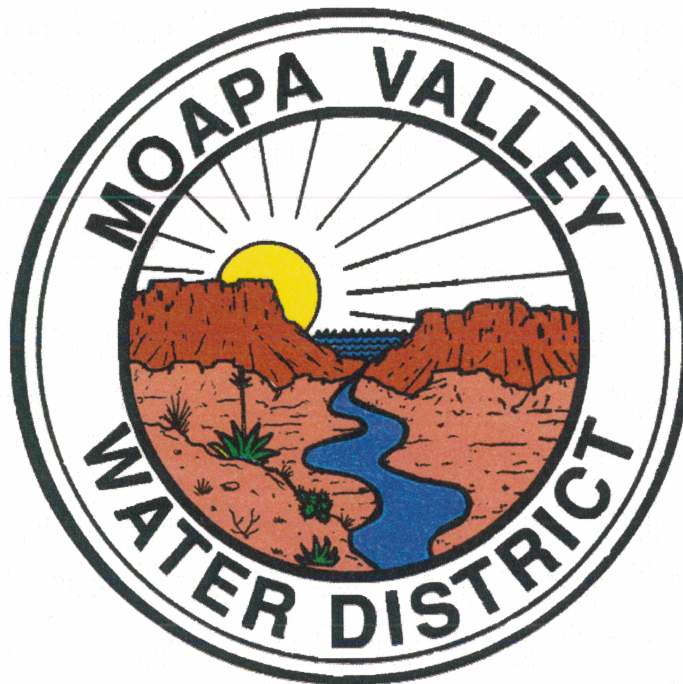


MOAPA VALLEY WATER DISTRICT

WATER CONSERVATION PLAN

April 2019



OWNER:

Moapa Valley Water District
601 N Moapa Valley Blvd
P. O. Box 257
Logandale NV 89021
(702)-397-6893

ENGINEER:

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Moapa Valley Water District (MVWD) provides potable water to customers within a service area that includes the towns of Overton, Logandale, Glendale, and Moapa. MVWD began water service in 1960 and since that time the service area has experienced an average population growth rate of approximately three percent per year. The most recent estimates indicate a current population of approximately 8,000 in the Moapa Valley area. A three to four percent per year average growth trend is expected to continue in Moapa Valley because of the areas favorable living conditions, which include a rural atmosphere and relatively short commute to Las Vegas. Generally speaking, the customer class that will experience the most growth will be residential with little growth being anticipated in the commercial and industrial classes.

According to Nevada Statutes Chapter 477 the MVWD was created for the purpose of “providing for the storage, conservation, distribution and sale of water within the District; authorizing the District to purchase, acquire and construct the facilities necessary to serve water to consumers within the District...”. MVWD’s primary goal is to deliver quality water to its customers. To achieve that goal, the existing water distribution system must be kept in good repair and new water infrastructure must be constructed to keep pace with growth. Additionally, existing water supplies must be properly managed and other potential water sources developed. An important part of that development and management is conservation.

Conservation is only effective if both water purveyors and customers participate in efforts to save. For its part, MVWD’s conservation responsibilities include leak detection and system maintenance, water reuse where possible, public education, creation of financial and regulatory incentives, and all other conservation management practices. Management practices include balancing conservation measures with District revenue requirements so that high quality water delivery can be guaranteed.

Conservation by water customers is crucial to the success of the conservation plan. The highest use category in the MVWD service area is residential so it is important that residential customers use water wisely. The principle purpose for wise water use is not to diminish quality of life for residential consumers but to reduce waste. Because of this the most important consumer conservation measures include the elimination of leaks, the use of water efficient appliances and equipment, and the installation of efficient irrigation systems.

This conservation plan has been created with the above mentioned elements in mind and includes the following:

- Conservation goals
- Existing and planned conservation measures and incentives
- MVWD use profile
- Educational materials
- Landscape code
- Drought plan

This plan is compliant with Nevada Revised Statutes (NRS) sections 540.121 through 540.151 and is available for public inspection at the following location:

**Moapa Valley Water District
601 N Moapa Valley Blvd
P. O. Box 257
Logandale NV 89021
(702)-397-6893**

Public comments about this plan are encouraged. Written comments may be sent to the address above.

The following are the MVWD conservation goals. Some of these goals involve ongoing efforts and others are definite projects that will improve the District's ability to manage available water. Project related goals will be revised or replaced by new goals as the conservation plan and District needs are periodically reviewed. Examples of ongoing goals include public education and leak detection.

1.1 Service

While conservation is important, it is just as important to make sure that MVWD receives enough revenue to continue providing efficient water delivery. All proposed conservation measures will be studied prior to implementation to insure that measures allow for maximum conservation without limiting or impairing MVWD's ability to provide optimal service.

1.2 Drought Plan Activation

Droughts can be difficult to define. For this reason parameters for determining the application of drought measures and specific levels of drought conditions need to be established in advance. Clark County has adopted the drought plan created by the Southern Nevada Water Authority (SNWA). For drought management, the SNWA plan uses four supply conditions: **(1) No Drought, (2) Drought Watch, (3) Drought Alert and (4) Drought Critical**. MVWD is currently using the SNWA drought plan but is also working on its own plan. MVWD working toward determining its own set of drought triggers to determine the point at which drought measures should be implemented. Since groundwater is currently the only source of supply for MVWD, percentage drops in well levels could be used as well as other conditions that are specific to the MVWD service area.

1.3 Effluent Use

MVWD has the goal of reusing an average 200,000 gallons per day of treated effluent from a proposed new wastewater treatment facility. To achieve this goal MVWD and the Clark County Water Reclamation District are working together toward the construction of the new treatment plant. Currently plans for the new facility have been completed and are ready to go to bid. The treated effluent could be used for parks, landscapes around public buildings and new golf courses.

1.4 Construction of a Demonstration Garden

As part of its five year plan, the district has included the construction of a demonstration garden. The purpose of the garden would be to promote the efficient use of water through low water use landscapes.

1.5 Schools Conservation Education

A few MVWD personnel are to become certified water conservation practitioners by the American Water Works Association (AWWA). MVWD also plans to purchase a groundwater model to be used for educational purposes. MVWD, in cooperation with local schools, will use these resources to offer water conservation instruction to school age children. Partnering with local schools will also allow for additional distribution of the educational materials already in use by the District. Additionally, these resources can be used in presentations at special events such as youth festivals, Boy and Girl Scout activities, and 4-H. To be successful in this effort MVWD will maintain a high profile among such organizations so that they are aware such presentations are available.

1.6 Unaccounted-for Water

MVWD has developed a plan to reduce unaccounted-for water. The plan's goals include a reduction in unaccounted-for water to 10% in Fiscal Year (FY) 2007, 8% in FY 2008 and 6% in 2009.

1.7 Plan Review and Benchmarks

General benchmarks have been established by which the effectiveness of this conservation plan may be measured. Table 1.1 shows benchmarks for estimating residential water use that were taken from the Environmental Protection Agency (EPA) website.

TABLE 1.1

Residential Estimation Benchmarks

Type of Use	Likely Range of Values
INDOOR USES	
Average household size	2.0 – 3.0 persons
Frequency of toilet flushing	4.0 – 6.0 flushes per person per day
Flushing volumes	1.6 – 8.0 gallons per flush
Fraction of leaking toilets	0 – 30 percent
Showering frequency	0 – 1.0 showers per person per day
Duration of average shower	5 – 15 minutes
Shower flow rates	1.5 – 5.0 gallons per minute
Bathing frequency	0 – 0.2 baths per person per day
Volume of water	30 – 50 gallons per cycle
Washing machine use	0.2 – 0.5 loads per person per day
Volume of water	45 – 50 Gallons per cycle
Dishwasher use	0.1 – 0.3 Loads per person per day
Volume of water	10 – 15 gallons per cycle
Kitchen faucet use	0.5 – 5.0 Minutes per person per day
Faucet flow rates	2.0 – 3.0 gallons per minute
OUTDOOR USES	
Average lot size	5000 – 8000 square feet
Average house size	1200 – 2500 square feet
Landscape area	4000 – 5000 square feet
Fraction of lot size in turf	30 – 50 percent
Water application rates	1 – 5 feet per year
Homes with pools	10 – 25 percent
Pools evaporation losses	3 – 7 feet per year
Frequency of refilling pool	1 – 2 times per year

The benchmarks from table 1.1 can be used to estimate the daily ranges of personal and residential water usage. Table 1.2 shows the results of these calculations.

TABLE 1.2

Range of Water Use in Gallons per Day

Use	Per Individual (Low)	Per Individual (High)	Per Residence (Low)	Per Residence (High)
Toilets	6.4	48.00	19.14	143.52
Showers	0.00	75.00	0.00	224.25
Baths	0.00	10.00	0.00	29.90
Washing Machine	9.00	25.00	26.91	74.75
Dish Washer	1.00	4.50	2.99	13.46
Kitchen Faucet	1.00	15.00	2.99	44.85
Bathroom Faucet	1.00	9.00	2.99	26.91
Landscape	N/A	N/A	24.59	153.70
Total	18.40	186.50	80.61	711.34

The residential ranges in table 1.2 were established using an average household size of 2.99 persons per residence taken from the 2000 United States Census data for Moapa Valley. According to table 1.2, the average household would use 395 gallons per day (gpd). MVWD customers used 211 gallons per day per

residence in 2004. Although MVWD customer's average use is below 395 gpd, there is still room for improvement. Table 2.6 estimates that 10 percent of the total amount used from 1998 to 2020 can be conserved. By applying that same 10 percent to the average residential total over that same period of time (assuming the 2004 residential daily usage of 211 gpd), each residence should save approximately 180,000 gallons over 23 years.

This plan will be reviewed every five years and revised to meet the current specific conservation needs of the MVWD service area. Water use should be compared to historical usage information and estimates in section 2 as well as the benchmarks in table 1.2.

1.8 Submeters

MVWD is considering the implementation of a sub-metering program for multifamily projects. The "NATIONAL MULTIPLE FAMILY SUBMETERING AND ALLOCATION BILLING PROGRAM STUDY" found that sub-metering achieves significant water savings compared with conventional single metering. The study was done with the cooperation of ten water utilities including SNWA. A copy of the executive summary of the study is included in Appendix F.

1.9 Plan Goal

The primary goal of the conservation plan is to encourage water conservation within the District.

END OF SECTION

Section 2 – Water Use Profile and Forecast
SECTION 2 – WATER USE PROFILE AND FORECAST

This section outlines a profile of water production and use as well as a quantitative description of the MVWD water system that will include the following:

- Water rights information
- Existing supply sources and their production
- System water use profile with customer classifications and unaccounted for water
- Water use forecast using projected population growth

The purpose of this section is to compare water sources with demand and establish a basis for conservation measures and incentives.

2.1 Water Rights

2.1.1 Ground Water Rights. Table 3.3 is a summary of current ground water right permits held and applications filed by MVWD. The information in this table comes from an August 2003 “Report on the Status of Water Rights and Water Permits” prepared for MVWD by Taney Engineering in Las Vegas.

TABLE 2.1

Summary of MVWD Ground Water Rights

Name	Use	Duty (AFA)	Permit Number
Logandale Well	Municipal	644.39	68524
Logandale Well	Municipal	280.55	69523*
Logandale Well	Irrigation	1,569.45	24007
Baldwin Spring	Municipal & Domestic	2,132.20	13445
MX-6 Well	Municipal	**	46932
Jones Spring	Municipal & Domestic	723.80	22739
Arrow Canyon Well #1	Municipal	**	55450
Arrow Canyon Well #2	Municipal	6792.71	66043
Arrow Canyon Well #1	Municipal	**	52520
Lytle Well	Irrigation	90	26371

2.1.2 Surface Water Rights. MVWD surface water rights exist via ownership of stock in the Muddy Valley Irrigation Company. Each preferred share is equal to 8.36 acre-feet annually (AFA) and common shares equal .79 AFA. MVWD owns 141.879 preferred shares or 1186 AFA (141.879 x 8.36) and 292.666 common shares or 231.20 AFA (292.666 x .79). Thus the MVWD total surface water rights amount to 1417.20 AFA.

2.2 Supply Sources, Production and Storage

Table 2.2 shows 2012 average monthly demand and peak demand for each active well in the MVWD system. Table 2.3 shows annual averages and peaks for 2007 through 2012 for each well.

TABLE 2.2

Monthly Well Demand Summary for MVWD 2012

Name	2012 Average Monthly Demand (gal)	2012 Peak Demand (gal)	Month of Peak Demand
MX Well	2,125,916	8,593,000	May
Arrow Canyon Well	64,661,000	105,712,000	August
Baldwin Spring	462,500	3,821,000	March
Jones Spring	0	0	Not Applicable
Logandale Well	0	0	Not Applicable

TABLE 2.3

Well Demand Summaries for MVWD 2007 – 2012

Name	Average Annual Demand (gal)	Peak Demand (gal)	Year of Peak Demand
MX Well	43,979,614	125,056,000	2008
Arrow Canyon Well	644,963,833	801,705,000	2012
Baldwin Spring	215,506,15157	380,041,000	2009
Jones Spring	103,880,500	228,880,000	2008
Logandale Well	73,804	73,804	2009

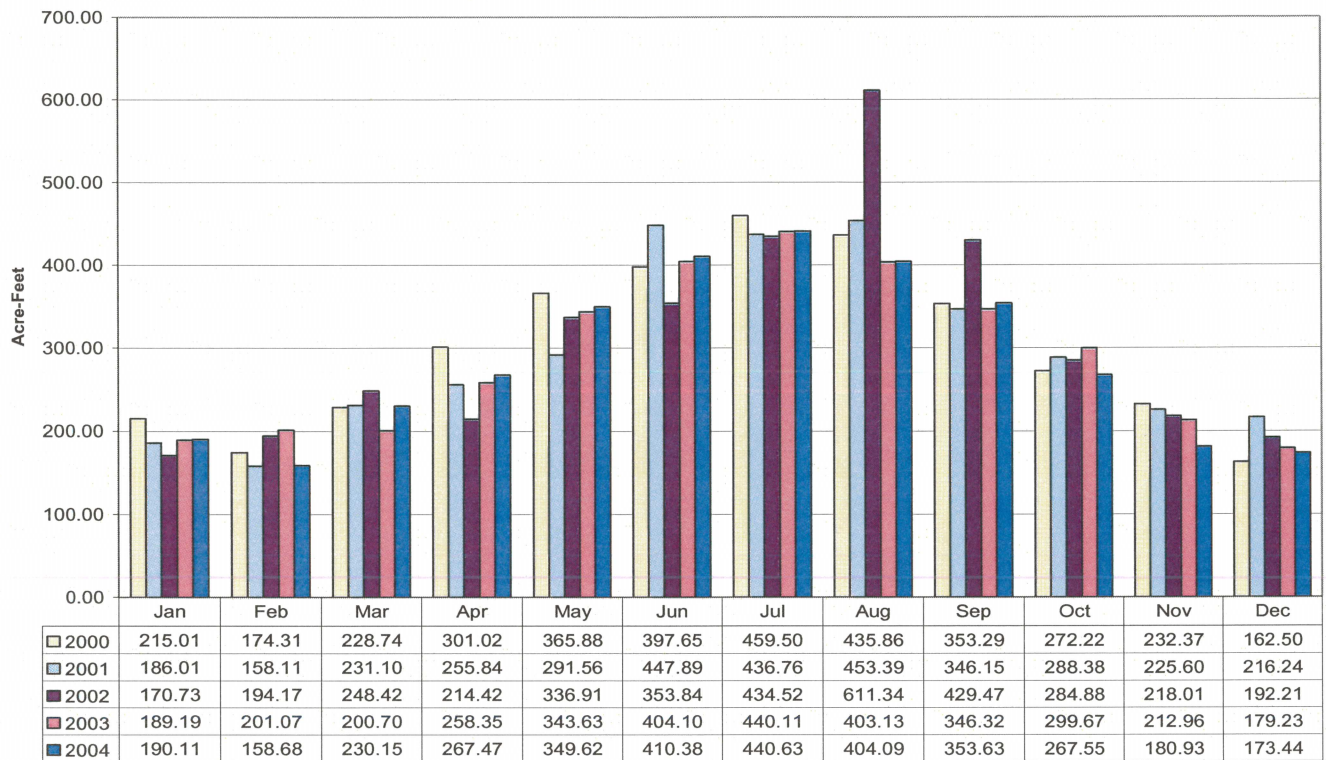
Figure 2.1 shows production amounts by month for the years 2007 through 2012. It is interesting to note that although there has been steady population growth in the Moapa Valley area during this period, water production has been steady with the exception of 2011 and 2012 when there was a production decrease.

Figure 2.2 graphs individual well production from 2007 through 2012. During this period the Arrow Canyon well made the greatest contribution to the system, producing an average of 68.5% of the total followed by Baldwin, Jones, MX, and the Logandale Well. The groundwater basin for all wells is the Muddy River Springs.

Storage facilities for the district include: one, 3.0 million gallon tank; two, 1.5 million gallon tanks; two, 1.0 million gallon tanks; one, 200,000 gallon tank; and one, 100,000 gallon tank. Total storage capacity = 8.3 million gallons.

FIGURE 2.1

Monthly Production Amounts 2000 - 2004

**FIGURE 2.2**

Annual Well Contributions 1998 - 2004



2.3 Water Use Profile

MVWD provides water for the following basic categories of water consumers:

- Metered Customers
- Hydrants, including construction use
- County
- Cemeteries
- Nevada Department of Transportation (NDOT)
- Miscellaneous

The yearly total of water sold in each of these basic customer categories is included in table 2.4.

TABLE 2.4

Amount of Water Sold to All Customers 2010 through 2012 (Acre-feet)

Customer	2010	2011	2012
Metered	1925.85	1796.21	1818.32
Hydrant	34.96	47.35	62.47
County	357.06	412.34	414.37
Cemeteries	16.40	24.30	18.60
Miscellaneous	7.48	4.38	4.22
NV Energy	273.69	85.15	50.31
Total	2615.44	2369.73	2368.29

Metered customers are further classified according to connection type. Metered classifications include:

- Single-family residential.
- Multi-family residential, including apartments and mobile home parks.
- Industrial
- Commercial, including retail businesses, hotels and motels, and services.
- Institutional, including county, state and church use.

Table 2.5 shows the number of meters and units served for the metered customer classifications. Because of their low usage there are approximately 17 non-residential (commercial, etc...) meters included in the single-family residential category. Hotel and motel meters include units with and without kitchens.

TABLE 2.5

Metered customers

Customer Class	Customer	No. of Meters	Units Served
Single-family residential	Home owners	2744	2744
Multi-family residential	Apartments, Mobile home parks	26	464
Commercial	Service businesses, Retail, Hotels and Motels	79	87
Industrial	Manufacturers	15	15
Institutional	County, State, Churches	60	60

Figure 2.3 shows the gallons per capita per day residential use for 2007 through 2012. The chart demonstrates that per capita use has declined since 2010. To obtain these results, single-family and multi-family residential consumption numbers were combined and divided by total population estimates.

FIGURE 2.3

Metered Customer Annual Consumption 2002 - 2004

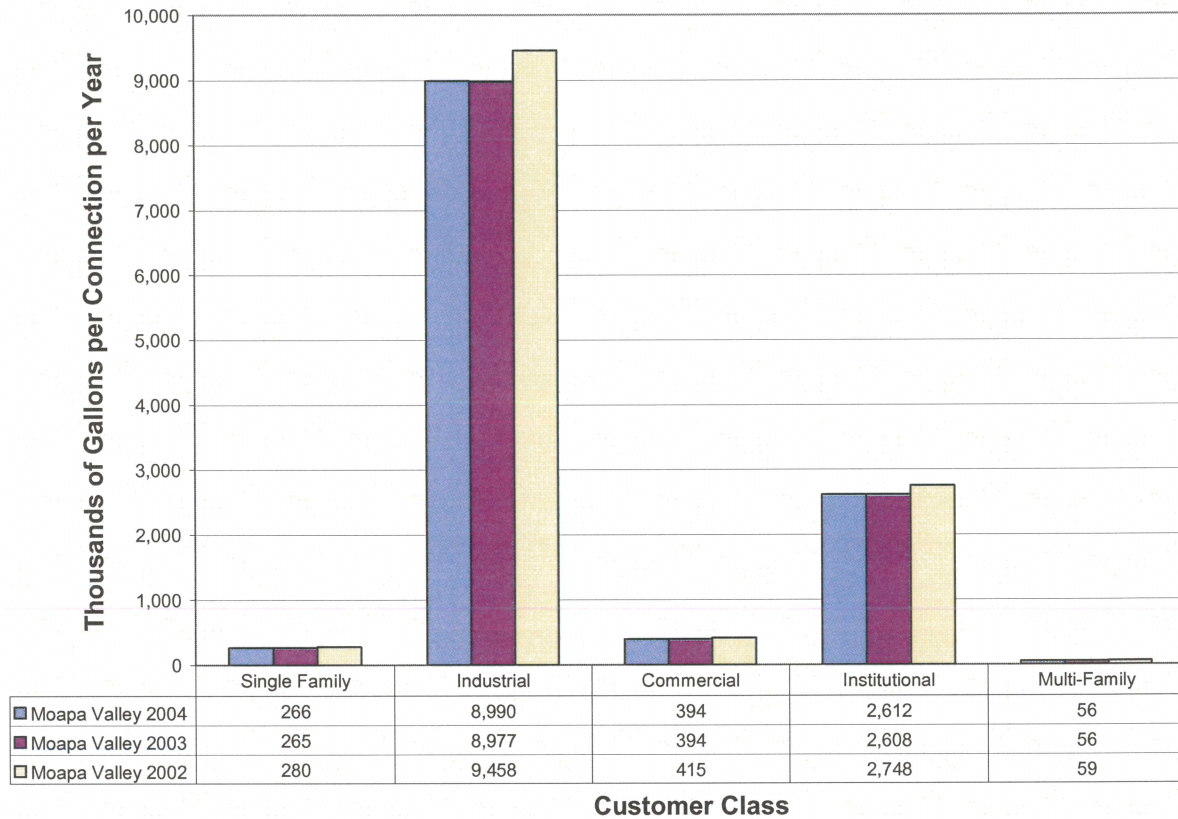


Figure 2.4 shows the gallons per capita per day residential use for 2002 through 2004. The chart demonstrates that per capita use has declined since 2002. To obtain these results, single-family and multi-family residential consumption numbers were combined and divided by total population estimates.

FIGURE 2.4

Residential Use per Capita per Day

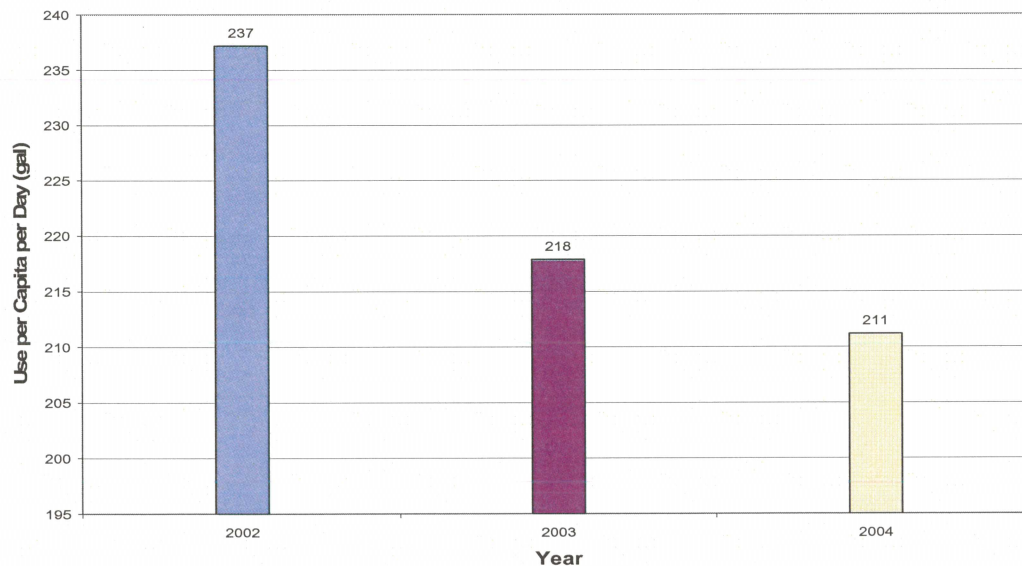
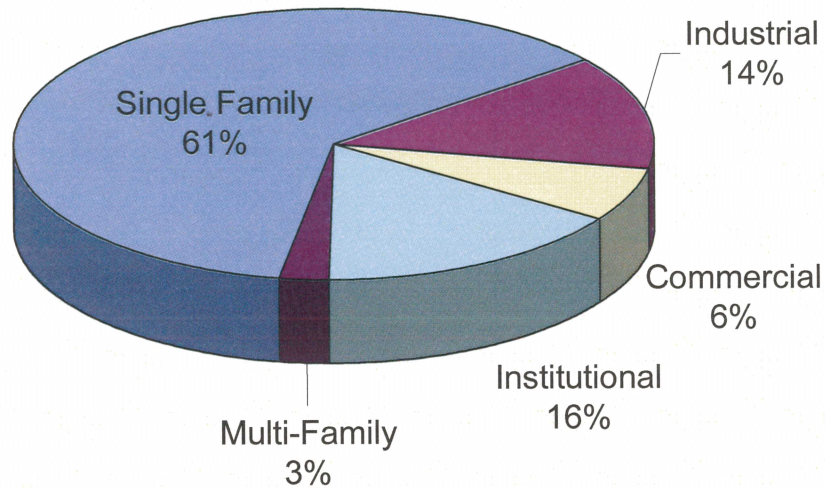
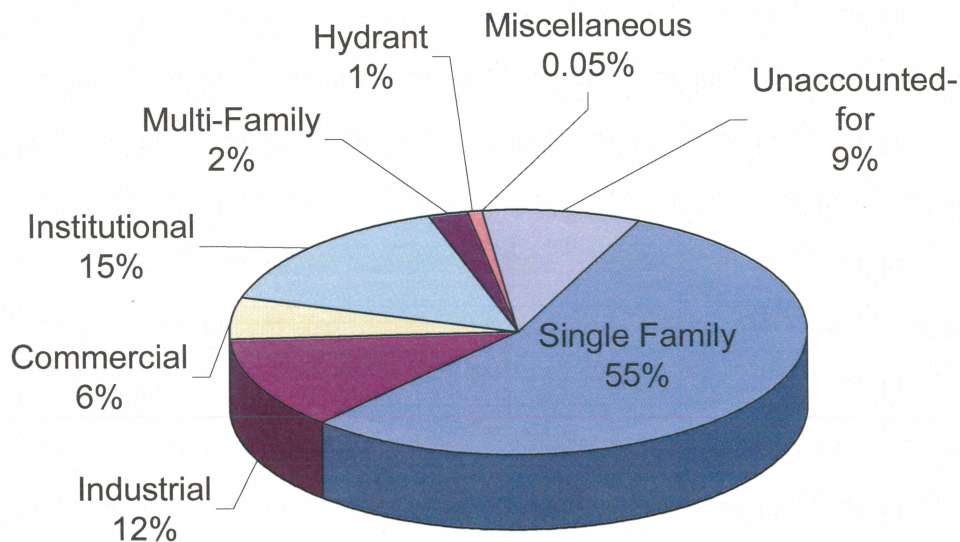


FIGURE 2.5

Use percentages for metered customer classifications

**FIGURE 2.6**

Use percentages for all customer classifications



2.4 Water Demand Forecast

Table 2.6 and Figure 2.7 are taken from Chapter 5 of “Wastewater Flow Projections”, of the Northeast Clark County 208 Water Quality Management Plan Amendment. The MVWD demand forecast is higher than that in the 208 plan amendment because of different population estimates; however the projected water rights are adequate to meet the demand in either case.

The 208 plan estimate shows demand with and without conservation. Although the chart seems to indicate that demand with conservation is not substantially different than demand without, the total water saved over the 22 year period would be 10 percent of the total amount consumed, or 9186 acre-feet. The amount conserved is equivalent to two years supply of water.

