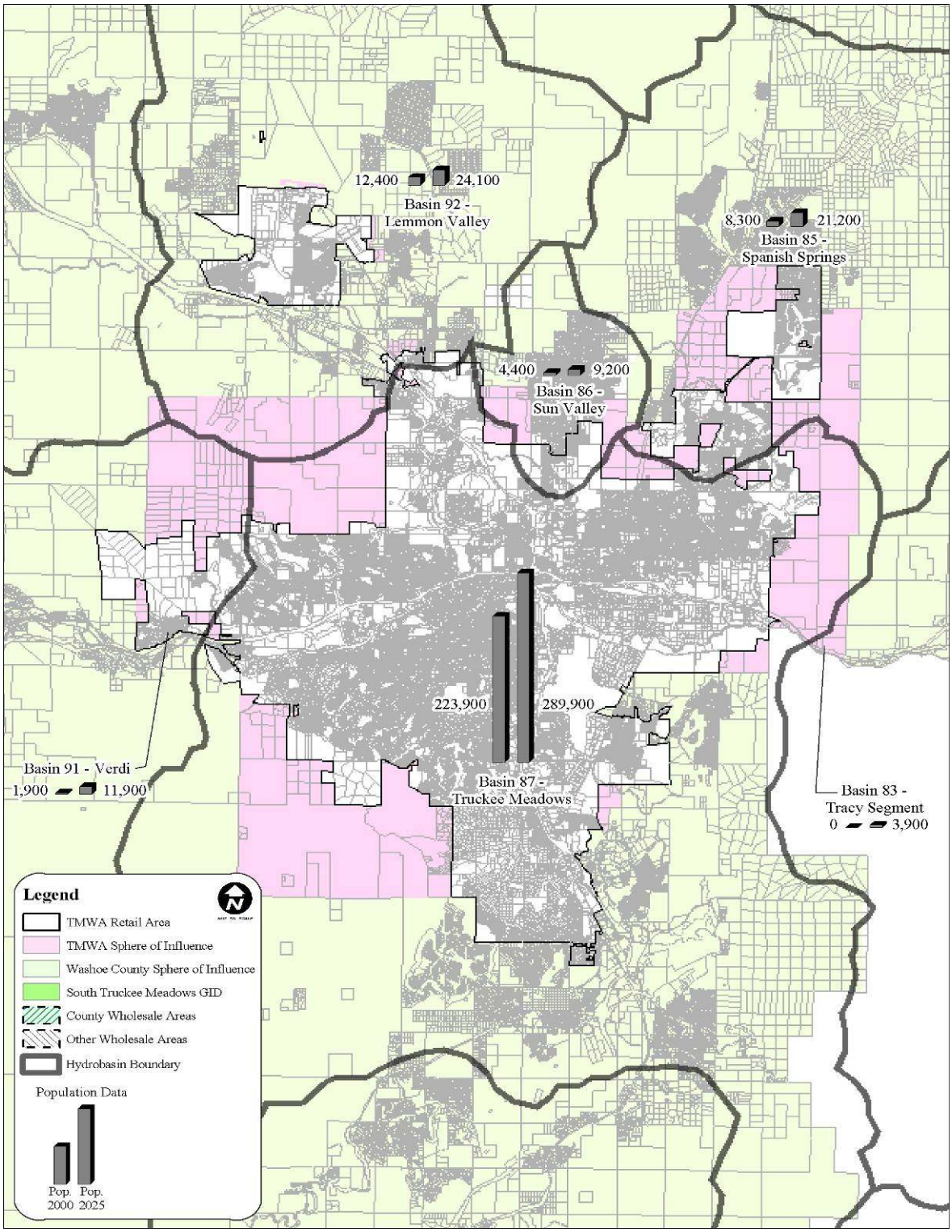

Figure 19: Comparison of 2000 and 2025 TMWA Retail Populations by Hydrographic Basins

The third step in calculating future water demands is to project water demand by customer class[16].

Residential Accounts Total residential dwelling unit count was projected by dividing population by 2.361, which is the average number of persons per dwelling unit within TMWA's retail service boundary calculated in the second step of the analysis. Of the total residential units projected, there are 4 major types: existing metered units, existing flat-rate units, new metered units, and retrofit/converted units. Unit types were further broken into lot size by ranges of square feet, for example 5,000 to 5,999 square feet. Using historical data, average usage per lot size category in acre-feet was estimated for each type of dwelling unit as presented below:

	Flat-Rate	Metered Units			Converted Residences	
Lot Size (sqft)	Units	Built pre 1992	Post 1992 < 1yr service	Post 1992 > 1yr service	< 1yr service	> 1yr service
0-999	0.14	0.25	0.17	0.18	0.14	0.17
1000-3999	0.14	0.34	0.25	0.27	0.14	0.22
4000-4999	0.42	0.40	0.30	0.33	0.42	0.37
5000-5999	0.41	0.42	0.33	0.36	0.41	0.38
6000-6999	0.53	0.46	0.36	0.40	0.53	0.45
7000-7999	0.49	0.49	0.40	0.44	0.49	0.46
8000-8999	0.61	0.53	0.44	0.48	0.61	0.53
9000-9999	0.61	0.55	0.45	0.50	0.61	0.54
10000-11999	0.83	0.56	0.47	0.51	0.83	0.64
12,000-15,999	0.86	0.62	0.52	0.57	0.86	0.68
16,000-19,999	0.97	0.72	0.61	0.67	0.97	0.79
>20,000	1.26	0.62	0.52	0.57	1.26	0.85
Multi-family Unit	0.19	0.17	0.13	0.12	0.19	0.15

The usage factors are different prior and post 1992 due to local planning agencies implementing new plumbing codes requiring low-flow showerheads and low-flow toilets. For a typical 6,000 to 7,000 square foot lot, these changes result in a savings of approximately 0.06 acre-feet/year. Data also shows that metered households less than 1 year in age use less water in the first year than in subsequent years. Residences converting from flat-rate to metered rates however, are assumed to take a one-year lag to fully change water use behavior. These usage factors were multiplied by number of units in each year for each lot size to determine total demand by residential dwelling unit type. An important distinction in this methodology is that the residential water demand projections are based on the number of dwelling units, and should not be mistaken to be the number of service connections.

[16] See Appendix F for detail of demand projection methodology.

Also included within the residential demand projection methodology is the effect of metering the remaining flat-rate residential customers. Existing single family or multi-family flat-rate customers may convert to metered billing for the following reasons:

- customers voluntarily ask for a meter;
- policy implemented March 1, 2002 triggers a meter on residences when:
    - a new owner moves to a residence that is currently flat-rate, or
    - there is a change of tenant in a residence that is currently flat-rate.

This WRP assumes that 20 residences per month, or 240 residences per year voluntarily convert. It assumes that 11% of flat-rate residences per year convert due to the March 1, 2002 policy. This percentage is based on approximately 400 accounts that have qualified per month since March 1, 2002.

Customers that are retrofit as part of the systematic meter retrofit program will continue to be billed flat-rate unless one of the 2 above-mentioned circumstances occurs. The model assumes that all accounts are metered and billed as such beginning 2010, therefore an average 2,350 services are assumed retrofitted per year through the end of 2009.

Commercial Accounts Commercial water demand was forecast by multiplying average water use per employee per year for each industry sector by projected number of employees per sector. Industry sectors included services, hotel gaming and recreation, finance, insurance and real estate, construction, natural resources (forestry, agriculture & mining), manufacturing, wholesale trade, retail trade, and government. Estimates of demand per sector employee have been examined in the past, however, this model forecasts per employee demand across all industries to be the same. TMWA data shows that consumption per commercial connection has been close to static since 1992 therefore disaggregating is not expected to produce significantly different results than would be produced using varying water use factors by sector for TMWA's water demand forecast.

Due to a change in use pattern revealed by the data after 1992, average annual growth (decline) in use per employee from this date was calculated. A large decline in water use per employee occurred prior to 1992, and since then has declined very slowly. The significant decline in annual water use per employee during the 1980's could be due to various factors, the major one of which is likely to be behavior changes post metering all commercial customers, and requiring all commercial irrigation accounts be separate from indoor consumptive use. Three price increases in the 1990's and the 1987 to 1994 drought also affected water usage during this time period as watering restrictions were imposed.

Irrigation Accounts To project future irrigation water demand, total connections and use per irrigation connection per year were plotted to look for trends in the data. As with commercial accounts, the data showed a change in the overall consumptive use pattern before and after 1992. Large swings in usage due to weather however, particularly with the last drought, made estimates based on usage post 1992 look extraordinarily high. To obtain a more reasonable average annual increase, an average of annual use from 1983 to 2000 was calculated. Using this average also produced better estimates of past irrigation consumption than using data exclusively 1992 onward.

To estimate total future demand for irrigation accounts, the average increase in acre-feet consumed per year (1983-2000) was applied to actual year 2000 irrigation consumption and each year thereafter through year 2025; in effect applying a constant average increase.

Wholesale Accounts Wholesale accounts serviced by TMWA are separate from the TMWA retail system. Wholesale geographic areas include:

1. Spanish Springs,
2. South Truckee Meadows, [17]
3. Hidden Valley, and
4. Sun Valley.

Figure 16 shows the location of these wholesale areas. The map also identifies South Truckee Meadows General Improvement District ("STMGID"), which is a separate water purveyor not receiving wholesale water deliveries from TMWA.

TMWA has assumed that the following County elections for wholesale deliveries will be adequate for future demand through 2025: 875 acre-feet for Hidden Valley, 3,400 acre-feet for Spanish Springs (per the Spanish Springs Facility Plan July 2001), 1,800 acre-feet for South Truckee Meadows (per the South Truckee Meadows Facility Plan August 2002), and Sun Valley contract supply is for 2,500 acre-feet. Supply is for build-out in each area, which may occur before or after 2025, but is assumed to occur by 2025 for purposes of this forecast.

System-wide losses / Unaccounted for water Due to the number of unmetered services TMWA does not currently have the ability to audit the system for losses. The 1995 WRP estimated losses of 7%. The industry typically ranges between 7% and 15%, with many service providers assuming 10% water loss. By estimating flat-rate customer water usage for the years 1996 through 1998, and adding to metered consumption, it was estimated that approximately 9.6% system loss was occurring during this time period. During the modeling of this WRP water demand forecast, results consistently estimated 2.5% greater than historical demands for simulated years. The cause for this overestimation is most likely to be from flat-rate services. The model was adjusted by using 7.1% unaccounted for water (9.6% estimated system loss minus 2.5% model correction for flat-rate customers and inaccuracies in usage measurement or miscellaneous unknowns).

Demand Forecast Results Table 12 shows projected TMWA Retail Demand. Total TMWA residential water use is forecast to increase from 52,200 acre-feet in 2000 to 59,300 in 2025. Of this increase, 79% is by single-family residences and 21% by multi-family residences. Growth in single-family usage between 2000 and 2025 is 13%, and for multi-family usage 18%. This WRP demand forecast quantifies the effect of having the entire system on meters. It is projected that approximately 8,365 acre-feet will be saved per year as a result of metering the

[17] South Truckee Meadows encompasses South East Truckee Meadows (Double Diamond) and South Truckee Meadows. The August 2002 South Truckee Meadows Facility Plan identifies the need for annual wholesale deliveries of 1,800 acre-feet at buildout.

remaining flat-rate customers. The demand forecast assumes that the entire system is metered beginning January 2010, and allows one-year lag to fully capture behavior changes.

Total commercial water demand is forecast to increase from 15,000 acre-feet to 22,000 acre-feet by 2025, an increase of 7,000 acre-feet. The average annual rate of growth of water usage per employee declined between 1996 and 2000. Actual consumption will vary up and down over time; however, the trend of gradually declining use per employee is projected through 2025. Consumption in millions of gallons per employee per year is forecast to decline from 22.9 to 22.4.

Table 12: Projected TMWA Retail Demand (units in acre-feet)

Year	Single family	Multi-family	Subtotal Residential	less Retrofit savings	Total Residential	Commercial	Irrigation	Total Retail
2000	43,979	8,239	52,218	0	52,218	14,979	6,162	73,360
2001	44,791	8,265	53,056	0	53,056	15,540	6,441	75,040
2002	45,480	8,405	53,885	0	53,885	16,042	6,720	76,650
2003	46,170	8,545	54,715	-513	54,201	16,460	7,000	77,670
2004	46,786	8,670	55,457	-1,928	53,529	16,800	7,279	77,610
2005	47,360	8,787	56,147	-3,186	52,960	17,085	7,558	77,610
2006	47,927	8,902	56,829	-4,306	52,523	17,355	7,837	77,720
2007	48,484	9,015	57,499	-5,303	52,196	17,637	8,116	77,950
2008	49,038	9,128	58,166	-6,190	51,976	17,930	8,396	78,310
2009	49,590	9,240	58,830	-6,980	51,849	18,226	8,675	78,760
2010	50,132	9,350	59,483	-7,683	51,800	18,519	8,954	79,280
2011	50,663	9,458	60,121	-8,365	51,756	18,804	9,233	79,800
2012	51,180	9,563	60,743	-8,365	52,378	19,079	9,512	80,970
2013	51,683	9,665	61,348	-8,365	52,983	19,343	9,792	82,120
2014	52,172	9,765	61,937	-8,365	53,572	19,598	10,071	83,250
2015	52,648	9,861	62,510	-8,365	54,145	19,846	10,350	84,350
2016	53,111	9,955	63,066	-8,365	54,701	20,085	10,629	85,420
2017	53,560	10,047	63,607	-8,365	55,241	20,316	10,909	86,470
2018	54,001	10,136	64,137	-8,365	55,772	20,541	11,188	87,510
2019	54,435	10,224	64,659	-8,365	56,294	20,762	11,467	88,530
2020	54,863	10,311	65,174	-8,365	56,809	20,979	11,746	89,540
2021	55,285	10,397	65,682	-8,365	57,317	21,194	12,025	90,540
2022	55,701	10,482	66,183	-8,365	57,818	21,405	12,305	91,530
2023	56,111	10,565	66,676	-8,365	58,311	21,612	12,584	92,510
2024	56,514	10,647	67,161	-8,365	58,795	21,815	12,863	93,480
2025	56,910	10,727	67,637	-8,365	59,271	22,014	13,142	94,430
Total Change	12,931	2,488	15,419		7,054	7,034	6,980	21,070
Percent Change	29%	30%	30%		14%	47%	113%	29%

Total irrigation usage is forecast to grow from 6,200 acre-feet to 13,100 acre-feet, an increase of 6,900 acre-feet or 113%. Such significant growth in this sector may not be realized if Reno and Sparks increase effluent reuse or other non-potable resources in the region.

Retail Demand by Jurisdiction: Table 13 shows projected retail demands by jurisdiction. Demand within Reno's jurisdiction boundary, including its Sphere of Influence per the May 2002 Regional Plan is estimated to grow from 50,800 acre-feet annually in 2000 to 61,100 in 2025, a total increase of 10,300 acre-feet.

Table 13: Projected Retail Demand by Jurisdiction (units in acre-feet)

Year	City of Reno	City of Sparks	Unincorporated County	Total
2000	50,833	19,203	3,323	73,360
2001	51,816	19,720	3,502	75,040
2002	52,795	20,291	3,562	76,650
2003	53,358	20,717	3,587	77,670
2004	53,191	20,852	3,566	77,610
2005	53,060	20,996	3,548	77,610
2006	53,006	21,176	3,534	77,720
2007	53,033	21,392	3,526	77,960
2008	53,135	21,645	3,523	78,310
2009	53,299	21,929	3,524	78,760
2010	53,510	22,237	3,527	79,280
2011	53,716	22,547	3,531	79,800
2012	54,374	23,032	3,564	80,980
2013	55,010	23,512	3,596	82,120
2014	55,836	23,769	3,638	83,250
2015	56,690	23,972	3,680	84,350
2016	57,518	24,178	3,721	85,420
2017	58,316	24,391	3,760	86,470
2018	59,092	24,611	3,798	87,510
2019	59,848	24,841	3,835	88,530
2020	60,319	25,311	3,906	89,540
2021	60,658	25,892	3,987	90,540
2022	60,820	26,627	4,082	91,530
2023	60,920	27,412	4,176	92,510
2024	61,016	28,028	4,431	93,480
2025	61,112	28,103	5,214	94,430
Change	10,279	8,900	1,891	21,070
Percent Change	20%	46%	57%	29%

Demand within Sparks' jurisdiction boundary, including its Sphere of Influence per the May 2002 Regional Plan is estimated to grow from 19,200 acre-feet annually in 2000 to 28,100 in 2025, a total increase of 8,900 acre-feet.

Demand within the unincorporated County's jurisdiction boundary is estimated to grow from 3,400 acre-feet annually in 2000 to 5,200 in 2025, a total increase of 1,900 acre-feet.

These results do not include system losses. Although Reno (within TMWA's boundary) is projected to develop the greatest amount of land and have the greatest water demand increase between 2005 and 2025, total demand growth is not as large proportionate to land development. This result is because Reno has the greatest number of flat-rate customers converting to meters, and has the greatest savings associated with the retrofit program.

Total System Demand Forecast To project TMWA retail demand, wholesale demand and losses are added to projected TMWA retail demand.

Total wholesale demand is projected to grow from 3,400 acre-feet in 2000 to approximately 8,600 acre-feet in 2025. Total annual demand (retail and wholesale) is then multiplied by the unaccounted for water factor to obtain total annual projected demand.

Total consumption (net production) is forecast to grow from 80,200 acre-feet in 2000 to 110,300 acre-feet in 2025. A slower growth in residential use is projected from 2004 through 2011 due to metering existing flat-rate customers. The results are summarized in Table 15 and historic and projected demand illustrated in Figure 20.

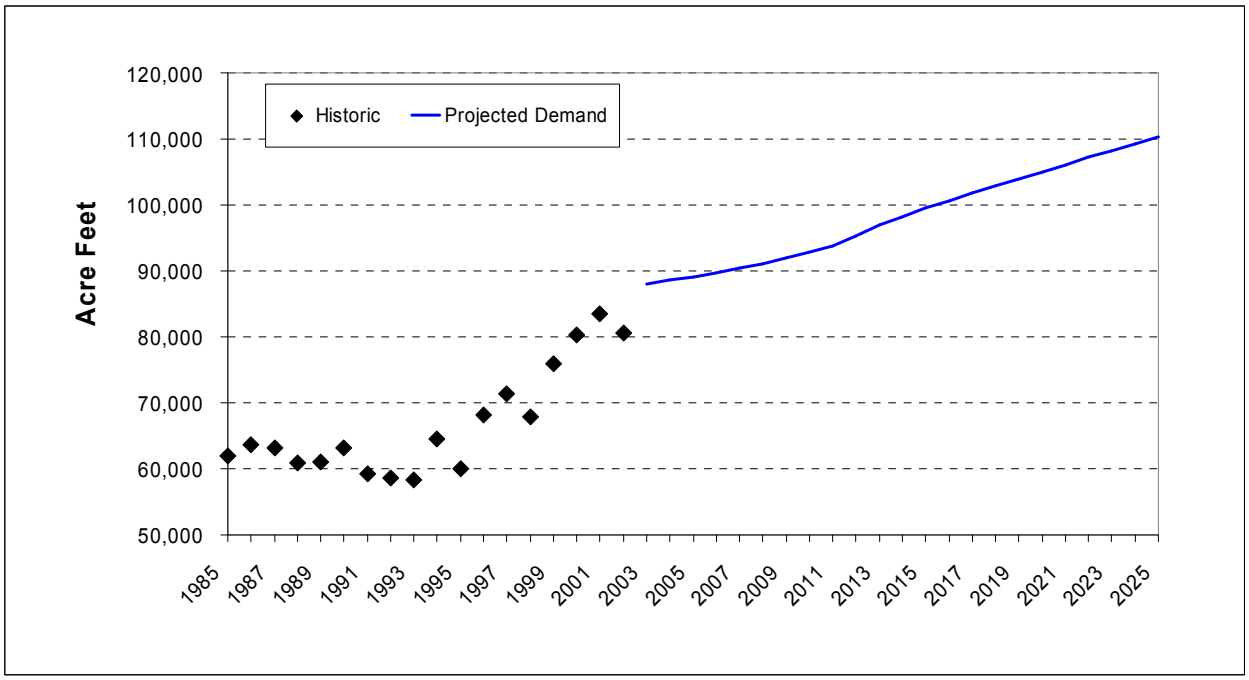

Figure 20: Historic and Projected Demand to 2025

Table 14: Demand Forecast for TMWA (units in acre feet)

Year	Single Family	Multi-Family	Subtotal Residential	Meter Retrofit Savings	Total Residential w / Savings	Commercial	Irrigation	Subtotal Commercial and Irrigation	**Total TMWA Demand**	Sun Valley	[1] FSPR Accounts	Subtotal Wholesale	**Total System Demand**	Unaccounted for and [2] Losses	**Net Production [3]**
														7.1%	
2000	43,979	8,239	52,218	0	52,218	14,979	6,162	21,141	**73,359**	2,137	1,259	3,396	**76,755**	5,418	**82,180**
2001	44,791	8,265	53,056	0	53,056	15,540	6,441	21,981	**75,037**	2,156	1,284	3,441	**78,478**	5,539	**84,020**
2002	45,480	8,405	53,885	0	53,885	16,042	6,720	22,762	**76,647**	2,176	1,558	3,734	**80,381**	5,673	**86,060**
2003	46,170	8,545	54,715	-513	54,201	16,460	7,000	23,459	**77,661**	2,195	1,831	4,027	**81,687**	5,766	**87,460**
2004	46,786	8,670	55,457	-1,928	53,529	16,800	7,279	24,079	**77,608**	2,213	2,073	4,285	**81,893**	5,780	**87,680**
2005	47,360	8,787	56,147	-3,186	52,960	17,085	7,558	24,643	**77,603**	2,229	2,298	4,527	**82,130**	5,797	**87,930**
2006	47,927	8,902	56,829	-4,306	52,523	17,355	7,837	25,192	**77,715**	2,245	2,523	4,768	**82,483**	5,822	**88,310**
2007	48,484	9,015	57,499	-5,303	52,196	17,637	8,116	25,754	**77,950**	2,261	2,743	5,004	**82,954**	5,855	**88,810**
2008	49,038	9,128	58,166	-6,190	51,976	17,930	8,396	26,325	**78,301**	2,277	2,963	5,240	**83,541**	5,897	**89,440**
2009	49,590	9,240	58,830	-6,980	51,849	18,226	8,675	26,901	**78,751**	2,292	3,181	5,474	**84,224**	5,945	**90,170**
2010	50,132	9,350	59,483	-7,683	51,800	18,519	8,954	27,473	**79,273**	2,308	3,396	5,704	**84,977**	5,998	**90,980**
2011	50,663	9,458	60,121	-8,365	51,756	18,804	9,233	28,037	**79,794**	2,323	3,606	5,929	**85,722**	6,051	**91,780**
2012	51,180	9,563	60,743	-8,365	52,378	19,079	9,512	28,591	**80,969**	2,337	3,810	6,148	**87,117**	6,149	**93,270**
2013	51,683	9,665	61,348	-8,365	52,983	19,343	9,792	29,135	**82,118**	2,352	4,009	6,360	**88,478**	6,245	**94,730**
2014	52,172	9,765	61,937	-8,365	53,572	19,598	10,071	29,669	**83,241**	2,366	4,202	6,568	**89,808**	6,339	**96,150**
2015	52,648	9,861	62,510	-8,365	54,145	19,846	10,350	30,196	**84,340**	2,379	4,390	6,769	**91,109**	6,431	**97,550**
2016	53,111	9,955	63,066	-8,365	54,701	20,085	10,629	30,714	**85,416**	2,392	4,573	6,965	**92,381**	6,520	**98,910**
2017	53,560	10,047	63,607	-8,365	55,241	20,316	10,909	31,225	**86,466**	2,405	4,750	7,155	**93,621**	6,608	**100,230**
2018	54,001	10,136	64,137	-8,365	55,772	20,541	11,188	31,729	**87,500**	2,417	4,924	7,342	**94,842**	6,694	**101,540**
2019	54,435	10,224	64,659	-8,365	56,294	20,762	11,467	32,229	**88,522**	2,430	5,096	7,526	**96,048**	6,779	**102,830**
2020	54,863	10,311	65,174	-8,365	56,809	20,979	11,746	32,725	**89,534**	2,442	5,266	7,707	**97,242**	6,864	**104,110**
2021	55,285	10,397	65,682	-8,365	57,317	21,194	12,025	33,219	**90,536**	2,454	5,433	7,886	**98,423**	6,947	**105,370**
2022	55,701	10,482	66,183	-8,365	57,818	21,405	12,305	33,710	**91,527**	2,466	5,597	8,063	**99,590**	7,029	**106,620**
2023	56,111	10,565	66,676	-8,365	58,311	21,612	12,584	34,196	**92,507**	2,477	5,759	8,237	**100,744**	7,111	**107,860**
2024	56,514	10,647	67,161	-8,365	58,795	21,815	12,863	34,678	**93,474**	2,489	5,919	8,407	**101,881**	7,191	**109,080**
2025	56,910	10,727	67,637	-8,365	59,271	22,014	13,142	35,156	**94,427**	2,500	6,075	8,575	**103,002**	7,270	**110,280**

[1] Includes Spanish Springs, Hidden Valley, South Truckee Meadows and South East Truckee Meadows.

[2] Industry range is 7 to 15%. Estimate based on data for 1997, 1998, and 1999 indicates 9.6% losses. Adjustment to 7.1% allows for approximately 2.5% overestimation of water use in base year of forecast.

[3] Net Production does not include surface water that is treated and recharged during the winter months via the wells.

Extended Forecast. The demand forecast was extended another 30 years to 2055 to provide a longer-range demand curve. The primary reason to extend the forecast was to get an estimate of when 119,000 acre-foot supply (including retail and wholesale deliveries) would be reached. This supply figure is the maximum demand available under a TROA supply plan. TROA and non-TROA supply options and the significance of the 119,000 acre-foot number are described in detail in Chapter 5. The forecast is extended through 2055 by extrapolating the percentage growth rate from 2017 to 2025. Net production of 119,000 acre-feet is projected to be reached in 2033.

By extending the forecast in this way, TMWA has assumed that it continues to provide increased retail or wholesale deliveries to meet demands in the region's projected growth areas. The growth curve in the absence of this assumption is dramatically lowered, with buildout demand ranging from 119,000 to 123,000 acre-feet assuming TMWA retail and expansion boundaries do not change. Figure 21 is a graph showing the extended forecast.

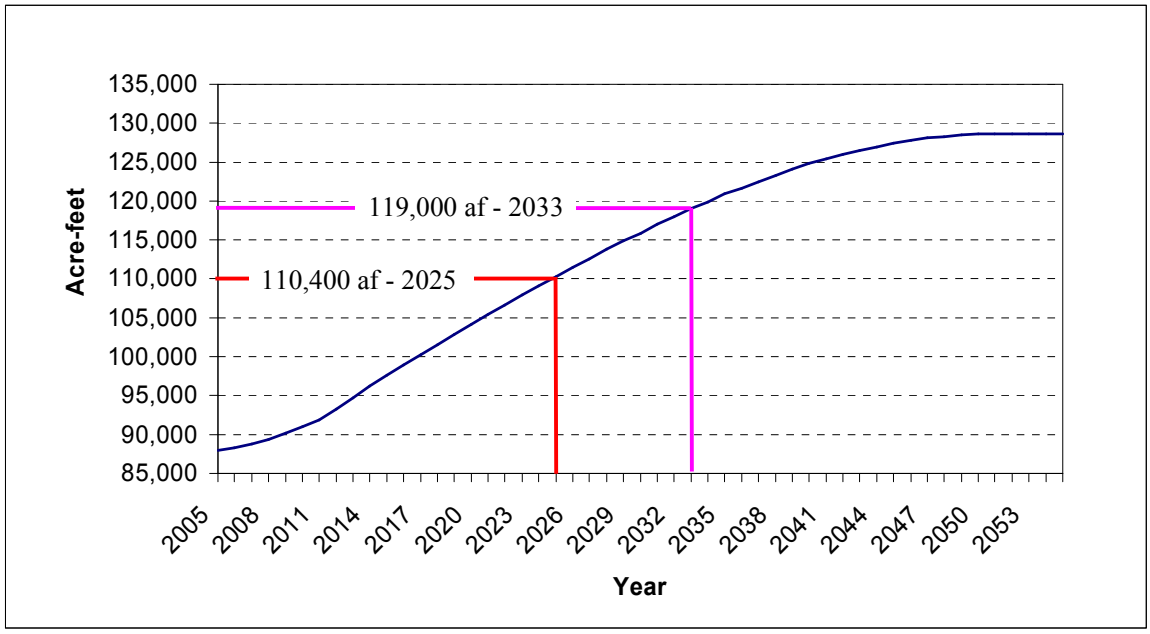

Figure 21: Demand Forecast 2005 to 2055

Demand by Hydrographic basin Although not required per the terms of the JPA, TMWA also projected water demand by hydrographic basin for TMWA's retail and wholesale customers. Table 15 shows projected water demand by hydrographic basin. TMWA current retail and future expansion areas lie within six hydrographic basins. The Truckee Meadows basin is projected to experience the greatest increase in water demand, approximately 14,900 acre-feet. Spanish Springs and Lemmon Valley are projected to experience the next largest increases of 6,500 acre-feet and 2,700 acre-feet respectively. The Verdi hydrographic basin is projected to increase by over 2,000 acre-feet, followed by Sun Valley hydrographic basin at just

over 1,500 acre-feet. The Tracy Segment hydrographic basin lies at the very east of TMWA's expansion area, and should this area be served by TMWA, is projected to add just under 1,000 acre-feet of new retail demand. At this time, TMWA has rolled demand in this hydrographic basin into the Truckee Meadows hydrographic basin.

The South Truckee Meadows and Hidden Valley wholesale demands are located in the Truckee Meadows hydrographic basin. Spanish Springs wholesale is located in the Spanish Springs hydrographic basin. Sun Valley wholesale is located in the Sun Valley hydrographic basin. Figure 18 shows total water demands by hydrographic basin projected to be served by TMWA.

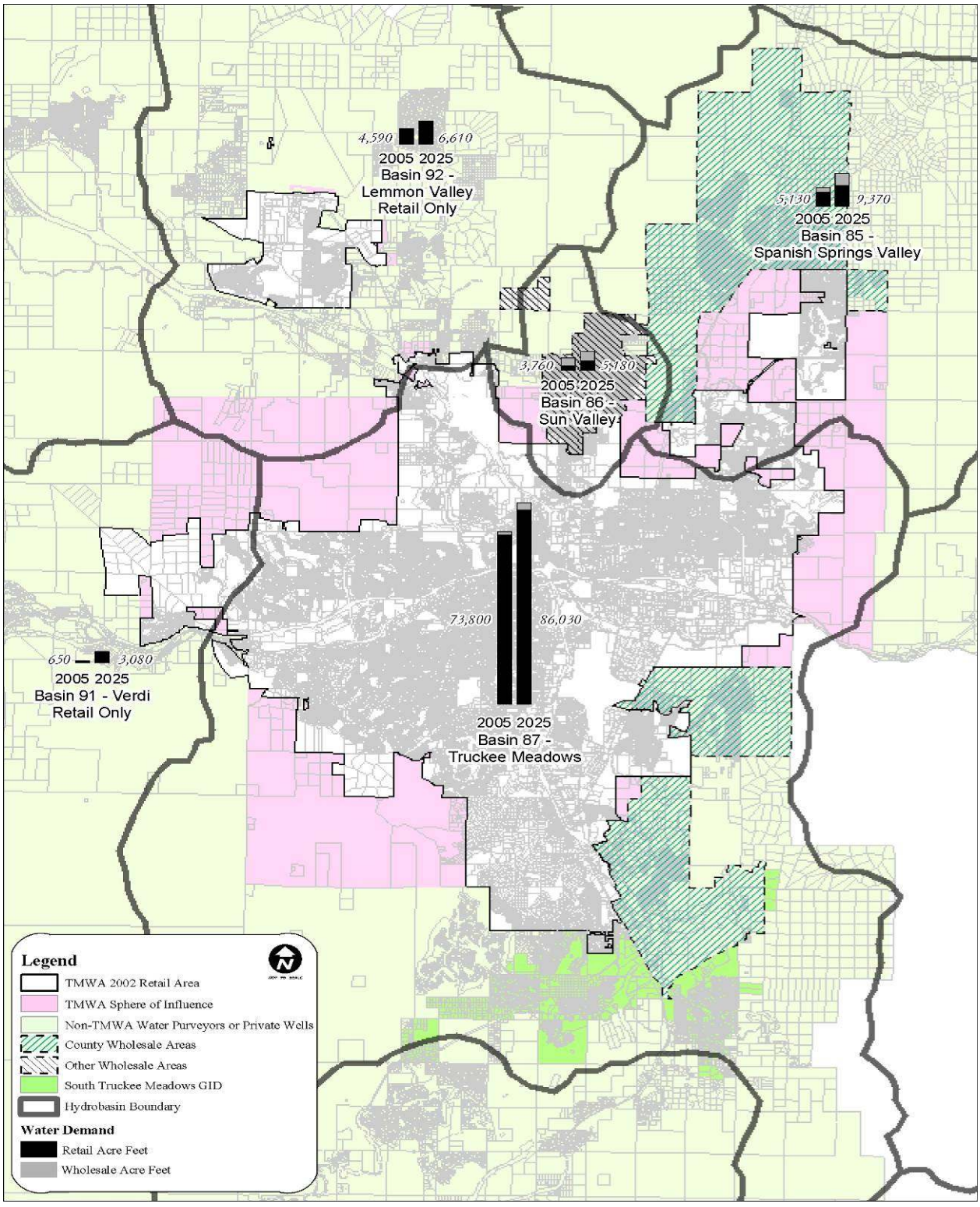

Figure 22: TMWA Water Demands By Hydrographic Basins

Table 15: Projected Demand by Hydrographic basin (units in acre feet)

Year	Basin 85 Spanish Springs			Basin 86 Sun Valley			Basin 87 Truckee Meadows			Basin 91 Verdi	Basin 92 Lemmon Valley	Total
	Retail	*Wholesale*	*Total*	*Retail*	*Wholesale*	*Total*	*Retail*	*Wholesale*	*Total*	*Retail*	*Retail*	
2000	2,606	298	2,904	1,371	2,288	3,658	70,079	1,050	71,129	589	3,893	82,180
2001	2,849	297	3,146	1,384	2,308	3,693	71,312	1,078	72,390	606	4,184	84,020
2002	3,179	488	3,667	1,399	2,329	3,728	72,501	1,180	73,681	625	4,354	86,060
2003	3,530	679	4,208	1,402	2,350	3,753	73,089	1,282	74,371	639	4,483	87,460
2004	3,799	847	4,646	1,386	2,369	3,755	72,650	1,372	74,022	642	4,530	87,600
2005	4,128	1,005	5,132	1,372	2,386	3,758	72,339	1,456	73,795	646	4,587	87,920
2006	4,499	1,161	5,660	1,359	2,404	3,763	72,042	1,540	73,582	649	4,649	88,310
2007	4,908	1,315	6,223	1,349	2,420	3,770	71,825	1,622	73,447	654	4,713	88,810
2008	5,362	1,468	6,830	1,341	2,437	3,778	71,685	1,704	73,388	658	4,780	89,440
2009	5,602	1,621	7,222	1,336	2,454	3,790	71,814	1,785	73,599	667	4,888	90,170
2010	5,602	1,771	7,372	1,335	2,471	3,805	72,211	1,865	74,076	679	5,040	90,980
2011	5,589	1,917	7,506	1,333	2,487	3,820	72,614	1,943	74,557	692	5,196	91,780
2012	5,600	2,060	7,659	1,344	2,502	3,847	73,641	2,020	75,661	709	5,388	93,270
2013	5,610	2,198	7,808	1,355	2,518	3,872	74,641	2,094	76,734	726	5,580	94,730
2014	5,621	2,333	7,954	1,365	2,533	3,897	75,615	2,166	77,780	743	5,771	96,150
2015	5,631	2,464	8,096	1,375	2,547	3,922	76,564	2,236	78,800	759	5,962	97,540
2016	5,642	2,592	8,234	1,384	2,561	3,945	77,490	2,304	79,794	774	6,152	98,900
2017	5,652	2,716	8,368	1,394	2,575	3,968	78,390	2,370	80,760	789	6,342	100,230
2018	5,662	2,837	8,499	1,403	2,588	3,991	79,277	2,435	81,711	804	6,528	101,540
2019	5,672	2,957	8,629	1,413	2,601	4,014	80,312	2,499	82,811	822	6,549	102,830
2020	5,682	3,075	8,757	1,423	2,614	4,038	81,347	2,562	83,909	839	6,560	104,110
2021	5,692	3,192	8,884	1,561	2,627	4,188	81,981	2,624	84,606	1,119	6,571	105,370
2022	5,702	3,307	9,008	1,799	2,640	4,438	82,295	2,686	84,981	1,608	6,582	106,620
2023	5,711	3,420	9,131	2,037	2,652	4,690	82,590	2,746	85,336	2,103	6,593	107,860
2024	5,721	3,531	9,252	2,271	2,664	4,936	82,881	2,805	85,686	2,592	6,604	109,080
2025	5,730	3,640	9,370	2,501	2,676	5,177	83,169	2,864	86,032	3,076	6,615	110,280
Change	3,125	3,342	6,467	1,130	389	1,519	13,089	1,814	14,903	2,487	2,722	28,100
Percent Change	120%	1121%	223%	82%	17%	42%	19%	173%	21%	422%	70%	34%

Factors Affecting Future Demand Results

There are several factors that can change the future water demand results, system-wide, by jurisdiction, or by hydrographic basin.