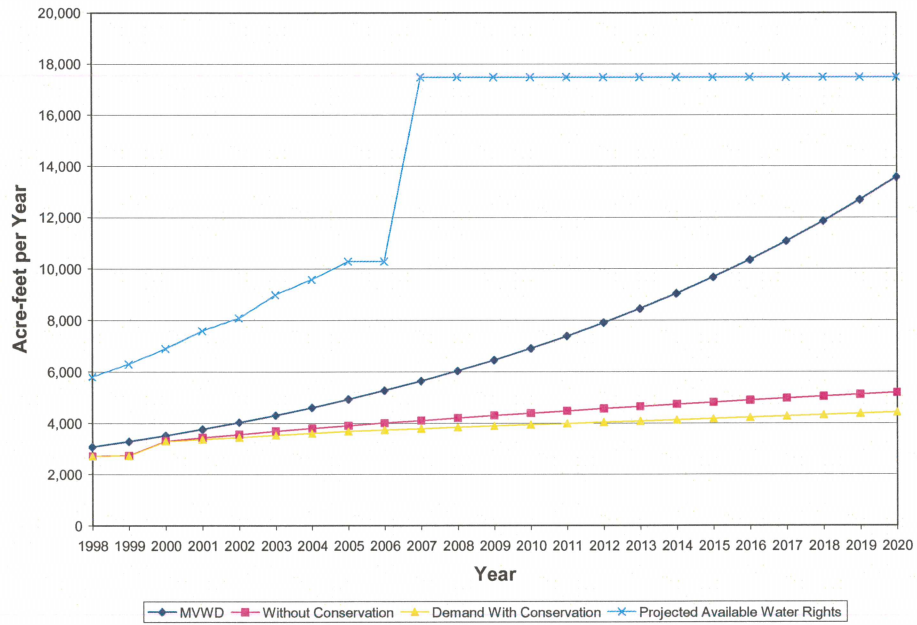
TABLE 2.6

Estimated Plan Water Demands and Amount Saved Through Conservation (Gallons Per Year)

Year	No conservation	Conservation	Amount Conserved
2010	3,147	2,987	52,136,160
2011	2,445	2,323	39,753,822
2012	2,667	2,534	43,338,183
2013	2,628	2,497	42,686,481
2014	2,681	2,520	52,462,011
2015	2,748	2,555	62,889,243
2016	2,817	2,592	73,316,475
2017	2,887	2,627	84,721,260
2018	2,959	2,693	86,676,366
2019	3,033	2,730	98,732,853
2020	3,109	2,798	101,339,661
Total	31,121	28,856	738,052,515

FIGURE 2.7

Demand and Projected Water Rights Forecast through 2020


END OF SECTION

Conservation incentives are those things that increase awareness and encourage conservation. There are three general categories of conservation incentives; Educational, Financial, and Regulatory. MVWD has implemented educational and financial incentives and is subject to the regulatory incentives governing Clark County. This section covers the incentives that are currently in place in MVWD as well as those planned for the future.

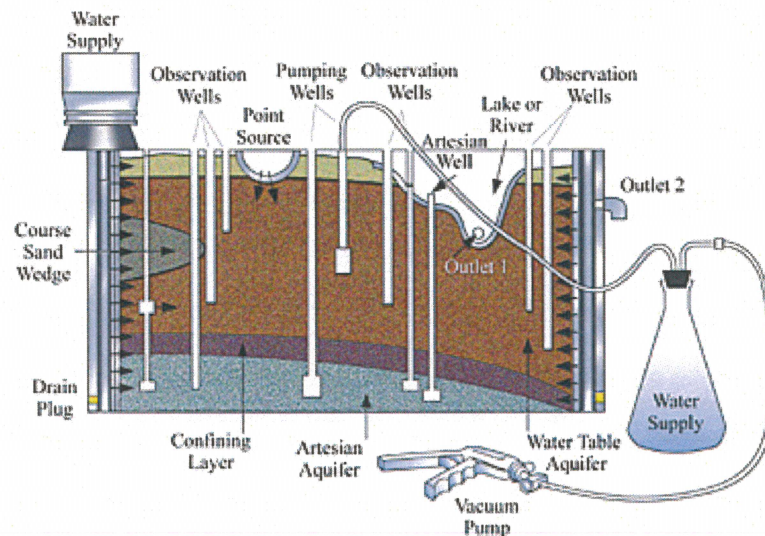
3.1 Educational Conservation Incentives

3.1.1 Literature. MVWD has a number of educational pamphlets that relate to water conservation, most of which have been published by the American Water Works Association (AWWA). MVWD distributes these materials to water customers in May of even years and November of odd years. Appendix A has a summary of that literature and samples of the guides.

3.1.2 Ground Water Model. MVWD will be obtaining a ground water model (see figure 3.14) to use in school presentations. These presentations will be done periodically within the local school district.

FIGURE 3.1

University of Nebraska Standard Ground Water Model



3.1.4 Education for Large Water Consumers. Certain MVWD customers consume large amounts of water as a natural result of their functions. These customers have the responsibility of irrigating landscapes that may include large turf areas. Schools, county facilities, and cemeteries are among such users. MVWD can encourage these entities to use water more efficiently by sponsoring courses offered by the Irrigation Association. These courses provide information on irrigation techniques including audits, design, installation and maintenance. Information for the Irrigation Association may be found at www.irrigation.org.

3.2 Financial Conservation Incentives

3.2.1 Rates. MVWD uses an inclining block rate structure, meaning that rates increase with consumption and thus encourage conservation. Rates within the district are divided into two classes; residential and commercial/industrial. Table 3.1 shows residential rate blocks and table 3.2 commercial/industrial.

TABLE 3.1

Residential Rates

Class	Meter Size	No. of Single Family Units	Service Charge	Block	\$ per 1000 gallons	Limit*
R2	¾" – 1"	1	\$37.18	1	\$2.67	Up to 8,000
				2	\$2.96	8,001 up to 42,000
				3	\$3.24	Everything above 42,000
R4	1 ½"	3 or 1 ½" Meter	\$99.14	1	\$2.67	Up to 8,000
				2	\$2.96	8,001 up to 42,000
				3	\$3.24	Everything above 42,000
R5	2"	1 or More	\$141.83	1	\$2.67	Up to 8,000
				2	\$2.96	8,001 up to 42,000
				3	\$3.24	Everything above 42,000

TABLE 3.2

Commercial/Industrial Rates

Class	Meter Size	Service Charge	Block	\$ per 1000 gallons	Block Usage*
C1	¾" / 1"	\$46.82/\$56.17	1	\$2.67	15,000/30,000
			2	\$2.96	85,000/120,000
			3	\$3.24	100,000/150,000
C2	1 ½"	\$99.14	1	\$2.67	30,000
			2	\$2.96	170,000
			3	\$3.24	200,000
C3	2"	\$141.83	1	\$2.67	50,000
			2	\$2.96	200,000
			3	\$3.24	250,000
C4	3"	\$251.99	1	\$2.67	200,000
			2	\$2.96	800,000
			3	\$3.24	1,000,000
C5	4"	\$386.94	1	\$2.67	1,000,000
			2	\$2.96	3,000,000
			3	\$3.24	4,000,000
C6	6"	\$722.93	1	\$2.67	1,000,000
			2	\$2.96	3,000,000
			3	\$3.24	4,000,000

3.2.2 Savings from Efficient Plumbing Fixtures. Even though the Federal Energy Policy Act (FEPA) has mandated the manufacture and installation of efficient plumbing fixtures since 1994, there are still inefficient fixtures and appliances in use. Table 3.3 shows the potential savings from efficient fixtures.

TABLE 3.3

Potential Water Savings

Fixture*	Fixture Capacity	WATER USE (gpd)		WATER SAVINGS (gpd)	
		Per Capita	Per Household**	Per Capita	Per Household**
<i>Toilets***</i>					
Efficient	1.5 gal/flush	6.0	16.2	N/A	N/A

Section 3 – Conservation Incentives

Low-Flow	3.5 gal/flush	14.0	37.8	8.0	21.6
Conventional	5.5 gal/flush	22.0	59.4	16.0	43.2
Conventional	7.0 gal/flush	28.0	75.6	22.0	59.4
Showerheads†§					
Efficient	2.5 [1.7] gal/min	8.2	22.1	N/A	N/A
Low-Flow	3.0 to 5.0 [2.6] gal/min	12.5	33.8	4.3	11.7
Conventional	5.0 to 8.0 gal/min	16.3	44.0	8.1	22.0
Faucets†§					
Efficient	2.5 [1.7] gal/min	6.8	18.4	N/A	N/A
Low-Flow	3.0 [2.0] gal/min	8.0	21.6	1.2	3.2
Conventional	3.0 to 7.0 gal/min	13.2	36.6	6.4	17.2
Fixtures Combined					
Efficient	N/A	21.0	56.7	N/A	N/A
Low-Flow	N/A	34.5	93.2	13.4	36.4
Conventional	N/A	54.5	147.2	33.5	90.4

Source: Amy Vickers, "Water Use Efficiency Standards for Plumbing Fixtures: Benefits of National Legislation", *American Water Works Association Journal*, Vol 82 (May 1990): 53

*Efficient = post-1994, Low-Flow = post-1980, Conventional = pre-1980; **Assumes 2.7 persons per household.

***Assumes four flushes per person per day. Does not include losses through leakage.

†For showerheads and faucets: maximum rated fixture capacity [measured fixture capacity]. Measured capacity equals about 2/3 the maximum.

§Assumes 4.8 shower-use-minutes per person per day and 4.0 faucet-use-minutes per person per day.

The potential savings shown in table 3.3 could make a plumbing retrofit program feasible.

3.3 Regulatory Conservation Incentives

3.3.1 Codes and Ordinances. The landscape code for the MVWD service area is found in the Clark County Unified Development Code (Title 30), Chapter 30.64. The code is called "Site Landscape and Screening Standards" and is known as the landscape development code. It includes an extensive plant list which is included in Appendix C.

Currently there are no golf courses in the MVWD service area but it is likely that at least one will be constructed in the near future. Prior to construction a code requiring use of treated effluent for golf course irrigation should be established.

Clark County has adopted the SNWA Drought Plan. Although the drought declaration triggers in the plan apply specifically to the Las Vegas area (see section 1.2), the measures included in the plan can be implemented anywhere in Clark county. Section 1.2 discusses the MVWD goal regarding drought declaration.

END OF SECTION

SECTION 4 – CONSERVATION MEASURES

This section describes current and planned conservation measures within the MVWD service area. A conservation measure is a device or practice that reduces water consumption. Conservation measures are divided into two fundamental categories; 1. Hardware or equipment and, 2. Behavior or management practices. Examples of hardware measures include low-volume toilets and irrigation rain sensors. Examples of behavioral measures include not using the toilet as a trash can and watering lawn less frequently.

Some conservation measures are mandated by state and/or federal laws and others are voluntarily implemented by local water purveyors and/or customers. This section describes both current MVWD conservation measures and those that the District plans to implement in the future.

4.1 Plumbing Standards

The most recent federal plumbing standards (table 4.1) are included here since these standards are applicable to the MVWD service area. It is valuable to include California's standards for reference since in most cases California's requirements are more stringent. The comparison infers that there are plumbing fixtures available that exceed federal efficiency requirements thereby offering consumers alternatives that maximize conservation efforts.

TABLE 4.1

Federal and California Plumbing Standards

Device	FEDERAL ENERGY POLICY ACT (FEPA)		CALIFORNIA	
	Manufacture	Effective Date	Sale and Installation	Effective Date
Shower Heads	2.5 gpm*	1/1/94	2.5 gpm	3/20/92
Lavatory Faucets	2.5 gpm	1/1/94	2.2 gpm	3/20/92
Sink Faucets	2.5 gpm	1/1/94	2.2 gpm	3/20/92
Metering Faucets	*	1/1/94	†	7/1/92
Tub Spout Diverters	Not included in FEPA		0.1 to 0.3‡	3/20/92
Residential Toilets	1.6 gpf	1/1/94	1.6gpf	3/20/92
Flushometer Valves	1.6 gpf§	1/1/97	1.6 gpf	1/1/92
Commercial Toilets	1.6 gpf	1/1/97	1.6 gpf	1/1/94
Urinals	1.0 gpf	1/1/94	1.0 gpf	1/1/92

* Gallons per minute.

** 0.25 gal/cycle (pertains to maximum water delivery per cycle).

† Hot water maximum flow rate range from 0.25 to 0.75 gal/cycle and/or from 0.5 gpm to 2.5 gpm, depending on controls and hot water system.

‡ 0.1 (new), to 0.3 gpm (after 15,000 cycles of diverting).

§ Gallons per flush.

4.2 MVWD Conservation Measures

4.2.1 MVWD Supervisory Control And Data Acquisition (SCADA). Although the SCADA system itself does not conserve water, it is a management tool that can be used to conserve. SCADA can be used to detect distribution system leaks and to regulate pressure. Pressure regulation can help to reduce the amount of water lost when leaks occur or when valves are left open. SCADA is considered a management practice conservation measure.

4.2.2 Training. MVWD is planning to have two service personnel trained in conservation. The training will be done by the AWWA with the goal that both employees will become AWWA conservation certified. This is a management practice measure.

- 4.2.3 Wastewater Reuse. Currently the sewer ponds in Overton, Nevada have an average inflow of .201 million gallons per day. MVWD is working with the Clark County Water Reclamation District on a proposed project to build a wastewater treatment plant in order to reuse the approximately 200,000 gallons per day of wastewater. The treated effluent could be used to irrigate public parks, landscaping around public buildings, construction projects, and golf courses (there are currently no golf courses in the MVWD area but there soon will be).
- 4.2.4 Meter Calibration Program. MVWD has a meter calibration program that includes periodic testing of meters within the service area. The service area has been divided into four routes. The program is progressing slowly but steadily since calibration takes approximately fifteen minutes per meter.
- 4.2.5 Bowman Reservoir Surface Water Treatment Project. Per an April 2005 Water Treatment Evaluation done by Black and Veatch, MVWD is “evaluating the use of Bowman Reservoir as a viable source of potable water supply”. The use of water from the reservoir would require that it be treated.
- 4.2.6 Leak Detection and Repair. The detection and repair of leaks is an ongoing measure for MVWD and the district has put great effort into the maintenance of the delivery system. As part of its effort to find leaks, MVWD commissioned a survey by Utilities Services Associates in November 2001. The survey detected only one leak and it was repaired. As a result of the survey it was determined that the most cost effective way for water systems this size to find leaks is through customer notification and field observation by MVWD personnel.
- 4.2.7 Drought Measures. Nevada Statutes chapter 477 section 3 item 14 states that MVWD has the power “To restrict the use of district water during any emergency caused by drought...”. Clark County has adopted the SNWA drought plan. The plan includes measures for residential, commercial, industrial, and institutional water use. It also contains specific factors that trigger drought declarations in the Las Vegas area (see section 1.2) but don’t apply to MVWD. However the drought measures in the plan are applicable to the MVWD and that part of the plan can be applied within the District. A copy of the SNWA/Clark County Drought Plan is included in Appendix D.

4.3 Consumer Conservation Measures

- 4.3.1 Sub-metering. Sub-meters are meters installed in the main water lines that enter the individual units of multi-family properties (apartments, condominiums, duplexes, etc...) and/or subdivided areas of commercial, industrial, or institutional (ICI) facilities. Traditionally such properties and facilities were built with one master meter that served the entire complex or facility. Sub-meters can be used as a measure that property or company owners can use to conserve water and cut costs. Submetering has the following basic advantages:

- Decrease in overall water consumption of 18% to 39%¹
- Fair allocation of water costs to residents.
- Potential increase in property owners net operating income.
- Increase in water use efficiency
- Proper allocation of water costs within ICI operations

¹ *Submetering, RUBS, and Water Conservation*, prepared for the National Apartment Association and the National Multi Housing Council by Industrial Economics Incorporated, June 1999.

In residential applications, sub-meters can reduce consumption by making the individual users responsible for their own water bill. When water use by multi-family units is measured by a single meter, leaks in individual units often go undetected. Measuring the consumption of each unit may also discourage waste.

In ICI applications separate meters can be used for individual processes thereby encouraging use efficiency. Landscape irrigation can be monitored separately from facility use. In institutions such as

universities, water costs can be directed to the departments that use the water. Manufactures can cut costs and determine which processes or equipment needs to be improved or replaced.

There are some disadvantages to sub-metering. Retrofits may be expensive and may prove to be economically unfeasible. Also some of the financial incentive for landlords to install conservation devices (low-volume toilets and low-flow fixtures) is removed. These shortcomings however are not present in new construction. Whether new construction or retrofit, consideration should be given to both conservation and cost.

- 4.3.2 General Consumer Conservation Measures. Consumer residential, landscape, industrial, commercial and institutional measures are included in Appendix B.

END OF SECTION

APPENDIX A – EDUCATIONAL MATERIALS

Read any good meters lately? Guide provides instruction for reading and interpreting meter information. It also teaches water customers how to measure the amount of water they use in different applications (see figure 3.1).

Yes, you can...fix a leaky faucet by yourself pamphlet gives step-by-step instructions on how to fix a leaking faucet. It includes a list of tools necessary to perform the repairs (see figure 3.2).

FIGURE A.1



FIGURE A.2



Preventing Floods and Leaks in Your Home emphasizes the importance of locating a master valve and discusses where it might be. It also deals with faucet, toilet, and hose leaks (see figure 3.3).

Disaster Preparedness, Storing Water for Emergencies addresses four important emergency questions; How much water should be stored, How long can tap water be stored safely, What is a boil water order, and How will I know when the water is safe again (see figure 3.4).

FIGURE A.3

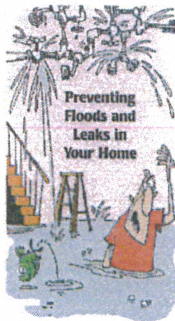


FIGURE A.4



25 Facts About Water is a list of 25 water facts that encourage conservation (see figure 3.5).

FIGURE A.5



FIGURE A.6



Lets Learn About the Water Cycle diagrams the seven stages of the water cycle (see figure 3.6).

FIGURE A.7



FIGURE A.8



Its a Natural makes suggestions regarding landscape including planning, design, soils, and irrigation (see figure 3.7).

Water Conservation at Home discusses in-home conservation practices for bathroom, kitchen, and outdoor water use (see figure 3.8).

55 Facts Figures & Follies of Water Conservation is similar to "25 Facts about Water" but it provides a bit more information (see figure 3.9).

FIGURE A.9

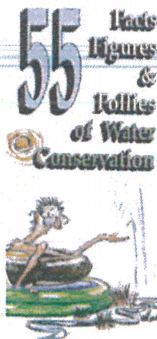


FIGURE A.10



In addition to the above mentioned AWWA publications, MVWD distributes three University of Nevada Cooperative Extension Fact Sheets. Fact Sheet 90-09 "Making a Little Water Go a Long Way in Your Home" contains residential conservation tips (see figure 3.10), Fact Sheet 90-40 "Watering Tips to Beat the Drain on the Southwest's Water Supply" provides tips to make landscapes more water efficient (see figure 3.11) and Fact Sheet 91-32 is a list of low water-use plants for southern Nevada (see figure 3.12).

FIGURE A.11

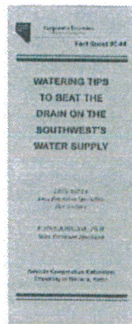


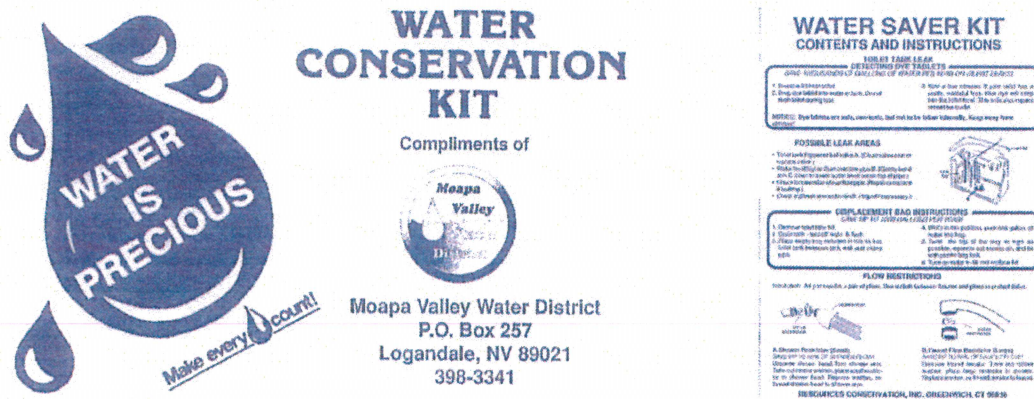
FIGURE A.12



3.1.2 Conservation Kit. Along with literature MVWD distributes free conservation kits. These kits contain leak detecting dye tablets, shower and faucet head flow restrictors, and a toilet tank displacement bag (see figure 3.13). A sample kit is included in Appendix A.

FIGURE A.13

MVWD Conservation Kit



APPENDIX B – CONSERVATION MEASURES

B.1 RESIDENTIAL CONSERVATION MEASURES

B.1.1 Behavioral Measures

B.1.1.1 Residential Water Audits. Water audits could target high use customers first and then be offered to all customers. The following elements should be part of an effective audit.

- Purpose for the audit.
- Estimation of use for all fixtures and appliances.
- Check for and repair leaks.
- Evaluation of Landscape (See "Landscape Conservation Measures")
- Evaluation of outdoor water use.
- Evaluate efficiency measures.
- Educate customers using available flyers

An audit should take no more than 30 to 45 minutes.

B.1.1.2 Additional Measures. The sample pamphlets in Appendix A include additional behavioral conservation measures.

B.1.2 Hardware/Equipment Measures

The following is a list of devices/practices that will reduce water consumption in the home.

Measure	Description
<i>Bathroom/Kitchen Fixtures</i>	
Low-flow toilets	1.6 gallons per flush
Toilet retrofit devices	Bladders (bags), dams, early close flappers, other hardware and adjustments
Toilet leak repairs	Includes detection (dye tabs) and replacement of worn parts.
Low-volume shower heads	2.5 gallons per minute @ 80 psi
Showerhead retrofit devices	Includes temporary cutoff valves and restrictors.
Low-volume faucets	2.5 gallons per minute @ 80 psi
Faucet retrofit devices	Includes aerators, activation sensors, self closing and metered valves
Faucet maintenance	Includes washer replacement, repacking, tightening, and cleaning aerators
Water pressure reduction	Only needed if house pressure exceeds what's required
<i>High Efficiency Appliances</i>	
Clothes washers	27 gallons per load
Dish washers	4.5 gallons per load

B.2 LANDSCAPE CONSERVATION MEASURES

B.2.1 Behavioral Measures

B.2.1.1 Landscape Water Audits. Landscape water audits should be conducted on park and golf course irrigation systems and could be considered an option on residential irrigation systems, targeting high-volume users.

- Purpose for the audit.
- Estimation of outdoor use based on meter records.
- Check for and repair leaks.
- Evaluation of Landscape (size, soil, amount of turf, types of plants)
- Evaluation of irrigation system (Timers, Use of drip, Precipitation amounts).
- Efficiency recommendations.
- Educate customers using available flyers

A residential landscape audit should take no more than an hour. Parks and golf courses could take substantially longer.

B.2.1.2 Xeriscape™. Xeriscape is a method of landscaping that employs low-water use plants, turf, ground covers, shrubs and trees. It includes careful planning, soil analysis, and irrigation system design.

B.1.1.3 Additional Measures. The sample pamphlets in Appendix A include additional behavioral conservation measures.

B.2.2 Hardware/Equipment Measures

Landscape hardware measures consist of two basic groups: (1) Landscape materials and (2) irrigation equipment.

Measure	Description
<i>Landscape Materials</i>	
Trees, plants, and grass	Should be well suited to climate and altitude and be drought tolerant
Organic mulch	Grass clippings, leaves, wood chips, bark, and pine needles. Organic mulches help to retain soil moisture and keep ground cool around plants.
Inorganic mulch	Boulders, gravel, pavers, decomposed granite, and stepping stones. Inorganic mulches are generally more for decorative purposes but they reduce the amount of trees, plants, and turf thereby conserving water.
Compost	Made of manure or biosolids and wood, straw, grass, and leaves. Helps plants stay healthy and retains moisture in the soil.
<i>Irrigation Equipment</i>	
Valves	Should be sized to meet requirements and checked periodically for leaks
Sprinkler Heads	Should match water volume requirements of area being irrigated.
Sprinkler Nozzles	Should have proper arc of coverage and proper trajectory.
Irrigation Controllers	Should have required number of stations, programs, and starts. Also rain delays and sensor terminals.
Drip irrigation	Insures water is directed to where it's needed.

B.3 INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL (ICI) CONSERVATION MEASURES

B.3.1 Behavioral and Hardware/Equipment Measures

B.3.1.1 ICI Water Audits. Since ICI water audits can require a substantial amount of time (4 hours or more), it may be necessary to have a private engineering firm hired by the water user conduct the audit. There is incentive for ICI customers to pay for audits since the results of an audit could translate into substantial savings. An ICI water audit should include the following elements:

- Support from ICI owners, managers, and employees
- Survey/Estimation of facility use based on meter records.
- Calculation of water-related costs.
- Evaluation of efficiency measures.
- Evaluation of payback periods for measures.
- Efficiency recommendations and implementation.
- Tracking and reporting system.

B.3.1.2 Manual Washing. Manual washing is cleaning done on surfaces with hoses and cloths.

MANUAL WASHING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none">• Surfaces should be swept or brushed off before using water to clean.	<ul style="list-style-type: none">• High pressure low-volume hoses with automatic shut-off nozzles• High-pressure pumps, steam cleaners.

B.3.1.3 Vehicle Washing. Vehicle washing includes manual washing and automated car washes or a combination of both.

VEHICLE WASHING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none">• Limit number of spray nozzles and set flow rates at lowest volume and pressure required.• Adjust nozzles in automated systems so that they take full advantage of gravity and position. Also make sure water shuts off after vehicles have passed.• Increase conveyor speeds or reduce rinse cycle time.• Sweep wash area before using water to clean.• Establish a regular maintenance schedule that includes checking for leaks and making repairs.	<ul style="list-style-type: none">• Recycling systems. These would include filters and storage tanks.• High pressure pumping systems.

B.3.1.4 Kitchens and Restaurants. Kitchen and restaurant conservation is divided into four areas of application; 1. Food and drink preparation, 2. Dishwashing, 3. Garbage disposal and scraping trough, and 4. Ice making.

FOOD AND DRINK PREPARATION

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Presoak and wash food service articles in basins instead of running water. • Reduce thawing of food with hot water unless required by law. If required use lower flow. • Avoid running water to melt ice in sinks. • Use full loads in dishwashers and other automated equipment. • Serve water only when requested by customers. 	<ul style="list-style-type: none"> • Low-volume faucets • Hands-free foot pedal valves for faucets • On demand hot water dispensers

DISHWASHING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Presoak utensils, dishes, and pots and pans in basins of water instead of using running water prior to loading dishwashing machines. • Scrape food off of plates rather than use running water. • Operate scraping troughs only while dishes are actually being washed. • Assess the water efficiency of the current dishwashing system to determine where improvements might be made. • Always wash full loads in automated machines. • Operate conveyor type dishwashers only when dishes are actually passing through the machine. • Verify that the dishwashing equipment is using the minimum amount of flow recommended by the manufacturer. • Since many older automated dishwashing systems are neither energy nor water efficient, evaluate the cost of retrofitting or replacing existing equipment. • Turn dishwashers off when not in use. • Routinely check all dishwashing equipment to ensure there are no leaks. • Post signs requesting that personnel minimize their use of utensils, dishes, and pots and pans to save water. 	<ul style="list-style-type: none"> • Manual pre-wash sprayers with "dead man" shut off controls. • Low-flow spray heads on all sprayers. • New water efficient dishwashing equipment. • Electronic eye sensors that shut off conveyer type systems when dishes are not passing through the machine.

GARBAGE DISPOSER AND SCRAPING TROUGH

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Eliminate disposers and troughs. • Use the minimum acceptable flow rate on all machines. • Reuse wastewater in the mixing chamber of the disposer. 	<ul style="list-style-type: none"> • Garbage strainers (instead of disposers) • Sensors that detect the amount of flow in a disposer and regulate flow accordingly. • Solenoid valves that turn water off when the disposer is off. • Flow regulators for disposer supply lines.

ICE MAKERS

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Use the minimum flow rate recommended by the manufacturer on water cooled icemakers. • Adjust machines to produce ice only when it's needed. <p>Collect spent cooling water and reuse it for non-potable purposes.</p>	<ul style="list-style-type: none"> • Air-cooled icemakers. • Re-circulating systems for water-cooled icemakers. • Ice flake machines that use less bleed off than cube machines.

B.3.1.5 Laundries and Laundromats. This section includes measures that are applicable in hotels, motels, hospitals, nursing homes, diaper services, restaurants, and coin operated Laundromats.

LAUNDRIES AND LAUNDROMATS

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Operate equipment with full loads only. • Reduce water levels for partial loads. • Back flush filters or softeners only when necessary. 	<ul style="list-style-type: none"> • Computer controlled rinse water reclamation systems. • Wash and rinse water treatment and reclamation systems. • Continuous batch washers. • Ozone laundry systems. • Horizontal axis washers.