Developable Land The forecast includes a "developable land" constraint to account for reduced economies of scale associated with the future development of residential and commercial properties, a tighter water rights market with competing buyers (developers, water quality interests, and wildlife interests), other resources becoming scarce and expensive, and other constraints such as impact fees, facility fees, or environmental mitigation costs that cause financial returns to fall below industry expectations.

Development of vacant land was assumed to continue at the average pace experienced since 1996 within the various County planning areas. The average pace of growth is based on total land developed each year per the Washoe County Assessor's records. The projection of TMWA retail demand as shown in Table 12 is influenced by this calculation. If significantly slower growth is experienced, projected demands will be significantly lower through 2025.

Institutional Requirements The developable land approach that is used to project demand by jurisdiction and hydrographic basin uses average historic rates of growth (land built) since 1996 to estimate the pace of future land development. The percentage of population projected within each jurisdiction was based on pace of growth by sub-area. The model cannot capture institutional requirements that change in the future. Population by sub-area could vary if planning authorities change requirements for processing entitlements, impose building moratoriums or other such changes, also affecting water demands by year.

Vitality of the Economy The actual rate of growth of development in Washoe County will depend on the national economy, regional economic activities, local supply and demand of resources, and local government actions. A national recession, for example, could push the demand curve out by several years.

Weather A major drought could reduce demand in some of the projected years. Reduced usage for drought is expected to show a temporary reduction in water use; in the long-term total consumption is expected to move back to the projected demand curve.

Conversion of Flat-Rate Units to Meters Converted homes average water use is expected to range between the rate of a flat-rate home and a metered home, but not drop as low as non-retrofit metered homes on average. This expectation is based on the assumption that homeowners are relatively price inelastic with regards to water, and that water-intensive habits and hobbies developed under flat-rate water billing (such as the care of a vegetable plot), are unlikely to change water usage to the full extent of a non-converted metered unit. In addition, new metered homes are equipped with more efficient water using devices such as dishwashers and laundry machines.

TMWA weighted the usage for these homes as 40% flat-rate, and 60% metered use. Historical data indicates that metered (non-retrofit) single family homes use 60% to 65% the water of a flat rate home on an annual basis. Using the 40/60 weighting in this forecast, usage per retrofit homes is estimated to drop to approximately 85% of a flat-rate home. TMWA will

monitor actual changes in consumption so that the weighting is adjusted in future demand studies, if necessary.

Conservation The demand forecast prepared for this plan assumes that conserved water as a result of conservation programs currently in place will continue in the future. The conserved water may be due to either continuance of existing programs, or their replacement with other programs. Future new conservation programs not outlined in this resource plan may result in additional water savings not incorporated in the demand forecast.

Price Elasticity Impacts The demand forecast has assumed that consumers will absorb any price changes due to inflation and no change in water use behavior will occur. When a rate change is implemented, TMWA expects some level of reaction in customer water use. This response to change in the price of water is called price elasticity. TMWA's best estimates of water price elasticity in the Truckee Meadows range from 0.196 for single-family to 0.25 for multi-family, and 0.66 to 0.91 for commercial customers[18]. (Elasticity between 0 and 1 is considered "price inelastic" meaning that the customer is not sensitive to price change. Elasticity greater than 1 is considered "price elastic" meaning that the customer is very responsive to price changes).

Price elasticity was not incorporated in the water demand model because the model does not account for future revenue needs and the change in real water prices (i.e., absent inflation effects). In addition, given the price elasticities that are estimated for TMWA, the response to rate changes is anticipated to be relatively small compared to the use responses due to weather and institutional requirements such as watering restrictions.

Per Capita Demand

While the forecast of water use is not calculated using a per capita method, TMWA has estimated historical per capita demand and projected per capita demand based on the results of the TMWA future demand model. Figure 23 summarizes both the historical per capita demand, and the per capita demand per day (gpcd) through 2025.

Due to metering the system, demand per capita is anticipated to decrease approximately 6 percent. In this methodology, system demand less wholesale demand is spread among TMWA's retail population. During the 1940-50's, consumption was approximately 440 gpcd. By the late 1970's consumption was approximately 340 gpcd, and over the past 5 years has averaged 270 gpcd. From the inception of meter retrofit to a fully metered system, consumption is expected to decrease from 340 gpcd to 250 gpcd; a 25% decrease, of which the majority is due to metering. This is very close to estimates prepared for Sierra during the late 1970's when the projected benefits of metering were being considered.

[18] See Appendix G for residential price-elasticity estimates and Appendix H for commercial price-elasticity estimates.

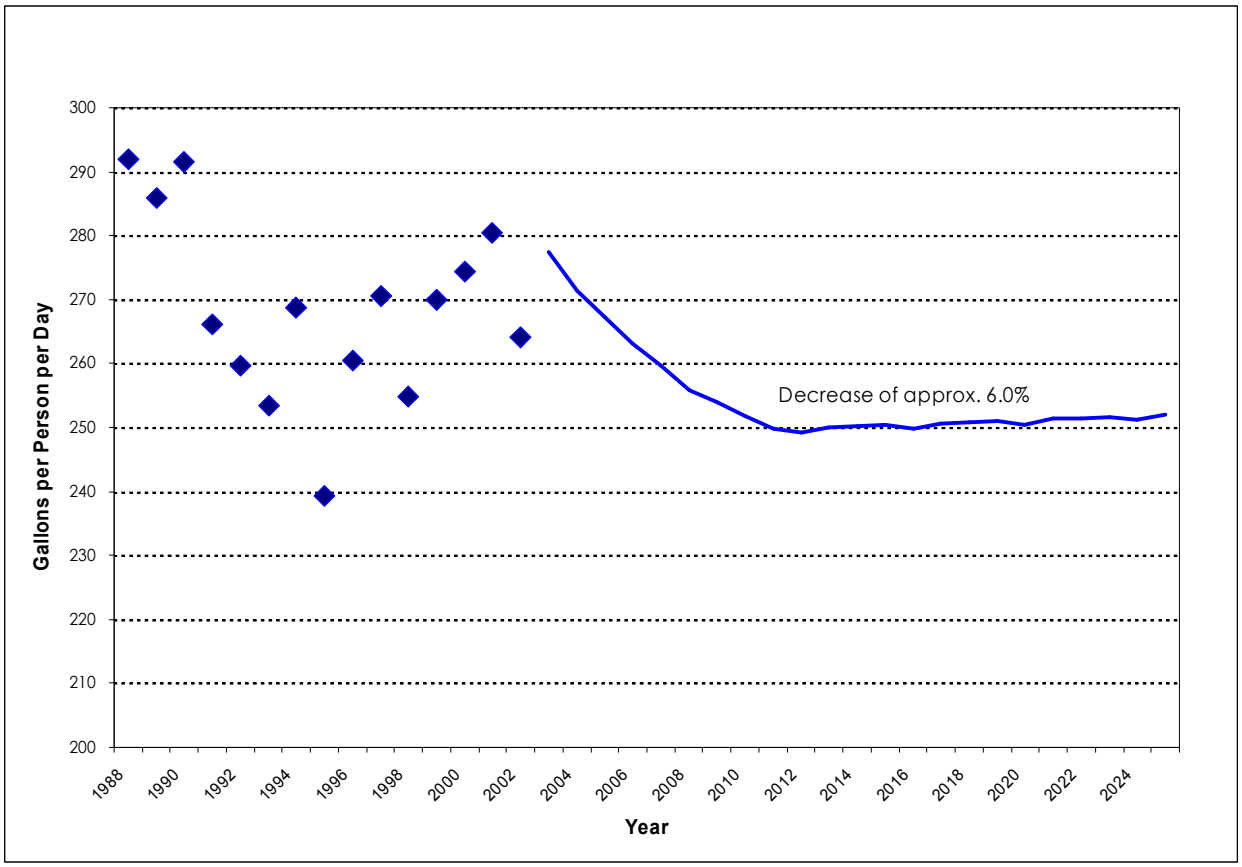

Figure 23: Historic and Projected Gallons per Capita per Day

Peak Day Forecast

TMWA's model projects annual consumption in acre-feet for a non-drought year. Future production facilities must meet peak day consumption requirements and supply drought year commitments.

To satisfy the production year requirement for the drought year and non-drought year conditions, TMWA conjunctively manages its surface and groundwater production facilities. Chapter 2 described this process at a macro-facility level. Here, the facility planning goals are delineated further. Drought-year facility planning goals include:

- Minimize use of all reserve resources (POSW, credit water and groundwater) in the event of consecutive drought-years.
- Maximize groundwater use (up to 22,000 acre-feet annually) in the more critical months: July, August, September and October.

- Minimize the use of POSW during the year, particularly in the more critical months: July, August, September and October.
- Maximize river diversions while releasing the minimum amounts of POSW to meet production requirements.
- No groundwater should be pumped from November through April, and delayed use as far into May as possible. Glendale water treatment plant must be on-line in April.
- Artificial recharge should occur as early in October as possible and continue through April.
- Maximize storage of POSW under ISA; or POSW and credit water under TROA.
- Storage in reservoirs should be maximized in the spring and to the extent not limited by flood control levels in the winter months.

The non-drought-year facility planning goals include:

- Maximize surface water diversions every month. Surface water production is the first supply to use.
- Limit, groundwater use (attempting to average less than 15,950 acre-feet annually) to the critical months: July, August, and September, and eliminate its use as early as possible in October. No groundwater should be used in April, and if possible, delay its use until June.
- None of TMWA's POSW should be used during the year.
- Artificial recharge, though not required as long as the annual-average (or less) target is achieved can and should occur as early in October as possible and continue through April to store credit water for future use.
- Maximize storage of POSW under ISA; or POSW and credit water under TROA.

Model results project peak day consumption during the non-drought years to increase from 147.1 MGD in 2002 to 189.5 MGD in 2025. (Actual peak day consumption for 2002 was 146.9 MGD on July 11th which is within 0.6% of the model projection). While drought years or other weather occurrences may see actual peak days varying from the non-drought year projections, the projections reflect the long-term trend in consumption, and the level of consumption to which system capacity must be able to respond.

Projected peak day consumption during drought years is estimated to be non-drought year peak day consumption reduced by 10%. Historical data shows that peak day consumption has been reduced between 2% and 11% from prior year consumption when the Truckee Meadows has been experiencing drought. As the system is metered, TMWA will continue to evaluate potential water conservation savings.

While TMWA is able to mathematically calculate peak day demand by Purveyor Member per the retail demand projections, the results hold no value in determining how peak capacity is

met. TMWA operates its facilities as a unified system. The system has been engineered as one functioning system in the interest of efficiency and lowest cost to the community.

Successful scheduling of the use of surface and ground water resources to meet the conditions outlined above will increase the yield of TMWA's resources and will require investment in additional production facilities. The projected rated surface water treatment and groundwater well production requirements are shown in Table 16. Total production capability shown in Table 16 is greater than projected peak day consumption, be it groundwater in non-drought years or surface water in drought years. This cannot be avoided since water supplies dictate which facilities will be utilized in any given year. The projections shown here, however, reflect the minimum amount of production capacity required to maximize the yield of TMWA resources (as constrained by both the drought and non-drought scenarios).

Resources to meet future supplies under non-drought and drought year scenarios including commitments and limitations are described in Chapter 5.

Table 16: Projected Peak Day and Production Facilities Requirements

	Consumption			Production Facilities Requirements [1]		
Year	Demand Acre-ft --a-- *Acre-feet*	Non-Drought Year Peak Day --b-- *MGD*	Drought Year Peak Day --c-- *b x 0.9* *MGD*	Surface --d-- *MGD*	Ground --e-- *MGD*	Total --f-- *d + e* *MGD*
2003	88,090	151.4	136.3	87.1	59.1	146.2
2004	88,590	152.3	137.0	87.4	59.7	147.1
2005	89,100	153.1	137.8	87.9	60.4	148.3
2006	89,740	154.2	138.8	88.5	61.0	149.5
2007	90,430	155.4	139.9	89.4	61.6	151.0
2008	91,140	156.6	141.0	90.5	62.2	152.7
2009	91,970	158.1	142.3	91.7	62.8	154.5
2010	92,870	159.6	143.7	93.1	63.4	156.5
2011	93,760	161.1	145.0	94.5	64.1	158.6
2012	95,340	163.9	147.5	97.1	64.7	161.8
2013	96,890	166.5	149.9	99.6	65.3	164.9
2014	98,220	168.8	151.9	102.0	65.9	167.9
2015	99,470	171.0	153.9	104.4	65.9	170.3
2016	100,620	172.9	155.6	106.7	65.9	172.6
2017	101,750	174.9	157.4	109.0	65.9	174.9
2018	102,860	176.8	159.1	111.3	65.9	177.2
2019	103,950	178.7	160.8	113.5	65.9	179.4
2020	105,030	180.5	162.5	115.7	65.9	181.6
2021	106,110	182.4	164.1	117.9	65.9	183.8
2022	107,170	184.2	165.8	120.0	65.9	185.9
2023	108,220	186.0	167.4	122.1	65.9	188.0
2024	109,250	187.8	169.0	124.2	65.9	190.1
2025	110,270	189.5	170.6	126.3	65.9	192.2

[1] 5 MGD of demand can be met with storage capacity on a peak day.

Summary

This chapter included TMWA's water demand forecast, factors impacting the demand forecast, and peak day projections. It accomplished the following goals:

- Estimated water demand within each Member's jurisdiction within the Authority's retail service area (Article 5 (ii)).
- Satisfied JPA Article 5 (iii) by presenting the projection of peak day consumption for the entire system and identified that it was not applicable to project peak day consumption by Purveyor Member.

In developing the water demand forecast, TMWA's TPEM projected population and employment forecasts lie within 10% deviation in any one year of the 2003 Consensus Forecast projection. Population and employment by jurisdiction and hydrographic basin was presented. GIS analysis indicates that total developable land within TMWA's retail and expansion boundaries is significantly less when US Forest Service and a 6,000 foot elevation level are imposed as constraints to serving those areas.

Growth in demand from the Cities of Reno and Sparks is projected to significantly slow from 2025 onwards assuming historical growth rates and current jurisdiction boundaries hold. If these assumptions are realized, TMWA build-out demand is projected to be range from 119,000 acre-feet to 123,000 acre-feet. TMWA's future demand is projected to continue growing in the Central Truckee Meadows but also significantly increase in outlying areas. Relative growth in demand (2002 to 2025) in Reno is less than might be expected due to the effect of metering the system. The majority of the older, flat-rate households are located in the City of Reno. Approximately 70% of the total savings from metering is projected to be from Reno households, 25% from Sparks, and 5% from the unincorporated County households.

The projected peak day demands are reasonable estimates to be used for planning future facilities. Just as managing the water resources in a conjunctive manner produces the maximum committable yield of those resources, projected peak days under drought and non-drought conditions seek to maximize the use of surface and groundwater resources. In doing so the capital investment in additional projection facilities is minimized.

Even though Article 5 of the JPA instructs TMWA to establish water supplies "separately to each Member from all sources", separating supplies, and potentially facilities, this would be counter productive to efficient resource and facility planning and management, and would likely result in over-investment in facilities and exhaustion of available resources at rates faster than predicted in this plan. For these reasons analysis of separating facilities was not included.

Chapter 4 Water Conservation Plan

Water conservation is a vital part of an integrated water resource plan. Water conservation can influence customer utility bills, the need for future facilities or timing of those facilities, drought protection for the community, and the rate at which new resources are needed. There has been a process of developing and implementing a conservation program over the past 16 years, implemented by TMWA and the Regional Water Planning Commission. In developing water conservation strategies for TMWA, there are three overriding planning objectives that must be satisfied.

JPA Conservation Objectives Article 5(i) of the JPA requires TMWA to "prepare, update and oversee the implementation of a water conservation plan for the use of municipal, industrial, and domestic water supplies within the retail service area of the Authority and to carry out the former Sierra Pacific Power Company role with regard to the Water Conservation Agreements with Members."

NRS Conservation Objectives In addition to Article 5(i), TMWA is required to meet NRS 540.131 through 540.151, which calls for a conservation program that provides:

a) Methods of public education to (1) increase public awareness of the limited supply of water in the State and the need to conserve water, (2) encourage reduction in the size of lawns and encourage the use of plants that are adapted to arid and semiarid climates.

b) Specific conservation measures required to meet the needs of the service area, including, but not limited to, any conservation measures required by law.

c) Management of water to (1) identify and reduce leakage in water supplies, inaccuracies in water meters and high pressure in water supplies, and (2) increase the use of effluent.

d) A contingency plan for drought conditions that ensures a supply of potable water

e) A schedule for carrying out the plan

f) Measures to evaluate the effectiveness of the plan.