B.3.1.6 Swimming Pools. The measures in this section can be applied to commercial and residential swimming pools.

SWIMMING POOLS

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> • Limit the frequency of pool refilling. • Cover the pool with an insulated cover when not in use to reduce losses due to heat and evaporation. • Reduce the level of the pool to avoid losses due to splashing. • Lower the pool temperature. • Back wash filters only when necessary. If backwash is timed, verify that frequency is efficient. • Regularly check pool for leaks and cracks. Keep pool and filter clean to avoid unnecessary backwashing. 	<p>There are no special equipment measures that would help conserve water in pools. It is important however that available equipment is efficient and used properly.</p>

B.3.1.7 Cooling Systems. This section includes measures for three types of cooling systems: 1. Single-pass, 2. Evaporative, and 3. Equipment. Single-pass cooling uses fresh water to cool without re-circulating any of the water used in the first pass. Evaporative coolers are used for cooling in commercial and residential applications and are commonly known as swamp coolers. Equipment cooling includes both single-pass and re-circulating systems that are used to cool equipment and machinery.

SINGLE-PASS COOLING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> Reuse water for landscaping, vehicle washing, or another cooling application that allows for water to be at a higher temperature. Eliminate single-pass systems. 	<ul style="list-style-type: none"> Air-cooled equipment (i.e. compressors, pumps, icemakers, etc...) Automatic controls that insure coolers only operate when needed.

EVAPORATIVE COOLING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> Regularly check for leaks in hoses and pan. Replace pads at least annually. Shut cooler off when building is unoccupied. Annually service the equipment by oiling moving parts and cleaning off accumulated scale or corrosion. 	<p>There are currently no equipment measures for evaporative coolers. The design of the coolers is relatively simple.</p>

EQUIPMENT COOLING

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> Reuse water in single pass systems for other cooling purposes. Examples of reuse include cooling molten materials, landscape, or boiler make-up water. Replace all single pass cooling systems with closed-loop systems or replace water-cooled equipment with air-cooled. 	

B.3.1.8 Heating Systems. This section deals with conservation measures for boilers and steam generators which are used to heat large buildings and multiple-building facilities.

HEATING SYSTEMS

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> Regularly inspect systems for leaks and make repairs. Insulate all piping. Limit boiler bleed-off to a level that satisfies water quality requirements. Discharge blow-down into an expansion tank instead of using cold water to cool it. 	<ul style="list-style-type: none"> Flow meters for make-up and blow-down valves. Automatic controls to discharge blow-down.

B.3.1.9 Leaks and Water Losses. This section covers water conservation measures relating to leaks and losses.

LEAKS AND WATER LOSSES

Behavioral Measures	Hardware/Equipment Measures
<ul style="list-style-type: none"> Regularly check for leaks at all water connections. Keep in mind that higher pressure applications have more incidence of leakage. Regularly check all vessels that contain water for cracks or bad seals. Regularly check all heating and cooling systems. Repair any leaks that are discovered. 	<ul style="list-style-type: none"> Leak detection equipment. This could include sonic or probe type equipment. Any equipment used to stop a leak. This would depend on the material of the pipe or vessel that has a leak.

B.3.1.10 ICI Maintenance Practices. This section reemphasizes maintenance conservation measures for ICI facilities that have been mentioned in previous sections. These measures should become standard procedure at all ICI facilities.

- Create a maintenance schedule that includes schedules for leak detection inspections and meter reading, and repair procedures.
- Monitor water-use records keeping track of any increases or decreases in use.
- Conduct water audits every one to three years.
- Shut off supply lines to areas that are not being used.
- Install pressure reducers where feasible.
- Keep a maintenance schedule to clean cooling and heating equipment regularly.
- Recycle and reuse water when feasible.
- Insulate all hot water pipes.
- Replace old equipment with water saving equipment.
- Install timers wherever possible.
- Educate employees on water saving techniques.

B.4 General Residential Behavioral Measures

This list of conservation behaviors and is divided into four parts: Home, Landscaping, Community, and Miscellaneous.

HOME BEHAVIORS

- When washing dishes by hand, don't let the water run while rinsing. Fill one sink with wash water and the other with rinse water.
- Evaporative coolers require a seasonal maintenance checkup. For more efficient cooling, check your evaporative cooler annually.
- Run your washing machine and dishwasher only when they are full and you could save 1000 gallons a month.
- Use the garbage disposal sparingly. Compost instead and save gallons every time.
- Keep a pitcher of water in the refrigerator instead of running the tap for cold drinks, so that every drop goes down you not the drain.
- Check your water meter and bill to track your water usage.

7. Wash your produce in the sink or a pan that is partially filled with water instead of running water from the tap.
8. Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.
9. If your shower can fill a one-gallon bucket in less than 20 seconds, then replace it with a water efficient showerhead.
10. Collect the water you use for rinsing produce and reuse it to water houseplants.
11. We're more likely to notice leaky faucets indoors, but don't forget to check outdoor faucets, pipes, and hoses for leaks.
12. When you shop for a new appliance, consider one offering cycle and load size adjustments. They are more water and energy-efficient than older appliances.
13. Time your shower to keep it under 5 minutes. You'll save up to 1000 gallons a month.
14. Install low-volume toilets.
15. When you clean your fish tank, use the water you've drained on your plants. The water is rich in nitrogen and phosphorus, providing you with a free and effective fertilizer.
16. Put food coloring in your toilet tank. If it seeps into the toilet bowl, you have a leak. It's easy to fix, and you can save more than 600 gallons a month.
17. Plug the bathtub before turning the water on, and then adjust the temperature as the tub fills up.
18. Designate one glass for your drinking water each day. This will cut down on the number of times you run your dishwasher.
19. Don't use running water to thaw food.
20. Grab a wrench and fix that leaky faucet. It's simple, inexpensive, and can save 140 gallons a week.
21. When doing laundry, match the water level to the size of the load.
22. Teach your children to turn the faucets off tightly after each use.
23. Before you lather up, install a low-flow showerhead. They're inexpensive, easy to install, and can save your family more than 500 gallons a week.
24. Soak your pots and pans instead of letting the water run while you scrape them clean.
25. Make sure you know where your master water shut-off valve is located. This could save gallons of water and damage to your home if a pipe were to burst.
26. Turn off the water while you brush your teeth and save 4 gallons a minute. That's 200 gallons a week for a family of four.
27. Make sure your toilet flapper doesn't stick open after flushing.
28. Make sure there are aerators on all of your faucets.
29. Install an instant water heater on your kitchen sink so you don't have to let the water run while it heats up. This will also reduce heating costs for your household.

30. Cut back on rinsing if your dishwasher is new. Newer models clean more thoroughly than older ones.
31. Bathe your young children together.
32. Winterize outdoor spigots when temps dip to 20 degrees F to prevent pipes from bursting or freezing.
33. Insulate hot water pipes so you don't have to run as much water to get hot water to the faucet.
34. Drop that tissue in the trash instead of flushing it and save gallons every time.
35. If your toilet was installed prior to 1980, place a toilet dam or bottle filled with water in your toilet tank to cut down on the amount of water used for each flush. Be sure these devices do not interfere with operating parts.
36. Install water softening systems only when necessary. Save water and salt by running the minimum number of regenerations necessary to maintain water softness.
37. Wash clothes only when you have a full load and save up to 600 gallons each month.
38. Listen for dripping faucets and toilets that flush themselves. Fixing a leak can save 500 gallons each month.
39. Cook food in as little water as possible. This will also retain more of the nutrients.
40. Turn the water off while you shampoo and condition your hair and you can save more than 50 gallons a week.
41. Choose new water-saving appliances, like washing machines that save up to 20 gallons per load.
42. Select the proper size pans for cooking. Large pans require more cooking water than may be necessary.
43. Turn off the water while you shave and you can save more than 100 gallons a week.
44. If you accidentally drop ice cubes when filling your glass from the freezer, don't throw them in the sink. Drop them in a house plant instead.
45. To save water and time, consider washing your face or brushing your teeth while in the shower.
46. For hanging baskets, planters and pots, place ice cubes under the moss or dirt to give your plants a cool drink of water and help eliminate water overflow.
47. Throw trimmings and peelings from fruits and vegetables into your yard compost to prevent from using the garbage disposal.
48. Keep a bucket in the shower to catch water as it warms up or runs. Use this water to flush toilets or water plants.
49. When you are washing your hands, don't let the water run while you lather.
50. Pre-treat stains before washing clothes to avoid re-washing.
51. Use the shortest wash cycle for lightly soil cloths.
52. Check washing machine hoses regularly for leaks.
53. Do not pre-rinse dishes except in cases of sticky or burn-on food.

54. Scrape off food with a utensil or used paper napkin when pre-cleaning for dishwasher.

LANDSCAPE BEHAVIORS

1. Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.
2. Avoid planting turf in areas that are hard to water such as steep inclines and isolated strips along sidewalks and driveways.
3. Plant during the spring or fall when the watering requirements are lower.
4. Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.
5. Use a layer of organic mulch around plants to reduce evaporation and save hundreds of gallons of water a year.
6. Divide your watering cycle into shorter periods to reduce runoff and allow for better absorption every time you water.
7. Only water your lawn when needed. You can tell this by simply walking across your lawn. If you leave footprints, it's time to water.
8. Adjust your lawn mower to a higher setting. Longer grass shades root systems and holds soil moisture better than a closely clipped lawn.
9. Use the sprinkler for larger areas of grass. Water small patches by hand to avoid waste.
10. Use porous materials for walkways and patios to keep water in your yard and prevent wasteful runoff.
11. Direct downspouts and other runoff towards shrubs and trees, or collect and use for your garden.
12. Install a rain shut-off device on your automatic sprinklers to eliminate unnecessary watering.
13. Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.
14. Reduce the amount of grass in your yard by planting shrubs and ground cover with rock and granite mulching.
15. Remember to check your sprinkler system valves periodically for leaks and keep the heads in good shape.
16. Don't water your lawn on windy days. After all, sidewalks and driveways don't need water.
17. Water your plants deeply but less frequently to create healthier and stronger landscapes.
18. When watering grass on steep slopes, use a soaker hose to prevent wasteful runoff.
19. Group plants with the same watering needs together to get the most out of your watering time.
20. Remember to weed your lawn and garden regularly. Weeds compete with other plants for nutrients, light, and water.
21. While fertilizers promote plant growth, they also increase water consumption. Apply the minimum amount of fertilizer needed.

22. Avoid installing ornamental water features and fountains that spray water into the air. Trickling or cascading fountains lose less water to evaporation.
23. Buy a rain gauge to track how much rain or irrigation your yard receives. Check with your local water agency to see how much rain is needed to skip an irrigation cycle.
24. Teach your family how to shut off your automatic watering systems. Turn sprinklers off if the system is malfunctioning or when a storm is approaching.
25. Set a kitchen timer when watering your lawn or garden with a hose.
26. Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.
27. Use a screwdriver as a soil probe to test soil moisture. If it goes in easily, don't water. Proper lawn watering can save thousands of gallons of water annually.
28. Avoid over-seeding your lawn with winter grass. Once established, ryegrass needs water every three to five days, whereas dormant Bermuda grass needs water only once a month.
29. Landscape with Xeriscape trees, plants and groundcovers. Call your local conservation office for more information about these water thrifty plants.
30. If you have an evaporative cooler, direct the water drain to a flowerbed, tree, or your lawn.
31. Leave lower branches on trees and shrubs and allow leaf litter to accumulate on top of the soil. This keeps the soil cooler and reduces evaporation.
32. Start a compost pile. Using compost when you plant adds water-holding organic matter to the soil.
33. Use sprinklers that throw big drops of water close to the ground. Smaller drops of water and mist often evaporate before they hit the ground.
34. More plants die from over-watering than from under-watering. Be sure only to water plants when necessary.
35. Water only as rapidly as the soil can absorb the water.
36. Aerate your lawn. Punch holes in your lawn about six inches apart so water will reach the roots rather than run off the surface.
37. When you give your pet fresh water, don't throw the old water down the drain. Use it to water your trees or shrubs.

COMMUNITY BEHAVIORS

1. Encourage your school system and local government to help develop and promote a water conservation ethic among children and adults.
2. Make suggestions to your employer to save water (and dollars) at work.
3. Support projects that use reclaimed wastewater for irrigation and other uses.
4. Encourage your friends and neighbors to be part of a water-conscious community.
5. Pick-up the phone and report significant water losses from broken pipes, open hydrants and errant sprinklers to the property owner or your water management district.

MISCELLANEOUS BEHAVIORS

1. Install covers on pools and spas and check for leaks around your pumps.
2. Periodically check your pool for leaks if you have an automatic refilling device.
3. Use a commercial car wash that recycles water.
4. Don't buy recreational water toys that require a constant flow of water.
5. Use a grease pencil to mark the water level of your pool at the skimmer. Check the mark 24 hours later. Your pool should lose no more than ¼ inch each day.
6. When the kids want to cool off, use the sprinkler in an area where your lawn needs it the most.
7. Make sure your swimming pools, fountains, and ponds are equipped with re-circulating pumps.
8. Wash your car on the grass. This will water your lawn at the same time.
9. Bathe your pets outdoors in an area in need of water.
10. While staying in a hotel or even at home, consider reusing your towels.
11. When backwashing your pool, consider using the water on your landscaping.
12. When you have ice left in your cup from a take-out restaurant, don't throw it in the trash, dump it on a plant.

APPENDIX C – LANDSCAPE CODE

30.64 Site Landscape and Screening Standards

30.64.010 Purpose. The purpose of requiring landscaping and screening is to:

1. Improve the quality of air and discourage plant material that is high in pollen production.
2. Promote the visual image desired by the community through the use of low water, climate adaptable plant materials.
3. Increase the compatibility of adjacent uses and minimize the harmful impacts of differing uses by providing alternative buffering standards which will act as a visual barrier. The buffering standards will also provide justification and mitigation for waivers to the design standards required elsewhere within this Title.
4. Reduce dust, noise, glare and heat; assist in wind control; and minimize water runoff onto streets.
5. Conserve natural resources, including water, in conformance with the Water Conservation Plan and/or Drought Plan developed by the Southern Nevada Water Authority. (Ord. 2934 § 6, 8/2003; Ord. 2741 § 12 (part), 5/2002)

30.64.020 Fences and Walls. Perimeter fences and walls are permitted and/or required in accordance with the provisions of this section. An additional one foot of decorative embellishment is permitted on each wall.

1. **When Permitted.** Unless otherwise specified in Tables 30.64-1 and 30.64-2, fences and walls not required (but permitted) shall comply with this subsection (1). However, when constructed in conjunction with a retaining wall, the specified maximum wall height may be increased to include the height of the retaining wall up to a maximum of twelve feet (12'), subject to compliance with 30.64.050(4), unless otherwise specified in the Chapter. Security fences are permitted in conjunction with Temporary Government Facilities in any zoning district, subject to the requirements for security fences in 30.08.030 and Table 30.64-2.
 - A. **Single Family Residential Development and Multi-family Buildings not within a dwelling group.** Fences and walls may be up to six (6) feet in height except if within fifteen (15) feet of the front property line or private street/easement (see Table 30.64-1 for front yard restrictions). Fences or walls which meet the setbacks for accessory buildings shall conform to accessory building height restrictions.
 - B. **Multiple Family Dwelling Group Development.** Fences and walls shall be a maximum of six (6) feet high, shall be decorative if in the urban area, and shall be set back for landscaping along streets as required in Table 30.64-2 below.
 - C. **Commercial and Special Development.** Fences and walls over three feet in height are not permitted within required street setbacks (10 foot minimum) unless required to buffer adjacent uses as approved by the Commission or Board. Any fence or wall within the street setback shall be decorative. Congregate care, independent and assisted living, major school, and recreational facilities may have fences and walls within street setbacks subject to approval by the Commission or Board. Fences or walls within side and rear setbacks not adjacent to a street nor on the property line shall not exceed six (6) feet in height.
 - D. **Industrial Development.** Fences and walls, including security fences and walls, are permitted at a ten (10) foot maximum height around the perimeter of the development within the required setback when fence or wall is set back for required landscaping along streets. The maximum height may be increased up to thirteen (13) feet to accommodate additional height needed for retaining walls.

E. **Vacant Property.** Temporary fences may be constructed on vacant property, subject to the height restrictions above, in order to control access and dust, and to prevent the dumping of refuse. Walls within subdivided lots may be constructed per the requirements for walls within the district.

F. **Hillside Walls.** Walls within hillside developments shall comply with the following.

- i. Walls shall conform to the topography of the site.
- ii. To the greatest extent practical, walls shall incorporate the use of graduating steps.
- iii. Walls shall either incorporate the use of native materials or be earth tone colors to match the native soils and rocks.
- iv. The use of decorative fences is encouraged around side and rear yards.
- v. Decorative fences only shall be allowed around natural areas.
- vi. The maximum cumulative height of a series of retaining walls is thirty-six (36) feet where for each nine (9) feet of vertical height, a six (6) foot horizontal offset shall be provided, and where anything over nine (9) feet must be a decorative fence. (See Figure 30.64-1)

2. **Required.** Fences and walls are only required when shown in Tables 30.64-1 and 30.64-2.

3. **Redundant Walls.** This section establishes the general policy of not requiring redundant walls in close proximity to each other that could cause unsafe or unhealthful conditions, such as gaps which collect trash and/or trap animals and/or people. A redundant wall is not required when the adjacent property owner agrees that the existing wall will serve as an adequate buffer, even if the existing wall is less than six (6) feet in height, subject to a notarized letter of consent. Otherwise, a six (6) foot high redundant wall shall be constructed as a buffer when required. The separation between the walls shall be four (4) inches or less or at least thirty (30) inches wide. The gap at the end of any redundant walls shall be secured with a see thru, locked gate which allows for access, visibility, and maintenance. The area between the walls shall be kept free of debris and weeds.

4. **Measurement of Fence or Wall Height.** The actual height of fences or walls must meet the minimum height requirement but may exceed the minimum height by up to 1 foot.

A. Where the finished grade line of a lot is above or below the finished grade line of an abutting lot or street, the finished grade shall be the point on the high side, except within the front yard of single-family residences, which shall be measured from the low side.

B. An additional one (1) foot for lighting and/or decorative features is allowed on top of columns.

5. **Gated Communities.** Developments with interior private streets or drives may restrict access to the development subject to the following:

A. Access gates shall be decorative and set back a minimum of 50 feet from the lip of gutter of the street intersecting the street or drive for stacking of vehicles.

B. Egress gates shall be set back a minimum of 20 feet from the lip of gutter of the street intersecting the street or drive.

- C. Guard enclosures and/or related equipment shall be set back a minimum of 20 feet from the right-of-way line of the street intersecting the private street or drive, but need not conform to any other setback, and may be located within the private street.
- D. Access codes to the gates shall be provided to the Metropolitan Police Department and the Clark County Fire Department.
- E. Perimeter walls and gates enclosing the community are permitted up to eight feet in height, including within the front yards of lots facing the access control gates, or as permitted by 30.64.050(4) when constructed in conjunction with a retaining wall. (Ord. 3229 § 12 (part), 6/2005; Ord. 3209 § 10 (part), 5/2005; Ord. 2934 § 7, 8/2003; Ord. 2741 § 12 (part), 5/2002; Ord. 2573 § 14, (part) 2001)

Figure 30.64-1 Hillside Retaining Walls

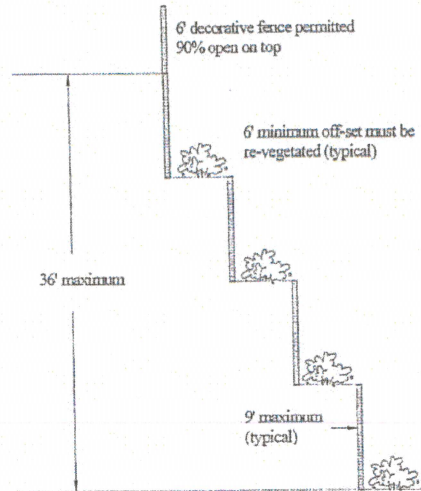
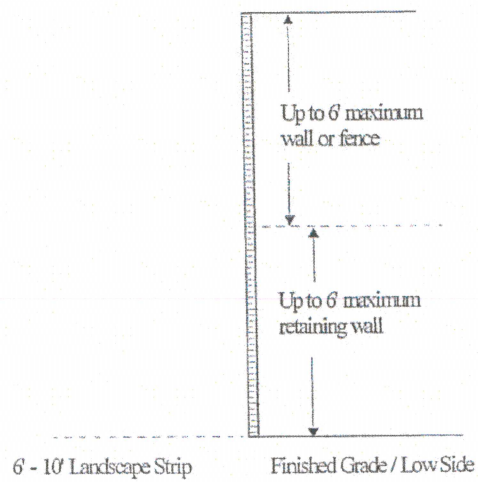


Figure 30.64-15 Retaining Walls



Notes:

1. 6' maximum height for wall and/or fence over retaining wall portion per 30.64.050(4)
2. A 6' to 10' landscape strip may be required per 30.64.050(4)

(Ord. 3209 § 11 (part), 3/2005)

30.64.030 Landscaping.

4.
 - a. **Landscaping Required.** Except for mines, gravel pits, temporary uses, public facilities without buildings, and the rear yards of single family dwellings, any disturbed area of a developed property not occupied by outside activity areas/storage areas, structures, parking, driveways, drive aisles, bus turnouts, and sidewalks shall be landscaped and maintained in a clean condition. Disturbed areas designated for future development need not have live landscaping.
5.
 - b. **Landscape Design Objectives.**
 - A. 1. Landscape plans shall incorporate water conserving design which includes appropriate soil, soil amendments to absorb and retain water and encourage the formation of deep root systems, mulch, drainage, and microclimates, and includes groupings of plants with similar water requirements on an irrigation line. Grading and hydrology should whenever possible be designed to maximize the use of storm water for on-site irrigation.
 - B. 2. The selection and orientation of plant material on the south and west sides of buildings is preferred to promote energy conservation and solar gains.
6.
 - c. **Live Landscaping.**
7.
 1. All required landscaping shall be planted with live plants, except as provided in subsection (a) above. For property which has an elevation of 4,000 feet above sea level or more, natural and native landscaping is encouraged to be preserved and included into landscape area.
 2. Trees shall not be planted within approximately three (3) feet of a dedicated right-of-way, public access easement, or public utility easement running parallel to a dedicated right-of-way.
 3. Any tree within 5' of a sidewalk, street, public utility easement adjacent to a street, or wall shall be planted with a root shield designed to redirect root growth.
 4. Efforts to keep and maintain existing drought-tolerant trees, especially if mature, are highly encouraged.
- d. **Maintenance.**
 - 1. Fences, walls and landscaped areas shall be maintained.
 - 2. Landscaped areas shall not be used for parking of vehicles, display of merchandise or other uses detrimental to the landscaping; however, signs are permitted per Chapter 30.72.
 - 3. Any required plant material that does not survive, or sustains severe damage, shall be replaced within ninety (90) days.
 - 4. Landscaping required outside decorative fences and walls shall be maintained through a maintenance agreement. Whenever a landscaping area is an easement or is located within a common lot, the easement or common lot shall be shown on any major or minor subdivision map. All areas specifically intended for landscaping purposes shall be shown on required improvement plans.
 - 5. If a sidewalk is established behind landscaping, or if the sidewalk meanders, a public access easement must be granted and the sidewalk and any landscaping shall be subject to the provision of a maintenance association and a license and maintenance agreement approved by the Department of Public Works.

- e. **Plant Materials.**

- 1. Except for single family residential development, all required plants shall consist of materials selected from the plant list in Appendix C, Plant Materials, and/or as recommended for local use by the Las Vegas Valley Water District's *Desert Demonstration Gardens Self-Guided Tour & Southern Nevada Plant List*, except that all cactus, and annual and perennial flowers, are permitted. If the genus is listed, all varieties of that genus are permitted, even if all common names are not listed, except where specifically prohibited. All stock shall conform to the standards listed in the "American Standards for Nursery Stock" as required by section 555.200 (Standards for Nursery Stock) of the Nevada Administrative Code. The use of plants listed in Appendix C, part 7, Allergenic Potential List, are discouraged. The following plants are expressly prohibited in all developments:

- - A. European Olive trees, all fruiting varieties;
 -
 - B. Fruitless Mulberry trees; and
 -
 - C. Any plant listed on the Nevada State Department of Agriculture's noxious weed list. As shown in Appendix C, Part 8.

- 2. An oasis is an area where non-drought tolerant landscaping designs are permitted. Plants not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Las Vegas Valley Water District's *Desert Demonstration Gardens Self-Guided Tour & Southern Nevada Plant List*, may be used in an oasis if they are grouped in separately programmed irrigation areas according to their water requirements providing that:

1. A. The area of the oasis shall not exceed one percent (1%) of the net area of the development;
2. B. The oasis is not located within the required street frontage landscaping.

- 3. Alternative plant materials may be approved by the Zoning Administrator by an administrative minor deviation per Table 30.16-8, where documentation is provided by the applicant from the State Department of Agriculture, the Las Vegas Valley Water District or a publication equal and acceptable to the Zoning Administrator indicating that the plant is drought tolerant and is not an invasive or noxious plant. (Ord. 2741 § 12 (part), 5/2002)

- f. **Irrigation.** A water conserving irrigation system is required for all landscaping. Drip or similar systems with no over spray shall be used when irrigating non-turf vegetation. Irrigation systems shall be maintained in good operating condition. The use of irrigation systems which utilize reclaimed wastewater is preferred, and required for golf courses as soon as a source of reclaimed wastewater is available. Restrictions for over spray shall not apply when water used will be provided by one or more of the following methods:

1. Water is provided for the applicant's own wells or appurtenant or transferred water right which can be legally used to irrigate the property on which a golf course is developed;
2. Water is provided by the water purveyor; however, the applicant must contribute to an exterior water efficiency retrofit program approved by the water purveyor to offset the impacts on water resources and system delivery capacity in an amount equivalent to two (2) times the amount of water used to irrigate turf.

3. Groundwater provided from the shallow aquifer. Applicant may develop and provide the groundwater at his/her sole cost, or may compensate the appropriate water district to develop ground water pursuant to an agreement with the district. The agreement must have been executed by both parties at the time of the application.
1.
 - g. **Swales.** Within landscape areas greater than six (6) feet in depth, a two (2) foot wide minimum swale shall be provided adjacent to sidewalks unless a perimeter fence or wall is constructed within two (2) feet of the sidewalk.
 - h. **Storm Water Detention/Retention Basins.** When provided, private on-site detention/retention basins which are not paved or riprapped shall be landscaped if in non-single family residential development to enhance the natural configuration of the basin. Grading, hydrology and landscape plans should be integrated to make maximum use of site storm water runoff for supplemental on-site irrigation purposes.
 - i. **Ground Cover.** Any portion of a landscape area not planted shall be covered with decorative rock, bark, mulch or other material suitable for reducing dust and evaporation, and improving the aesthetic appearance of the area. Non-porous materials should not be placed under the mulch where plants exist.
 - j. **Turf.** Turf limitations apply as follows:
 1. Development within subdivisions approved after July 1, 1992 shall not impose restrictions which require the use of turf in landscaping or which prevent the use of xeriscaping as an alternative to turf;
 2. The maximum slope of a turf area shall not exceed thirty-three percent (33%);
 3. Turf areas shall not be located within six (6) feet of a street, curb, paved surface other than a single-family residential driveway, or sidewalk if adjacent to a paved surface.
 4. Except within single family residential development, no area of turf shall have a width or depth less than ten (10) feet. This area may be less than ten (10) feet wide if adjacent to a planter bed or other landscape area which will catch overspray;
 5. The area of turf within multiple family dwelling groups and non-residential development, except for parks, cemeteries, and schools, shall not exceed 30% of the landscaped area within the development; and
 6. The area of turf within the front yard of single-family residential lots shall not exceed fifty percent (50%) of the net area of the front yard; and
 7. Golf courses, shall be limited to a maximum of 90 acres for 18 holes and 10 acres for a driving range;
 - A. The turf limitation of golf courses may be exceeded if the applicant demonstrates to the satisfaction of the water purveyor that irrigated turf, in excess of the amount specified, will have no significant impact on water resources or water peak demand delivery capacity, because water used for the additional turf will be provided by one or more of the following methods:
 - i. Water provided from applicant's own wells or appurtenant or transferred water rights which can be legally used to irrigate the property on which the golf course is developed;
 - ii. Water provided from the water purveyor. However, the applicant must contribute to an

exterior water efficiency retrofit program approved by the water purveyor to offset the impacts on water resources and system delivery capacity, in an amount equivalent to two (2) times the amount of water used by the turf grass;

- iii. Groundwater provided from the shallow groundwater aquifer. Applicant may develop and provide the ground water at his sole cost or may compensate the appropriate water district to develop ground water pursuant to an agreement with the district. The agreement must have been executed by both parties at the time of the application;

- B. The restrictions for turf area shall not apply to any property that is the subject of a development agreement between the county and the owner or former owner of the property; provided, the development agreement is in effect as of April 5, 2000 and at the time of commencement of construction of the golf course.

- k. **Required Trees.** Trees shall be planted as required in Tables 30.64-1 and 30.64-2, and as shown in Figures 30.64-4 through 30.64-14, if large fifteen (15) gallon trees are being planted. Trees located beneath or adjacent to overhead power lines are not required if the power company certifies that the landscape requirement poses a hazard. Unless otherwise specified by the Commission or Board, trees and alternative distances can be provided as follows:

1. One large tree (at maturity will be 40 feet or higher and have a minimum 20 foot spread) is required for each thirty linear feet of street or property line frontage.
2. One medium tree (at maturity will have a minimum 20 foot spread) is required for each twenty linear feet of street or property line frontage.
3. One small tree (at maturity will have a less than a 20 foot spread) is required for each ten linear feet of street or property line frontage.
4. These distances may be increased by ten (10) feet if twenty-four (24) inch box trees are planted instead of fifteen (15) gallon trees.
5. A variety of species and appropriate clustering of plants to provide a homogeneous buffering effect are encouraged within the landscape area.

- l. **Landscape Strip.**

1. Sidewalks, drive aisles, and driveways providing access from the street to and within the development are permitted within a landscape area or strip.
2. Except as required by Tables 30.64-1 and 30.64-2, sidewalks that encroach into landscaped areas (are offset from curb or meandering) may be provided subject to the following:
 - i. Sidewalks shall maintain a minimum three (3) foot offset from the curb and may then be located anywhere within the area between the curb offset and the front or side street setback unless otherwise specified within this Title or per the Director of Public Works.
 - ii. Areas between the sidewalk and the curb shall be landscaped.
 - iii. A landscape area as required shall be provided within the distance between the curb and the front setback, shall contain the quantity of plant materials as required per Figures 30.64-8, 30.64-9, 30.64-10 and/or 30.64-13, and shall abut the sidewalk.

- iv. The tree spacing may be increased by ten (10) feet.
 - v. If a sidewalk meanders or is installed behind landscaping (offset from curb), a public access easement must be granted.
 - vi. 5' by 5' wheelchair turnouts at 200' intervals are required if sidewalk is less than five feet (5') wide.
3. When dedication for bus turnouts is required, the landscape strip is not required adjacent to the bus turnouts.
- m. **Certificate of Compliance.** A Certificate of Compliance stating that landscape materials have been installed per this title shall be signed by the property owner or contractor and submitted to the Building Official.
- 1. Single family residences may be occupied prior to the landscaping being installed if the developer or property owner signs a Certificate of Compliance prior to the issuance of building permits stating that all required landscaping shall be installed within six (6) months of the date of the Certificate of Occupancy.
 - 2. Buildings other than single family residences may be occupied prior to the landscaping being installed; however, the required landscaping shall be installed prior to final Certificate of Occupancy.
 - 3. If drought restrictions established by this Title prohibit the planting of landscaping during specified months, the required landscaping need not be installed until 60 days following the date from which planting is permitted to resume. (Ord. 3094 § 3, 7/2004; Ord. 3062 § 4, 5/2004; Ord. 3020 § 3, 2/2004; Ord. 2934 § 8, 8/2003)

Figure 30.64-2 Planter Design

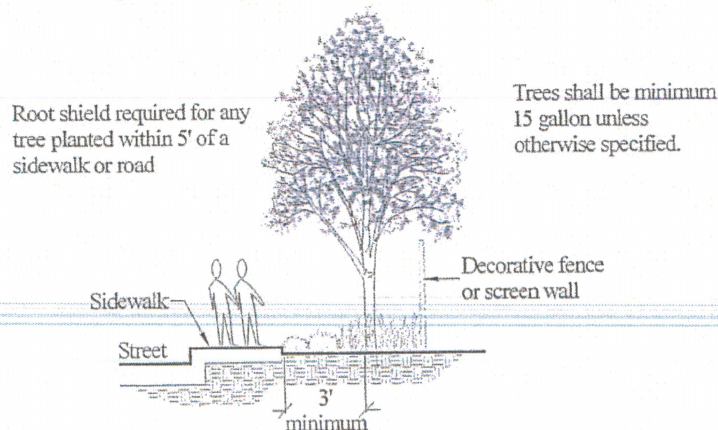
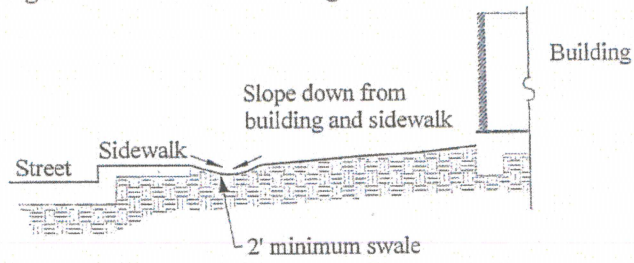


Figure 30.64-3 Swale Design



30.64.040 Screening and Buffering Requirements. Tables 30.64-1 and 30.64-2 establish the minimum screening and buffering requirements for development as depicted in Figures 30.64-4 through 30.64-14.

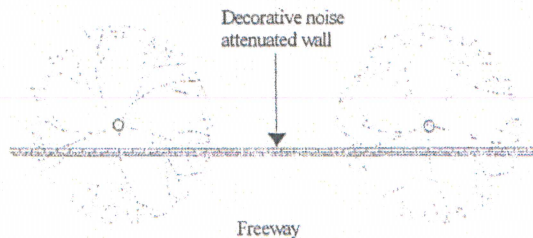
Table 30.64-1 Single-Family Residential Screening and Landscape Buffer Requirements^{1,6}			
	Rural Residential Development⁷	Suburban Residential Development and/or Residential Estates PUD	Compact Residential Development
Perimeter on Private or Local Streets – Rear Yard Only⁵	Figure 30.64-5 ² OR Figure 30.64-6 ²	Figure 30.64-5 OR Figure 30.64-6	Figure 30.64-7 OR Figure 30.64-8
Side or Rear on Collector/Arterial Streets⁵	Figure 30.64-5 ² OR Figure 30.64-6 ²	Figure 30.64-7 OR Figure 30.64-8	Figure 30.64-9 OR Figure 30.64-10
Adjacent to Freeway	Figure 30.64-4 No wall required in Community District 5.	Figure 30.64-4 Noise attenuating wall required per NDOT ³ standards.	Figure 30.64-4 Noise attenuating wall required per NDOT ³ standards.
Adjacent to a Less Intensive Use^{4,5}		When adjacent to rural residential use: Six (6) foot minimum/maximum decorative wall (may be eliminated in rural area by an administrative minor deviation).	When adjacent to suburban or rural residential use: Figure 30.64-11 with one tree per thirty (30) feet. Wall may be eliminated in rural area by an administrative minor deviation.
Front Yards (within 15' of front property line)	Figure 30.64-8 when fronting on a collector or arterial street except a wall or fence is not required. A six foot maximum decorative fence may be permitted (fence need not be decorative in rural areas; or, with administrative minor deviation approval, if adjacent properties have similar fences).	If a wall or fence is not required, a five foot maximum decorative fence may be permitted (fence need not be decorative in rural areas; or, with administrative minor deviation approval, if adjacent properties have similar fences).	If a wall or fence is not required, a five foot maximum decorative fence may be permitted.
Retaining Walls⁵	When wall is on side or rear yard, see 30.64.050(a)(4) and Figure 30.64-15.	When wall is on side or rear yard, see 30.64.050(a)(4) and Figure 30.64-15.	When wall is on side or rear yard, see 30.64.050(a)(4) and Figure 30.64-15.
Additional Requirements: <ol style="list-style-type: none"> These requirements are minimum standards. More intensive landscaping shown in other figures is also permitted. If full off-site improvements are deferred, the required landscaping and irrigation system need not be provided until the off-site improvements are installed, unless rural street standards apply. The requirement does not apply to lots which are 40,000 square feet or larger; however, if provided, must follow regulations within table. Nevada Department of Transportation. The Zoning Administrator may allow breaches in the wall for pedestrian access and trails by an administrative minor deviation and letters of consent from adjacent property owners. Specified maximum wall heights may be increased to include the height of a retaining wall in accordance with Section 30.64.050(4). <i>(reserved)</i> Fencing materials in the rural residential districts may include traditional farm fencing (smooth twisted wire mounted on posts) or alternative fencing used for confining domestic animals, provided that all fencing is compatible with the rural character of the immediate area. 			

(Ord. 3229 § 12 (part), 6/2005; Ord. 3209 § 10 (part), 3/2005; Ord. 3106 § 11, 8/2004; Ord. 3008 § 8, 12/2003; Ord. 2934 § 10 (part), 8/2003; Ord. 2741 § 12 (part), 5/2002)

Table 30.64-2 Non-Single-Family Residential Screening and Landscape Buffer Requirements ¹				
	Multi-Family Development	Commercial & Mixed Use Development	Industrial Development	Special Development
Adjacent to any Street ²	Figure 30.64-9 OR Figure 30.64-10	Figure 30.64-13	Figure 30.64-13	Figure 30.64-13 (except as permitted by 30.64.020(1)(C))
Adjacent to Freeway	Figure 30.64-4 In the rural area, only the noise attenuating wall per NDOT ² standard is required.	Figure 30.64-4 Noise attenuated wall not required. In rural area, landscaping not required.	Figure 30.64-4 Decorative wall required, need not be noise attenuated. In rural area, landscaping not required.	Figure 30.64-4 Decorative wall required, need not be noise attenuated. In rural area, landscaping not required.
Adjacent to a Less Intensive Use ^{3,5}	When adjacent to rural residential: Figure 30.64-11 with one tree per twenty (20) feet. When adjacent to suburban or compact residential: Figure 30.64-11 with one tree per 30 feet. Wall may be eliminated in the rural area by an administrative minor deviation.	When adjacent to any residential ⁴ use: Figure 30.64-11 with one tree per twenty (20) feet. Wall may be eliminated in the rural area by an administrative minor deviation.	When adjacent to any residential ⁴ use: Figure 30.64-11 with one tree per twenty (20) feet. Wall may be increased to ten (10) feet. Wall may be eliminated in the rural area by an administrative minor deviation.	When adjacent to any residential ⁴ use: Figure 30.64-11 with one tree per twenty (20) feet. Wall may be eliminated in the rural area by an administrative minor deviation.
Retaining Walls ⁵	When wall is on the side or rear yard not adjacent to a street, see 30.64.050 (a)(4) and Figure 30.64-15. If adjacent to a street, figures 30.64-9 or 30.64-10.	When wall is on side or rear yard not adjacent to a street, see 30.64.050 (a)(4) and Figure 30.64-15. If adjacent to a street, the height of any retaining wall shall not exceed thirty-six (36) inches.	When wall is on side or rear yard not adjacent to a street, see 30.64.050(a)(4) and Figure 30.64-15. If adjacent to a street, the height of any retaining wall shall not exceed thirty-six (36) inches except when screening outside storage (see outside storage below).	When wall is on side or rear yard not adjacent to a street, see 30.64.050 (a)(4) and Figure 30.64-15. If adjacent to a street, the height of any retaining wall shall not exceed thirty-six (36) inches.
Outside Storage	Not applicable.	Per Table 30.44-1.	Maximum height up to thirteen (13) feet when any height over ten (10) feet is for retaining wall. When adjacent to non-industrial uses, eight (8) foot minimum screened fence or wall required. When adjacent to street, must comply with Figure 30.64-8, except screened fence or wall may be increased to ten (10) feet without additional landscaping.	Per Table 30.44-1: Walls cannot be located within the setback.
Security Fencing ⁶			Walls/fences permitted above may be security walls.	See Table 30.44-1 for special uses and airports within the P-F District which permit security walls.
Parking Lot Landscaping		Figure 30.64-14	Figure 30.64-14	Figure 30.64-14

Table 30.64-2 Non-Single-Family Residential Screening and Landscape Buffer Requirements ¹				
	Multi-Family Development	Commercial & Mixed Use Development	Industrial Development	Special Development
Other Wall		A decorative fence enclosing outdoor space adjacent to not more than fifty percent (50%) of a commercial building is permitted if no closer than three (3) feet to the sidewalk.		
Additional Requirements: 1. Exceptions to required landscaping are as follows: A. If the property is outside of the service area of the nearest water purveyor, live landscaping need not be planted until water service is extended to the site, providing an irrigation system is installed for the future planting and rockscaping is provided in the interim, except that development within the rural area need not provide the future irrigation system. B. If full off-site improvements are deferred, the required landscaping and irrigation system need not be provided until the off-site improvements are installed. 2. Nevada Department of Transportation. 3. The Zoning Administrator may allow breaches in the wall for pedestrian access and trails by an administrative minor deviation with letters of consent from adjacent property owners. 4. Including uses such as, but not limited to, schools, places of worship, libraries, museums, cemeteries, day care, child care, congregate care, assisted/independent living facilities, or hospitals. 5. Specified maximum wall heights may be increased to include the height of a retaining wall in accordance with Section 30.64.050(4). 6. Security fences are permitted in conjunction with Temporary Government Facilities in any zoning district, subject to the requirements for security fences in this Table and 30.08.030. (Ord. 3229 § 12 (part), 6/2005; Ord. 3209 § 10 (part), 3/2005; Ord. 2934 § 10 (part), 8/2003; Ord. 2741 § 12 (part), 5/2002)				

Figure 30.64-4 Freeway Buffer



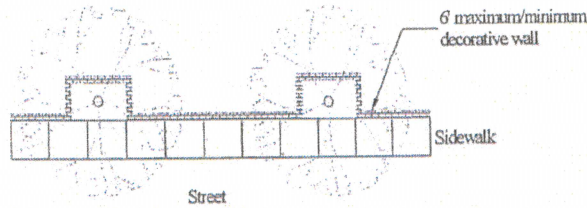
One large tree (15 gallon) required every 50 linear feet, generally spaced 50 feet apart; or

One tree for every 100 feet if 24" box trees, generally spaced 100 feet apart; or

Plants, such as shrubs, vines, or ground cover which when full grown will cover 50% of the wall surface facing the freeway

Rural areas: Wall need not be decorative

Figure 30.64-5 Street Buffer - Wall Offsets



Number of trees required: per 30.64.030(k)

One medium or large tree required in each 4' x 4' (or greater) tree well; alternatively, if rural street standards apply, trees planted inside the wall per 30.64.030(k) are permitted

Tree wells are encouraged to be located on common property lines

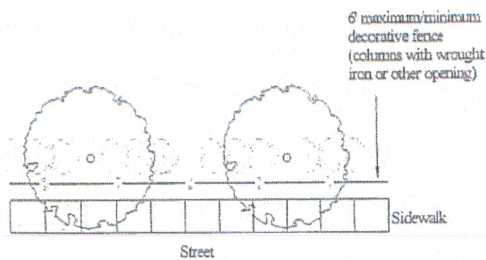
Rural Areas: Wall need not be decorative
Sidewalk not required if rural standards apply

NOTES:

1. Trees are not required when their location conflicts with septic system separation requirements
2. Maximum/minimum wall height may be increased in accordance with 30.64.050(4)

(Ord. 3209 § 11 (part), 3/2005; Ord. 2934 § 12 (part), 8/2003)

Figure 30.64-6 Fence with Landscape Screen



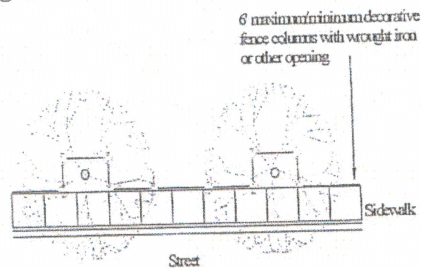
Number and size of trees required: per 30.64.030(k)

Shrubs sufficient to screen rear yards, generally spaced 5 feet apart

Rural Areas: Fence need not be decorative
Sidewalk not required if rural standards apply

(Ord. 2934 § 12 (part), 8/2003)

Figure 30.64-7 Fence Off-Sets



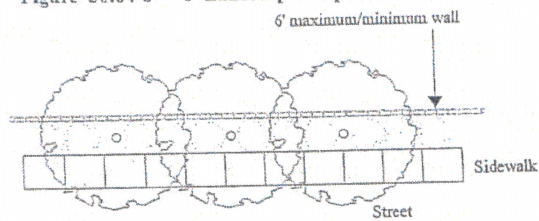
Number of trees required: per 30.64.030(4)

One large tree required in each 6' x 10' fence offset (alternative 4' x 4' offset permitted only when landscaping is behind fence)

Rural Areas: Fences need not be decorative
Sidewalk: not required if rural standards apply

(Ord. 2934 § 12 (part), 8/2003)

Figure 30.64-8 6' Landscape Strip with Wall



Number of trees required: 1 per 20 linear feet of street frontage (excluding driveways), generally spaced 20 feet apart.

Landscape strip must be 3' minimum/6' average, with 6' minimum adjacent to trees.

Wall or fence is not required for single family residential development fronting on collector or arterial streets.

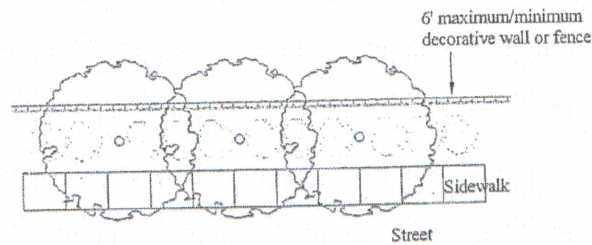
Wall may be increased to 8' if average landscape strip is increased to 10', or wall may be increased in accordance with 30.64.050(4).

Shrubs shall be designed to cover more than fifty (50) percent of the landscaped area when mature, and may be grouped if distributed along entire strip.

Rural areas: Walls need not be decorative.

(Ord. 3209 § 11 (part), 3/2005; Ord. 3106 § 12, 8/2004)

Figure 30.64-9 10' Landscape Strip with Wall or Fence



Number of trees required: 1 per 20 linear feet of street frontage, (excluding driveways)
generally spaced 20 feet apart

Landscape strip must be 6' minimum/10' average

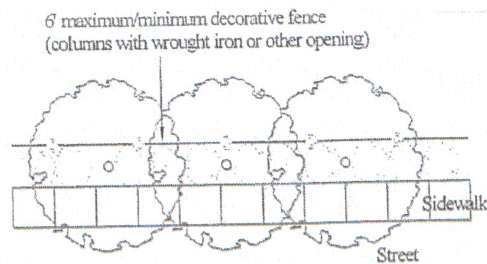
Wall/fence may be increased to 8' if average landscaping is increased to 15', or wall may be increased in accordance with 30.64.050(4)

Shrubs shall be designed to cover more than fifty (50) percent of the landscaped area when mature, and may be grouped if distributed along entire strip

Rural areas: Fences/walls need not be decorative

(Ord. 3209 § 11 (part), 3/2005)

Figure 30.64-10 6' Landscape Strip with Fence



Number of trees required: 1 per 20 linear feet of street frontage, generally
spaced 20 feet apart

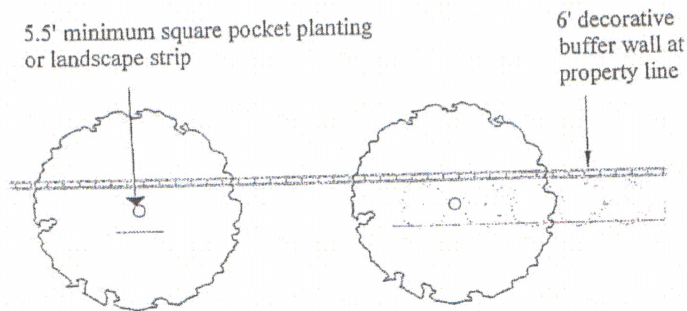
Landscape strip must be 3' minimum/6' average/6' minimum adjacent to trees

Fence can be increased to 8' if average landscaping is increased to 10'

Shrubs shall be located to cover more than fifty (50) percent of the landscaped area
when mature, and may be grouped if distributed along entire strip.

Rural areas: Fence need not be decorative

Figure 30.64-11 Buffer Adjacent to a Less Intensive Use

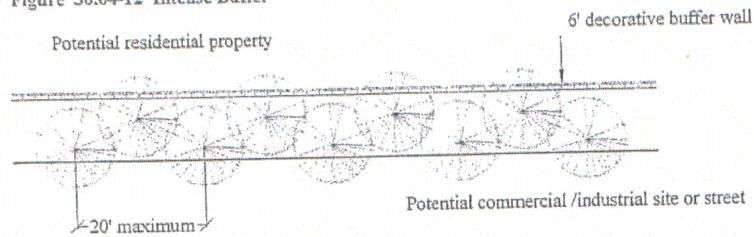


Where adjacent property is developed, trees shall be 24" box large evergreen trees to quickly mature and cover the distance between trees.

Quantity of trees per Tables 30.64-1 and 2

Rural area: Wall need not be decorative

Figure 30.64-12 Intense Buffer



Trees shall be 24" box large evergreen trees designed to expand and screen the distance between trees and planted in off-set rows.

Where intense landscape buffering is required along a street, the landscaping shall be installed on the street side of the wall.

When adjacent to street, shrubs shall be located to cover more than fifty (50) percent of the landscaped area and may be grouped if distributed along entire strip.

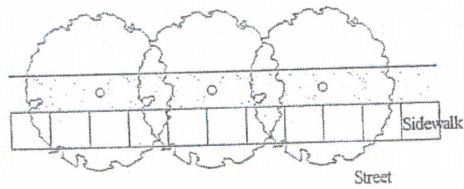
5.5 foot minimum square pocket planting or 10' landscape strip.

Wall height may be increased in accordance with 30.64.050(4)

Rural area: Wall need not be decorative.

(Ord. 3209 § 11 (part), 3/2005)

Figure 30.64-13 Street Landscaping



Number of trees required: per 30.64.030(k)

Landscape strip must be 3' minimum/6' average, with 6' minimum adjacent to trees

Shrubs shall be designed to cover more than fifty (50) percent of the landscaped area and may be grouped if distributed along entire strip

Fences and walls are not permitted within a required setback unless required by the Commission or Board or to screen outside uses (See Table 30.64-2)

(Ord. 2934 § 12 (part), 8/2003; Ord. 2778 § 3, 7/2002; Ord. 2764 § 5, 6/2002)

Figure 30.64-14 Parking Lot Landscaping
(Not required within parking garages)

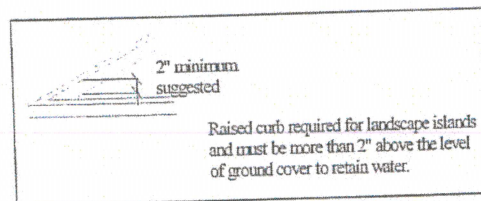
Islands can be designed at the end of rows, between rows, or both

One large tree shall be provided for every 8 parking spaces, or one medium tree may be substituted for every 6 spaces, with trees generally distributed throughout the parking lot

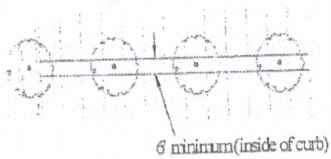
Parking adjacent to other trees need not be included

The total number of trees may be reduced by 20% if 10% or more of the parking lot is landscaped, xeriscaped, or finished with a permeable surface or pavers

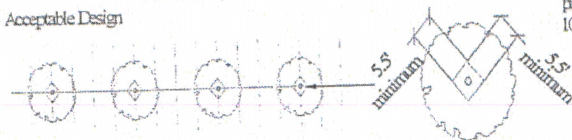
Parking lots which exist or were approved prior to March 2000 can be retrofitted, resulting in a 10% parking reduction



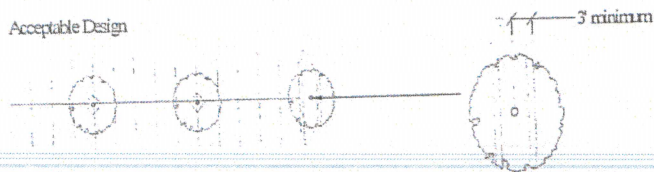
Preferred Design



Acceptable Design

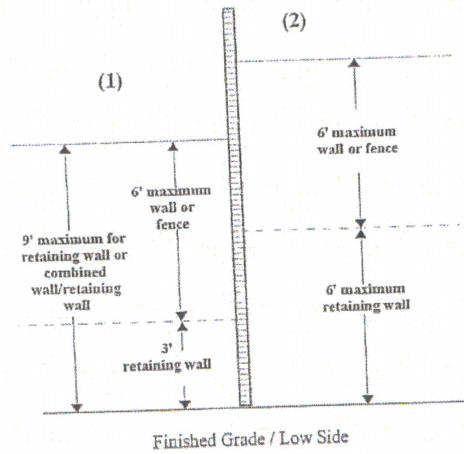


Acceptable Design



24" box trees shall be planted within all diamond planters

Figure 30.64-15 Retaining Walls



Notes:

(1) 3' minimum retaining wall plus 6' maximum wall (or fence) is permitted per 30.64.050(a)(4)(A).

(2) 6' retaining wall plus 6' fence or wall (need not be open) is permitted per 30.64.050(a)(4)(B).

NOTE: Within required street setbacks (where a wall or fence is otherwise not permitted), a retaining wall only may be constructed to a maximum height of three feet (3').

(Ord. 3229 § 12 (part), 6/2005; Ord. 2573 § 14 (part), 2001; Ord. 2510 § 14 (part), 2000)

30.64.050 Alternative Standards.

- a. **Fences and Walls.** Except for fences and walls within the front yards of single family residences, fences, walls and hedges over six (6) feet in height are permitted within required setbacks when:
1. The Commission or Board determines that a fence or wall over six (6) feet is required to mitigate the effect of a use on an adjacent use with the approval of a related land use application.
 2. The Zoning Administrator determines that additional height, up to eight (8) feet in overall height, is appropriate with an administrative minor deviation application and notarized letters of consent from adjacent developed property owners.
 3. The Zoning Administrator determines that additional height, up to the height permitted for accessory structures, is appropriate for an open decorative or chain link fence and/or lighting enclosing a game area, with an administrative minor deviation application and with notarized letters of consent from adjacent property owners.
 4. Retaining walls shall not exceed a maximum height of three feet (3') except as permitted by subsections (A) or (B) below. However, in no case shall walls (including retaining walls) for commercial development exceed three feet in height above the finished grade of the street (or sidewalk if constructed) within required street setbacks (see 30.64.020(1)(C)). (Also see Table 30.64-2 for Outside Storage)
 - A. Adjacent to developed property whose elevation is lower than the developing property, a retaining wall or combined wall/retaining wall may be permitted to a maximum height of nine (9') feet. (See Figure 30.64-15)
 - i. Alternatively, a retaining wall system (hillside development) may be permitted per Figure 30.64-1.
 - B. Specified maximum wall heights may be increased to a maximum of twelve feet (6' wall plus 6' retaining wall) for the following, subject to the landscape provisions specified and compliance with subsection (5) below (See Figure 30.64-15):
 - i. Subdivision walls (perimeter or interior) along any local or private street shall provide a six-foot (6') landscape strip (see Figure 30.64-8).
 - ii. Perimeter subdivision walls along any collector or arterial street shall provide a ten-foot (10') landscape strip (see Figure 30.64-9).
 - iii. Walls adjacent to non-developed property (no additional landscaping required).
 - iv. Walls adjacent to developed properties when the finished grade of the developing property is lower than the finished grade of the developed property (no additional landscaping required).
 5. Retaining walls shall not exceed two (2') feet within any sight visibility zone.
 6. The Director of Public Works and/or the Director of Development Services determines that a wall is required to protect property or public safety. The height and design of such a wall, including those within flood control facilities, shall be as required.
- b. **Adjustments to site landscape and screening standards.** Proposals to utilize standards different from those provided elsewhere in this chapter may be considered in light of the unique characteristics of an individual site, including those created by the shape and location of property, design of existing

or proposed structures, and the operation of the uses proposed for the site. Adjustments to site landscape standards include those related to screening and buffering, placement and amount of site landscape materials, parking lot landscaping, amount of turf, and the location of fences and walls. The determination of the acceptability of such adjustments shall be based upon consideration of the following:

1. The provision of landscape proposals to reduce environmental problems and to further the County's compliance with the Federal Clean Air Act Amendments of 1990 such as, but not limited to, increased use of allowable landscape species which increase the absorption of carbon dioxide and production of oxygen, and produce low amounts of pollen.
 2. The ability of the proposed standards to result in the same or improved screening and buffering function as results from the standards of Table 30.64-1
 3. The ability of the proposed standards to provide the same or enhanced visual character to the site as would result from the application of the landscape requirements for which alternative standards are being offered.
 4. The ability of the proposed standards to maintain water demand equal to or less than that anticipated to be required by the installation and maintenance of the landscape plan and materials for which the alternative standards are being offered.
 5. The ability of the proposed standards to result in site landscaping that maintains or increases the site development compatibility with that of adjacent sites in the manner anticipated through the application of the landscape requirements for which alternative standards are offered.
- c. The Commission or Board may approve modified standards, including reduced or additional landscaping or fence height, as a condition imposed in conjunction with the approval of a land use application or by a waiver of standards application per Table 30.16-7, which, in their estimation, will better accomplish the purposes of this Chapter. In addition, the specialized requirements within Table 30.44-1 shall supersede the requirements of this Chapter. (Ord. 3229 § 12 (part), 6/2005; Ord. 3209 § 10 (part), 3/2005; Ord. 2934 § 9, 8/2003; Ord. 2769 § 105, 7/2002; Ord. 2573 § 14 (part), 2001)

30.64.060 Water Features. Variances or waivers to the use and size restrictions within this Section shall not be permitted and the Zoning Administrator shall not accept such an application. As the conservation of water resources is vital to the general prosperity, health, safety and welfare of the County, the development of water features for recreational, scenic and landscape purposes shall be severely limited. Any water feature permitted under this Section shall only be permitted if the system is designed to re-circulate water within the feature.