TMWA is required to adopt a plan to provide incentives to (a) encourage water conservation in its service area; (b) to retrofit existing structures with plumbing fixtures designed to conserve the use of water, and (c) for the installation of landscaping that uses a minimal amount of water. In addition, the plan must be accompanied by an analysis of the feasibility of charging variable rates for the use of water to encourage the conservation of water.

TROA Conservation Objectives TMWA has assumed responsibilities along with RSW to implement the water conservation element of TROA. The TROA Water Conservation Agreement, entered into in July 1996 between PLPT, Sierra, Reno, Sparks, and Washoe County fulfills the PSA requirement Section 29(c) and stipulates that a result of the agreement, the signatories will not make further determination whether such design criteria (10%) is met in ensuing drought situation years. The agreement requires TMWA to spend $50,000 per year for public education and $100,000 per year escalated at 3.5% per year (currently $125,000) for implementation of landscape efficiency programs, and $100,000 per year for the "Water Watcher

Program" with distribution of water saving devices and materials regarding water saving measures. RSW supported the agreement by enacting local ordinances to restrict lawn watering, established laws for lawn watering and prohibiting water waste. When retrofit water meters are at least 90% installed then the requirement to spend on landscape measures and the water watcher program is extinguished as is the requirement to implement mandatory twice-a-week watering.

To satisfy all these objectives outlined above, TMWA's conservation plan has been categorized following the guidelines of the NRS. The plan consists of three elements that address:

- A. public education
- B. other conservation measures
- C. system management.

Conservation measures, target audience, and the primary benefit to TMWA of each measure are summarized in Table 17.

TMWA's Conservation Plan is comprised of the conservation measures currently practiced and described for its retail customers under each of these three sections. TMWA will continue the programs described herein unless required to do otherwise. At conclusion of this chapter the reader will find that the Conservation Plan meets the requirements of the JPA, NRS, and TROA Conservation Agreement.

Table 17: Conservation Measures

	Primary Benefit	Target Audience
A. Public Education		
Irrigation Management Workshops & Certifications	1, 2	Landscape Professionals
Homeowner Workshops	1, 2	Residential Users
Public Education/Presentations, Free Kits	1, 2	Residential, Children
Yard Fitness	1, 2, 3	All Users
Landscape Retrofit	1, 3	Irrigation & Residential Users
Water Watchers	1	All Users
Teacher Materials	2	Children
Pilot Audit Program **	1, 2	Residential Users
B. Other Conservation Measures		
Water Management Programs	1, 3	Large Water Users
Water Rates	1	All Users
Codes and Ordinances	1	All Users
C. System Management		
Meter Retrofit Program	1, 3	Residential
Meter Replacement	1	Commercial and Irrigation
Coordination of Effluent Use	3	Irrigation
Non-Potable Water Service	3	Irrigation
Leaks and System Repairs	1, 4	All Users
System Pressure Standards	1, 4	All Users
Unauthorized Use of Water	1, 4	Construction

** Proposed pilot program run by TMWA for the Regional Water Planning Commission.

1 Reduces water waste
2 Education
3 Peak day savings
4 Minimize operation and maintenance to distribution facilities

A. Public Education

Irrigation Management Workshops and Certifications In February 2002, TMWA initiated a training and certification program for local landscape industry professionals. A two-day training class leading to certification as a Landscape Irrigation Auditor was conducted at TMWA facilities. Those who completed the training were awarded with a certificate of recognition by TMWA. In addition to the Landscape Irrigation Auditor class, a one-day Spanish class was also held. Certificates were awarded in Spanish and English. Due to the success of the classes, the RWPC is funding the class in April 2003 and TMWA will participate in hosting this event.

Homeowner Workshops As an outcome of the Consumer Outreach Group which was formed to gain input for the landscape retrofit program, TMWA has partnered with Washoe County to offer a 'Common Sense Gardening Series' at Rancho San Rafael, a regional park with an extensive arboretum. The arboretum contains examples of low water-use plants and native plants. TMWA is co-sponsoring guided tours of water efficient plants, and seminars including designing and winterizing irrigation systems, turf alternatives, and expert panel sessions.

Public Education, Distribution of Kits and Materials TMWA utilizes every opportunity to promote wise water use, attending public events and distributing information. Organizations can request that TMWA present conservation advice to a specific audience. A residential indoor and outdoor guide provides water savings tips for households, as well as some general usage information about TMWA customers and how to read your meter.

Doorhangers are left at residences whenever TMWA has visited a neighborhood, reminding customers of their watering times, and conservation tips. Bill inserts remind customers of both summer and winter habits that can conserve water, and TMWA uses its billing system to print conservation messages and facts. TMWA's internet site www.tmh2o.com, also provides local conservation facts, tips, and links to professional horticulture sites.

In addition, TMWA is producing a video set that is aired every month on public television SNCAT. One of the first videos made, that is available for public education, addresses conservation. The series is called "Fresh from the Tap". Education on winterizing irrigation systems was also presented on this series in December 2002.

"Yard Fitness" Program Called the "Yard Fitness" program, TMWA sponsors an advertising campaign for mandatory two-days-a-week watering during the summer months, and for a fall 'cool-down' period during the autumn months. The program began as a voluntary program in 1987 to spread the use of water more evenly throughout the week and reduce total weekly and daily water production used for landscape irrigation. The plan calls for watering deeper and less often, and assigns days of the week when customers should water.

Advertisements are placed on the TV, radio, and in local newspapers. TMWA also distributes tips on yard and turf maintenance, and reminders of watering days and times with bill inserts and refrigerator magnets. TMWA's Yard Fitness Program for 2002 was centered on children and a poster contest was run to generate some new ideas and eye-catching pictures for conservation. The Yard Fitness Program is partially mandatory and partially voluntary. Outdoor watering is limited to twice-a-week, and watering between 1pm and 5pm is prohibited. Tips on how to keep a healthy landscape are provided as information.

Landscape Retrofit The landscape retrofit program encompasses promotion of water efficient landscaping in the Truckee Meadows primarily through education. In the infancy of this program, Sierra conducted several studies, engaging outside consultants and forming focus groups to form a program that balances the needs of our community between visually pleasing landscapes and reduction in water use. As a result of these efforts, Sierra produced a guide to Water-Efficient Landscaping in the Truckee Meadows with ideas for yard designs, irrigation layout, plant selection, and maintenance. TMWA has revised the publication and will continue to produce the guide in the future. On March 1, 2003, TMWA will be launching an interactive guide on its website. This interactive guide will provide searchable functions, enabling the customer to individualize their needs from the guide easily.

In January 2002, TMWA formed its first outreach group to enhance the program with new ideas and implement ideas brought out in previous studies. The outreach group recommended helping the school district in taking out large turf areas, and providing homeowner workshops at regional parks. Long-term recommendations included setting water budgets, additional rate tiers to penalize excessive water users, and financial rewards for customers consistently achieving lower than budget water use. During 2002, TMWA hired professional landscape services to remove large turf areas at select schools district sites. For 2002, a total of 77,000 square-feet of turf was removed and replaced with low water use plants, materials, and hardscapes.

Water Watchers TMWA hires at least four temporary seasonal water consultants during the summer months to enforce the two-days-a-week summer watering schedule, provide advice to customers, and help high bill customers reduce their water consumption.

Teacher Materials TMWA currently provides EPA teaching materials for grade school via the Internet site ***www.tmh2o.com***. TMWA is developing a series of modules that meet the Nevada standards for the science curriculum, and will be releasing the first set of materials in the spring of 2003. Modules will be released for school grades over the next two years so that children can be introduced to the subject and build their knowledge base with each grade that they progress through. Teachers will be able to either download the materials directly from the Internet, or order the materials from TMWA.

Residential Audit Program TMWA does not have an official audit program. The water consultants do provide limited audit services where particular cases warrant them, however, at this time, a customer cannot call and request a general home water audit as TMWA does not have staff time allocated to this within the budget for conservation. TMWA does provide low-flow shower-heads, automatic hose shut-offs, and other retrofit devices that can result in substantial annual water savings for households. Free kits are available at special events and upon request.

TMWA and Washoe County have signed an interlocal agreement for TMWA to provide a pilot residential audit program for the summer of 2003. This audit program includes a comprehensive house (indoor and outdoor) water audit to be performed by two auditors. If the program is successful, TMWA and the RWPC may consider extending the program.

B. Other Conservation Measures

Water Management Programs The Washoe County School District ("WCSD") is one of TMWA's largest municipal customers. TMWA has prepared a Water Management Program for the School District to help them reduce water use on their sites, lowering their water bills, and reducing peak day demand for TMWA. Several creative ideas have surfaced including water budgets and use of non-treated water at some sites. Similar water management programs may be prepared for other large municipal customers in the future.

Water Rates Metered customers pay an inverted block structure with two tiers. First tier usage is set at the approximate average indoor water usage of 6,000 gallons per month for single-family residential customers, and based on the average actual use during the months of December, January, February and March for commercial customers. Usage in excess of the first tier allowance is charged a higher rate per 1,000 gallons.

For single family residential metered customers, the first 6,000 gallons per month is charged at $1.56 per 1,000 gallons. Usage in excess of 6,000 gallons per month is charged at $2.43 per 1,000 gallons. Multi-unit residential metered customers are charged $1.56 per 1,000 gallons for the first 4,000 gallons used per month, and $2.43 per 1,000 gallons for usage in excess of 4,000 gallons per month. For commercial customers, the first tier usage, defined as the customer's average consumption level, in gallons per month, during the months of December, January, February, and March, water is charged at $1.76 per 1,000 gallons, and usage above the average level is charged at $2.43 per 1,000 gallons.

TMWA will continue to use a tiered rate structure for metered customers, and will consider increasing the number of tiers in upcoming rate changes. Increased tiers provides greater incentive to the heavy water users to conserve, and also creates revenue with which to enhance existing conservation measures to help those excessive water users.

Codes and Ordinances TMWA is working with local agencies to require landscape designs that make sense in our high desert environment. TMWA also supports the RWPC in their efforts to change the residential hot water plumbing code to reduce pipe size where applicable.

The Cities of Reno and Sparks, and Washoe County (April 2002, July 2002, and March 2002 respectively) have enhanced ordinances that support TMWA's conservation efforts and allow enforcement of penalties to water wasters. The ordinances give TMWA Board of Directors authority to recommend to the local governments that a water emergency be declared with associated watering restrictions[19].

[19] Appendix I contains the water waste and water emergency ordinances.

C. System Management

Meter Retrofit Program The installation of water meters in the incorporated areas of the Truckee Meadows evolved over a period of 15 years. The NRS prohibited cities with populations greater than 7,500 people from the installation and operation of water meters. With rapid population growth in the Cities of Reno and Sparks in the latter half of the twentieth century increasing demands on limited water resources it became apparent that this condition needed to change. In 1979 this condition was changed and meters were installed at commercial customer services and meters began to be installed at irrigation services. In 1985 NRS was modified to allow customers to volunteer for installation of meters and required meters in new homes after July 1, 1988. With passage of AB 900 in 1990, Sierra was authorized to install meters on remaining flat-rate customers and in 1995 the PUCN approved the "Finance and Meter Retrofit Construction Plan".

Per the terms of the PSA which will be incorporated into the TROA, Sierra was required to provide a financing plan for the installation of water meters on 44,651 unmetered, flat-rate water customers (as of November 1994, when Sierra's 1995 WRP was approved). The finance plan meets the requirements of the conditions for effectiveness of the PSA and TROA. Flat-rate water customer counts at that time included approximately 6,330 customer connections where metering facilities had been previously installed and were awaiting the "drop-in" of a water meter.

The financing element of the meter retrofit program has always been a "pay-as-you-go" process. No long-term bond financing has been included to fund this program. On February 21, 1995, the PUCN approved a rule change to Sierra's Rule 17 which allowed Sierra to collect $1,350 for every 1 acre foot of demand dedicated for water service and use the funds for drop-in meter installations, individual customer requests for a meter, or installation of meter-related facilities when required by repairs on customer services due to emergency repair or customer initiated construction. The current retrofit fee of $1,830 per acre-foot of demand was approved in 1999.

Project management of the Retrofit Program initiated setting up the program in early 1995. By June 1995, all the elements—financing, accounting, cash collection and management, personnel, equipment and data tracking were in place to begin installations of meters. By 1995 year-end, 503 customers had volunteered to convert to metered billing.

In 1996, the Retrofit Program tested the efficiency of 'random' installs (for customers who volunteered for a meter) versus systematic installs when groups of meter installations were clustered together based on geography. Tests concluded that the number of installs could average 12 or more per day on a systematic basis as compared to the 1.5 to 3.5 per day on a random basis.

The RWPC sought legislation in 1997 to allow the installation of meters without customers' consent but continue the requirement for customer consent for metered billing. The effort failed and the program continued in 1997 and 1998 with random requests for retrofits. At that time the Retrofit Program began to actively pursue installing metering facilities (meter boxes and setters) in cooperation with Reno, Sparks and Regional Transportation Commission in streets scheduled for reconstruction and/or repaving. Over 4,500 facilities were installed through

systematic installations in conjunction with street repaving in those years. After some reductions in crew size, a three-man crew was able to average 12 or more installations per day in the new areas of Reno/Sparks and average 7 or more installations per day in the older, downtown areas of Reno/Sparks. In 1999 and 2000, the Retrofit Program installed over 6,500 metering facilities in conjunction with street repaving programs.

TMWA assumed the meter financing plan responsibilities and the program is an integral part of TMWA's integrated resources plan. It provides the following benefits and is a necessary part of the Truckee Meadows water resource strategies.

- Encourages efficient use of water resources
- Delays future development of water supplies and/or treatment capacity
- Promotes equity in billing
- The developer-financed plan imposes no cost on existing customers.

In March 2002, as a result of a November 28, 2001 Board action, TMWA began installing meters, and billing on the metered rate whenever a single family residence changed tenant. Meter retrofit funds will finance these installations, but that will result in fewer systematic installations over the coming years. It will take another 5 to 7 years to completely meter the system based on current financing made available through annual meter retrofit fees of over $2 million annually. The Retrofit Program will continue to:

- Cluster random retrofits, both from tenant change-outs and voluntary requests, to achieve better economies of scale
- Retrofit in a systematic fashion, recognizing that the program is moving into older areas of Reno and Sparks that will require more extensive ground work and/or service line repair to install the metering facilities
- Collect money from new development to fund the program
- Install facilities and meters as funds are available
- Retrofit until all flat-rate services are retrofit and ready to convert to metered billing.

Table 18 summarizes the Retrofit Program funding and expenses since June 1995. The total number of retrofits installed (setters) as of this writing is 26,770 with 8,904 meters installed in those setters. 1,329 meters have been dropped-in to pre-existing metering facilities. Of the total customers requiring retrofit, there are approximately 15,180 single-family customers and 2,700 multi-family customers requiring meter facilities and a meter (total of 17,880 which is 44,651 less 26,771) facilities to install and 35,750 meters to install.

Table 18: Retrofit Program Funding Summary

	June 1995 Through September 2002			
	Drop-In Meters ---a---	Retrofits ---b---	Project Management ---c---	TOTAL ---d---
INCOME				
Contributions				$18,486,542
Net Interest Earned				$328,680
TOTAL INCOME				$18,815,222
Labor & Transportation	$377,416	$5,948,908	$489,697	$6,816,021
Facilities Parts & Materials	$1,680,306	$4,502,509	$5,549	$6,188,364
Concrete, Supplies, Fees, Permits	$6,098	$3,198,668	$45,905	$3,250,670
Contracted Installations	$0	$588,063	$0	$588,063
A&G Overhead	$13,304	$400,152	$351,418	$764,874
TOTAL EXPENSES	$2,077,123	$14,638,300	$892,569	$17,607,993
INCOME LESS EXPENSES				$1,207,229
Number of Setters				
TMWA Installed	0	2,345	0	2,345
Sierra Installed	0	16,871	0	16,871
Contractor Installed	0	1,223	0	1,223
Total Setters Installed	0	20,439	0	20,439
Setters Installed prior to 1995				6,332
Total Setters Installed To Date				26,771
Remaining Flat-Rates needing Setters				*17,880*
Number of Meters				
TMWA Installed	175	2,170	0	2,345
Sierra Installed	1,154	4,210	0	5,364
Contractor Installed	0	970	0	970
Total Meters Installed	1,329	7,350	0	8,679
Meters Installed prior to 1995				225
Meters Installed To Date				8,904
Remaining Flat-Rates needing Meters				*35,747*

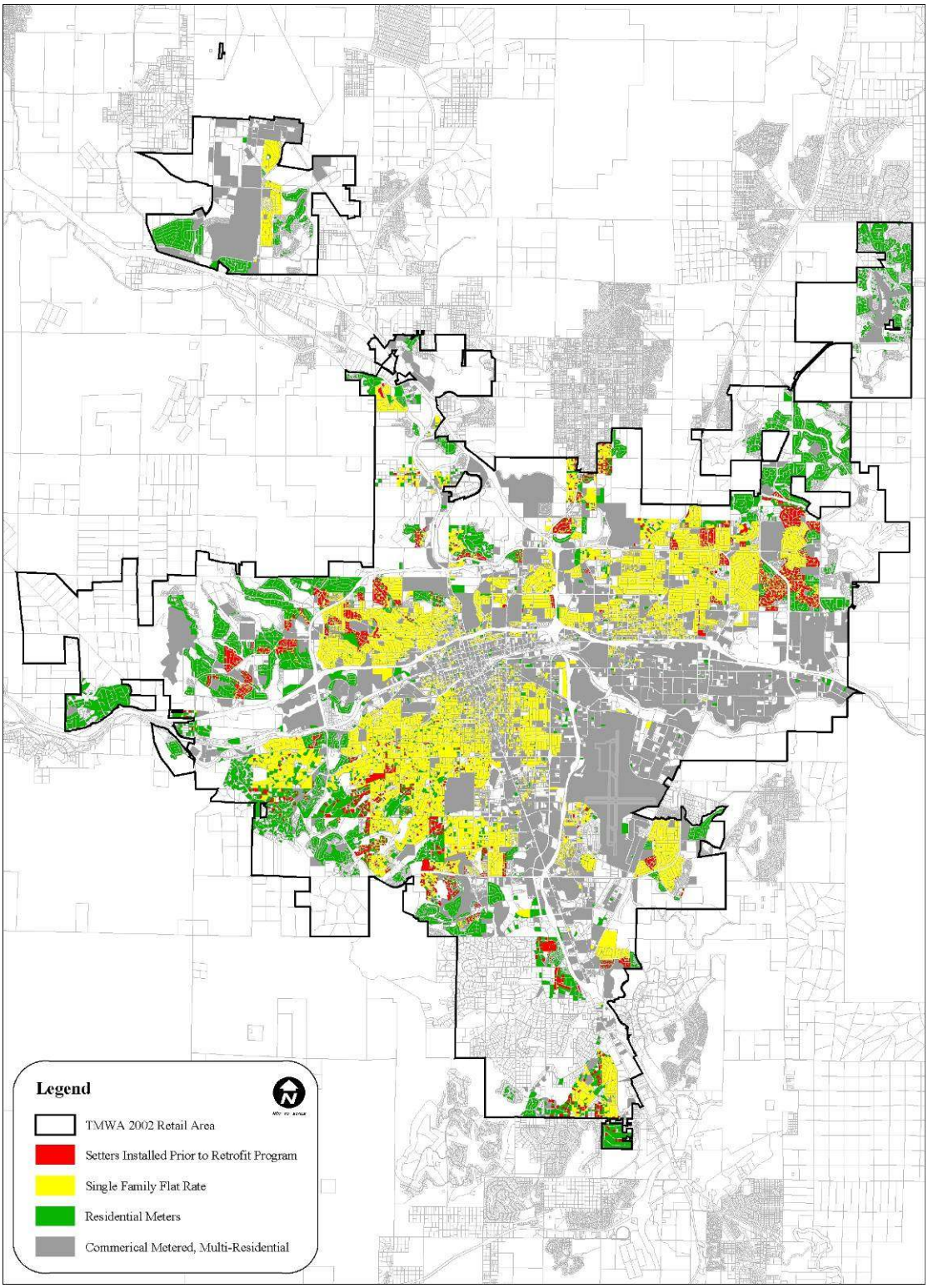

Figure 24: Parcels Requiring Meter Retrofit, June 1995.