1. **Swimming Pools.** Swimming pools are considered to be accessory uses in all districts when not a principal use of the property. All pools (above ground and below grade) shall comply with the following. Swimming pools which exceed the permitted area shall only be permitted in accordance with subsection (2) below (Manmade Lakes).
 - A. Pool water line must be a minimum five (5) feet away from the required front yard and shall not be constructed across a property line.
 - B. All pools must be enclosed by a minimum five (5) foot high fence or wall (which may be a building wall) with self-closing and self-latching gates or doors, the latching device being located on the inside and not less than four (4) feet above the ground designed to prevent access to the pool without going through the gate. If visible from the street then the pool must be surrounded by a decorative wall.

- C. As a further precaution, it is suggested all doors and windows shall be self-closing and self-latching, and a non-climbable five-foot fence be constructed to separate the pool/spa from the residence (see Figure 30.64-16).
- D. Waterfalls or other decorative features associated with a pool may encroach into a yard setback, must conform to maximum wall height, and may not cross a property line.
- E. Within developments other than single-family residences, the water surface area of outdoor swimming pools for a development shall not exceed the following.
 - i. Four percent (4%) for the first ten (10) acres or less and four-tenths percent (0.4%) for the additional total development area that exceeds ten (10) acres.
 - iii. For a resort hotel, an additional five (5) square feet will be allowed for each guest room.
 - iv. Area in addition to that permitted in subsections (i) and (ii) above may be permitted if in conformance with the provisions Subsection (2) below.

2. Manmade Lakes. Manmade lakes are prohibited, except for the following.

- A. A body of water constituting a wetlands project or located in a recreational facility which is owned or operated by a political subdivision of this State and that utilizes nonpotable water.
- B. A body of water which is located in a recreational facility that is open to the public and owned or operated by the United States of America or the State of Nevada.
- C. A body of water which stores water for use in flood control, in meeting peak water demands or for purposes relating to the treatment of sewage by a political subdivision of this State.
- D. A body of water which stores water for use by the Las Vegas Valley Water District or by a water district created pursuant to NRS Chapter 318.
- E. Bodies of water located on a golf course or a cemetery which are used for the purpose of storing irrigation water for the same and which have a combined aggregate surface area less than five and one-half percent (5.5%) of the total golf course or cemetery area, respectively.
- F. A body of water which stores and distributes water or reclaimed wastewater for use by an irrigation district created pursuant to NRS Chapter 539.
- G. A body of water which stores water used in a mining reclamation project.
- H. A body of water which is located or is proposed to be created within a nonprofit youth camp for the benefit of youth in learning and experiencing watercraft activities and water safety.
- I. A body of water, with no limitations on its area, which may include decorative, recreational and/or entertainment features, located at a resort hotel, provided it is subject to the following.
 - i. The resort hotel demonstrates that the resort hotel benefits the community and is in the public interest as evidenced by the approval of the resort hotel under this Title, provided, that the bodies of water or features are shown on the plans and advertised in the notice of public hearing.
 - ii. The applicant demonstrates to the satisfaction of the water purveyor that the proposed body of water will have no significant impact on water resources or water peak demand delivery capacity, because of the use of one (1) or more of the following methods. The method or

methods used shall be the highest priority method or methods feasible, as reasonably determined by the appropriate water district, as listed in the following priority order. The applicant shall submit a Water Efficiency Plan to the water purveyor, which must be approved by the water purveyor prior to the issuance of permits.

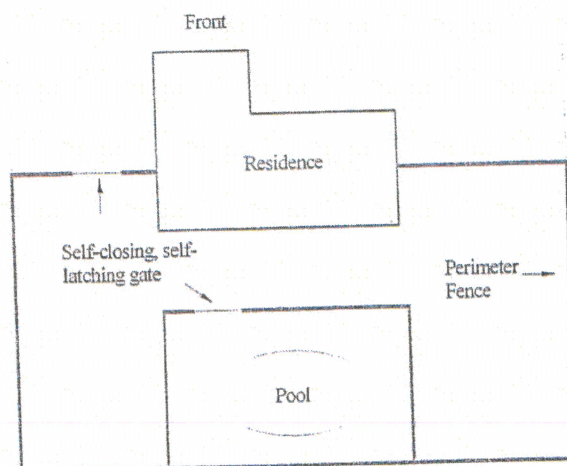
- (a) Use of well water if the property upon which the body of water is located is part of a single development that has appurtenant non-revocable water rights existing on or before July 1, 1995.
 - (b) Use of groundwater from the shallow groundwater aquifer.
 - (c) Use of reclaimed wastewater from a municipal system or the subject property. If the applicant contributes to an exterior water efficiency retrofit program approved by the water purveyor to offset the water resources used, in an amount equivalent to the amount of water used by the body of water.
 - (d) Use of water from the water purveyor. However, the applicant must contribute to an exterior water efficiency retrofit program approved by the water purveyor to offset the impacts on water resources and system delivery capacity, in an amount equivalent to two (2) times the amount of water used by the body of water.
- iii. The applicant must submit an efficient water use plan for the entire resort hotel to the water purveyor. The applicant must receive plan approval from the appropriate water district before issuance of any building permits for the body of water.
- iv. If reclaimed wastewater or water from a shallow aquifer will be used, the property may be subject to the approval of an effluent management plan and/or an appropriate sewer surcharge fee for discharging excess conventional pollutants from either process into the municipal sewer system. If excess Total Dissolved Solids (TDS) is discharged, the property must fund salinity reduction programs through the Clark County Sanitation District for reducing the total TDS use equivalent by the amount of the excess TDS contributed.
3. **Manmade Decorative Water Features.** The water surface area of outdoor manmade decorative water features for a single development shall be limited as follows. Decorative water features which exceed the permitted area shall only be permitted in accordance with subsection (2) above (Manmade Lakes).
- A. Two percent (2%) for the first ten (10) acres or less and two-tenths percent (0.2%) for the additional total development area that exceeds ten (10) acres.
 - B. For a resort hotel, an additional two and one-half (2 1/2) square feet for each room used for sleeping accommodations.
 - C. For a resort hotel, additional area shall be allowed where:
 - i. The water is from a shallow groundwater aquifer system, which may be operated in conjunction with a system using reclaimed wastewater resulting from the use of potable water and the subsequent on-site treatment of the used water, on the single development. However, any such reclaimed wastewater may be used only to the extent that shallow groundwater is unavailable.
 - ii. Any additional water features using shallow groundwater or reclaimed wastewater generated on the site, as provided above, do not, in aggregate, exceed an additional square footage

increment equal to the amount of outdoor manmade decorative water features calculated under subsections (A) and (B) above.

- iii. The necessary groundwater permit and water treatment process approvals have been obtained from the appropriate agencies having or asserting jurisdiction.
- iv. A deed restriction has been recorded stating that the continuing operation of outdoor manmade decorative water features may require the continuing operation of systems to provide water from a shallow groundwater aquifer or from reclaimed wastewater generated on the single development as provided above.

4. **Manmade Recreational Water Theme Park.** The water surface area of manmade recreational water theme park for a single development is limited to twenty percent (20%) for the first twenty (20) acres or less and two percent (2%) for the additional total development area that exceeds twenty (20) acres. (Ord. 2950 § 2, 9/2003)

Figure 30-64-16 Suggested Swimming Pool Precautions



30.64.070 Drought Restrictions. During a drought, as defined in 30.08.030, the following additional restrictions shall apply to development. These restrictions cannot be waived or varied. Except for the prohibited operation of manmade decorative water features per Section 30.64.070(C) and the planting of cool season grasses per Section 30.64.070(A)(1), any development or facility that has obtained approval of a land use application or permit for construction prior to August 1, 2003, which approved landscaping not in conformance with the restrictions listed in this ordinance, will not be subject to these restrictions (water features thus approved may be constructed but not operated).

- A. During Drought Watch, the following landscape material restrictions shall apply:

1. The planting of cool season grasses (for example, tall fescue or rye grass) is prohibited during the months of May through August; however, the planting of warm season grasses (for example, bermuda and zoysia) is permitted.
 2. Residential Landscape Restrictions: Single-family and multifamily developments are prohibited from installing new turf in common areas of residential neighborhoods. This restriction shall not apply to privately owned and maintained parks, including required usable open space, provided that no turf area dimension is less than 10 feet.
 3. Non-Residential Landscape Restrictions: The installation of new turf in non-residential developments is prohibited. This restriction shall not apply to major schools, parks, amphitheatres or cemeteries, provided that no turf area dimension is less than 10 feet; to turf required by other governmental jurisdictions and/or regulatory agencies; or to golf courses and driving ranges, provided that turf is limited to not more than 50% of what is permitted under subsection 30.64.030(j)(7).
- B. During Drought Alert, the following additional landscape development restrictions for residential development shall apply:
1. The installation of new turf is prohibited in residential front yards.
 2. For single-family residential lots, the installation of new turf shall not exceed 50 percent of the gross area of the side and rear yard or 100 square feet, whichever is greater, provided no turf area dimension is less than ten feet. In any case, a maximum of 5000 square feet of turf is permitted.
- C. Operation of Manmade Decorative Water Features. During a Drought Watch and Drought Alert, the use of manmade decorative water features shall be prohibited, including the use of existing features. The following uses shall be exempt:
1. Swimming pools, spas and recreational water parks. The use of covers for pools and spas is encouraged.
 2. One (1) water feature of less than 200 square feet surface area in conjunction with a single-family residence or a residential development, except that any water feature located at the entry of a residential development shall not be operated. During Drought Alert, the maximum area of a fountain permitted to be operated shall not exceed 25 square feet.
 3. Water features that are necessary and functional components serving other allowable uses, such as storage ponds on a golf course or cemetery, or aeration devices.
 4. Indoor water features, or features with the majority of the total water volume contained indoors or underground. If practical alternatives exist for separating indoor and outdoor components (such as timers or shut-off valves), they shall be separated and managed accordingly.
 5. Commercial water features operated in conjunction with a resort hotel as defined by Section 463.01865 of the Nevada Revised Statutes, if 1) a water efficiency and drought response plan which addresses guidelines suggested by the Southern Nevada Water Authority is submitted to the Zoning Administrator prior to January 30, 2004, for facilities existing as of the effective date of this ordinance, or prior to certificate of occupancy for future facilities, and 2) a sign is posted at the feature stating that the feature is operating in compliance with the drought ordinance and that a water efficiency and drought response plan is on file with the local water purveyor.
 6. Water features necessary to sustain aquatic animals, provided that such animals have been actively managed within the water feature prior to declaration of drought.

7. Water features will not be required to be drained. A recirculating water pool to maintain pumps, pond liners, and ancillary equipment, but only between the hours of 1:00 a.m. and 4:00 a.m. or whenever freezing conditions require system preservation, may be maintained.
8. Water features in developments which conform to the following, subject to the approval of an Administrative Design Review to verify compliance:
 - i. The property owner, homeowner's association, or landscape maintenance association reduces consumptive water use for the development by reducing the amount of turf (functional or non-functional) within the development by fifty square feet for each square foot of surface area of the water feature if a rebate for turf conversion is not requested from the Water Smart Landscape program of the Southern Nevada Water Authority. Turf removed after the declaration of drought watch or drought alert will qualify under this subsection; however, turf removed before the declaration of drought watch on January 1, 2002, shall not qualify;
 - ii. If the development cannot reduce non-functional turf area, the property owner, homeowner's association, or landscape maintenance association shall pay the following fee to the Water Smart Landscape program of the Southern Nevada Water Authority for the period ending the next calendar year: ten dollars (\$10) per square foot of surface area. A receipt verifying fee payment shall be provided with the administrative design review application;
 - iii. If the development does not have enough non-functional turf required to qualify under subsection (i) above, the property owner, homeowner's association, or landscape maintenance association shall first reduce non-functional turf to the extent possible, and then pay the following fee to the Water Smart Landscape program of the Southern Nevada Water Authority for the period ending the next calendar year: ten dollars (\$10) per square foot of surface area for the proportion of turf area not available for conversion. A receipt verifying fee payment shall be provided with the administrative design review application.
 - iv. For each subsequent year during drought watch or drought alert that the water feature is operated, the property owner, homeowner's association, or landscape maintenance association shall pay the following fee to the Water Smart Landscape program of the Southern Nevada Water Authority by January 1 of the year during which the water feature will be operated: two hundred dollars (\$200).
 - v. Temporary signs indicating the water feature is permitted to operate in conformance with drought restrictions shall be posted as follows: 1) sign area shall not be less than four (4) or greater than sixteen (16) square feet, and 2) sign(s) shall be visible from any street from which the water feature is visible.
- D. Any person or association, regardless of date of establishment, is prohibited from imposing or enforcing private covenants, conditions, restrictions, deed clauses or other agreements between the parties, which prevent the utilization of water efficient landscaping, including but not limited to xeriscape, provided such landscaping receives appropriate architectural review approval. In any event, landscaping materials and designs may not be prohibited solely on the basis that they make use of water-efficient landscaping, per Title 24 (as amended). (Ord. 3094 § 4, 7/2004; Ord. 2975 § 1, 11/2003; Ord. 2950 § 3, 9/2003; Ord. 2934 § 11, 8/2003)

NOTE: Trees marked with a double asterisk (**) shall be considered to have invasive root systems and shall not be planted within 3' of a wall, sidewalk, street, or public utility easement adjacent to a street in required landscape areas even if those trees are listed on the Southern Nevada Water Authority's *Water Smart Landscapes Program Plant List*. Additionally, it shall not be assumed that other varieties of a particular genus of these trees are permitted even if all common names are not listed. Trees not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Southern Nevada Water Authority's Water Smart Landscapes Program Plant List, may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).

Appendix C - Plant List, Part 1, Trees																											
Genus	Common Name	Average Height			Average Spread			Type	Landscape Use					Possible Problems					Shape								
		Small, Up to 20'	Medium, 20-40'	Large, over 40'	Small, Up to 20'	Medium, 20-40'	Large, over 40'		Evergreen	Semi-deciduous	Deciduous	Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase
LARGE TREES																											
EVERGREEN																											
Arceastrum	Queen Palm			X				X											X					X			
Cedrus	Blue Atlas Cedar			X				X						X									X				
	Deodar Cedar			X				X						X									X				
Dalbergia (latifolia & sissoo)	Indian Rosewood**			X				X															X				
Phoenix	Date Palm			X				X															X				
Pinus	Mondell Pine			X				X						X									X				
	Aleppo Pine**			X				X						X									X				
	Stone Pine			X				X						X									X				
	Chir Pine			X				X						X									X				
Quercus	Holly Oak			X				X						X									X				
	Cork Oak			X				X						X									X				
	Southern Live Oak			X				X						X									X				
	Heritage Live Oak			X				X						X									X				
DECIDUOUS																											
Carya	Pecan			X				X															X				
Catalpa	Western Catalpa			X				X						X									X				
Celtis	Western Hackberry			X				X						X									X				
Fraxinus	Fan-Tex Ash**			X				X						X									X				
	Modesto Ash**			X				X						X									X				

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Appendix C - Plant List, Part I, Trees			Common Name		Average Height		Average Spread		Type			Landscape Use					Possible Problems					Shape						
Genus			Small, Up to 20'	Medium, 20-40'	Large, over 40'	Small, Up to 20'	Medium, 20-40'	Large, over 40'	Evergreen	Semi-deciduous	Deciduous	Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase	Narrow
LARGE TREES (continued)																												
DECIDUOUS (continued)																												
Ginkgo		Maidenhair Tree		x			x			x			x		x						x			x				
Gleditsia		Moraine Honey Locust		x			x			x								x			x			x				
		Ruby Lace Honey Locust		x			x			x								x						x				
		Shademaster Honey Locust		x			x			x																		
Platanus		Sycamore, Plane Tree**		x			x			x			x				x											x
Populus		Poplar, Cottonwood**		x			x			x										x								x
Quercus		Valley Oak		x			x			x			x							x				x				
		Chinquapin Oak		x			x			x			x							x				x				
		Red Oak**		x			x			x			x											x				
Robinia		Black Locust**		x			x			x			x											x				
Schinus		California Pepper		x			x			x			x											x				
Ulmus parvifolia		Lacebark Elm, Chinese Elm		x			x			x			x											x				
MEDIUM TREES																												
Albizia		Silk Mimosa Tree		x			x			x			x		x			x								x		
Brachychiton		Bottle Tree		x			x			x															x			
Casuarina		Beefwood, She-Oak		x			x																					
Celtis		Netleaf Hackberry		x			x			x																		
Cercidium		Blue Palo Verde		x			x			x																		
		Desert Museum		x			x			x																		
Diospyros (Persimmon)		Japanese Persimmon		x			x			x																		
Eleagnus		Russian Olive**		x			x			x																		
Eucalyptus microtheca		Coolibah, Flooded Box**		x			x			x																		

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Appendix C - Plant List, Part 1, Trees																												
Genus	Common Name	Average Height		Average Spread		Type	Landscape Use					Possible Problems					Shape											
		Small, Up to 20'	Medium, 20-40'	Large, over 40'	Small, Up to 20'		Medium, 20-40'	Large, over 40'	Evergreen	Semi-deciduous	Deciduous	Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase	Narrow
MEDIUM TREES (continued)																												
Fraxinus	Arizona Ash								X																			
Koeleruteria	Goldenrain Tree								X																			
Lagerstroemia	Crape Myrtle								X																			
Laurus	Bay Laurel								X																			
Ligustrum	Glossy Privet								X																			
Melia azedarach	Chinaberry, Texas Umbrella, Bead, Persian Lilac, Pride of India**								X																			
Parkinsonia	Mexican Palo Verde								X																			
Pistacia	Mountain Atlas Pistache								X																			
	Chinese Pistache								X																			
	Pistachio Nut								X																			
Pithecellobium	Texas Ebony								X																			
Prosopis	Argentine Mesquite								X																			
	Colorado Mesquite								X																			
	Chilean Mesquite								X																			
	Texas Honey Mesquite								X																			
	Western Honey Mesquite								X																			
	Velvet Mesquite								X																			
Prunus	Purpleleaf Plum								X																			
Quercus	Emory Oak								X																			
	Escarpment Live Oak								X																			
Rhus lancea	African Sumac								X																			
Robinia	Idaho Locust								X																			
	Purple Robe Locust								X																			

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Appendix C - Plant List, Part 1, Trees																											
Genus	Common Name	Average Height			Average Spread			Evergreen	Semi-deciduous	Deciduous	Landscape Use					Possible Problems					Shape						
		Small, Up to 20'	Medium, 20-40'	Large, over 40'	Small, Up to 20'	Medium, 20-40'	Large, over 40'				Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase	Narrow
MEDIUM TREES (continued)																											
Salix	Willow**		x			x			x	x	x	x															
Sambucus	Mexican Elderberry		x						x	x	x																
Sapinum	Chinese Tallow		x			x			x	x	x																
Thuja	American Arborvitae		x			x			x	x	x	x	x	x	x	x											
Vitex	Chaste Tree		x			x				x	x	x															
Xylosma Congestum	Xylosma		x					x			x																
SMALL TREES																											
Acacia	Mulga Tree	x			x			x																			x
	White Thorn Acacia	x			x				x			x	x	x													
	Cat-Claw Acacia	x			x				x			x	x	x													
	Twisted Acacia	x			x							x	x	x	x	x											
	Sweet Acacia	x			x				x					x	x												
	Shoestring Acacia	x			x				x																		
	Strawberry Tree	x			x				x																		
Arbutus																											
Aucuba Japonica	Japanese Aucuba	x			x			x	x																		
Bauhinia	Bauhinia			x							x																
Brahea	Palm							x																			
Butia	Pindo Palm	x			x			x																			
Cercidium	Foothills Palo Verde	x			x				x																		
Cercis	Redbud		x		x				x																		
Cercocarpus Leditifolius	Desert Mahogany	x			x			x																			
Chamaerops	Mediterranean Palm	x			x																						

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Appendix C - Plant List, Part 1, Trees																											
Genus	Common Name	Average Height	Average Spread	Type			Landscape Use					Possible Problems					Shape										
				Small, Up to 20'	Medium, 20-40'	Large, over 40'	Evergreen	Semi-deciduous	Deciduous	Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase	Narrow	
SMALL TREES (continued)																											
Chilopsis	Desert Willow	x																									
Chitalpa	Chitalpa	x																									
Citrus	Citrus (species)																										
Cordia Boissieri	Texas Olive																										
Cupressocyparis	Leyland Cypress	x																									
Cupressus	Cypress																										
Elaeagnus Angustifolia	Russian Olive	x																									
Eriobotrya	Loquat	x																									
Eucalyptus cinerea	Eucalyptus, Gum, Silver Dollar Gum, Argyle Apple, Corkscrew, Florist's**																										
Ficus	Fig	x																									
Fraxinus	Raywood Ash	x																									
Geijera	Australian Willow	x																									
Gleditsia	Sunburst Honey Locust	x																									
Leucaena	Golden Ball Lead Tree	x																									
Magnolia	Magnolia	x																									
Malus	Crabapple	x																									
Olea (Fruitless cultivars only)	Swan Hill Olive	x																									
Osmanthus	Sweet Olive	x																									
Pinus	Japanese Black Pine	x																									
Pittosporum	Willow Pittosporum	x																									
Podocarpus	Yew Pine																										
Prosopis	Screwbean Mesquite	x																									
Punica	Pomegranate	x																									

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Appendix C - Plant List, Part 1, Trees																											
Genus	Common Name	Average Height		Average Spread		Type			Landscape Use					Possible Problems					Shape								
		Small, Up to 20'	Medium, 20-40'	Large, over 40'	Small, Up to 20'	Medium, 20-40'	Large, over 40'	Evergreen	Semi-deciduous	Deciduous	Canopy/shade	Accent	Wildlife Habitat	Flower	Screen	High Litter	Fruit Drop	Disease	Pests	Thorns	Spreading	Rounded	Pyramidal	Single-trunked	Multi-trunked	Vase	Narrow
SMALL TREES (continued)																											
Pyrus	Evergreen Pear	x			x				x										x				x		x		x
Quercus	Red Rock Oak		x		x				x	x									x					x			
Sophora	Sophora (species)			x	x		x	x	x	x										x				x			
Trachycarpus	Palm			x	x		x																	x			
Washingtonia	Palm			x	x		x									x											
Zizyphus	Chinese Jujube	x			x										x					x							x

(Ord. 3174 § 10(part), 1/2005; Ord. 2934 § 13, 8/2003; Ord. 2741 § 14, 5/2002)

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Appendix C - Plant List, Part 2, Shrubs				Specimen	Formal Hedge	Informal Screen	Buffer	Accent	Foundation	Fragrances	Evergreen	Deciduous
Genus	Common Name	Growth Rate	Size H x W	Landscape Use						Type of Shrub		
Abelia	Glossy Abelia	Moderate	3'x4'						x		x	
Abutilon												
Acacia												
Agarita												
Ambrosia												
Anisacanthus	Desert Honeysuckle	Moderate	4'x3'			x		x	x			x
	Mexican Flame	Moderate	3'x3'					x				x
Anisodonta	Pink Desert Hibiscus	Slow	3'x2'					x	x		x	
Arbutus	Strawberry Bush	Slow	15'x15'	x							x	
Artemisia	Wormwood	Fast	1'x1'					x			x	
	Big Sagebrush	Moderate	8'x6'				x				x	
Atriplex	Four-Wing Saltbush	Fast	5'x8'			x	x				x	
	Quail Bush	Fast	8'x12'			x	x				x	
Baccharis	Desert Broom	Fast	5'x5'			x	x				x	
Buddleia	Butterfly Bush	Fast	6'x6'					x			x	
Buddleia	Wooly Butterfly Bush	Moderate	5'x5'					x			x	
Buxus	Japanese Boxwood	Moderate	3'x3'		x						x	
Caesalpinia	Yellow Bird of Paradise	Fast	5'x5'					x				x
	Mexican Bird of Paradise	Fast	10'x6'					x				x
	Red Bird of Paradise	Fast	6'x6'					x				x
Calliandra	Baja Fairy Duster	Fast	5'x4'	x		x		x	x			x
	Fairy Duster	Fast	3'x4'					x	x			x
Calliontomon												
Camellia												
Caryopteris												
Cassia	Feathery Cassia	Fast	6'x6'	x		x			x		x	
	Desert Cassia	Fast	6'x6'	x		x			x		x	
	Silver Leaf Cassia	Fast	6'x6'			x			x		x	
	Shrubby Senna	Moderate	10'x6'			x	x					x
Ceanothus												
Ceratoides												
Cercis	Western Redbud	Moderate	10'x10'					x				x
Cercocarpus	Curl-Leaf Mountain	Slow	8'x6'	x							x	
	Mahogany											

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Appendix C - Plant List, Part 2, Shrubs				Specimen	Formal Hedge	Informal Screen	Buffer	Accent	Foundation	Fragrances	Evergreen	Deciduous
Genus	Common Name	Growth Rate	Size H x W	Landscape Use						Type of Shrub		
	Alderleaf Mountain Mahogany	Slow	6'x4'		x		x				x	
Chrysactina												
Chrysothamnus	Golden Rabbit Brush	Fast	4'x4'	x		x		x			x	
Cistus	Purple Rockrose	Fast	3'x3'				x		x		x	
Convolvulus	Bush Morning Glory	Fast	2'x3'						x		x	
Cordia	Texas Olive	Fast	10'x10'	x		x					x	
	Little-Leaf Cordia	Fast	4'x8'			x						x
Cotinus												
Cotoneaster	Red Clusterberry	Moderate	6'x6'			x					x	
Cowania	Cliff Rose	Slow	6'x4'	x				x			x	
Dalea	Black Indigo	Fast	4'x5'						x		x	
	Pink Indigo Bush	Fast	4'x5'						x		x	
	Silver Dalea	Fast	3'x3'						x		x	
Dodonaea												
Dyesodia												
Elaeagnus	Ebbing's Silverberry	Moderate	8'x8'			x					x	
Encelia	Brittlebush	Fast	3'x4'					x			x	
Ephedra	Morman Tea	Slow	3'x3'					x			x	
Dremophila												
Ericameria	Turpentine Bush	Moderate	2'x2'					x			x	
Eriogonum	Pink Buckwheat	Moderate	2'x3'								x	
Euonymus	Evergreen Euonymus	Moderate	6'x6'			x					x	
Euryops	Green Bush Daisy	Fast	3'x3'					x			x	
Fallugia	Apache Plume	Slow	6'x4'	x		x	x				x	
Feijoa	Pineapple Guava	Slow	6'x4'	x		x		x			x	
Fraxinus	Gregg Ash	Moderate	10'x8'					x	x	x		x
Gardina												
Genista												
Hibiscus	Rose-of-Sharon	Moderate	10'x8'	x		x		x				x
Hymenoclea												
Ilex												
Juniperus	Shrub Junipers	Moderate	Varies			x					x	
Justicia	Chuparosa	Moderate	6'x6'					x			x	
	Mexican Honeysuckle	Moderate	3'x4'					x			x	
Lagerstroema	Crape Myrtle	Slow	12'x6'					x				x
Lantana	Bush Lantana	Fast	3'x3'					x			x	

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Appendix C - Plant List, Part 2, Shrubs				Specimen	Formal Hedge	Informal Screen	Buffer	Accent	Foundation	Fragrances	Evergreen	Deciduous
Genus	Common Name	Growth Rate	Size H x W	Landscape Use						Type of Shrub		
Larrea	Creosote Bush	Moderate	8'x6'			x	x			x	x	
Lavandula												
Leucophyllum	Silver Cloud Sage	Moderate	5'x5'			x			x		x	
	Thunder Cloud Sage	Moderate	5'x5'			x			x		x	
	Texas Ranger	Moderate	6'x6'			x			x		x	
	Compact Texas Ranger	Moderate	5'x5'			x			x		x	
	Green Cloud Texas Ranger	Moderate	6'x6'			x			x		x	
	White Cloud Texas Ranger	Moderate	6'x6'			x			x		x	
	Rain Cloud Sage	Moderate	3'x4'			x			x		x	
	Chihuahuan Sage	Moderate	6'x6'			x			x		x	
	Rio Bravo Sage	Moderate	4'x4'			x			x		x	
	Sierra Bouquet Sage	Moderate	3'x4'			x			x		x	
	Blue Ranger	Moderate	6'x6'			x			x		x	
Ligustrum	Texas Privet	Moderate	8'x6'			x					x	x
Lobelia												
Lycium												
Mahonia	Oregon Grape	Slow	4'x3'						x	x		x
Maytenus												
Myoporum												
Myrtus	Dwarf Greek Myrtle	Moderate	4'x4'		x	x						x
Nandina	Heavenly Bamboo	Slow	6'x4'			x				x		x
	Dwarf Heavenly Bamboo	Moderate	1'x1'						x	x		x
Nerium												
Photinia	Redtip Photinia	Moderate	10'x12'			x				x		x
Pittosporum	Mock Orange	Slow-Med.	6'x6'			x						x
Platycladus	Golden Arborvitae	Slow	3'x2'	x		x			x			x
Plumbago												
Pollomintia												
Prunus												
Punica	Pomegranate	Slow	4'x3'	x		x	x					x
Pyracantha	Hybrid Pyracantha	Moderate	8'x8'		x					x		x
Pyrus												
Rhapiolepis	Indian Hawthorne	Moderate	4'x4'							x		x
Rhododendron												
Rhus	Red-Flame Sumac	Moderate-Fast	15'x15'			x	x					x
	Sugar Bush	Slow	10'x10'			x					x	

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Appendix C - Plant List, Part 2, Shrubs				Specimen	Formal Hedge	Informal Screen	Buffer	Accent	Foundation	Fragrances	Evergreen	Deciduous
Genus	Common Name	Growth Rate	Size H x W	Landscape Use						Type of Shrub		
	Squaw Bush	Slow	3'x3'			x					x	
	Evergreen Sumac	Slow	8'x10'			x					x	
Rose												
Rosmarinus	Rosemary	Moderate	4'x4'	x	x	x			x		x	
Ruellia												
Salvia	Mexican Blue Sage	Moderate	2'x2'					x			x	
	Chaparral Sage	Moderate	3'x3'			x			x		x	
	Desert Sage	Moderate	3'x3'				x				x	
	Mealy-Cup Sage	Moderate	1'x2'					x				x
	Autumn Sage	Moderate	2'x2'					x			x	
	Mexican Bush Sage	Moderate	3'x3'					x				x
Simmondsia												
Sophora	Mescal Bean	Slow	15'x10'	x				x			x	
Spartium												
Syringa												
Tecoma	Yellow Bells	Moderate	6'x6'			x		x				x
Teucrium												
Unquadia												
Vauquelinia	Arizona Rosewood	Slow	15'x10'	x		x					x	
Viburnum	Spring Bouquet	Moderate	6'x6'			x	x		x		x	
Viguiera												
Xylosma	Shiny Xylosma	Moderate	15'x15'			x	x				x	
Zauschneria												
Zexmenia												
Zinnia												

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Appendix C - Plant List, Part 3, Ground Covers/Vines	
Genus	Common Name
Acacia	Creeping Acacia
Achillea	Fern Leaf Yarrow
Anacyclus	
Antigonon	Coral Vine
Aptenia	Hearts and Flowers
Baccharis	Centennial Broom
Bougainvillea	
Bulbine	
Calylophus	Sundrops
Campsis	Trumpet Creeper vine
Carpobrotus	
Convolvulus	Bush Morning Glory
Cotoneaster	Rockspray
Dalea	Trailing Indigo Bush
Drosanthemum	Purple Iceplant
Dymondia	
Dyssodia	Dahlberg Daisy
Euonymus	Wintercreeper
Fragaria	
Gazania	Gazania
Gelsemium	Carolina Jasmine
Hardenbergia	Lilac Vine
Hedera	Ivy varieties
Hypericum	
Jasminum	Primrose Jasmine
Juniperus	Groundcover Junipers
Lantana	Trailing Lantana
Lobelia	
Lobularia	
Lonicera	Hall's Honeysuckle Vine
Macfadyena	Cat's-Claw vine
Malephora	
Melampodium	Blackfoot Daisy
Myoporum	Prostate Myoporum
Oenothera	Primrose
Parthanocissus	
Phlox	
Podranea	Pink trumpet vine
Polygonum	Silver Lace Vine
Portulaca	
Pyracantha	Firethorn
Rosa	Lady Bank's Rose

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Appendix C - Plant List, Part 3, Ground Covers/Vines	
Genus	Common Name
Rosmarinus	Prostrate Rosemary
Sedum	
Solonum	
Stachys	Lamb's Ears
Tecomaria	
Teucrium	Germander
Thymus	
Trachelospermum	Jasmine
Verbena	Verbena
Vinca	
Vitis	Arizona Grape
Wisteria	Japanese Wisteria
Zinnia	Prairie Zinnia

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Appendix C - Plant List, Part 4, Accents/Succulents	
Genus	
Agave	
Aloe	
Alie	
Asperagus	
Beaucamea	
Cycas	
Dasyllirion	
Dicon	
Echeveria	
Euphorbia	
Fouquieria	
Graptopetalum	
Hesperaloe	
Kalanchoe	
Manfreda	
Nolina	
Nolina	
Pachypodium	
Sabal	
Sedum	
Sempervivum	
Washingtonia	
Yucca	

Appendix C - Plant List, Part 5, Ornamental Grasses	
Genus	
Arundo	
Bambusa	
Bouteloua	
Brachypodium	
Carex	
Chasmenthium	
Cortaderia	
Cymbopogon	
Elymus	
Eragrostis	
Festuca	
Imperata	
Miscanthus	
Muhlenbergia	
Nolina	
Ophiopogon	
Otatea	
Panicum	
Pennisetum	
Phalaris	
Phormium	
Phyllcotachyo	
Sealeria	
Sisyrinchium	
Stipa	

NOTE: Plants not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Southern Nevada Water Authority's Water Smart Landscapes Program Plant List, may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).

Appendix C - Plant List, Part 6, Turf/Lawns	
Genus	Common Name
Agrostis	Creeping Bent Grass
Buchloe	
Cynodon Pollenless Hybrids	Bermuda Grass Hybrids
Festuca	Improved Tall Fescues
Lolium	Rye Grass
Paspalum vaginatum	Seashore Paspalum
Poa	Poa trivialis
Stenotaphrum, Secundatum	St. Augustine Grass
Trifolium	White Dutch Clover
Zoysia	Zoysia Grass

Appendix C, Part 7, Allergenic Potential List	
Botanical Name	Common Name
Amaranthus spp	Pigweed
Ambrosia spp	Canyon ragweed
Artemisia tridentata	Sagebrush
Atriplex spp.	Saltbrush
Chrysothamnus nauseosus	Rabbit brush
Cynodon dactylon	Bermuda grass
Juniperus spp.	Juniper
Ligustrum spp	Privet
Morus alba	Mulberry
Olea europaea	Olive
Pennisetum sataceum	Fountain grass
Salsola kali	Russian thistle
Sorghum halepenses	Johnson grass
Tamarix aphylla	Tamarisk, Salt cedar
Ulmus pumila	Siberian elm

NOTE: Plants not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Southern Nevada Water Authority's Water Smart Landscapes Program Plant List, may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).

Appendix C, Part 8, Noxious Weeds	
Botanical Name	Common Name
Peganum harmala	African Rue
Rorippa austriaca	Austrian fieldcress
Sphaerophysa salsula	Austrian peaweed
Swainsona salsula	
Alhagi camelorum	Camelthorn
Isatis tinctoria	Dyer's woad
Galega officinalis	Goats rue
Kalmath weed	Hypericum perforatum
Hemlock	
Poison	Conium maculatum
Water	Cicuta maculata
Horse nettle	
Solanum carolinense	Carolina
Solanum elaeagnifolium	White
Knapweed	
Centaurea diffusa	Diffuse
Centaurea repens	Russian
Euphorbia esula	Leafy spurge
Glycyrrhiza lepidota	Licorice
Salvia aethiopis	Mediterranean sage
Lepidium latifolium	Perennial pepperweed
Tribulus terrestris	Puncture vine
Sorghum	Johnson grass
	Sorghum alum
	Perennial sweet sudan
Centaurea maculosa	Spotted knapweed
Tamarix	Tamarisk, Salt Cedar
Thistle	
Cirsium arvense	Canada
Carduus nutans	Musk
Onopordum acanthium	Scotch
Sonchus arvensis	Sow
Centaurea iberica	Iberian star
Centaurea calcitrapa	Purple star
Centaurea solstitialis	Yellow star
Linaria dalmatica	Toadflax, dalmatian
Cardaria draba	Whitetop or hoary cress

NOTE: Plants not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Southern Nevada Water Authority's Water Smart Landscapes Program Plant List, may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).

Appendix C - Plant List, Part 9, RED ROCK DESIGN OVERLAY DISTRICT		
NATURAL AREA PLANT LIST		
(Plants approved for use within natural areas per Section 30.48.330(e)(1)(B)(iv))		
BELOW 3,500 Feet		
Plant Type	Common Name	Scientific Name
Trees & Shrubs	Creosote Bush	Larrea Tridentata
	Desert Globemallow	Sphaeralcea Ambigua
	Cottonwood	Populus Fremonti
	Gooding's Willow	Salix Goodingii
	Hopsage	Grayia Spinosa
	Mojave Yucca	Yucca Schidigera
	Mormon Tea	Ephedra Viridis, Ephedra Nevadensis
	Range Ratany	Krameria Parvifolia
	White Bursage	Ambrosia Dumosa
Grasses and Forbs	Big Galleta	Hilaria Rigida
	Bush Muhly	Muhlenbergia Porteri
	Desert Marigold	Baileya Multiradiata
	Desert Trumpet	Eriogonum Inflatum
	Sand Dropseed	Sporobolus Cryptandrus
Various Cacti	Barrel Cactus	Ferrocactus Acanthoides
	Cottontop	Echinocactus Polycephalus
	Old Man Cactus (Cholla)	Opuntia Erinacea
	Silver Cactus (Cholla)	Opuntia Echinocarpa
	Staghorn Cholla (Buckhorn Cholla)	Opuntia Acanthocarpa
	Strawberry Hedgehog	Echinocarpus Engelmannii
	Utah Agave	Agave Utahensis
3,500 to 6,000 Feet		
Plant Type	Common Name	Scientific Name
Trees and shrubs	Banana Yucca	Yucca Baccata
	Blackbrush	Coleogyne Ramossissima
	Buckwheat	Eriogonum Californicum
	Horsebrush	Tetradymia
	Joshua Tree	Yucca Brevifolia
	Mojave Yucca	Yucca Schidegera
Grasses and Forbs	Desert Needle Grass	Achnatherum Speciosum
	Desert Trumpet	Eriogonum Inflatum
	Galleta	Hilaria Rigida
	Indian Ricegrass	Orzaopsis Hymenoides
	Purple Three-Awn	Stipa Purpurea
Various Cacti	Barrel Cactus	Ferrocactus Acanthoides
	Cottontop	Echinocactus Polycephalus
	Old Man Cactus (Cholla)	Opuntia Erinacea
	Silver Cactus (Cholla)	Opuntia Echinocarpa
	Staghorn Cholla (Buckhorn Cholla)	Opuntia Acanthocarpa
	Strawberry Hedgehog	Echinocarpus Engelmannii
	Utah Agave	Agave Utahensis

(Ord. 3174 § 10(part), 1/2005; Ord. 2914 § 4, 7/2003)

NOTE: Plants not listed in Appendix C, Plant Materials, and/or not recommended for local use by the Southern Nevada Water Authority's Water Smart Landscapes Program Plant List, may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).

Appendix C - Plant List, Part 10 TREES WITH INVASIVE ROOT SYSTEMS	
Trees listed in this Table are considered to have invasive root systems and are prohibited within 3' of a wall, sidewalk, street, or public utility easement adjacent to a street in required landscape areas. Trees not listed in this Table and/or not recommended for local use by the Southern Nevada Water Authority's <i>Water Smart Landscapes Program Plant List</i> may only be approved by the Zoning Administrator pursuant to Section 30.64.030(e)(3).	
Genus / Species	Common Names
<i>Pinus halepensis</i>	Aleppo Pine
<i>Robinia pseudoacacia</i>	Black Locust
<i>Platanus racemosa</i>	California Sycamore, Western sycamore
<i>Eucalyptus microtheca</i>	Eucalyptus, Coolibah, Flooded Box
<i>Eucalyptus cinerea</i>	Eucalyptus, Gum Tree, Silver Dollar Gum, Argyle Apple, Corkscrew Eucalyptus, Florist's Eucalyptus
<i>Fraxinus velutina</i> "Fan-Tex"	Fan-Tex Ash
<i>Fraxinus velutina</i> "Modesto"	Modesto Ash
<i>Melia azedarach</i> (aka <i>Umbraculiformis</i>)	Texas Umbrella Tree, Chinaberry, Bead Tree, Persian Lilac, Pride of India
<i>Populus fremontii</i>	Fremont Cottonwood
<i>Salix matsudana</i> "Navajo" OR <i>Salix globosa</i>	Globe Navajo Willow, Globe Willow, Navajo Willow
<i>Populus nigra</i> "italica"	Lombardy Poplar
<i>Platanus x acerifolia</i>	London Plane Tree
<i>Quercus rubra</i>	Red Oak
<i>Eleagnus angustifolia</i>	Russian Olive, Oleaster
<i>Ulmus pumila</i>	Siberian Elm
<i>Eucalyptus polyanthemus</i>	Silver Dollar Gum, Silver Dollar, Red Box
<i>Dalbergia sissoo</i> OR <i>Dalbergia latifolia</i>	Sisso, Sissoo, Sissu, Sisham
<i>Salix</i> (all)	Willows (all)
<i>Morus alba</i>	White Mulberry, Fruitless Mulberry, Common Mulberry, Silkworm Mulberry

(Ord. 3174 § 10(part), 1/2005)

**Moapa Valley Water District
Drought Response Water Conservation Implementation Plan**

<u>Event</u>	<u>Response</u>
NO DROUGHT	No restrictions
(DROUGHT WATCH) Static groundwater level decreases by 5 feet	Newspaper, TV, and Radio Notice
(DROUGHT ALERT) Static groundwater level decreases by 10 feet	<p>Reduce yard watering to two days per week. Even numbered residences may water on Wednesdays and Saturdays, while odd numbered residences may water on Tuesdays and Fridays.</p> <p>Commercial establishments including apartments and condominiums may water on Mondays and Thursdays.</p> <p>No washing of driveways or other outside non-irrigation use will be allowed.</p> <p>District personnel will patrol the community for water wasting. Drought punitive water rates will be implemented.</p> <p>Punitive water rates shall be 200% of the current adopted water service rates.</p>
(DROUGHT CRITICAL) Static groundwater level decreases by 20 feet	<p>All outside irrigation will be suspended. Drought punitive water rates will be implemented.</p> <p>Punitive water rates shall be 400% of the current adopted water service rates.</p>

WATER

- www.amsa-cleanwater.org
- www.energystar.gov

DROUGHT

- DroughtMonitor@ndmc.unl.edu

LANDSCAPE

- <http://www.usda.gov/news/garden.htm>

EDUCATION

- www.wateruseitwisely.com
- <http://www.washoeet.dri.edu/>

INSTITUTIONAL

- www.lvwd.com
- www.snwa.com
- www.co.washoe.nv.us/water_dept/rwpc/regionalplm
- www.tmh20.com
- <http://www.cabq.gov>
- www.ci.phoenix.az.us/WATER/wtrteach.html
- <http://www.owue.water.ca.gov/leak/faq/faq.cfm>

LEAK DETECTION

- http://www.who.int/docstore/water_sanitation_health/leakage/begin.html

APPENDIX F – SUBMETERING STUDY EXECUTIVE SUMMARY

**NATIONAL MULTIPLE FAMILY SUBMETERING
AND ALLOCATION BILLING PROGRAM STUDY
EXECUTIVE SUMMARY**

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Multi Housing Council, City of Austin, City of Phoenix, City of Portland, City of Tucson,
Denver Water Department, East Bay Municipal Utility District, San Antonio Water System, San
Diego County Water Authority, Seattle Public Utilities, and Southern Nevada Water Authority

DISCLAIMER

This study was funded by the following agencies and organizations: United States Environmental Protection Agency, National Apartment Association, National Multi Housing Council, City of Austin, City of Phoenix, City of Portland, City of Tucson, Denver Water Department, East Bay Municipal Utility District, San Antonio Water System, San Diego County Water Authority, Seattle Public Utilities, and Southern Nevada Water Authority. The sponsors assume no responsibility for the content of the research study reported in this publication or for the opinions or statements of fact expressed in the report. The mention of trade names for commercial products does not represent or imply the approval or endorsement. This report is presented solely for informational purposes.

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FOREWORD

As water utilities pursue options for new supplies, one option involves capturing savings from water conservation programs. This process also includes continually searching for additional water conservation opportunities through new measures and new technologies. Beneficiaries of improved efficiencies and cost-effective savings include water and wastewater utilities, the utility customer, and the environment.

One potential source of water savings is in the multi-family sector where utilities typically bill the owner through one master meter and the residents pay for their water and wastewater as part of the monthly rent. Embedded in this paradigm is little or no incentive for the end user, the resident, to save water because there is no direct pricing signal since water is paid for in the rent.

As water and wastewater costs increase faster than the rate of inflation, multi-family dwelling owners are seeking to shift these uncontrolled costs directly to the resident instead of including them as part of the rent. Owners are using two basic methods to bill residents. One method involves billing for actual consumption via metering. The second method involves billing based upon an allocation formula, such as the number of people, number of bedrooms, square footage, etc. However, the allocation method does not appear to provide an incentive for residents to save water because the pricing signal is diluted since the charge is based upon a pre-determined formula and not on actual use. One of the primary objectives of this study was to investigate the savings potential if multi-family residents are billed for their use either through actual metering or some type of allocation formula.

Nationally, up to 4% of multi-family residents may now be metered and charged for their consumption based upon actual volume of use. Another 9% pay for their water through various allocation formulas and about 2% are billed through a combination of metering and allocation programs. That leaves about 85% of multi-family residents still paying for their water and wastewater as part of their rent, often referred to as "in-rent". Because the water use of around 60 million people, 20-25% of all residents, could be reduced, there is a great deal of interest in the potential water savings, the cost and benefits involved in capturing savings, and the administrative issues associated with separate billing programs. While some utilities are metering individual multi-family dwelling units, most are not. And while still other utilities have

investigated local water savings associated with separate billing systems, such as the City of Austin, Las Vegas Valley Water District, San Antonio Water System, and Seattle Public Utilities, study funding partners agreed that much more empirical data were needed on this subject.

The study had five main objectives: 1) to determine the water savings potential in the multi-family sector resulting from both direct metering and allocation programs, 2) to understand the current regulatory framework governing separate billing programs across the U.S., 3) to access the current business practices in the billing service companies (read and bill industry), 4) to draw conclusions from the findings, and 5) to make recommendations that offer consumer protection, provide ethical business practices for the industry, and capture cost-effective water savings.

This report reflects the results of an effort that began over three years ago in cooperation with the EPA, two national apartment associations, and 10 water utilities. It is hoped that the information presented in this report will be found timely, useful, and objective; will add to the current body of knowledge; and that the appropriate organizations, including water utilities, will consider adopting and implementing the study's recommendations.

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This research would never have been completed without the cooperation of the multi-family property owners, managers, and residents that completed the various mail and telephone surveys conducted in this study.

This study would not have been possible without the vision and generous resource commitments from the following sponsoring organizations: United States Environmental Protection Agency; National Apartment Association; National Multi Housing Council; City of Austin; City of Phoenix; City of Portland; City of Tucson; Denver Water Department; East Bay Municipal Utility District; San Antonio Water System; San Diego County Water Authority; Seattle Public Utilities; and Southern Nevada Water Authority.

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Finally, this project would never have come to fruition without the guiding spirit of the project manager Dick Bennett of the East Bay Municipal Utility District. He conceived, organized, and administered the project from day one. His support, diligence, management skills, and enthusiasm were instrumental in every phase of this effort.

EXECUTIVE SUMMARY

More and more buildings in the multi-family housing sector are converting to systems where each multi-family dwelling unit pays for water and wastewater directly instead of including these charges as part of the rent. The three most common ways in which separate billing is accomplished are: (1) Through direct submetering of water use by means of a water meter installed on a single or multiple points of entry water line(s); (2) Through a Ratio Utility Billing System (RUBS), which bases the water bill on an allocation formula that uses floor space, number of occupants, etc.; or (3) A hybrid of the two where total water use is estimated based on the ratio of metered hot (or cold) water use (and sometimes selected appliances) in a unit to the total water use of all occupants. It is estimated that there are now more than 1.2 million apartment renter households that are billed separately for water and sewer using one of these billing system methods (NMHC 2001).¹

RESEARCH OBJECTIVES

The goals of the National Multiple Family Submetering and Allocation Billing Program Study were to determine the merits of separate billing programs including the potential water savings, costs and benefits from various perspectives, and the accompanying administrative and regulatory issues. In the study, a retrospective analysis of water use in multi-family properties in 13 cities was conducted. The 13 study cities were weighted towards the West and southwestern region of the United States, but contain a wide variety of utilities serving a broad and diverse group of customers. Properties equipped with submeters or that have undergone a billing system conversion (impacted properties) were identified and compared against control (in-rent) properties where water and wastewater fees are included as part of the rent. The study compared the two groups using historic billing data provided by participating water utilities combined with an extensive series of mail surveys and site visits. The data collected for study provides a wealth of information about how submetering and allocation affect water use, property owners, and residents. Embedded in these data are insights into this developing industry, including the

¹ Based on data from the 2001 American Housing Survey. Assumes a multi-family property has at least five dwelling units. The number is higher if smaller properties are included in the analysis.

quantitative aspects of separate billing. The data are also useful for examining the impacts of the 1992 Energy Policy Act plumbing standards and other factors that may influence water use. It is anticipated that the database of submetered and allocated billing program information developed for this study will be a resource for researchers and planners to explore for years to come, particularly if it is maintained and updated.

TERMINOLOGY AND DEFINITIONS OF BILLING METHODS

The following terms and definitions are used throughout this report.

In-Rent Properties

In-rent properties refer to all properties where the owner does not separately bill residents for water and wastewater. A slight variation of this standard “in-rent” arrangement can occur when there is a homeowners association (HOA) at a property that collects flat monthly fees.

Impact Properties

Impact properties refer to all properties that bill separately for water and/or wastewater by submetering, ratio utility billing systems, or a hybrid of the two. Within these different billing methods, the party actually billing for water needs to be defined. The *owner* refers to either an individual or an organization that owns and/or manages a rental property. A third-party *billing service company* (billing company) is a private, for-profit entity that provides billing services for water, wastewater, trash collection, and energy to owners of multi-family properties. A *utility* is a regulated provider of water and/or wastewater service to a set of customers. Utilities may be public or private entities and they are responsible for treating, delivering, and billing for water and/or wastewater.

Submetering

Submetering in this report is defined as full capture metering that occurs downstream of a water utility master meter. There are three different types of submetering that can occur:

Single point of entry submetering

Dual point of entry submetering

Point-of-use submetering

Hybrid Metering

Hybrid metering, referred to as “hot water hybrid” (HWH) in this report, are billing systems where only a portion of the water such as the hot water consumption (or occasionally the cold water) for each unit in a multi-family dwelling is measured. This information is then typically used to extrapolate the total water bill.

Ratio Utility Billing Systems

Ratio utility billing systems (RUBS) use an allocation formula to estimate water consumption for each unit in a multi-family dwelling. RUBS systems are not based on the actual consumption at each unit, rather individual bills are prorated from the overall utility master meter bill based on one or a combination of quantitative measures such as square footage, number of occupants, or number of fixtures.

RESEARCH APPROACH

The project team developed a multifaceted approach to accomplish the research objectives set out for this study.

1. **Selection of participating study sites:** After invitations were sent to utilities and water providers across the United States and Canada followed by personal phone calls and contact, representatives from 13 study sites volunteered to participate and partially fund this research. These 13 participating water providers were: (1) Denver Water, Colorado; (2) Seattle Public Utilities, Washington; (3) City San Diego Water Dept., California; (4) Hillsborough County, Florida; (5) City of Phoenix, Arizona; (6) City of Tucson, Arizona; (7) City of Austin, Texas; (8) San Antonio Water System, Texas; (9) City of Portland, Oregon; (10) East Bay Municipal Utility District, California; (11) Irvine Ranch Water District, California; (12) City of Indianapolis, Indiana; and (13) Southern Nevada Water Authority & Las Vegas Valley Water District, Nevada. Participation required the utility to provide complete billing data for the multi-family subclass from their service area and project support.
2. **Quality assurance and quality control (QAQC):** Procedures to ensure the quality of the data and the research methods were implemented throughout the study.

3. **Owner/postcard survey:** To identify “impact”² properties in each utility, owner surveys were developed, tested and implemented to all eligible properties in each utility. This survey was necessary because in most cases there was no independent source of information about what properties use the various billing systems in any utility service area, and the study did not want to rely on information supplied solely from the billing companies, many of whom could not share their client lists in any case. In order to avoid a fatal bias in the study group selection, postcards were sent to all owners of multi-family properties listed in the water providers billing databases. The responses from this survey were used to identify the impact properties.
4. **Database development:** All data collected in this study including historic water billing records and survey response data were stored in a customized Microsoft Access database.
5. **Manager survey:** To obtain detailed information about properties identified in the owner/postcard survey, a survey was developed, tested and sent to managers of impacted and in-rent properties.
6. **Regulatory and policy review:** To evaluate the administrative and regulatory issues surrounding third party billing programs throughout the country, surveys were sent to various potential regulators in all 50 states and to more than 100 of the largest water and wastewater utilities. Additionally a detailed policy literature review was conducted.
7. **Matched pair selection and site visits:** Study team utilized the results from the manager survey to make statistically similar pair matches for site visits and comparison. A site visit protocol was developed and the study team worked with participating utilities to conduct site visits.
8. **Resident survey:** To solicit resident opinions and experiences with different billing methods, a survey instrument was developed, tested, and sent to residents using addresses provided on the manager survey. Some residents also provided copies of their water and wastewater bills sent by various read and bill companies or owners.
9. **Read and bill company survey:** To obtain information about billing practices and policies a survey was sent to 36 third party billing companies.
10. **Statistical analysis and modeling:** Once the data collection and analysis was complete, the

² Impact properties – multi-family properties billing separately for water and/or wastewater services using RUBS, submetering, hot water hybrid, or other methods.

research team used all of the assembled information to develop analytical tools and relationships to quantify potential water savings and explain indoor multi-family residential water use.

11. **Final products:** The final products of this research project include this final report and the database.

RESEARCH FINDINGS

Prevalence of Billing for Water and Wastewater at Multi-family Properties

RUBS, submetering, or hybrid metering was reported in 13.4% of the 7942 properties that responded to the owner/postcard survey. However, looking at the number of units indicated on the postcard survey, 35.4% of units are billed through RUBS, submetering, or hybrid systems. This represents the best estimate from this study of the prevalence of this practice in the multi-family sector. The postcard survey was sent to the owner of every multi-family property in the billing databases of the participating study sites that fit the initial criteria³. Nation-wide the prevalence of separate billing for water and wastewater may be somewhat less because the study sites selected to participate in this study often had a notable concentration of properties receiving water and wastewater bills based on data provided by billing service companies.

Table ES.1.1 Breakdown of each billing method for all properties identified

		Billing Method					Total
		In-Rent	HWH	Sub.	RUBS	Other ^a	
All respondents	Properties	6760	42	311	717	142	7972
	% of properties	84.8%	0.5%	3.9%	9.0%	1.8%	100%
	Units	286,355	3,912	47,547	112,049	10,400	460,263
	% of units	62.2%	0.8%	10.3%	24.3%	2.3%	100.0%

^aIncludes "Other" as well as respondents who left the question blank.