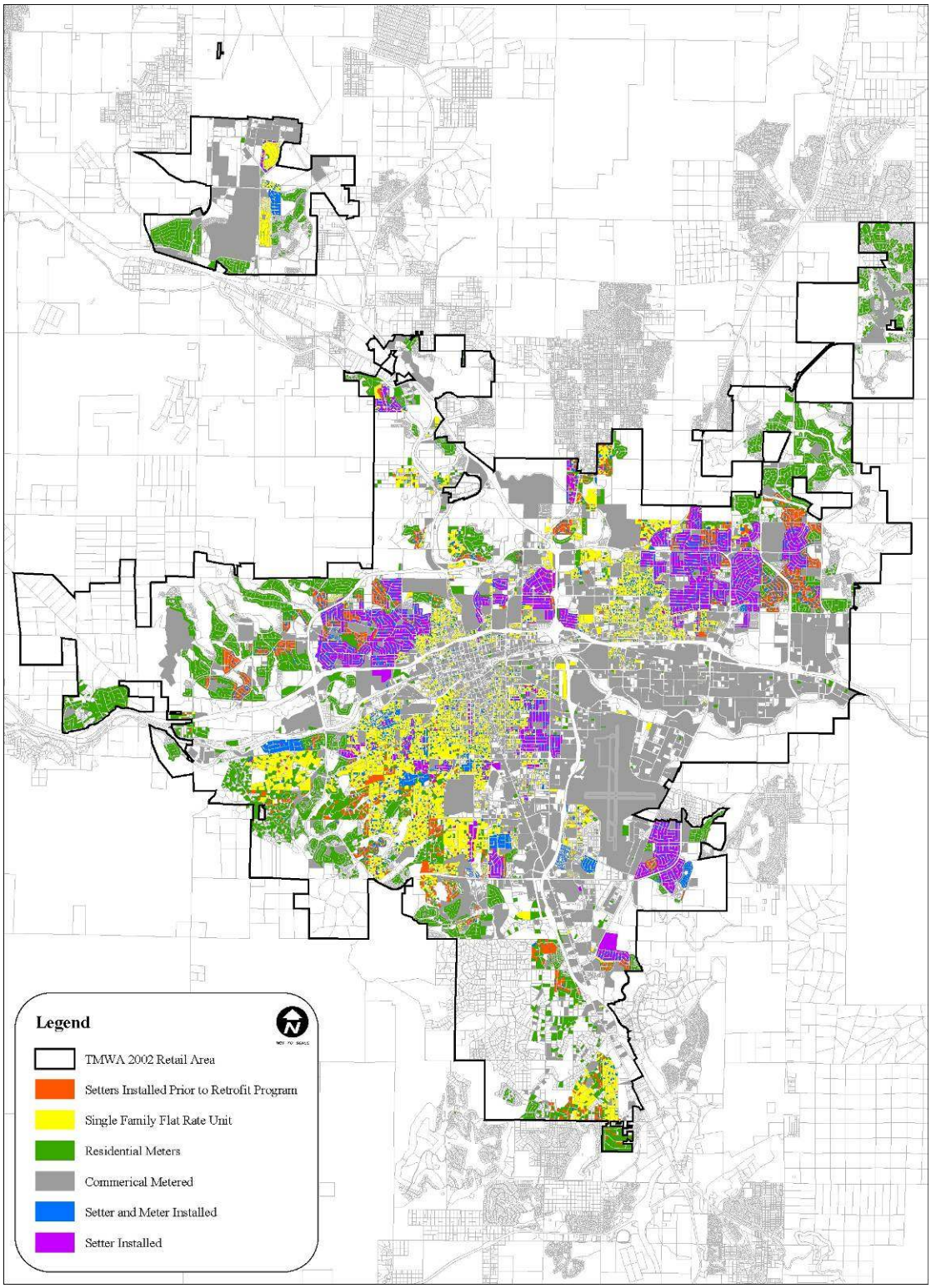

Figure 25: Parcels Requiring Meter Retrofit, June 2002.

The map in Figure 24 highlights in yellow the area where retrofits were required at the start of the program. Figure 25 shows the areas of the service area where setters and voluntary

meter conversions have occurred through June 2002. Retrofits in late 2001 and 2002 declined due to the need to start TMWA as a business and because the areas where retrofits were to occur are older services.

Meter Replacement Since TMWA was created, crews have been targeting large commercial meters that were install in the 1980's. Many of these meters are no longer functioning properly and are a source of lost revenue. An additional benefit of this process is the detection and repair of leaks resulting from the older facilities. This program is also resulting in further reduction of water waste.

Effluent Water Service Co-ordination with Local Agencies Expansion of the use of effluent is a goal of RSW. TMWA has been asked by RSW to ensure that effluent is being applied at suitable sites where the infrastructure is or is planned to be installed while meeting return flow obligations associated with the use of effluent. When new business applications are reviewed by TMWA, verification will be made whether the site applying for municipal, treated water has already been designated or is within feasible range to be serviced by effluent water.

Supplying large turf sites with effluent or other non-potable sources leaves capacity for new municipal demand that requires treated water, enabling the water resources to go further.

Non-Potable Service Effective November 1, 2002, TMWA has "Non-Potable Service" ("NPS") to provide sources of untreated water to sites that can receive treated or untreated Truckee river water or poor quality ground water with minimal capital investment. Non-potable water service is available at a significantly reduced rate than treated water, providing incentive for qualified customers to switch to this service. The service will reduce TMWA peak day demand and lower system capacity needs. It is anticipated that irrigation and construction sites utilizing this service will also conserve water due to the requirement to demonstrate responsible watering practices specified in the contract for this service.

Specific facility needs for each service connection will be identified in the service agreement between TMWA and the customer receiving non-potable service. The recipient of this service will have to demonstrate at each site the ability to tolerate the interruptible nature of this service and/or the potential to switch between treated and untreated water.

Leaks and System Repairs TMWA repairs detected and reported water breaks and leaks as soon as is practicable. Of primary concern is assessing public safety and safety of the work crews, minimal interruption to public and private services, as well as minimizing overtime expenditures. If water leaks are not large, not causing a safety problem, and are reported outside normal working hours, field supervisors will determine the urgency of the needed repairs and schedule repair work accordingly.

When the source of the leak is determined and the appropriate underground locations of other utilities are completed, the crew will excavate the leak site and make repairs. In the case of a leaking poly-butylene pipe, the crew will usually replace the entire service, as this type of pipe has proven particularly prone to leaks. All leaks are reported and entered into a database. TMWA repaired 221 leaks over the fiscal period of 2001-2002, with the majority of leaks and repairs taking place in the summer months when pipes are stressed by increased demands.

System Pressure Standards Engineering design criteria require that a pressure of 40 to 125 PSI be maintained at the customer's connection. Pressures exceeding 125 PSI may increase the possibility of main breaks or accelerate the development of leaks, both on TMWA and the customer facilities. Excessive pressure results in more water delivered through the tap since flow rate is proportional to pressure. This can result in such forms of water waste as sprinkler overspray, faucet splashing and higher leakage flow rates.

Unauthorized Use of Treated Water Use of water without dedicated water rights, or for temporary purposes without TMWA permission, is illegal. Use of fire hydrants as a water source is also illegal under both City ordinances except for City vehicles.

All of these measures outlined in elements (a) through (c) comprise TMWA's plan for conservation in every year through 2025, regardless whether it is a drought or non-drought year. TMWA increases conservation efforts during droughts. The goal during droughts is to further reduce water use in the event successive drought years are experienced. The Drought Plan is a cooperative effort with the Regional Water Planning Commission, the Cities of Reno and Sparks, and Washoe County. Four stages of conservation are identified:

Stage 1. Includes voluntary two-days-a-week watering and is called for when it is predicted that Floriston Rates may not be met all year.

Stage 2. Requires mandatory two-days-a-week watering and is called when Floriston Rates are not met.

Stage 3. Prohibits planting new lawns in the summer and limits watering to once-weekly after August 15. It is called when TMWA predicts it will use more than 3,000 AF from Independence Lake.

Stage 4. Emergency Condition. Measures to be determined as needed. Measures could include no outside watering or even a building moratorium. Stage 4 would be implemented if TMWA were unable to meet customer demands.

With the agreement to satisfy condition 29(e) of the PSA in 1996, RSW agreed to twice-a-week-watering until the system is fully metered. In essence the region is always in Stage 2 of the drought plan. Two-day-a-week watering has certainly reduced peak day demand. The ability for substantial water savings reducing demand 15% to 20% during drought years exists, as was demonstrated during the last drought.

Since the region is effectively in Stage 2 until two-days-a-week watering is no longer mandatory, and since river operating conditions have changed since these stages were made, it is appropriate that review and possible revision of the stages is conducted in the near future.

Summary

This chapter presented TMWA's Conservation Plan in satisfaction of Article 5(i) of the JPA. This water conservation plan is for the use of municipal, industrial, and domestic Water Supplies within the retail service area of the Authority, including continuation of the Water Conservation Agreements with PLPT and TMWA's Members.

This chapter, upon adoption by the Board, will also satisfy the requirements of NRS 540.313 through 540.151, that a conservation plan be submitted by TMWA to Nevada Division of Water Resources.

TMWA has a comprehensive conservation program that is designed to achieve 20% savings through 2025. Water savings will accrue from metering the system fully (10% savings) and continuing conservation programs that together will achieve at least 10% savings in any year. TMWA will continue to fulfill its water conservation agreements with all parties, including its Members. Quantification of savings as a result of each measure is not estimated, as the sum of all measures is designed to achieve 10% savings in all years, not only drought years in satisfaction of the water conservation contingency Section 29 (e) of the Preliminary Settlement Agreement ("PSA"), which was meet by the 1996 Water Conservation Agreement entered into by the Pyramid Lake Paiute Tribe, Sierra Pacific, City of Reno, City of Sparks, and Washoe County.

A detailed description of the progress of the water meter retrofit program was presented with maps illustrating the areas within TMWA's retail boundaries that have been retrofitted, as well as remaining flat-rate customer areas.

TMWA will continually assess the benefits from these measures and may modify programs to reflect new practices and technologies. As needed, TMWA forms consumer outreach groups for input and consumer perspective on the effectiveness of the programs. Success of a program is evaluated differently depending on the type of program, and may be measured by attendance, water saved from repaired leaks, estimated reduction of peak day usage, visibly improved water management practices, and number of children receiving water conservation education.

Figure 26 shows use per service has dropped since 1987 and remained stable since 1994, indicating that TMWA's conservation plan with all its measures work[20]. TMWA has and will continue to seek innovative ways to enhance its conservation program including integration of conservation into system management as evidenced by its non-potable water service, effluent coordination with local agencies, and water management programs.

[20] This sustained level of conservation occurred even though over 24,500 new residential services were added over the period 1987 to 2001.

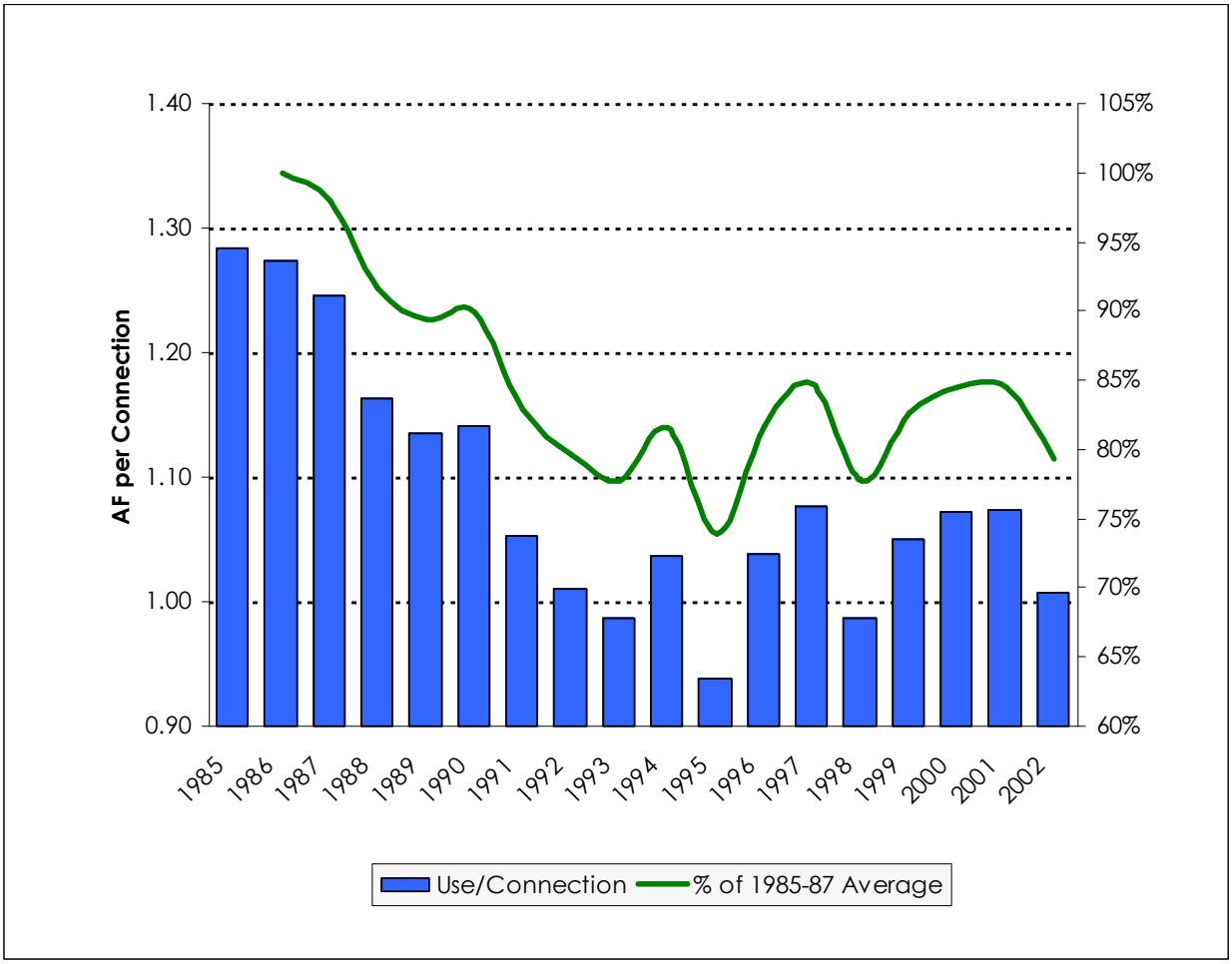

Figure 26: Annual Use per Connection

Chapter 5 Future Water Resources

This chapter examines the water supply projects that may be developed and implemented in the future to meet projected demands. TMWA is actively pursuing those projects that will meet future resource requirements and be implemented in the most economic fashion. The selection of the next water supply project is a function of project's yield, project cost, and project ease of implementation.

The current practice of expanding new service commitments is based on new development acquiring and dedicating irrigation water rights to TMWA for new service. Dedications of Truckee River irrigation rights will proceed at a rate of at least one acre-foot to every acre-foot of new demand. With TROA the water right dedication will be 1.11 acre-feet of water rights per acre-foot of demand. The number of water rights that will be dedicated to TMWA will also depend on options for drought reserves to meet drought-year demands. The amount of water rights that can be supported by a drought reserve is the committable yield. Depending on the drought design, the number of water rights is estimated here:

Drought year design (Number of Years)	Maximum Committable Yield	Commitments at June 2002	Water Rights Dedicated at 1.0:1.0 Ratio	Water Rights Dedicated at 1.11:1.0 Ratio
8	113,000	89,660	23,340	25,907
9	110,800	89,660	21,140	23,465
10	99,000	89,660	9,340	10,367

Even though the planning horizon in 2025 estimates 110,300 acre-feet of water will be delivered, the acquisition of water rights used for commitments is always a few years ahead of when the demands are to occur. The values shown are reasonable to use as estimates for total rights to be acquired prior to the implementation of any other supply project.

With the current practice of dedication of water rights, the question regarding the availability of Truckee River water rights must be addressed. This is true for any combination of supply projects whether with or without TROA. In the following section the number of water rights available to supply TMWA's needs is discussed.

Availability of Truckee River Water Rights

Since several of the projects in this plan rely on the continued conversion of Truckee River irrigation water rights to municipal use, it must be determined if sufficient water rights will

be available to implement these projects. In 2001, the RWPC assessed the availability of Truckee River water rights. Many of the findings in the study, entitled *"Analysis of Decreed Truckee River Water Rights and Projections of Future Demand",* are summarized in this chapter. The study looked at both the availability of water rights and provided an estimate of full build-out water demand.

The study examined both TMWA and WDWR service areas and did not directly delineate the build-out water requirements by service boundaries. The study assumed that implementation of a highly effective program for recovery of fractionated water rights would be possible.

The study made the following assumptions about water rights availability:

- Return Flow, Active Residential Irrigation (ditch rights), Non-Agricultural Irrigation such as for open space, and Water Quality/Wildlife are not available for conversion to M & I use.
- Water rights from tributaries were not considered available for conversion in the study due to the present inability to transport the water to a treatment facility.
- Active Agriculture, Inactive Residential, Inactive Public Ways and Inactive Other provide the majority of the available water rights that can be converted to M & I.

The ability to dedicate a Truckee River water right to M&I use is contingent on:

- The inherent conditions of each water right.
- The chain of title of ownership must be clean and brought up to the current owner.
- The water right duty and location must be in agreement with the records of the State Engineer.
- Issues affecting the potential availability of water rights for M & I uses are subject to interpretation by the State Engineer and Federal Water Master.

Due to the above limitations, Table 19[21] reflects the estimated availability of water rights (and degree of recovery efficiency) and the number of water rights that will likely remain unavailable for municipal dedication.

[21] Analysis of Decreed Truckee River Water Rights and Projections of Future Demand, Stantec Engineering, 2001.

Table 19: Summary of Potential Direct Truckee River Water Right Available for Conversion to Municipal and Industrial Use

Category	Total Water Rights (acre-feet)	Minimum Recovery (acre-feet)	Maximum Recovery (acre-feet)	Unrecoverable (acre-feet)	Recovery Rates
Active Agriculture	13,871	7,339	11,834	2,037	50% to 90%
Inactive Residential	8,694	0	2,608	6,086	0% to 30%
Inactive Public ways	3,333	3,167	3,167	166	95%
Inactive Other					
Est. Public ways	4,117	3,911	3,911	206	95%
Other Parcels	22,040	6,612	17,632	4,408	30% to 80%
Total	**52,055**	**21,029**	**39,152**	**12,903**	

In order to quantify the amount of Truckee River water rights that could potentially be converted to meet future water demands, a set of conversion factors for each category of potentially available water rights was created. Only direct Truckee River, Hunter Creek, and Dog Creek water rights are currently considered available for municipal dedication. Presently no facilities exist for treatment of Tributary water rights from other streams and creeks (e.g., Evans, Thomas, Galena, and Browns), therefore these rights are not yet acceptable for municipal dedication.

The RWPC study suggests between 21,000 and 39,000 acre-feet of direct diversion water rights may be converted for municipal use. However, water from other tributary streams may be available in the future for municipal dedication. If construction of additional surface water treatment facilities, which would both collect and treat the tributary water, were to occur. The study suggested that approximately 9,198 to 16,827 acre-feet could then be recovered from Tributary sources. The County, which is responsible for planning in the south Truckee Meadows, approved its facility/resource plan for that area in August 2002. The plan recommended the construction of one or two surface treatment plants to capitalize on the majority of these rights to meet future demands in that area.

Water Right Acquisition for Effluent Reuse and Water Quality Settlement Agreement

Truckee River water rights currently used for the irrigation of parks, golf courses, and greenbelts could become available for municipal uses if treated effluent can be delivered to these sites for irrigation. However, the use of those rights may be limited due to the need to address water quality of the lower Truckee River which relies on effluent to return river flows diverted upstream for consumptive purposes.

Pursuant to TROA and the relevant Nevada State Engineer's rulings, wastewater effluent generated from the use of groundwater does not need to return to the Truckee River. Based upon

the 10-year (1992-2001) average ratio of effluent to supply of 48 percent, approximately 7,660 acre-feet of effluent (48% times 15,950 acre-feet of average groundwater pumping by TMWA)[22] are attributable to the use of TMWA groundwater rights, and may be reused without regard to return flows to the Truckee River. The present discharge permit for the Truckee Meadows Water Reclamation Facility (TMWRF) allows an annual average of 40 MGD of effluent to be discharged to the Truckee River. This is equivalent to an annual discharge of 44,800 acre-feet per year. Using the TROA total demand of 119,000 less 3,000 acre-feet of north valley Truckee River water use which is exempt from return flow, approximately 55,680 acre-feet of effluent would have to be treated by TMWRF. Under current permit conditions, the difference between 55,680 and 44,800 acre-feet means 10,880 acre-feet of effluent needs to be used for landscape irrigation (such as parks, road medians, and golf courses) and agricultural irrigation (such as the UNR experiment station) in the Truckee Meadows and Spanish Springs Valley areas during the irrigation season.

It is assumed the portion of the effluent reuse that is not associated with the groundwater component of the TMWA water supply will require return flow water rights to be acquired and left in the Truckee River to be available to serve downstream water rights. This quantity can be determined as follows:

Annual effluent quantity	55,680 acre-feet
Less: 40 mgd river discharge	44,800 acre-feet
Equals: Effluent reuse	10,880 acre-feet
Less: Groundwater component	7,660 acre-feet
Equals: Reuse attributable to surface water	3,220 acre-feet

The 3,220 acre-feet of reuse is to be matched by an assumed 1.0:1.0 acquisition of Truckee Meadows water rights.

In 1996, RSW, PLPT, US Department of Interior, US Department of Justice, US Environmental Protection Agency, and the Nevada Division of Environmental Protection executed the Truckee River Water Quality Settlement Agreement ("WQSA") for the federal acquisition of water rights "to settle and dismiss pending litigation, to improve the water quality of the Truckee River, and increase flows to Pyramid Lake." Federal monies would match $12 million that RSW would spend to implement the agreement. It is estimated that the following number of water rights will be acquired using the $24 million:

Truckee Meadows, above Vista	900 acre-feet
Truckee between Vista and Wadsworth	1,500 acre-feet
Truckee Division of Newlands Project*	12,000 acre-feet
Total	14,400 acre-feet

[22] US Fish and Wildlife TROA EIS/EIR assumptions.

* Using 75% distribution system efficiency, the reduction in Newlands Project diversion from the Truckee Canal that can be available for water quality use is estimated as 16,000 acre-feet.

Combining the demand for Truckee River rights above Vista to meet projects water quality goals, an additional demand of 4,120 acre-feet (3,220 plus 900) will be placed on the water rights market.

From TMWA's perspective it appears that under the current dedication practices and using its current pool of drought reserves, there are sufficient direct-diversion water rights that can be recovered to meet the projected 2025 requirement of 23,340 acre-feet (or 25,904 at 1.11 acre-feet per acre foot of demand) since this amount falls within the projected recoverable range of 21,000 to 39,000 acre-feet.

To meet a full build-out demand of 119,000 to 123,000 acre-feet without TROA, TMWA will need an increment of new supply projects with associated water rights of 6,000 to 10,000 acre-feet. A total of approximately 33,000 acre-feet (10,000 plus 23,340) of water rights are needed for TMWA's projected retail and wholesale build-out demands. This amount is also within the range of recoverable rights.

The calculation of water rights to reach 119,000 acre-feet of supply under TROA requires the acquisition of approximately 42,000 acre-feet of water rights rather than 33,000 acre-feet. The difference of 9,000 acre-feet is due to water rights that must be dedicated at 1.11 acre-feet times the estimated 8,000 acre-foot demand reduction from water meter retrofits; water rights must be dedicated to compensate for the reduction in demand from meter retrofits.

These competing uses for these water rights—municipal supply and water quality—will require close coordination and cooperation among the interests to ensure there are sufficient water rights for all purposes.

Water Supply Projects

TMWA's current drought supply is able to support commitments for the year 2025, assuming the 8-year drought design. Therefore, between now and 2025, there is no need to supply additional water rights to create drought reserve projects with the exception of the 0.11 acre-feet for the TROA option. Beyond the planning horizon of 2025, the growth in developed land is expected to plateau, resulting in significantly reduced water demand growth. It is expected that at full build-out of TMWA's retail and wholesale service areas total water deliveries will range between 119,000 and 123,000 acre-feet of water. A few years beyond 2025, additional drought reserve projects will be needed. The projects reviewed will seek to provide TMWA with the resources necessary to deliver a total demand between 119,000 to 123,000 acre-feet/year of water.

Critical to any new water supply project is its yield or ability to provide water in the drought year, particularly those projects that rely on the conversion of Truckee River irrigation rights to municipal use. To implement a reliable Truckee River water-right-dependent project two requirements must be met: conversion of existing irrigation water rights to municipal use and adequate source of supply during drought periods. Not all projects require a drought year

supply, for example, groundwater importation. Groundwater rights are available for use at the same yield for both drought and non-drought years. Table 20 lists the water supply projects currently under consideration in this WRP.

This report discusses each project separately as if it would be the first project implemented. Each project discussion provides a general discussion of the project, a preliminary cost estimate, an estimate of project yield, and comments as to the feasibility and permitability of the project. The projects discussed here are not all inclusive, but are projects that have been studied in the past or continued to be considered viable. It may be that in the future as new technology becomes available or the political, regulatory or public opinion changes, new projects might be found or infeasible projects might become feasible.

Even though there is a difference between the drought year supplies for each project, all the projects reviewed (except the importation projects), are assumed to share the same source of water rights: Truckee River direct diversion water rights. One should not assume the projects can be added sequentially.

All the projects reviewed, except for importation projects, require the addition of new surface treatment facilities to meet the 2025 planning horizon and the projected build-out needs. At present, Chalk Bluff Phase 3 construction is to begin in 2004. This will add 15 MGD of new capacity at an estimated cost of $9 million. Chalk Bluff Phase 4 is projected on-line in 2013-2014, adding another 15 MGD of capacity at an estimated cost of $12 million. These capacity additions are sufficient to meet the peak day requirements through the planning horizon, and would be necessary for all future supply projects, except importation, that use surface water irrigation rights as part of the project supply. Unless the individual project has special or unique treatment requirements, individual project's cost-of-surface-treatment will not be estimated.

Table 20: Water Supply Projects

Project Name	Estimated Yield [afa] ----a----	Rights & Facility Costs ----b----	Irrigation Rights Required ----c----	Cost Per Acre-Foot of Yield [b/a] ----d----
Aquifer Storage and Recovery	8,000	$37.4 mil.	8,000	$4,700
Conjunctive Management with County Resources	2,000	$7.0 mil.	2,000	$3,500
Importation (Vidler/Intermountain Pipline):				
Configuration 1	10,700	$100.0 mil.	na	$9,300
Configuration 2	10,700	$96.6 mil.	na	$9,000
Configuration 3	13,900	$122.5 mil.	na	$8,800 $9,200 for Cold Springs
Local Reservoirs:				
Bull Ranch Creek	7,000	$55.5 mil.	7,000	7,900
Steamboat Ditch Mile 5	7,000	$53.4 mil.	6,400	8,300
Virginia Range	7,000	$64.7 mil.	8,500	7,600
Meter Retrofit**	8,400	$21.0 mil	0	2,500
Negotiated Settlement (TROA)***	32,000	$148.2 mil.	42,340	3,500
Purchase TCID Share of Donner Lake Storage	3,300*	$11.5 mil.	0	3,500

* Value depends on upstream storage contract availability. Without the contract, only 1,400 acre-foot yield is available.
** Assumes no Negotiated Settlement.
*** TROA yield was estimated at 39,000 acre-feet (119,000 acre-feet less 80,000 acre-feet of actual demand) when the PSA was signed. Upon its implementation the Interim Storage Agreement (ISA) is superceded by TROA. The ISA yield is being committed and was estimated at 7,000 acre-feet, hence 39,000 less 7,000 equals 32,000 acre-feet of yield remaining when TROA takes effect.

Aquifer Storage and Recovery ("ASR")

Aquifer storage and recovery ("ASR") is defined as the placement of excess treated surface water into the underground aquifer for later withdrawal. ASR is successful in many locations in Nevada and California, and has become increasingly important for seasonal water supply in Las Vegas Valley. ASR can increase the natural supply of groundwater by storing surface water when excess supply and treatment capacity exist and by mitigating groundwater contamination.

Groundwater can be recharged by the use of injection wells. Injection wells are the same wells that are used for production, equipped with the ability to allow for treated water to flow back into the wells under pressure. Figure 6 shows the location of current recharge wells that are discussed in Chapter 2.

This program will be in addition to the current Groundwater Management Order discussed in Chapter 2. TMWA will increase amount recharged by 1,000 acre-feet per year in the non-drought years using water rights that were collected prior to 1995 under the 1.72:1.00 ratio if available, otherwise additional rights would be acquired. This will allow an extraction of 4,500 acre-feet in the drought years. This management of surface water and groundwater will support new service commitments of 8,000 acre-feet.

Estimated Cost and Yield. Using existing recharge wells, TMWA has the ability to inject an additional 1,000 acre-feet of treated surface water into the ground. Additional facilities will be needed to extract the full drought year supply in peak months. The extraction of 4,500 acre-feet of drought supply used in conjunction with surface water in non-peak months results an estimated yield of 8,000 acre-feet/year.

To implement this resource, TMWA will acquire an additional 8,000 acre-feet of irrigation rights at a cost of $28 million (8,000 times $3,500). TMWA projects 13 new wells capable of delivering a total of 13 MGD will be needed. Each well is estimated at $720,000 each, total capital cost for these wells would be $9.4 million. To facilitate the increase in recharge during non-drought-years, 14 MGD of surface water treatment would be required. The total project cost is estimated at $37.4 million.

Feasibility/Permitability. Implementation of this project will require the location of at least 13 new well sites with good groundwater quality, otherwise a small treatment plant to treat this groundwater would be required. This project would also require the approval of the State Engineer.

Conjunctive Management with Washoe County

TMWA's water system is connected with WDWR's water systems by means of wholesale water services. If agreements can be reached, then WDWR's groundwater resources could be rested during non-peak winter months. TMWA would provide Truckee River water to

meet winter demands and in return TMWA could use a portion of the groundwater resource for peak use, drought use, or in times of emergencies.

Only WDWR facilities in Spanish Springs have sufficient capacity that could be used during drought years to extract additional groundwater. It is assumed that all water rights owned by Washoe County in this area are fully committed to serve their present or future customers. TMWA will provide 1,400 acre-feet of recharge water annually to the wells in Spanish Springs. The yield is calculated by assuming that Spanish Springs would be served by Truckee River water eight months of the year and their full groundwater rights would be utilized during the four summer months for peaking in non-drought and droughts, for use by both Spanish Springs and TMWA customers. No additional well capacity would be required to operate in this manner.

Estimated Costs and Yield. WDWR's wells would require some retrofit to provide for injection of recharge water. Sufficient excess capacity exists for this project to be implemented without significant capital expense (preliminary capital cost estimate is $500,000 to $1,000,000). The yield for this project is estimated to be 2,000 acre-feet for the 1,400 acre-feet of recharge water. The only significant expense required would be the purchase of 2,000 acre-feet of irrigation rights for $7 million (2,000 times $3,500).

Feasibility/Permitability. In order to implement this project, it would be necessary to address the following institutional issues; State Engineer approval and agreement with WDWR.

Importation Projects

There are currently 2 importation projects being proposed which may or may not be combined to provide a water supply for the North Valleys and possibly Cold Springs. The Intermountain Pipeline (formerly known as the Warm Springs Importation Project) is proposed to import groundwater from Dry Valley, Newcomb Lake, Warm Springs, and Bedell Flat. The Vidler water supply (formerly known as the Truckee Meadows Importation Project or Honey Lake Project) is proposed to import groundwater from Fish Springs Ranch.

The water importation supply main from the north is planned to supply a constant flow of water all year to meet build-out demands with excess winter capacity being used to recharge local aquifers to help meet peak demands. The build-out demand for the Stead / Lemmon Valley area was developed by RWPC using 2001 demand data, future demands associated with planned land uses, existing groundwater rights and additional demand potential associated with connecting a portion of the domestic well users up to the system. Currently the RWPC has 3 scenarios of groundwater importation combining the Vidler and Intermountain Pipeline proposals.

Under Configuration-1, 5,200 acre-feet of Vidler supply would be utilized and 5,500 acre-feet of Intermountain Pipeline supply would be utilized to reach the estimated build-out demand of 10,700 acre-feet. Under Configuration-2, 8,000 acre-feet of Vidler supply and 2,700 acre-feet of Intermountain Pipeline supply would be utilized. Under Configuration-3, water is also supplied to Cold Springs, an additional demand of approximately 3,200 acre-feet could be supplied with 8,400 acre-feet of Vidler water and 5,500 acre-feet of Intermountain Pipeline.

These projects are unique in that they do not directly increase TMWA's water supply yield but nevertheless would meet a portion of TMWA's projected demands.

Estimated Yield and Cost. The project's sponsors estimate a cost of $100.0 million for configuration 1 including purchase of water rights, $96.6 million for configuration 2 including purchase of water rights, and $122.5 million for configuration 3 including purchase of water rights.

Feasibility/Permitability. This project appears to be quite feasible. This project would require the approval of the State Engineer to export the water from the northern basins to the Stead area.

A potential benefit of a North Valleys importation project could allow reallocation of TMWA's current resources. If Truckee River water were to continue to be supplied to the North valleys, TMWA projects a 6,200 acre-feet/year (see Table 15) demand using approximately 650 acre-feet of groundwater and 5,550 of Truckee River water. When Truckee River water is exported out of the Truckee Meadows with the return flow of sewer, then additional Truckee Meadows rights must be used to provide for return flow at a rate of 0.5 acre-foot per acre-foot of water exported. However in the 1960's, 3000 acre-feet of Truckee River water was committed to serve the Stead area which is exempt form return flow requirements. Therefore,

		Surface Water Rights
TMWA Projected Demand	6,200 acre-feet	
Less: Groundwater Rights	650 acre-feet	
Equals: Truckee River Water	5,550 acre-feet	
Less Surface Water Exempt From Return Flow	3,000 acre-feet	3,000 acre-feet
Equals: Return Flow	2,550 acre-feet	2,550 acre-feet
Times 0.5 to Estimate Return Flow Rights	1,275 acre-feet	1,275 acre-feet
Total Water Rights Required		6,825 acre-feet

As can be seen above up to 6,825 acre-feet of Truckee River water could be reallocated to other parts of the TMWA service areas if the North Valley Importation project should occur. The estimated value of the water rights that could be reallocated is $23.8 million (6,825 times $3,500).