Estimated Water Use By Different Billing Methods

One of the central purposes of this study was to determine the water savings associated with submetered and allocation billing programs in multi-family housing. This research question was the over-arching theme for the entire project and a majority of time and effort was spent collecting and analyzing data to provide information on the potential water savings from submetering and RUBS. Keep in mind that this study did not set out to estimate national

"averages" of impact property water use, and the selected properties were not selected to be representative of the entire United States. Rather the primary goal was to determine the impacts of different billing programs.

Why are water savings so important? Water providers are keenly interested in identifying effective approaches to reducing water demand, as new supplies become increasingly expensive and difficult to obtain. National and state agencies are interested in improving water efficiency and promoting proven methods for achieving savings. The utility billing industry has promoted the practice of charging multi-family customers for water and wastewater services not only as a way to improve property owners' net operating income, but also as a way to effect water conservation. Water savings could provide justification for encouraging, promoting, and expanding billing programs and could unite water providers, regulators, and billing companies in a common goal. As a result there has been intense interest in this question.

To reach a conclusion regarding how water use differs between billing types, seven main analyses were conducted. The number of properties included in each analysis is included in Table ES.1.2. The results of each analysis are discussed in the sections that follow.

Table ES.1.2 Number of properties included in each analysis, by billing type

Description of Analysis	Number of Properties by Billing Method				Total
	In-Rent	Sub.	RUBS	HWH	
Postcard Survey	6493	273	595	41	7402
Manager Survey	858	118	177	22	1175
Statistical Model #1	705	101	150	-	956
Statistical Model #2	703	100	150	-	953
Statistical Model #3	531	79	136	-	746
Matched Pair	29	21*	14	-	64
Pre-Post Conversion	-	6	39	1	46

*7 HWHs were grouped with the submetered for this analysis

Submetering

Submetering was found to achieve statistically significant water savings of 15.3 percent (21.8 gal/day/unit) compared with traditional in-rent properties after correcting for factors such as year of construction (before 1995, 1995 or later), average number of bedrooms per unit, presence of play areas, presence of cooling towers, utility's average commodity charge for water and wastewater, whether a property was a rental or individually owned, and classification of the

³ See Chapter 3 for details.

property as a retirement community. Not all submetered properties used less water and the statistical model that demonstrated these savings predicted only about 25% of the variability in water use in the observed properties. Summarized water use analysis comparing submetered and in-rent properties is shown in Table ES.1.3. Statistically significant savings from submetering was found in every single comparison and analysis conducted in this study. Water savings ranged from -5.55 to -17.5 kgal per unit per year, or -15.20 to -47.94 gallons per unit per day (gpd) which is between -11% to -26%. Based on an evaluation of the different data sets, analyses, and models, the researchers concluded that multivariate model #2, highlighted in blue, provides the “best estimate” of expected water use and savings at submetered properties⁴. The number of properties used in each analysis can be seen in Table ES.1.2.

Table ES.1.3 Summarized water use analysis results, submetering

Data source or Analysis	Annual Indoor Water Use per Unit kgal (gpd)		Estimated Difference in Water Use (\pm 95% confidence interval)	Statistically Significant at 95% confidence level?
	In-Rent (or pre-conversion)	Submetering		
Postcard Survey	53.21 (145.8)	44.87 (122.9)	-15.7% \pm 6.2%	yes
Manager Survey	51.61 (141.4)	46.07 (126.2)	-10.7% \pm 9.3%	yes
Model #1	52.33 (143.4)	43.73 (119.8)	-16.4% \pm 9.3%	yes
Model #2	52.19 (143.0)	44.23 (121.2)	-15.3% \pm 9.3%	yes
Model #3	53.19 (145.7)	43.14 (118.2)	-18.9% \pm 10.3%	yes
Matched Pair	57.59 (157.8)	47.61 (130.4)	-17.3% \pm 17.0%	yes
Pre-Post Conversion	68.21 (186.9)	50.71 (138.9)	-25.7% \pm 27.2%	yes*
Conclusion	52.19 (143.0)	44.23 (121.2)	-15.3% \pm 9.3%	yes

* Test was significant at the 94% confidence level.

RUBS

This study found no evidence that Ratio Utility Billing Systems (RUBS) reduced water use by a statistically significant amount compared with traditional in-rent arrangements, and the data showed that the difference between water use in RUBS and in-rent properties was not statistically different from zero. While some RUBS properties used less water on average than

⁴ Submetered properties were identified by manager survey responses. Through the site visits, it was found that 3 out of 20 properties visited (15%) had indicated on the manager survey that they were submetered, but were found to only be metering the the hot water. Thus, the submetered sample is likely to contain some hot water hybrids.

in-rent properties, others used the same or more water on average than in-rent properties. Summarized water use analyses comparing RUBS and in-rent properties are shown in Table ES.1.4. Typically the 95 percent confidence interval for RUBS spanned a range that included an increase in expected water use as well as water savings. Statistically significant water use savings from RUBS were detected in only a single comparison test – the matched pair sample. The matched pair comparison relied on the smallest RUBS sample size in the study and, as explained in detail in the body of the report, the in-rent control sample did not appear to be representative of the population of in-rent properties in the study. Based on an evaluation of the different data sets, analyses, and models, the researchers concluded that multivariate model #2, highlighted in blue, provided the single “best estimate” of expected water use at RUBS properties. After correcting for a wide variety of factors and evaluating numerous different analytic models, the researchers concluded that no statistically significant impact from RUBS could be reliably expected. The number of properties used in each analysis can be seen in Table ES.1.2.

Table ES.1.4 Summarized water use analysis results, RUBS

Data source or Analysis	Annual Indoor Water Use per Unit kgal (gpd)		Estimated Difference in Water Use (± 95% confidence interval)	Statistically Significant at 95% confidence level?
	In-Rent (or pre-conversion)	RUBS		
Postcard Survey	53.21 (145.8)	52.10 (142.7)	-2.1% ± 4.3%	no
Manager Survey	51.61 (141.4)	53.45 (146.4)	3.6% ± 7.8%	no
Model #1	52.33 (143.4)	52.76 (144.5)	0.8% ± 7.4%	no
Model #2	52.19 (143.0)	52.58 (144.1)	0.7% ± 7.4%	no
Model #3	53.19 (145.7)	51.48 (141.0)	-3.2% ± 7.7%	no
Matched Pair	66.19 (181.3)	47.80 (131.0)	-27.8% ± 19.2%	yes*
Pre-Post Conversion	55.32 (143.4)	52.85 (144.4)	-4.5% ± 8.8%	no
Conclusion	52.19 (143.0)	52.58 (144.1)	0.7% ± 7.4%	no

* Results from this analysis are further explained in Chapter 5.

Hot Water Hybrid

Hot water hybrid billing systems may achieve water savings, however in this study the sample of hot water hybrid properties was too small to produce reliable results that can be

generalized to the broader population. Analysis of data from the limited sample of hot water hybrid properties does suggest that water savings, somewhat smaller than the magnitude found in submetering, *may* be achieved through this billing methodology. This study was unable to verify this finding of savings in a reliable, statistically rigorous manner because of the small sample size. Summary water use analysis results for hot water hybrid properties are shown in Table ES.1.5. The number of properties available for each analysis can be seen in Table ES.1.2. It should be noted that during the site visits it was discovered that 15% of the hot water hybrid properties had been mislabeled by the managers as submetered. This indicates that HWHs may be more common than originally thought, and is suggestive that they may have comparable savings to submetering. However, further research is needed to verify this.

Table ES.1.5 Summarized water use analysis results, hot water hybrid

Data source or Analysis	Annual Indoor Water Use per Unit kgal (gpd)		Estimated Difference in Water Use (\pm 95% confidence interval)	Statistically Significant at 95% confidence level?
	In-Rent (or pre-conversion)	Hot Water Hybrid		
Postcard Survey	53.21 (145.8)	49.61 (135.9)	-6.8% \pm 15.7%	no
Manager Survey	51.61 (141.4)	44.79 (122.7)	-13.2% \pm 20.5%	no

Multivariate Model Results – Best Estimate of Water Use and Savings

The purpose of the multivariate regression modeling and analysis in this study was to account or “correct” for factors that influence water use so that submetered and RUBS properties could be compared against in-rent properties on an equal basis. For example, if a submetered property was built in 1998 and equipped with water efficient fixtures it was important to correct for this so that water savings associated with the efficient fixtures not be incorrectly attributed to submetering when comparing against in-rent properties built before EPACT plumbing standards were put in place.

Using the relevant factors identified through the ANOVA and Pearson Correlation analyses, numerous multivariate regression models were developed using identified factors as the independent variable and annual indoor per unit water use as the dependent variable.⁵ Nearly all

⁵ Indoor water use was normalized by total number of units rather than on occupied units because vacancy rates were not found to be a statistically significant factor. Indoor water use was not normalized on a per occupant basis because many survey respondents left that question blank thus reducing the potential sample size. In addition, the

of these models included the billing methodology (submetering or RUBS) as a factor. The results of this methodology are a set of models that account for a variety of different factors shown to influence water use. At the same time these models also evaluate the impact of submetering vs. in-rent billing and RUBS vs. in-rent billing. Step-wise regression was also used to create a multivariate model that includes all of the relevant independent variables shown to have statistical significance.

The single most statistically powerful predictive multivariate regression model developed in this study was Model #2. This model was selected as the "best estimate" of water use and savings in submetered and RUBS properties because of the large sample size ($n=953$), because it had one of the highest coefficients of determination ($R^2=0.245$) of any of the more than 50 models examined by the researchers, and because the overall model was found to be statistically significant at the 95% confidence level. Model #2 includes eight independent variables identified as significant from the ANOVA and Pearson Correlation analyses. In addition, a ninth variable, the use of a RUBS, was forced into the model. Even though it was not found to be statistically significant whether a property used RUBS was central to this study and it was important that the variable be included explicitly. The resulting nine independent variables were:

- Average number of bedrooms per unit
- Year the property was built (1994 and earlier or 1995 and later)
- Rental property (private and government subsidized) vs. non-rental properties (i.e. condominiums, private resident owned, and other)
- Utility's average commodity charge for water and wastewater
- Presence of a play area
- Presence of a cooling tower
- Classification as senior citizen/retirement community
- RUBS
- Submetering

Fundamental information and statistics from the regression model are presented Table ES.1.6. The adjusted coefficient of determination (R^2) for Model #2 is 0.245. This indicates that the model explains about 25 percent of the variability in the data. The coefficient of determination (R^2) is a measure of the goodness of fit of the model to the actual data on which

site visits determined that the reported number of residents was a less accurate value than the reported number of

the model was based. A model with a perfect fit would have an R^2 value of 1.0. The P-value for the model itself is 0.00 indicating that whatever fit does exist is statistically significant at the 95% confidence level.

Table ES.1.6 Model #2 summary statistics, coefficient of determination, and significance

R	R Square	Adjusted R Square	Std. Error of the Estimate	Degrees of Freedom	F	P-value
0.502	0.252	0.245	21.39659	952	35.366	0.000

Predictors: (Constant), submetering, rental property (compared to non-rental property), play area, cooling tower, is the property considered a senior citizen/retirement community, average price utility charges for water and wastewater, RUBS, property built before 1995 (compared to properties built 1995 or later), average number of bedrooms per unit

Dependent Variable: Indoor water use per unit (average 2001, 2002)

The coefficients presented in Table ES.1.7 present the magnitude of the “effect” of the different independent variables in the model. The coefficients are additive, and details about how to formulate the generic equation from these coefficients are found in the body of the report. Of particular interest are the coefficients for RUBS and submetering. In Model #2, eight of the nine independent variables were statistically significant. The only factor that wasn’t statistically significant was RUBS. The B coefficient shows the magnitude of the effect, and is graphically displayed in Figure ES.1.1 and Figure ES.1.2. For submetering the B coefficient was -7.96 indicating that submetered properties used 7.96 kgal per unit *less* water than in-rent properties after adjusting the other significant independent variables. This effect was statistically significant at the 95% confidence level.

The B coefficient is a measure of the effect of each factor in the model. It is worth noting that three factors in this model were found to be more significant influences on multi-family water use than submetering. These are: (1) whether the property was built before 1995; (2) whether the property has a cooling tower; and (3) the average number of bedrooms per unit.

Another three factors were found to have an influence on water use with similar magnitude to submetering. These are: (1) whether the property is a senior/retirement community; (2) whether the property has a play area; and (3) whether the property is a rental.

units. Finally, the relationship between total indoor water use at a property and number of units was almost linear.

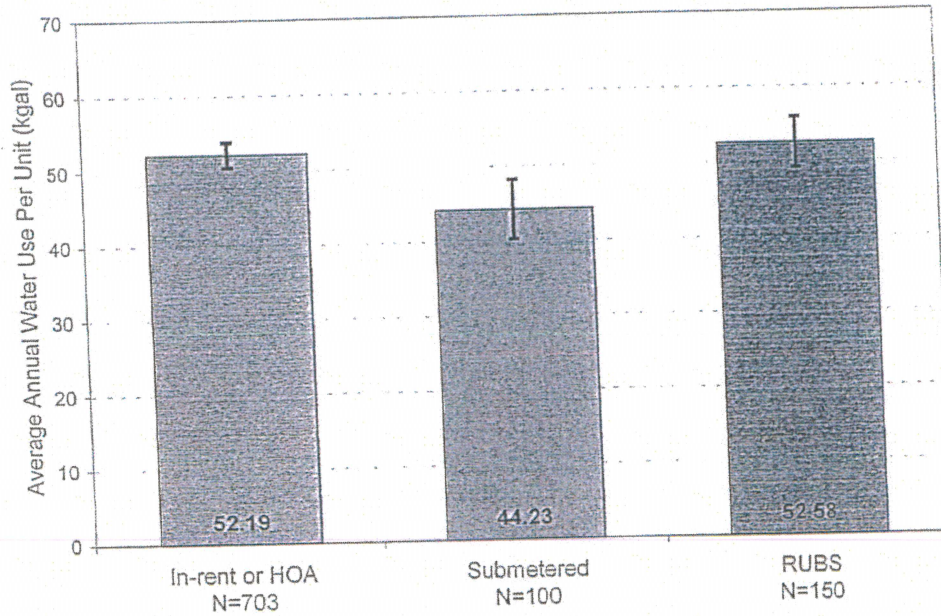


Figure ES.1.1 Adjusted average annual water use per unit – Model #2

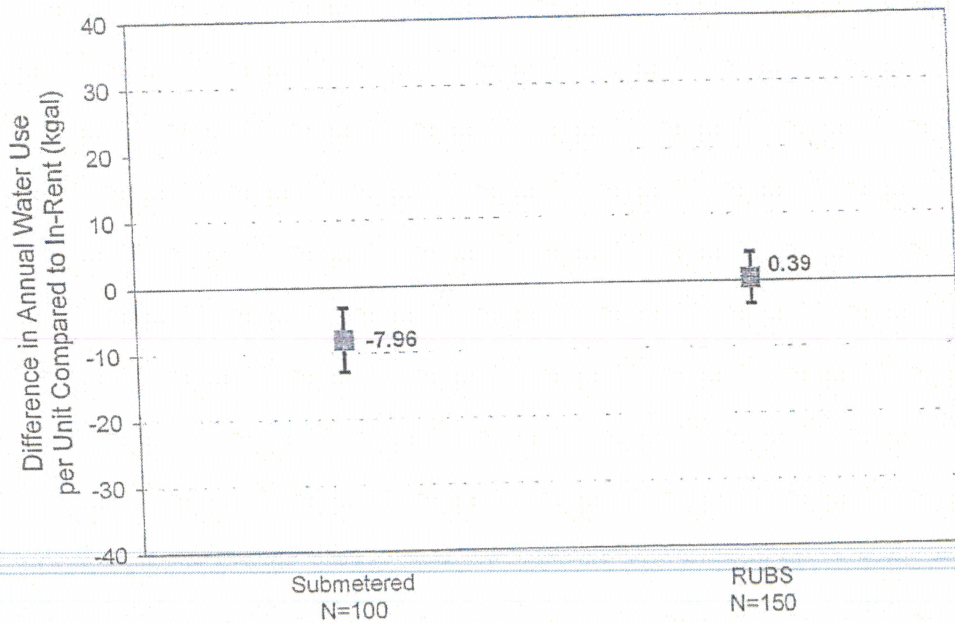


Figure ES.1.2 Difference in adjusted average annual water use of impacted properties compared to in-rent properties – Model #2

Table ES.1.7 Model #2 coefficients and significance of independent variables

Independent Variable	B*	Std. Error	t	P-value
(Constant)	19.95	4.61	4.323	.000
Property was built before 1995	10.84	2.29	4.736	.000
Property is a senior citizen/retirement community	-6.70	2.56	-2.618	.009
Property has a play area	6.80	1.94	3.513	.000
Property has a cooling tower	11.55	3.31	3.493	.001
Property is a rental [†]	6.84	1.74	3.926	.000
Property is billed through RUBS method	0.39	1.98	0.197	.844
Property is submetered	-7.96	2.47	-3.225	.001
Average commodity charge for water/wastewater [‡]	-2.01	.28	-7.072	.000
Average number of bedrooms per unit [‡]	17.44	1.54	11.313	.000

Dependent Variable: Indoor water use per unit (average 2001, 2002)

* Represents the magnitude of each independent variable in kgal per year per dwelling unit

[†] Rentals include private and government subsidized rentals. (Non-rentals include condominiums, private resident owned, and other).

[‡] Continuous variables, change is seen for every dollar or bedroom added.

Besides submetering, seven other independent variables (listed in Table ES.1.7) in the model were also statistically significant. Properties built before 1995 used 10.8 kgal per unit *more* than properties built after 1995 – this is presumably largely the result of the high efficient plumbing fixtures (toilets, showerheads, and faucet aerators) mandated for new construction by the 1992 Energy Policy Act (EPACT). The average number of bedrooms per unit is a reasonable surrogate for the number of people living in each dwelling unit. These models suggest that for every additional bedroom water use is *increased* by an average of about 17.4 kgal per unit. Rental properties used 6.8 kgal per unit *more* than properties that were non-rentals (condominiums, private resident owned, and other). Properties classified as senior citizen or retirement communities used 6.7 kgal per unit *less* than standard mixed-age multi-family properties. For every dollar increase in the average price charged by a utility per kgal, the water use at a property decreased 2.0 kgal per unit. Properties that reported having a play area used 6.8 kgal per unit *more* than properties without that amenity. The presence of a cooling tower increased per unit water use by 11.6 kgal. The prevalence of each of these characteristics in the manager survey respondents can be found in Chapter 4's section on "Manager Survey Results" or in the enumerated manager survey results in Appendix B.

COSTS AND BENEFITS

Beyond quantifying the water savings that can be measured by implementing a multi-family water and wastewater billing program, there are many issues that arise concerning these systems for utilities, for property owners, and for residents. As is true with any developing field, there are clear advantages to these systems, as well as costs and drawbacks that need to be addressed.

Utility Perspective

Supporting the installation of submeters represents an opportunity for water utilities to capture cost-effective water savings. Savings can be captured in new construction by either requiring the individual metering of multi-family units or by offering incentives in both existing and new multi-family dwellings. Because RUBS has not been found to render reliable savings, it is not cost-effective for utilities to offer incentives promoting RUBS programs. However, since the findings of this report indicate that the savings from fixture upgrades are more substantial than from submetering, utilities should consider offering cost-effective incentives for change-outs for all multi-family properties.

Table ES.1.8 shows a range of avoided costs for utilities, assuming annual savings of 7.96 kgal per dwelling unit (du) (21.8 gallons/du/day) from submetering. A utility avoided cost of \$500/AF would translate into a present value savings of \$152 for each dwelling unit that is submetered, assuming a 20 year useful life. The present value of benefits to the utility could be considered a justifiable subsidy that the utility could offer for submetering or other conservation efforts. Obviously, agency avoided cost and assumptions about product life impact the value of submetering for each utility.

Owner Perspective

In most cases, billing separately for water and wastewater will increase the owner's net operating income and property value. Despite the initial capital investment, submetering can be a cost-effective option for owners. In addition, submetering technology has improved so that the cost for submetering new construction and submetering most existing properties is reasonable. In the case of allocation, there is no initial investment and the payback is immediate. Owners could use this increase in income to improve overall water efficiency on the property, including

fixture upgrades. Nevertheless, before converting to a separate billing system, owners should be aware of the applicable federal, state, and local regulations.

Table ES.1.8 Avoided costs from submetering, utility perspective

Annualized Combined Water and Sewer Avoided Cost		Equivalent PV Avoided Cost*	Water Saved	Submeter Useful Life†	Value of Water and Sewer Benefits	PV of Benefits to Utility‡
(\$/acre-ft)	(\$/kgal)	(\$)	(gal/du/year)	(years)	(\$/year)	(\$)
\$200	\$0.61	\$3,432	7,957	20	\$5	\$61
\$300	\$0.92	\$5,148	7,957	20	\$7	\$91
\$400	\$1.23	\$6,864	7,957	20	\$10	\$122
\$500	\$1.53	\$8,580	7,957	20	\$12	\$152
\$600	\$1.84	\$10,295	7,957	20	\$15	\$183
\$700	\$2.15	\$12,011	7,957	20	\$17	\$213
\$800	\$2.46	\$13,727	7,957	20	\$20	\$243
\$1,000	\$3.07	\$17,159	7,957	20	\$24	\$304

* Assumes discount rate of 5% and a term of 40 years.

† Assumes that AMR submeters will be replaced twice in twenty years.

‡ Assumes discount rate of 5% and the assumed term of the submeter useful life (in this case, 20 years).

Table ES.1.9 shows the benefit/cost analysis for the life-cycle of a variety of submeter installation costs. In all of the cases, the owner is assumed to pay the monthly service fee. The benefit/cost ratio varies from 1.9 to 5.1 in all of the cases, assuming a utility water and wastewater commodity charge of \$5.27⁶. It should be noted that many owners would not stay with a property for the life cycle of submeters, rather most only own a property for an average of five years. If one looks at the simple payback for owning a property for five years, using the same assumptions from Table ES.1.9, the simple payback is less than one year for all cases. Table ES.1.10 shows the benefit/cost ratios for owners who chose to allocate. Here, the benefit/cost ratios range from 4.9 to 7.6.

A key component in these analyses is an assumption that the owner does not reduce the rent to the residents as part of a submetering program. The result is a net increase in rental costs to residents, and the researchers found that this was the most common practice during billing conversion. It is possible that an owner might choose to reduce rental rates in an amount similar to what each resident is paying for water every month. If the owner were also to pay the monthly

service charge, then the resident would experience no net increase in rental costs and the owner's benefit/cost ratio would be reduced substantially. This does not appear to be a common practice.

Resident Perspective

Based on the results obtained in the resident survey, consumers have varied opinions on water billing programs. Often these programs result in a water bill in addition to a monthly rent charge. While consumers receive electric or gas bills, many have come to expect that water charges are included in the rent. As currently practiced, water and wastewater billing programs do not appear to be an appealing option for residents of multi-family dwellings. Also, residents are typically charged a service fee (in conformance with applicable state and local law) in addition to their volumetric or allocated charge. Thus, in the short term, these billing programs cause an increase in monthly costs for residents. While there may be environmental benefits such as increased water conservation, there are many uncertainties involving separate billing that could be perceived as negative. Until separate billing for water and wastewater has some definitive standards and protections for residents, it is unlikely that most residents will embrace it. Direct metering and billing of water for apartment residents encourages water efficiency and promotes a water billing system that is as transparent as other utilities like gas and electricity, phone and cable whereby residents pay for what they use.

If a property owner were to reduce the rent in the approximate amount of the total water and wastewater bill (including the service fee), then the resident might experience no net increase in rental costs if all else is held constant. As noted above, this does not appear to be a common practice. If the property owner were to pay the service fee as recommended (see Recommendation 8, subsection 9), then the overall cost impact to the resident might be reduced. However as practiced today, it appears that water and wastewater billing programs result in increased costs for residents.

⁶ This was the average of the water and wastewater commodity charges for the thirteen study sites.

Table ES.1.9 Cost and benefit per unit analysis for owners who chose to submeter

Submetering Method	Efficient Fixtures?	Annual Water Use* (gal/du)	Useful Life† (years)	Annual Value of Water and Sewer Benefits‡	Capital or "First" Costs (\$/du)			Annual Service Fee§§	Meter Replacement***	PV of Costs †††	B/C Ratio
					Meter, Transmitter, and Installation**	Receiver, Computer, and Software††	Fixture Replacement ‡‡				
Submeter - New Construction	Yes	52,195	20	\$275	\$125	\$25	\$0	\$ 36	\$125	\$675	5.1
Submeter - Retrofit	Yes	52,195	20	\$275	\$300	\$25	\$0	\$ 36	\$125	\$850	4.0
	No	52,195	20	\$275	\$300	\$25	\$255	\$ 36	\$125	\$1,105	3.1
	Yes	52,195	20	\$275	\$560	\$25	\$0	\$ 36	\$300	\$1,597	2.1
POU metering†††	No	52,195	20	\$275	\$560	\$25	\$255	\$ 36	\$300	\$1,852	1.9

* Based on the total water use of the average in-rent unit (143.0 gal/du/day)

† Assumes that Automatic Meter Reading (AMR) equipment is used, and that based on current technology, that the battery life is limited to 10 years, and it is best to replace the entire meter, register, transmitter, and battery at same time (even though standard life for a meter is 15 years). Assumes that POU's will need to be replaced every 5 years.

‡ Based on a commodity charge for water and wastewater of \$5.27 per kgal (the average commodity charge for the thirteen study sites).

§ The present value of annually occurring benefits is calculated with a discount rate of 5%.

** May vary by property and location.

†† Calculated on a per property basis. This assumes a \$2,500 base cost spread over 100 units.

‡‡ Includes hardware and installation cost for a dwelling unit that is retrofit with 1.2 toilets for \$234, 2 aerators for \$4, and 1 showerhead for \$17. Not applicable to dwelling units that have already been equipped with hardware operating within 125% of EPACT standards. Only accounts for the first time cost, does not account for any ongoing replacement/maintenance schedule at the property.

§§ Assumes monthly service fee of \$3 is paid by owner.

*** Replacement costs for submeters (which will be replaced every 10 years) and POU meters (which will be replaced every 5 years).

††† The present value of annually occurring costs is calculated at a discount rate of 5%.

††† Assumes 7 meters per apartment, and \$80 per meter (includes hardware and installation).

Table ES.1.10 Cost and benefit for owners who choose to allocate

Billing Method	Efficient Fixtures?	Annual Water Use* (gal/du)	Useful Life† (years)	Annual Value of Water and Sewer Benefits†	PV of Benefits‡	Fixture Upgrade Cost** (\$/du)	Annual Service Fee†† (\$/du)	PV of Costs	B/C Ratio
RUBS	Yes	52,195	20	\$275	\$3,428	\$ 0	\$ 36	\$449	7.6
	No	52,195	20	\$275	\$3,428	\$ 255	\$ 36	\$704	4.9

* Based on the total water use of the average in-rent unit (143.0 gal/du/day).

† Assumes that the program will be in place for 20 years.

‡ Based on a commodity charge for water and wastewater of \$5.27 per kgal (the average commodity charge for the thirteen study sites).

§ The present value of annually occurring benefits is calculated with a discount rate of 5%.

** Includes hardware and installation cost for a dwelling unit that is retrofitted with 1.2 toilets for \$234, 2 aerators for \$4, and 1 showerhead for \$17. Not applicable to dwelling units that have already been equipped with hardware operating within 125% of EPACT standards. Only accounts for the first time cost, does not account for any ongoing replacement/maintenance schedule at the property.

†† Assumes monthly service fee of \$3 is paid by owner.

‡‡ The present value of annually occurring costs is calculated at a discount rate of 5%.

ANALYSIS OF PRICE ELASTICITY

Economic goods have a downward sloping demand curve. This means that the higher the price of the good, the less of it that is purchased. Within this broad statement, specific goods respond very differently to price. Some goods respond very little to price change, and others respond strongly. Economists have developed the concept of “price elasticity of demand” to characterize these differences. Price elasticity of demand is defined for each point on the demand curve as: The percentage change in consumption per percentage change in price. Since elasticity is a percent divided by a percent, it is a unitless number.

The elasticity analysis examined the price elasticity of water use based on utility water and wastewater rates. To simplify the analysis, the average non-seasonal (indoor) water use per unit per year in kgal (using 2001 and 2002 billing data) was calculated for each participating study site. These values were then plotted against the combined utility water and wastewater rate in \$/kgal. The results are shown in Figure ES.1.3. The cost for water and wastewater ranged substantially from \$2.83/kgal to \$10.11/kgal, providing a useful data set for analysis. To improve the model fit, the data point from Indianapolis was removed from the elasticity model. Indianapolis was the only study site to feature a declining block rate structure (i.e. the more water used, the lower the price). All other utilities had either flat rate or increasing block rate structures designed to send an increasing price signal as demand increases.