Local Reservoirs

In the recent past many local reservoir sites have been under consideration as possible solutions to expanding drought storage or as a source of emergency raw water in the event that the Truckee River is untreatable. Over the course of time many of these sites have since been developed into sub-divisions or other forms of development that has rendered these sites unusable. Some sites through investigation have been found to be unsuitable for reservoir construction. Eight possible sites were reviewed for potential development. Figure 27 shows the general locations of each possible site. All of these sites would require that a dam be constructed and all of the sites are located within Nevada. Although all of these reservoir sites lie within

Nevada, there may be Federal and Tribal permitting issues associated with the Clean Water Act and the Endangered Species Act, since all of the sites would be located on stream channels that are considered water of the United States, even thought they may be ephemeral in nature.

Past droughts and turbidity emergencies have demonstrated the need for development of storage facilities that can provide water when normal supplies are interrupted by either drought or impairment of water quality, whether by excessive sediment from storm events or by toxic spills into the river. Local water storage would also improve TMWA's ability to regulate storage releases and comply with the RWPC recommendation that TMWA diversify its water supply. Those reliability benefits that justify building a small local storage reservoir should also be considered with the Negotiated Settlement in place. In the past this concept has been supported because of the reliability enhancement it would offer.

The sites on a tributary to the Truckee River would be filled by exercising purchased Truckee River rights and acquired tributary rights. For those sites not on a tributary to the Truckee River, the reservoir would be filled by the purchase of and exercise of Truckee River rights. These sites would require the construction of treatment facilities or facilities to transport the water to a TMWA treatment plant. Because of location constraints, Thomas, Whites, and Galena Creeks are most likely to be more useful to WDWR for South Washoe County water demands. The Virginia Range has some limited potential for TMWA, being the closest site to Glendale Treatment plant.

In general these sites would be operated by diverting the consumptive use fraction of raw water to the site that would be held in storage for use during emergencies or droughts. For some of the sites it might be necessary to pump water into the reservoir for storage to be used in times of need. This will naturally be an economic disadvantage for such sites. The costs presented here a very preliminary and are only used for project ranking at this time.

The incremental yield calculations are based only on the site's ability to provide drought storage. The consumption portion of the water rights that were collected prior to 1995 under the 1.72:1.00 ratio would be diverted to generate reservoir storage for these projects (this assumes TROA is not implemented, under TROA these rights are stored in federal reservoirs).

Of the eight sites reviewed and shown on Figure 27, Mogul and Chalk Bluff have been found to be geologically unsuitable for dam construction. The Steamboat site may be difficult to build a dam but its location warrants future consideration. Thomas, Whites, and Galena Creeks are possible sites for water storage; however, at this time this time the County does not have the need for the water that would be stored in these sites and it would be too costly to build the reservoir and distribution system to CTP or GTP. This leads to Bull Ranch Creek and the Virginia Range sites as the best sites for current consideration.

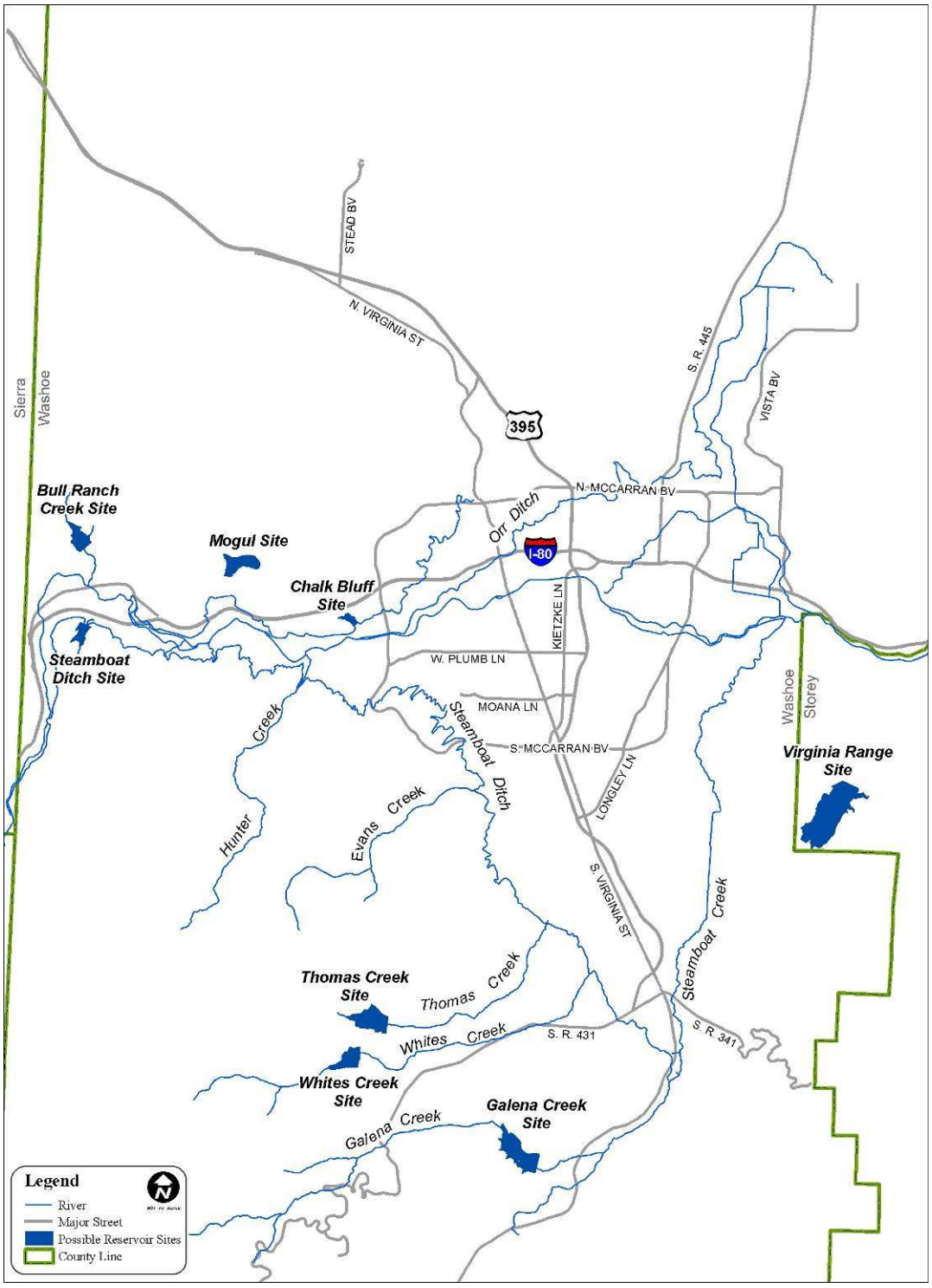

Figure 27: Potential Reservoir Sites

Bull Ranch Creek

Bull Ranch Creek is located north of the Truckee River approximately 1 mile northeast of Verdi, situated along the southwestern flank of Peavine Mountain. The creek is located at the bottom of a deep ravine with steep side slopes. This site has intermittent stream flows in a southerly direction terminating at the Truckee River. The Truckee River is approximately 1 mile south of the proposed dam location.

A preliminary assessment of the geology of the lower portion of the Bull Ranch Creek drainage basin was completed by TMWA. The dam site is located for largest storage at the optimum elevation for the dam is 5,480 feet. A preliminary assessment of the reservoir storage capacity was performed at a water level elevation of 5,460 feet (20 feet of freeboard) and shows a reservoir capacity of 8,500 acre-feet. The length of the dam is about 1,700 feet with a maximum height of 280 feet.

The proposed dam site is located within volcanics that appear to be generally massive and unaltered and should provide a competent material for abutment and foundation support. Based on the observed geologic conditions observed, dam seepage is likely low. There are no mapped faults trending through the project site.

A well-developed drainage channel extending to the Truckee River is located below the proposed dam location. Existing development near the drainage channel is currently minor. However, a proposed subdivision is planned adjacent to the drainage channel downstream.

The proposed dam location will span a relatively narrow ravine and dam earthwork volumes will be reduced. Shell material for the dam construction can likely be obtained from abutment areas and borrow sites within the reservoir area. Core material will likely not be encountered within the reservoir area; however, it is likely locally available. The proposed subdivision near the site contains thick surface deposits of clay soils exhibiting high plasticity characteristics. These soils or nearby would likely be suitable for dam core material. Quantities would have to be determined.

Estimated Cost and Yield. Based on past WRP studies the construction cost is estimated to be similar to the Steamboat Ditch Mile 5 site: Construction cost is $31.0 million and water rights of $24.5 million (7,000 times $3,500). Total project cost is estimated at $55.5 million

Feasibility/Permitability. From a geotechnical standpoint, this site has many positive attributes and does not have any significant disadvantage and the geologic constraints are minimal.

Steamboat Ditch Mile 5

The site is located on an unnamed tributary to the Truckee River, 5 miles downstream from the diversion works for the Steamboat Ditch (officially the Steamboat Canal), on the south side of Interstate 80 near Verdi. The drainage area is 0.7 square mile. The owners of the land approached Sierra with a proposal to provide land for a small reservoir (130 acre surface area) on a portion of their property. The developer would develop home sites on the balance of the property.

The proposed dam would be 140 feet high with a crest length of 1,300 feet. Storage capacity would be 6,400 AF.

Since tributary basin runoff is insignificant, water to fill the reservoir would be pumped from the Truckee River via the Steamboat Ditch and/or Fleish power flume through 3,000 feet of pipe. Return water would be gravity fed to the River for downstream diversion and treatment at the Chalk Bluff Plant. A pipeline and river crossing would be required to convey water directly to the Chalk Bluff Plant, thereby enhancing supply reliability, but such a facility is not included in these cost estimates.

Estimated Cost and Yield. Based on the 1995 WRP the projected yield of the project is 7,000 AF/yr. The estimated construction cost is $31 million and water rights costs of $22.4 million (6,400 times $3,500). Total project cost is $53.4 million.

Feasibility/Permitability. The specific benefits of this site include: close proximity to the Truckee River; construction of a spillway would be minimal due to the small drainage area. No known endangered species or archaeological sites exist in the area, but given its location near U.S. Forest service lands, environmental evaluation could be quite significant. Review of geologic maps also indicates concern about soil types and faulting in the area that might pose construction difficulties. Private parties own the land at this reservoir site.

Since water can be diverted from the river several miles farther upstream than for other sites by the potential use of Fleish power flume, this site offers benefits to reliability in the event of a toxic spill.

Virginia Range

This reservoir area is situated within an intermountain basin in the Virginia Range located east of the south Truckee Meadows approximately 3 miles southwest of Lockwood within Storey County. The site contains a lower and upper basin area. The upper basin has a width of approximately ½ mile and a length of 1 mile. The lower basin area is located north of the upper basin and consists of a smaller bowl-shaped depression with a small ravine located along the north side of this area. A possible dam location is within this ravine area.

This site has several possible dam locations and dam heights resulting in five possible dam heights and configurations:

- The first alternative is to construct a dam spanning the small ravine located within the north side of the lower basin area. This dam would have a recommended dam height elevation of 5,120 feet, a length of about 1,200 feet and a maximum height of 120 feet. This alternative would yield an approximate storage capacity of 1,400 acre-feet.
- The second alternative would be to raise the dam height (alternative #1) to an elevation of 5,150 feet. This would require a short extension of the dam west of the ravine area. This alternative would yield an approximate storage capacity of 4,000 acre-feet.
- The third alternative is to construct a second dam spanning the saddle area located between the lower and upper basin areas. The top of this dam would have an elevation of 5,200 feet. The dam would have a length of 1,600 feet and a maximum height of 50 feet. This would also require raising the dam located to the north (alternative #2) to an elevation 5,200 feet. This alternative would yield an approximate storage capacity of 8,500 acre-feet.
- The fourth alternative is to not construct the dam across the saddle area and let the water spill over into the upper basin area. This would require constructing a dam that would span a small ravine located at the south end of the basin area. This dam site would yield an approximate storage capacity of 34,000 acre-feet.
- The fifth alternative is to not construct a dam within the lower basin area and keep the reservoir entirely within the upper basin area. This would require constructing dams within both ends of the upper basin area. This alternative would yield an approximate storage capacity of 21,000 acre-feet.

For this study the third option provides a comparable volume of storage and is considered. From a geotechnical standpoint, this site has many positive attributes:

- The dam sites should provide a competent material for abutment and foundation support.
- Dam construction materials are likely available locally.
- Downstream constraints appear to be minimal. Downstream of the site is a drainage area that flows into a man-made drainage channel near Lockwood and terminates at the Truckee River.

The primary geologic constraint is that several faults trend through this site. A north trending fault is located along the eastern margins. This fault trends through the eastern abutment area sites. Exploration trenches cut perpendicular to the fault trace to verify the location of the faults and to approximate the age of the last displacement occurring along this fault trace would be required. A shear zone could be located within this fault trace and may require extensive grouting at the abutment area. The reservoir within the upper basin area is generally shallow and spread out over a large area; therefore, evaporation may be significant.

To make use of this site would require transporting Truckee River water via Steamboat Ditch and/or Thomas and Whites Creek water would be pumped from the intake area of an assumed future water treatment plant to the reservoir. Return water would be pumped from the

site and then gravity fed to the new plant in South Truckee Meadows, assumed to be located near Mt. Rose Highway and Steamboat Ditch. Further studies may also show other operational scenarios.

Estimated Cost and Yield. The storage of this site under alternative 3 is similar to Bull Ranch and Steamboat Mile 5 and thus the yield is also considered at 7,000 acre-feet. A cost study was conducted for this site as part of the 1995 WRP and the cost was estimated at $35 million for construction and treatment of the water. Water rights are estimated to cost $29.7 million (8,500 acre-feet times $3,500), producing a total project cost of $64.7 million.

Feasibility/Permitability. From a geotechnical standpoint, this site has many positive attributes and does not have any significant disadvantages and the geologic constraints are minimal. However, due to this site's location it would be very expensive to operate. Water would have to be piped a considerable distance and then pumped up into the Virginia Range.

Meter Retrofit and Conservation

This project is available should TROA not be implemented, because the water saved from meter retrofit under TROA is used to generate upstream storage for wildlife purposes and cannot be used for new service commitments. Absent TROA, TMWA estimates 8,400 acre-feet of water may be available for new service commitments.

This project is modified from the 1995 water resource plan and presented as a demand management project that would reduce water use by existing customers, allowing that water saved to be reissued for new development without additional conservation devices such as installation of low-flow toilets. Meter retrofits are installed at a developer's expense through the collection of the meter retrofit fee established in 1995. The estimated cost to complete the meter retrofit program is approximately $21 million. The water saved from retrofitting services would be credited towards the issue of new will-serve letters.

This project is attractive since it does not require acquisition of additional water rights or construction of treatment capacity; it incorporates a broader approach to water savings by offering several conservation measures; and it provides a long-term approach to conservation of water resources.

This project could be implemented if the following conditions existed:

- The State Engineer recognizes that the water saved from this project is available to service new commitments.
- TROA is not implemented.
- Local governments concur that the "freed-up" rights are available for rededication to new projects that would pay the program's cost.
- The community would have to support the concept that water saved from conservation should be used for future growth.

- The proceeds from the sale of new service commitments would have to be determined.

The supply generated by this project is available only if the current pool of resources does not change. Without TROA and the possibility that the ISA may not be renewed, this project supply would have to offset the lost supply

The use of conserved water has been a debated issue in the region for years. However, with ever-increasing demands on a shrinking resource base, the economic viability of a project of this nature may be required in the future without TROA.

Negotiated Settlement (TROA)

The Negotiated Settlement ("Settlement") of the Truckee River has the potential to provide water for the Truckee Meadows as well as quieting much of the controversy surrounding the operations of the Truckee River system to provide our current water supplies. During the period of 1979 through 1989, the parties were in gridlock over many of the issues which surrounded the interstate allocation of water, the operation of the reservoirs, and the needs of the endangered species. In the late 1980's Senator Reid took a special interest in the Truckee River issues. The parties had tried twice before (once in 1982 to reach a settlement and a second attempt in 1985 to pass the interstate allocation of water) to solve the river's complex issues but had been unsuccessful. Senator Reid's efforts resulted in the signing of the Preliminary Settlement Agreement ("PSA") in May of 1989 between Sierra Pacific Power Company and the Pyramid Lake Paiute Tribe ("PLPT"). That agreement, assumed by TMWA, allows TMWA to store its POSW in federal reservoirs for drought use in exchange for waiver of its hydroelectric water rights. Water rights currently owned by TMWA would be stored and used during droughts. In non-drought years excess storage is turned over to the US and Tribe to be used for recovery of endangered species. In dry years, portions of the Stampede Project Water supply were subordinated to allow for firm storage for the Truckee Meadows that does not evaporate or suffer losses unless it is the only water in the reservoir. This settlement resource will support 119,000 acre-feet of demand and in addition provide for additional drought reserves in the case of a worse than worst case drought. In 1990, due to the heroic efforts of Senator Reid and Congresswoman Vucanovich, Public Law 101-618 was passed in the final hours of the session. That Act includes provisions for the interstate allocation of water between the two states together with provisions for negotiation of the Truckee River Operating Agreement which provides TMWA customers with certainty regarding the operation of the system and additional drought supplies for existing as well as new customers. At the heart of this agreement is benefits for those who do sign and non-injury to the water rights of those who do not sign.

In order to fully implement the PSA and the Act the parties must enter into an operating agreement (TROA) and comply with numerous other contingencies. Effectiveness of some provisions of the Act is mutually contingent and is therefore part of the "negotiated settlement". Other parts of the Act are not part of the Settlement but are incorporated into the same legislation.