Two regression equations and curves were fit to these data to determine the price elasticity of demand – a straight line and a power curve. The fit of both models was quite good and the range of elasticities calculated fits well with previous research in this area. The straight line model had the highest coefficient of determination (r^2) value of 0.6437. Elasticities calculated through the straight line model ranged from -0.12 at \$2.83/kgal to -0.65 at \$10.11/kgal with an average of -0.29 and a median of -0.20. The constant elasticity power curve model had a coefficient of determination value of 0.5477. The elasticity calculated through this power model was -0.275. These results are shown in Table ES.1.11. The research team concluded that if a single elasticity value were to be selected, the preponderance of the results from this analysis point to an elasticity of -0.27. However, the linear model result clearly shows that elasticity varies with price and this should be taken into account when applying these values to planning and rate models.

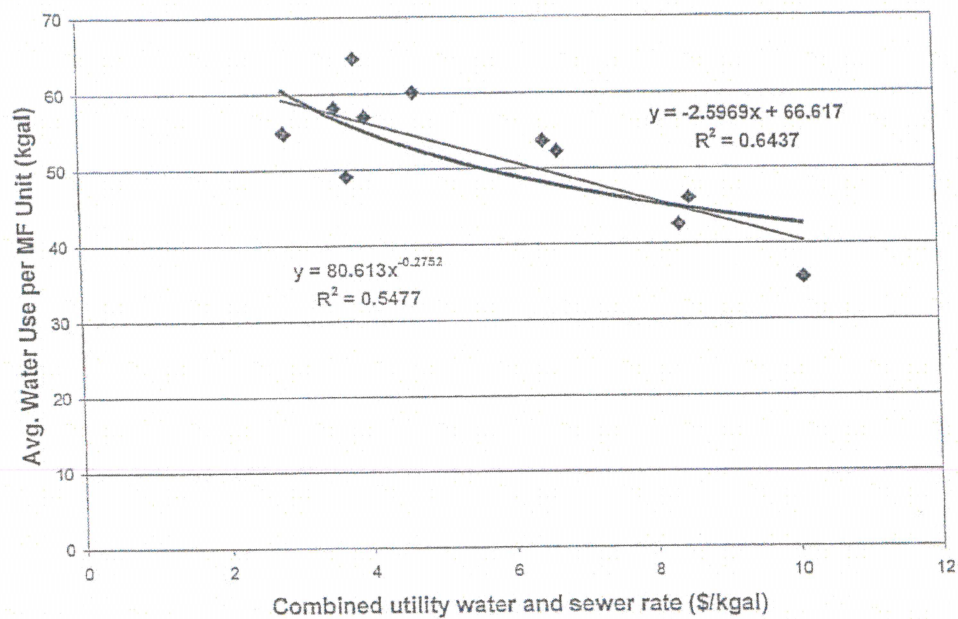


Figure ES.1.3 Demand curve and demand equations, elasticity analysis #1 (utility rates)

Table ES.1.11 Elasticity values, analysis #1 (utility rates)

Price (\$/kgal)	Straight Line Model Elasticity	Power Curve Model Elasticity
2.83	-0.1240	-0.2752
2.85	-0.1250	-0.2752
3.56	-0.1611	-0.2752
3.72	-0.1696	-0.2752
3.85	-0.1766	-0.2752
3.99	-0.1842	-0.2752
4.67	-0.2226	-0.2752
6.48	-0.3380	-0.2752
6.68	-0.3521	-0.2752
8.38	-0.4852	-0.2752
8.53	-0.4982	-0.2752
10.11	-0.6505	-0.2752
Conclusion: Elasticity = -0.27		

A second elasticity analysis examined

the price elasticity of water use based

on water and wastewater rates charged by third party billing service companies. A preponderance of the results from this analysis point to a likely range of elasticity values from -0.07 to -0.16 for submetered properties.

Policy Implications of Price Elasticity Analyses

The results of the elasticity analysis indicate that multi-family dwelling owners and managers are significantly more responsive to price than are residents who are submetered because the calculated percent difference in price elasticity is larger in the utility rate analysis by 70% or more. This result suggests that property owners are more likely to take action to conserve water on their properties in response to a change in price. It also implies that the owners have more opportunities to conserve water because they have a wider variety of uses over which they have control than do the residents, who basically control just their own domestic use. This has significant policy implications because as properties are converted to submetering and RUBS billing programs, owners no longer receive an effective price signal from the utility bill. This implies that the impetus to reduce demand and conserve water on the part of managers and owners is all but lost once a billing program is implemented. While the impact of water pricing is then passed on to the residents, it is apparent that they are much less sensitive to price than are the owners. Because many residents rent or lease their dwelling units, they are unlikely to invest in water conserving fixtures such as toilets, clothes washers, showerheads, faucets and leak repair. In many cases residents may not be permitted to install new fixtures. Leak repair remains the responsibility of the property manager and should be performed as a routine matter.

Interior Retrofits and Billing Programs

These results suggest that if utilities are interested in accelerating the installation of water conserving fixtures and appliances in their service area, it may be necessary to mandate these installations as a condition of conversion to a water and wastewater billing program. Once a water and wastewater billing program is implemented, most incentives to make these changes will be lost (except in common areas) and it is unlikely that residents will make these changes to their own units. Incentive based programs have spurred fixture change out and utilities may wish to encourage installation of water efficient fixtures in conjunction with their approval of water billing program in their service area.

REGULATORY FRAMEWORK REVIEW

The framework of regulations and related policies for multi-family water and wastewater billing systems is complex, quickly evolving, and unsettled, both at the federal level and in many states. During the time this research study has been in preparation, significant changes in the policy framework have been adopted by the federal government, several states, and major local jurisdictions, and important issues remain in flux.

Safe Drinking Water Regulation

In August 2003, seeking to encourage water conservation benefits attributed to submetering, the Assistant Administrator for Water proposed a significant re-interpretation of the Safe Drinking Water Act regarding submetered systems. In a policy shift that was finalized in December 2003, EPA noted that the "sale" of water had not actually been defined in the Safe Drinking Water Act, and that henceforth a multi-family property with submetered billing to residents would not be subject to the national primary drinking water regulations. Calling submetering an "effective but little-used tool" to promote water conservation, EPA clearly signaled a pullback from any insistence at the federal level that submetered systems would be required to perform the monitoring and record-keeping tasks of public water utilities, even if they nominally remained "public water systems." But citing a lack of evidence to support water saving benefits, the *new policy pointedly excluded RUBS and hot water hybrid allocation systems* from its scope, and urged states to consider whether flexibility was warranted for such systems as well. A challenge to EPA exclusion of RUBS and hybrid systems from this new policy has been mounted by a consortium of interested parties.

State Regulatory Survey

A survey of state policies toward multi-family billing systems is maintained by the National Submetering and Utility Allocation Association (NSUAA), a trade association for companies involved in multi-family billing for all types of utility services, i.e., water, wastewater, electric, natural gas, solid waste, etc. NSUAA attempts to track state and local policies toward both submetering and RUBS, as well as whether service fees are allowed as part of a billing system.

NSUAA cautions readers not to rely

on this summary information as legal

advice, noting that information is subject to frequent change and deals with matters of interpretation. With the permission of NSUAA, the latest (March 2004) overview of state policies regarding water and wastewater billing systems is presented in Table ES.1.12.

Table ES.1.12 NSUAA Summary of State Regulatory Policies

State	Submetering Allowed?	RUBS Allowed?	Service Fees Allowed?
Alabama	Yes	Yes	Yes
Alaska	Yes	Yes	Yes
Arizona	Yes	Yes	Yes
Arkansas	Yes	Yes	Yes
California	Yes	Yes	Yes
Colorado	Yes	Yes	Yes
Connecticut	Yes	Yes	Yes
Delaware	Yes	NO (only prior to 1996)	Yes
Florida	Yes	Varies by county	Yes
Georgia	Yes	Yes	Yes
Hawaii	Yes	Yes	Yes
Idaho	Yes	Yes	Yes
Illinois	Yes	Yes	Yes
Indiana	Yes	Unclear	Yes
Iowa	Yes	Yes	Yes
Kansas	Yes	Yes	Yes
Kentucky	Yes	Yes	Yes
Louisiana	Unclear	Yes	Yes
Maine	Yes	Yes	Yes
Maryland	Yes	Yes	Yes
Massachusetts	NO (legislation pending)	NO	NO
Michigan	Yes	Yes	Yes
Minnesota	Yes	Yes	Yes
Mississippi	Yes	NO	NO
Missouri	Yes	Yes	Yes
Montana	Yes	Yes	Yes
Nebraska	Yes	Yes	Yes
Nevada	Yes	Yes	Yes
New Hampshire	Yes	Yes	Yes
New Jersey	Yes	Yes	Yes
New Mexico	Yes	Yes	Yes
New York	Yes	Yes	Yes
North Carolina	Yes	NO	Yes
North Dakota	Yes	Yes	Yes
Ohio	Yes	Yes	Yes
Oklahoma	Yes	Yes	Yes
Oregon	Yes	Yes	Yes
Pennsylvania	Yes	Yes	Yes
Rhode Island	Yes	Yes	Yes
South Carolina	Yes	Yes	Yes
South Dakota	Yes	Yes	Yes
Tennessee	Yes	Yes	Yes
Texas	Yes	Yes	NO
Utah	Yes	Yes	Yes
Vermont	Yes	Yes	Yes
Virginia	Yes	Yes	Yes
Washington	Yes	Yes	Yes
West Virginia	Yes	Yes	Yes
Wisconsin	Yes	Yes	Yes
Wyoming	Yes	Yes	Yes
D.C.	Yes	Yes	Yes

Data developed by Marc Treitler and Brian Willie, Co-chairs of the Legislative and Regulatory Committee of the NSUAA.
Information about the NSUAA can be found at <www.nsuaa.org>. March 2004.

RECOMMENDATIONS

Guiding Principles for Submetering and RUBS Billing Programs

In light of the key findings and issues identified in this report, six principles are offered here to guide the development of policies to address separate billing systems for multi-family water and wastewater charges.

1. Submetering is a practice that offers documented water savings. As such, submetering should be fostered by public policies seeking to encourage water savings, together with appropriate measures to protect the consumer.
2. RUBS is a practice lacking statistically reliable water savings, while offering both similar and distinctive drawbacks compared with submetering. As such, RUBS implementation should be carefully bounded by public policy.
3. Any water and wastewater billing system – whether submetering, RUBS, or various hybrid systems – will reduce a multi-family property owner's incentive to invest in in-unit plumbing efficiency upgrades in pre-1995 structures. The initiation of any separate billing system in pre-1995 dwellings should be coupled with complete plumbing fixture upgrades within a specified time period.
4. The potential drinking water quality issues that may arise within the water systems of multi-family properties – such as backflow, cross-connection, metal uptake, and deterioration of buried distribution lines – should be approached with solutions that address all properties with comparable vulnerabilities, rather than narrowly focusing on properties that implement a water and wastewater billing program.
5. Best Management Practices for the billing of water and wastewater in multi-family housing should be implemented by the appropriate regulatory agency to ensure consumer protection for property owners and residents and to promote adoption of multi-family submetering.
6. Submetering equipment manufacturers, professional installers, third-party billing services, and owners should be held to reasonable standards of accuracy, reliability, and professional competence and conduct.

Public Policy and Business Practices

A transformation is taking place in the responsibility for water and wastewater service in multi-family properties across the United States. Consistent with the guiding principles

outlined above, the researchers offer the following recommendations to increase the likelihood that this transformation advances the public interest while fairly rewarding private investment and initiative.

Policies for Water and Wastewater Utilities

Water and wastewater utilities should implement the following measures to encourage submetering and to secure the benefits of improved efficiency for their systems.

Recommendation 1 – Require notice. Utilities should require multi-family property owners that seek to implement or convert to any billing system, or which have converted in the past, to notify the utility and/or agency. The utilities should keep permanent records of the properties using any water and/or wastewater billing system. As this report demonstrates, the water savings resulting from submetering can be substantial, and the water savings resulting from plumbing upgrades can be even more substantial. But the value for utilities is greatest if these savings can be recognized, plotted into trends, and incorporated into capital facility planning. If a utility does not know what fraction of its multi-family housing has already converted to separate water and wastewater billing methods, it will be hard-pressed to estimate the additional savings potential that remains from additional conversion. The status of separate billing and associated plumbing conversion (as recommended above) should be kept as current as possible.

Recommendation 2 – Apply volumetric billing to all multi-family properties. Ensure that volumetric billing is applicable to all multi-family properties for both water and wastewater charges. Although the prevalence of flat or fixed rate structures (where no portion of the charge varies with volume of use) for multi-family structures is unknown, it persists for single-family residences in many communities⁷ and may be broadly applicable at least to duplexes, 3-family, and 4-family dwellings in such locations. If multi-family resident billing is to be effective in sending a price signal to consumers in multi-family housing, then a responsive price signal has to be sent by the utility in the first place. Where outdoor use and attendant seasonal variation is large, many communities offer seasonal adjustment factors for wastewater service billed from

⁷In a survey of 420 California cities and districts in 2000, 86% of those surveyed maintained flat (non-volumetric) charges for wastewater service. Surveys in other states by the same firm found non-volumetric charges at 66% of surveyed utilities in Washington, 46% in Oregon, and 32% in Arizona (Black & Veatch 2000).

the water meter and/or exemptions from wastewater charges for submetered outdoor use. Submetering of irrigated landscapes offers an additional opportunity to manage outdoor water use efficiently, and should be encouraged in its own right for large parcels, such as multi-family dwelling complexes.

Recommendation 3 – Promote submetering and fixture retrofit. Encourage submetering through judicious targeting of utility water conservation incentives to multi-family submetering conversions. Utilities with active water conservation programs should consider steps to encourage full and partial capture submetering as well as plumbing fixture replacement in pre-1995 buildings. Since submetering offers substantially more savings than RUBS, utilities should consider directing some or all of their plumbing retrofit incentives in the multi-family sector to properties that choose submetering. Tiered incentives to provide additional benefits for properties electing to submeter is another approach. Fixture retrofit should also be promoted in properties that have already undergone billing conversion. While the design and absolute levels of incentive programs are highly site-specific, utilities should look to their incentive programs as an important tool for tipping the balance toward submetering.

Recommendation 4 – Explore direct billing of multi-family residents in new construction. In the interest of encouraging water efficiency gains, utilities should be open to expanding their role beyond traditional master metering of multi-family properties, particularly in new construction. As automated meter reading technology becomes more widely adopted by utilities themselves, the need for direct access by utility personnel to water meters serving multi-family dwellings becomes far less frequent. New construction allows flexibility for the placement of meters in locations designed to be accessible from, or in close proximity to, public space. Duplexes, 3-family, and 4-family units may be easily plumbed for meters from public space. These and other opportunities will present themselves to utilities willing to take the initiative to improve water efficiency and customer service. It should be noted that some utilities may not be interested or willing to venture into multi-family billing that would add a large number of new customers with a high turnover rate.

Policies for State and Local Governments

State law should clearly establish the legal framework for all forms of multi-family billing systems. In lieu of a patchwork of state agency administrative actions,

enactment of statutory language that specifically addresses multi-family billing for water and wastewater service is preferable, and would help ensure consistent policy across all agencies and localities. Similarly, state legislation is preferable to a local ordinance, but local action may well be necessary if state legislation is not forthcoming.

Recommendation 5 – Metering for all new multi-family construction.⁸

a. **Low-rise multi-family construction:** All new multi-family structures of one to three stories should provide for the measurement of *all* of the water use in each unit. This may be accomplished either through the installation of total-capture submeters for each unit, the installation of utility service meters for each unit, *or* the installation of multiple submeters affixed at every point of use in each unit. Upon occupancy, water and wastewater charges are to be billed to residents based only upon their water usage recorded by these individual measurement devices.

b. **High-rise multi-family construction:** All new multi-family structures of more than three stories constructed after a date which is four years after the effective date of the low-rise requirement above, should provide for the measurement of the water use in each unit. This may be accomplished either through the installation of total-capture submeters for each unit, multiple submeters affixed at points of use throughout each unit, or metered hot (or cold) water use as the basis for allocating all in-unit water use. The allowance of four additional years should be sufficient to resolve any remaining technical issues posed by high-rise plumbing configurations and meter placement. Upon occupancy, water and wastewater charges are to be billed to residents based only upon their water usage recorded by these individual measurement devices, or through an approved hot/cold water hybrid allocation system.

Recommendation 6 – Efficient plumbing fixtures required when implementing a billing program. Owners may institute a billing system or continue an already existing billing system for water and wastewater charges *provided* that prior to the institution of any separate billing program or for an existing program within 12 months of official notification, owners comply with the applicable provision (a or b) below:

⁸ Subsidized and low income housing developments will likely need to be exempted from this regulation because of various national, state, and local regulations governing the maximum allowable charges for rent and utilities. In addition it may be prohibitively expensive to redesign and submeter some high rise buildings designed with a central boiler.

a. **Older Properties:** Owners of multi-family structures constructed *before* January 1, 1995 (or one year after the effective date of a state or local statute setting a 1.6 gpf standard for all new toilets, if earlier), must perform a water audit in each unit to ensure, any leaks identified have been repaired, and each toilet, showerhead, and faucet aerator is either newly manufactured and installed within the previous 12 months, or operating at no more than 125% of the flush volume or flow rate, respectively, contained in the Energy Policy Act of 1992.

b. **Newer Properties:** Owners of multi-family structures constructed *after* January 1, 1995 (or one year after the effective date of a state or local statute setting a 1.6 gpf standard for all new toilets, if earlier) must perform a water audit in each unit to ensure, any leaks identified have been repaired, and each toilet, showerhead, and faucet is operating at no more than 125% of the flush volume or flow rate, respectively, contained in the Energy Policy Act of 1992.

Recommendation 7 – Once submeters are installed a RUBS system cannot be used.

Formula allocation systems (RUBS) may not be used in buildings where total-capture meters or partial-capture hybrid systems for individual units have been installed, even if the submetering billing program has been abandoned. To preserve the potential for water savings and maintain the relative benefit to consumers to more equitably distribute costs, abandonment of submetered systems should be discouraged. Limited allocation and estimated billing may be permitted in submetered properties on a temporary basis when specific meters cannot be read or are being serviced or replaced.

Recommendation 8 – Consumer protection. State or local landlord-tenant law or similar legal framework should address the special concerns arising from multi-family water and wastewater billing systems. The section below contains recommended practices for property owners, billing service companies, and water utilities to ensure that consumers are treated fairly. Any number of these practices could be fashioned into a statutory requirements. The degree to which some or all of these provisions are written into law will be based upon the experience of each jurisdiction.

Best Management Practices for Billing of Water and Wastewater Service in Multi-Family Housing⁹

⁹These best practices were adopted from and expand upon the guidelines published by the NSUAA

The researchers believe a comprehensive set of best practices in the form of regulated industry standards, would benefit all parties involved, including residents, property owners, water providers, regulators, and the billing service providers themselves. The best management practices (BMPs) should be implemented by the appropriate regulatory oversight agencies. BMP standards could greatly improve resident understanding and satisfaction with third party billing, and reduce consumer complaints to regulators.

Based on the research results, the following standards for best management practices for water and wastewater billing practices are recommended. BMPs for the billing service industry and for property owners are essentially the same and apply equally. In many cases, property owners and managers handle their own billing for water and are in fact the billing entity. Regardless of who produces the bill, either the owner/manager or a third party billing service company, it is incumbent upon the owner/manager to ensure the proper implementation of these best management practices. The owner maintains the underlying responsibility for the way the billing program is implemented and managed.

Resident rights related to water billing are closely tied to the BMPs for the water billing industry and provide a set of reasonable expectations for residents receiving water and wastewater bills from largely unregulated billing entities.

These best practices are intended to apply generally to *both* submetering and RUBS billing unless specifically noted.

- 1) **Billing entity.** Where permitted by law, water and wastewater utility bills may be issued by a property owner or qualified billing agent. Billing agents shall have appropriate insurance coverage.
- 2) **Water cannot be dedicated to public use.** Water and wastewater service will only be provided to residents of the property. Non-residents and the general public will not be served. (In many states, this ensures that the property owner is not deemed to be a public utility).
- 3) **Common area and vacant units.** The property owner shall pay for water and wastewater service used in common areas, administrative offices, vacant dwelling units, and other portions of the property not designated as dwelling units. Residents are only financially responsible for their own water and wastewater service costs. In RUBS properties, common areas should be separately metered. If not possible, a reasonable estimate of common area usage can be made that is based on the property's specific common area amenities.

4) **Water audit and leak repair.** Before instituting any separate billing system, the property owner/manager shall conduct a water audit of all units and common areas, testing for leaks, including toilet tank flapper valve leaks, and repair all leaks identified. Upon institution of the separate billing system, the property owner/manager shall commit to a reasonable standard of leak repair in all units, and shall maintain sufficient supplies of materials as may be necessary to ensure that common types of leaks (such as toilet flappers) are promptly repaired. When properly reported, non-emergency leakage at any plumbing fixture or fitting should be repaired within 5 business days. The process for reporting leaks and the owner/manager's commitment to leak repair shall be clearly stated in each resident's bill, and shall also be disclosed as part of the lease agreement.

5) **Pass through of water and wastewater costs.** Both the commodity and fixed service charges for water and wastewater shall be equivalent to the commodity charges contained in the property owner's bill from the local water and wastewater utility.¹⁰ Neither the billing entity nor the owner/manager shall inflate the costs of these charges. Utility commodity charges and the billing entity charges shall be clearly stated on every bill provided to residents and such rates and charges shall also be disclosed as part of the rental agreement.

6) **Submetering and RUBS methods and notification.** Water and wastewater bills to residents shall be calculated on the basis of fair and reasonable methods of cost allocation, including submeter readings or allocation formulas. The measurement or allocation method and/or formula is considered a matter of public record and shall be clearly stated on every bill provided to residents. The water and wastewater billing arrangement shall be fully disclosed to the resident in the rental agreement. When a new billing program is started, owners shall provide residents with at least 60 days notice prior to implementation. Billing can only begin after lease signing/renewal.

7) **Billing practices.** Water and wastewater bills shall be sent promptly after meter readings are made or after the master-meter bill from the utility is received. This is essential to ensure that the price signal is received in reasonably close proximity to the time of consumption. A reasonable amount of time (minimum of 10 business days) shall be allotted between the residents' receipt of a bill and the date payment is due.

8) **Records retention and inspection.** The property's master water and wastewater utility bills shall be retained for a period of not less than 24 months, and shall be available for inspection by any resident at reasonable hours and without charge. However, a nominal fee can be charged for any requests to copy bills.

9) **Fees.** The billing entity may charge reasonable fees. Fees are divided into two categories: (a) *recurring service fees*; and (b) *other fees*. *Recurring service fees* (also

¹⁰ In most cases, these charges will be based on the local utilities' rate schedules for multifamily housing, often priced by the size of the service connection to the master meter. In the case of duplex, 3-family, and 4-family units, the smaller service connections to these structures may result in their being charged at the same rate as single-family residences.

called monthly fees, administrative fees, or meter fees) shall be charged to the property owner/property manager, not to the residents. Where not subject to regulation, the owner is in the best position to negotiate favorable service fee charges with the billing company and responsibility for recurring service fees gives the owner an interest in negotiating the best fee. Property owners should pay the meter service fee since it is part of the infrastructure of the building and as such would be like repair and maintenance of any building supplied fixture or appliance. *Other fees* (new account fees, late fees, returned check fees, and other reasonable fees that relate to a specific resident account) shall be paid by the residents.

10) Complaints and disputes. A fair method for promptly resolving complaints and billing disputes shall be established by the billing entity that should have parity to the process that exists for the property owner contesting a bill to the local water utility. The billing entity shall be available during normal business hours via a toll free number, printed on every bill, to handle billing questions and complaints.

11) No shutoff of service. As stated by law, water and wastewater service cannot be shutoff to residents by the owner or his agents. The rental agreement can provide for a utility deposit or other legal remedy through which unpaid utility bills can be collected.

12) Information to be included in regular bills. The bill is the fundamental communication between the billing entity and the resident. As such, bills must be clear, comprehensible, and comprehensive. Billing entity water and wastewater bills shall include:

- (a) Clear statement of the current water and wastewater commodity charges and fees as well as any overdue or pending amounts;
- (b) Billing period covered by the bill;
- (c) Date payment is due;
- (d) Date after which payment is overdue;
- (e) Explanation of the billing method (Submetering, RUBS, hybrid);
- (f) Explanation of how charges are determined for current billing period. For *submetering* this will simply be a beginning and ending meter read, the volume consumed, and the commodity rate per unit volume. For *hybrid metering* this will be a beginning and ending meter read, the (hot or cold water) volume consumed, the calculation for allocating the remaining water volume, and the commodity rate per unit volume. For *RUBS* this should include the total volume of water used at the property (as measured by the utility at the master meter(s)), the deductions for common area, the percent of remaining amount allocated to the individual unit, the volume allocated to the unit, and the commodity rate per unit volume.

- (g) Utility commodity charges and the billing entity commodity charges (to assure equivalence);
- (h) Information for reporting leaks;
- (i) Toll free or local telephone number for customer complaints and billing disputes, and a brief description of the dispute resolution process.

Policies for the US Environmental Protection Agency

Recommendation 9 – Property owners should not be subject to the full suite of National Primary Drinking Water Regulations. Property owners should not be subject to the full suite of National Primary Drinking Water Regulations, with attendant registration and monitoring requirements, solely by virtue of their action to adopt a billing system for water and wastewater service, whether submetering or RUBS. The implementation of either billing system is unlikely to change the quality of water provided to customers on the property.

During the course of this study, EPA's interpretation of the requirements of the Safe Drinking Water Act have undergone substantial change on this issue, and the Assistant Administrator's memorandum to Regional Administrators dated December 16, 2003, goes a long way toward adopting this recommendation. The new guidance was drawn to focus on submetering, due to the potential of submetering to support full-cost pricing and the lack of documented water savings attributable to RUBS. EPA should, however, recognize that the value added to a property owner's balance sheet by instituting a billing system – either RUBS or submetering – creates an opportunity to fund the conversion of long-lasting but inefficient plumbing fixtures and fittings to EPACT compliant plumbing. Plumbing conversion will achieve immediate and significant water use reductions in properties of either billing type.

Recommendation 10 – EPA should promote water efficiency in multi-family housing. As part of its "Sustainable Infrastructure Program," the EPA Office of Water should devise a road map for the research, demonstration, and deployment of emerging technologies and practices that can make significant breakthroughs in multi-family water use efficiency. Property owners and their trade associations, water and wastewater utilities, state and local governments, tenant associations, landscape contractors, building contractors, and environmental advocates are all potential stakeholders and partners in such an effort. EPA should help accelerate the transformation of water and wastewater billing practices in multi-family housing

through targeted research, technical assistance, model ordinances, voluntary bench-marking, and public recognition. While this report advances our understanding of the benefits of submetering, the report has also found several other variables that significantly effect the water consumption of multi-family housing. The transfer of utility bill payment to residents is an important foundation upon which to build additional gains in water use efficiency.

Policies for Point of Use Meters

Recommendation 11 – Explore policies for POU standards. The current plumbing codes do not adequately address POU meters on a number of issues. Industry consensus standards are needed for application condition accuracy, installation protocols, product labeling, and maintenance. IAPMO¹¹, NIST¹², and ASME¹³ must evaluate the recommended changes in the plumbing standards.

Based upon the conclusions drawn from the ad hoc committee discussions the following recommendations are offered as standards for POU meters:

Labeling and Identification: Meters shall have the name of the manufacturer, model and serial number, approved orientation positions, and approved temperature ranges.

Manufacturer: Shall specify installation criteria.

Maintenance: Maintenance requirements for POU meters should be consistent with larger utility meters.

Low Battery Voltage: Data transmission needs to be deterministic in that either the data is transmitted accurately or not at all.

Visible Meter Reads: The meter shall have an encoded non-volatile memory. Metered customers shall have ready access to current reading values.

Accuracy: Changes to the current accuracy standards need to be addressed through applications to the appropriate plumbing organizations.

Installation Standards: Use or cite AWWA M6 Manual as reference and follow manufacturer installation specifications. Create a new IAPMO installation standard for water submeters.

¹¹ International Association of Plumbing and Mechanical Officials

¹² National Institute of Standards and Technology

¹³ American Society of Mechanical Engineers

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