Since the Settlement Act became law numerous additional benefits have been negotiated into TROA including new types of credit water that have been added to the categories set forth in the PSA; these include Water Quality Credit Water, California M&I Credit Water, California Joint Program Credit Water, California Environmental Credit Water, Additional California Environmental Credit Water Fernley Municipal Credit Water, Newlands Project Credit Water and Other Credit Water. Additionally minimum and Enhanced Reservoir Releases have been negotiated with guidelines for Preferred Instream Flows and Recreational Pools. There is a habitat restoration fund and Mandatory Exchanges for Donner Lake storage so that California can better meet their chosen instream flows and recreation pools in Donner. Also a complex set of rules for exchange priorities has been added.

A major contingency of the PSA and the Act is that an Operating Agreement be reached among five parties in order to implement the concepts set out in the PSA and the Act. The negotiation of a Truckee River Operating Agreement "TROA" has been in progress since the Act was passed. The document represents the culmination of 12 years of difficult negotiation to replace the 1934 Truckee River Agreement with a new agreement for the operation of the federal reservoirs and Donner and Independence. By law, in order for the TROA to become effective, five mandatory signatory parties must sign it: TMWA, State of Nevada, State of California, US, and PLPT.

In addition, it is possible that a number of other parties may choose to sign TROA:

- Carson/Truckee Water Conservancy District
- City of Reno
- City of Sparks
- Sierra Valley Water Company
- City of Fernley
- Washoe County
- Washoe County Water Conservation District

As its name implies, the Truckee River Negotiated Settlement has been a negotiated agreement among many parties. The Truckee Meadows community both gains and gives up something as part of the Settlement. TMWA and its customers have been a major participant to making the Settlement a reality and its customers are among the beneficiaries. Since TMWA's water customers are the taxpayers and sewer customers of Reno, Sparks, and Washoe County, many of the Settlement's benefits overlap across jurisdictional lines in the Truckee Meadows. Many of the benefits have not and cannot be quantified for the purposes of the analysis as a resource but have been and will continue to be taken into account by the community in its support for the Settlement. In addition, since both states benefit from the interstate allocation of the Truckee and Carson Rivers and from the Tahoe Basin, there are other parties in the two states who indirectly benefit from the Settlement even without having participated.

Benefits and requirements of the Settlement are summarized below:

- Interim drought storage for the TMWA customers until Settlement becomes effective

- Permanent drought storage for TMWA customers including emergency drought supplies during toxic spill conditions and worse than worst case droughts.
- Certainty associated with the Interstate Allocation of the Truckee and Carson Rivers as well as the Tahoe Basin between California and Nevada.
- Improved flexibility of River operations to accommodate changing circumstances, policies and values while protecting historic water rights from injury
- Improved timing of river flows for the threatened and endangered species in Pyramid Lake
- Provides for enhanced minimum reservoir releases and protects from claim to the contrary
- Provides for increased recreational pools in the reservoirs
- Provides for improved riparian habitat
- Provides for improved water quality enhancement through flow augmentation and retiming of flow
- Provides for reduced litigation and continued cooperation
- Provides for water storage for California municipal and industrial use as well as environmental uses
- Sets minimum bypass flows for the hydroelectric plants and protects from claims to the contrary.
- Provides for consistent dispute resolution
- Provides reasonable and consistent rules for effluent reuse

Estimated Yield and Costs. Although the development costs of TROA have been higher than predicted, it is probable that litigation costs would have exceeded the cost of negotiation. Most certainly the costs of uncertainty to the community would have grown as the issues in litigation grew. As shown by TMWA's conservation activities, the interim storage agreement, the Water Quality Settlement, the Tahoe-Truckee Sanitation Agency water quality settlement, the Tribe's setting of water quality standards and increased operations flexibility, the river system is already the beneficiary of increased communication and cooperation, and solutions are being found regularly to areas of previous impasses.

Upon TROA implementation, the interim Storage Contract is superceded by the Settlement operation. To take advantage of TROA's 119,000 acre-foot supply, the following Truckee Meadows water rights are estimated for this project (the estimates here are those submitted for the TROA EIS/EIR process):

Water rights for municipal demands	42,340
Water rights for water quality	6,700
Total	49,040

Reflecting back on the water rights availability discussion, the reader should be aware that the projected total of rights for the Settlement exceeds the projected recoverable amount of direct diversion water rights by 14,002 acre-feet (53,160 less 39,152), however if the tributary water rights are added into the equation and there is close cooperation and coordination between the water quality purposes and the water supply purposes, there would be nearly enough water rights.

The projected cost of water rights related to the use of rights for municipal purposes is $148.2 million (42,340 times $3,500).

Project Status. The National Environmental Policy Act and the California Environmental Quality Act require an environmental evaluation of the Truckee River Operating Agreement. The Bureau of Reclamation, the Fish and Wildlife Service, and the California Department of Water Resources commenced a process to complete these evaluations in 1996, however that process will need to be reinitiated in the near future because the agreement changed since that time and the parties were unable to forecast the nature of those changes. The EIS process, once commenced, is forecast to take 16 to 18 months.

A tentative schedule for completion of the Negotiated Settlement is for signing to occur around the end of 2004 or early 2005 and Orr Ditch and Truckee River General Electric court approvals, stipulations for dismissal to be sought thereafter. From now until execution of TROA, storage agreements must be negotiated, change applications must be filed and the change process completed contingent on the implementation of TROA. In addition, work must be done in order to allow the transfer of the Hydroelectric Assets to TMWA so that the agreement can be revised accordingly. TMWA will continue to use its interim storage contract in the meantime.

Purchase TCID's Share of Donner Lake Storage

General Description. The right to the water stored in Donner Lake, near Truckee is owned as tenants in common by TMWA and the Truckee-Carson Irrigation District (TCID). Since the 1988 WRP several attempts have been made to purchase TCID's half of Donner Lake water without success.

Estimated Yield and Costs. When operated in conjunction with the ISA the estimated annual yield of purchasing TCID's half of Donner Lake water is 3,300 acre-feet/yr. Costs associated with the Donner Lake storage option include acquiring TCID's share of the reservoir and at today's prices of an irrigation right the project would cost $11.5 million with treatment cost of approximately $7.8 million, for a total of $19.3 million.

If renewal of the ISA is not possible, the yield of Donner purchase is approximately 1,400 acre-feet for $4.9 million and treatment cost of approximately $3.3 million.

Feasibility/Permitability. Purchasing Donner Lake may result in TCID's Truckee Division having less drought storage. Providing equal benefit to the Truckee Division and the Carson division of TCID may hinder sale of TCID's share. Also, the U.S. filed a lien on this asset as part of the on-going recoupment case filed by the U.S. on behalf of PLPT.

There is expected to be little, if any, environmental impact from this project since the operation of Donner Lake would not change significantly.

Summary

This chapter discussed several critical issues facing TMWA and the region as a whole. Of primary importance is the availability of water rights to meet future demands. It is estimated that sufficient water rights are available to meet TMWA's 2025 demand and beyond.

Water rights will continue to be acquired under both TROA and non-TROA scenarios for as long as existing drought reserves can support the estimated committable yield.

The effect of drought design on the need for water rights is directly related to the level of commitment that can be support by the 8, 9, or 10 year design drought. It is clear that the 8 year drought design has significant advantages over the other designs and would allow TMWA to continue to expand services with the continued conversion of irrigation water rights through the year 2025. Should TMWA choose to maintain a 10 year drought standard, then TMWA must begin considering projects that would expand TMWA's drought supply. Under this scenario drought supply will be needed prior to TROA's implementation, however, the direct result of this action should TROA be implemented would be a surplus of drought storage. Selecting the eight year drought design is a reasonable course of action to take at this time, and would allow for continued growth until TROA is implemented.

Several water supply projects are available for developing additional resources or making existing resources more productive either in conjunction with TROA, in addition to TROA or without TROA. North Valley Importation has the ability to allow reallocation of Truckee River to meet demands in other parts of the Truckee Meadows. Local reservoirs were shown to provide both drought supply and increased system reliability. Having an alternative source of water in the event that the river is unusable would be attractive even if TROA is implemented.

TMWA will continue to play an active role in implementing and negotiating future water resources including artificial recharge, the Negotiated Settlement, and the importation project(s) for the North Valley (to the extent TMWA is able to assist WDWR in implementing this project). Projects awaiting resolution of TROA implementation – meter retrofit, purchase of TCID share of Donner Lake Storage and local reservoirs – will remain under future investigation as to cost and feasibility. These activities are vital in order to have the next implementable water resource available when demands dictate its need. Depending on the successful implementation of TROA, the other projects included in this review may or may not be required in the near future.

Chapter 6 Summary

The delivery of water to the residents of the Truckee Meadows began in the latter half of the 1800's. Over the years several water purveyors and ditch companies were combined, merged or purchased, ultimately forming the Truckee Meadows Water Authority (TMWA). TMWA began operating the water delivery system in the Truckee Meadows in 2001 after purchasing Sierra Pacific Power Company's water distribution system assets. The water distribution system includes over 1500 miles of pipes ranging in size from ¾ inch to 42 inches, two surface water treatment plants, and 33 tanks that combine to store over 100 MG of treated water. TMWA acquired and controls over 126,000 acre-feet of surface water, storage and groundwater rights that are managed to create the drinking water supply for approximately 74% of the residents of Washoe County living in and around Reno and Sparks, Nevada.

The rapid growth that Reno and Sparks experienced in the late 1970's stimulated the need for more extensive water planning as the pool of resources available at the time was estimated to be exhausted in the early 1980's. The purveyor became very active in analyzing and reviewing all potential water resources. Population and resulting demand estimates, based on then historic trends and growth rates, seemed to indicate an ever-expanding economy and population. Planning water supplies for the residents of the Truckee Meadows had to evolve and adapt as conditions were changing. Resource plans published in the 1980's and 1990's updated the latest information on potential water supply projects, sometimes adding new water supply concepts while discarding projects that could never be built or implemented for economic or regulatory reasons.

By the early 1990's economic growth in the hotel gaming sector had started to decline. A shift in the work force is evidenced by growth in other service sectors, away from the hotel gaming sector. Recent data shows decline in the hotel, gaming and recreation sector in Washoe County and suggests that the base economy in the Truckee Meadows is changing. Shifts in employment distribution among the industrial sectors influences future water demands.

Although total population has grown consistently over the years, water demand per service as measured by use per service connection peaked in 1987, has declined and remained relatively stable since 1993 despite TMWA adding over 24,500 new residential services between 1990 and 2001. The drought years of 1987 to 1994 were a major factor in reducing overall water demand in the Truckee Meadows, as are the annual conservation efforts by TMWA. The downward trend is projected to continue as progress toward retrofitting all flat-rate services with water meter nears completion in 2009.

The population and employment forecast developed for this resource planning relied on the 2000 US Census to identify existing population distributions. The econometric model developed for the plan identified structural changes in employment and a gradually decreasing growth rate in the future. The econometric model forecasts a decreasing population growth rate, at an average annual rate that is less than rates estimated in previous resource plans. In addition to gradual economic change, the constraint of buildable land was tested for effect on future water demands. Analysis of available land that could be developed in and surrounding the Truckee Meadows showed that the quantity of developable land in the future is shrinking. The availability

of land resources will be a constraint on future growth. As the supply of developable land is consumed, the price of land will increase which will have further slowing effects on growth.

Water will be delivered by TMWA to an estimated 360,000 persons living in the retail area and 48,000 persons living in the wholesale area in 2025. This value is higher than past planning estimates due to the fact TPEM incorporated the 2000 US Census population estimates and continued growth in the region. TMWA's conservation programs and completion of the Meter Retrofit program have significant impact on the water demand forecast. The benefit of conservation to our community and available resources is illustrated by 8,400 acre-feet projected savings from the Meter Retrofit Program alone. The Meter Retrofit program will continue to be funded as described in Chapter 4, however, TMWA could seek to accelerate this program with bond financing. TMWA will continue to collect usage data by lot size for each residential customer, and in particular, quantify the water savings by water meter retrofit.

The 2025 water demand projected for this plan is 110,300 acre-feet. In comparison, the 1995 WRP projected demands of 75,900 acre-feet under a "settlement" scenario, or 94,600 acre-feet under a "no-settlement" scenario. The Regional Water Supply and Quality Study projected demand of 118,000 acre-feet by 2025. Water demands will grow approximately 29,000 acre-feet, from 81,000 acre-feet of water delivered for consumption in 2002 to 110,000 acre-feet in 2025. More than 189.5 MGD of combined surface treatment and groundwater wells will be needed to meet peak day requirements in 2025. This means Chalk Bluff must be expanded from 69 MGD to 96 MGD by completing Phase 3 in 2004-2005 and Phase 4 in 2013-2014, and that the well development program must continue to meet it production targets.

Significant to water resource planning is the selection of a drought period to estimate the yield of TMWA's resources during droughts. In non-drought years when sufficient precipitation occurs, there is no need for TMWA to over pump its wells or release any of its privately owned stored water since the Truckee River can supply the majority of customer demands. TMWA manages its resources to take maximum advantage of Truckee River flows while minimizing use of its reserve supplies during non-drought years. Drought year supplies therefore determine the maximum amount of water service commitments TMWA can supply. Analysis presented in this plan showed that TMWA can commit to serve up to 113,000 acre-feet if the historic drought from 1987 to 1994 is the drought design criterion, or 99,000 acre-feet if the historic drought from 1987 to 1994 plus a repeat of 1987 and 1988 is the drought design criterion. Because the purpose of the more stringent drought design ultimately reduces the use of available resources and burdens the region with the costly requirement to replace the lost-committable resource, TMWA should adopt the 8-year drought design criteria, but limit the level of committable resources to 110,000 acre-feet (the 9-year drought design) in order to give TMWA the opportunity and time to reassess the drought design in future water plans and creates flexibility in managing TMWA's resources. Taking this action also preserves the opportunity for the local community to continue to develop in an orderly fashion without necessitating unreasonable and unnecessary interruptions during the next few years before TROA is implemented.

Figure 28 illustrates the potential supply development paths available to TMWA based on the water supply projects and associated costs described in this chapter. Four development scenarios are shown in the figure. Each of these combinations of water supply projects provides a water supply that exceeds the 20-yr water supply need identified in this plan, and each path has different water right and overall cost implications.

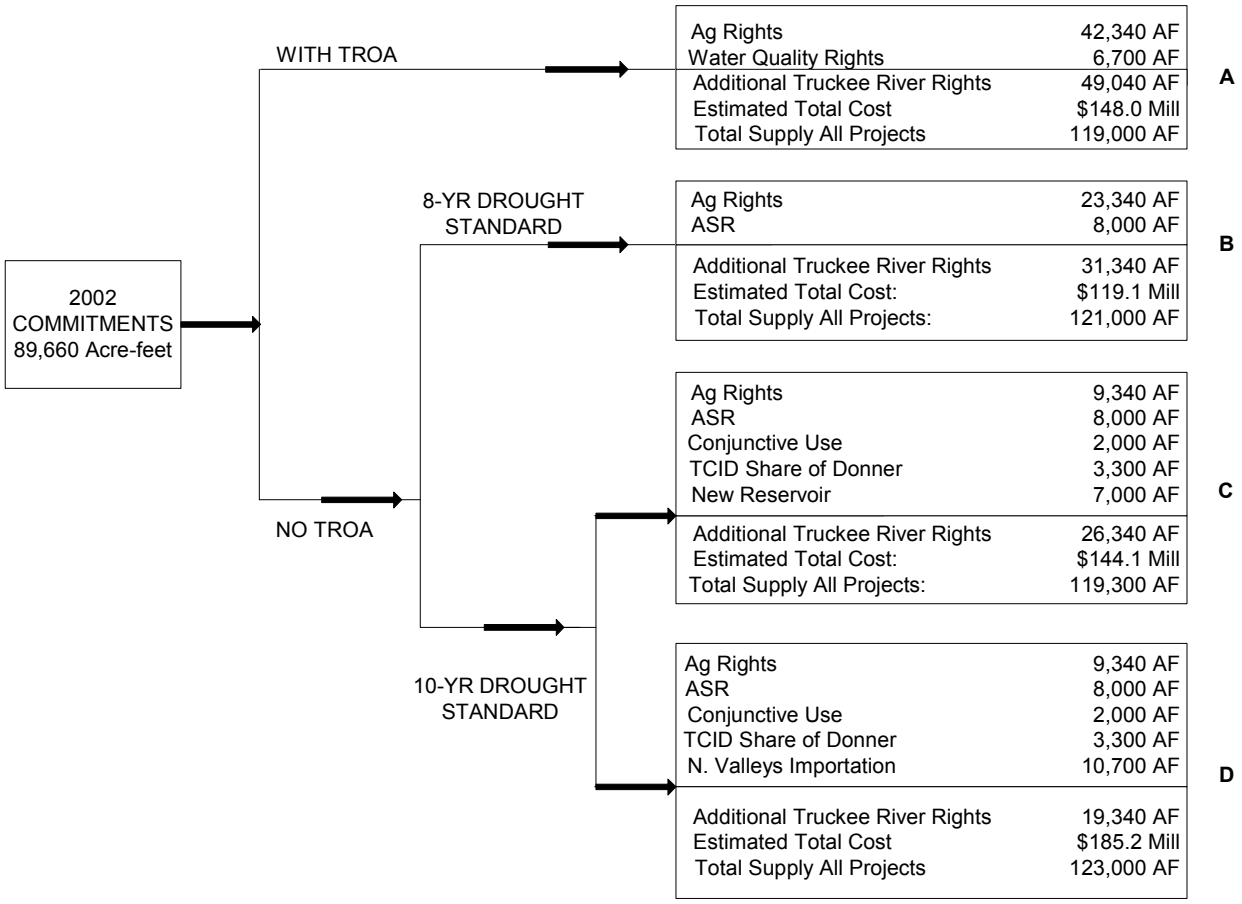

Figure 28: Water Supply Development Paths

The plan reviewed 8 Truckee River related projects and 4 groundwater-related projects. The incremental yield of the projects ranges from 2,000 to 42,000 acre-feet. There are sufficient Truckee River irrigation rights to meet the projected 2025 demand and future buildout requirements as illustrated by paths A, B, C, and D in the above figure. While this figure provides some alternative paths of water supply, there are many costs and benefits that are not reflected such as environmental considerations, permitting of projects, public safety regulations or timing of projects. TMWA will continue to pursue those supply projects that are economically feasible and that can be implemented to ensure water supplies are available as future demands require.