IMPACT OF URBAN WATER CONSERVATION ON GROUNDWATER PUMPING AND PROJECTED EFFLUENT FLOW IN THE TUCSON AREA

by

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INTRODUCTION

Present and projected water supplies in the Tucson Active Management Area (AMA) include groundwater, imported water derived from the Central Arizona Project (CAP), and treated municipal effluent.

Groundwater

Groundwater now provides nearly 100 percent of the water supply in the Tucson AMA. Approximately 333,000 acre-feet were depleted in 1980 by users in the area while natural recharge to the groundwater reservoir totaled about 68,000 acre-feet. About 265,000 acre-feet were consequently "mined" from the groundwater reservoir. This type of overdraft, extending through the past 40 years, has produced groundwater level declines of more than 180 feet in several parts of the basin (McNulty, 1983).

Projected overdrafts for coming years are displayed in Table 1. The assumptions implicit in these estimates and projections are that: 1) Central Arizona Project water and effluent will be fully utilized by 1990; and 2) no changes in per-capita use or irrigation efficiency will occur.

The goal of the management and conservation programs developed by the Tucson AMA will be to eliminate the projected overdraft by the year 2025 (McNulty, 1983).

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Imported Water

Upon completion of the delivery system to Pima County, CAP will provide a major supplementary water supply for the Tucson area. Projections for dependable annual supplies of CAP water and for natural groundwater recharge for Tucson are summarized in Table 2.

TABLE 1. OVERDRAFT ESTIMATES AND PROJECTIONS

	Overdraft (1,000 acre-feet)					
Year:	1980	1990	2000	2010	2020	2025
Pumpage	421	245	240	230	230	227
Incidental Recharge	88	76	73	70	70	70
Natural Recharge	68	68	68	68	68	68
OVERDRAFT	265	101	99	93	93	89

Source: McNulty (1983)

TABLE 2. PROJECTED SUPPLIES

	Projected Supplies (1,000 acre feet)				
Year:	1990	2000	2010	2020	2025
CAP	179	185	201	226	239
Natural Recharge	68	68	68	68	68
TOTAL	247	253	269	294	307

Source: United States Geological Survey, Water Supply Paper 1930-E, 1973.

Effluent

Sewage effluent is derived from the use of groundwater in Tucson homes and industries. It is not a new source of water, but represents an important source of reusable water, which can reduce groundwater demand if used.

In 1980, 48,000 acre-feet of effluent was generated. This is projected to increase to more than 120,000 acre-feet annually after 2020. More than 90 percent of the current amount is discharged from two sewage treatment plants — the Roger Road Sewage Treatment Plant and the Ina Road Water Pollution Control Facility. Eighty-five percent of the treated effluent is currently discharged to the Santa Cruz River. The remainder is used for agriculture and recreation.

Sewage effluent in Pima County is treated by the Pima County Wastewater Management Department (PCWMD), with the exception of a very small amount treated at privately owned package plants. Through an intergovernmental agreement, the City of Tucson owns 90 percent of the effluent from the two metropolitan treatment plants and also can specify the reuse plans for effluent from outlying facilities.

Estimates of future effluent flows for Pima County are based on population projections developed by the Arizona Department of Economic Security (DES) in 1979 and as amended in 1981. These projections have been adopted by the Pima Association of Governments (PAG) for planning. Based on various 201 basin facility planning efforts, as well as the Regional Facility Plan, a municipal wastewater contribution factor of 90 gallons per capita per day (gpcd) is used for planning and design (Tucson Metropolitan Wastewater Reuse Assessment, 1983). (The residential portion of this flow is 60 gpcd, as mentioned later.) Tucson Water assumes that 85 percent of the Pima County population is connected to the metropolitan sanitary sewerage system.

Present planning by PCWMD (1982) projects an expansion of the Roger Road Plant from 30 million gallons per day (mgd) to 40 mgd in 1984. An expansion to 50 mgd is anticipated before the year 2005. Depending on funding, expansion of the Ina Road Water Pollution Control Facility from 25 mgd to 35 mgd is planned in approximately three years. The Randolph Park treatment facility wil be expanded

to a capacity of 1.5 mgd in 2000. Thus by 2005 the combined capacities of the three metropolitan plants will be 86.5 mgd.

ROLE OF RESIDENTIAL WATER REUSE IN CONSERVATION

Table 3 shows effluent flow projections for the City of Tucson from 1985 to 2025. The projections shown in column 4 assume that 90 gpcd of effluent is generated. If a residential reuse system were installed, the residential fraction of the effluent discharged could be reduced from 60 gpcd to 5 gpcd (Brittain and Foster, 1983). This saving of 55 gpcd would reduce the total municipal discharge from 90 gpcd to 35 gpcd. Column 5 shows the projected effluent flow to the treatment plant if 10 percent, 20 percent, and 30 percent of the projected sewered population initiated a reuse system. This reduction in effluent flow can be used to estimate groundwater savings. Table 4 provides an estimate of groundwater savings based upon the three levels of residential participation in reuse. This savings estimate assumes that about 60 percent of the municipal water pumped for residential use reaches the treatment plant as effluent.

Table 5 (developed from Table 4) shows, for example, that by 1990, overdraft in the Tucson AMA could be reduced from 101,000 acre-feet to 89,000 acre-feet if 20 percent of the population employed residential water reuse systems.

SUMMARY

By extending the preceding section and Table 5, residential reuse can have a significant impact on groundwater overdraft in the future. By 2025, overdraft could be reduced from 89,000 acre-feet to 53,000 acre-feet if 30 percent of the projected population incorporated water reuse into their lifestyle. This is a 40 percent reduction in overdraft and represents a significant water savings.

An additional impact to be considered is the reduction in effluent at the treatment plant. By 2025, if 30 percent of the projected population incorporated water reuse, the effluent flow would be 111,000 acre-feet per year instead of the projected 133,000 acre-feet.

TABLE 3. EFFLUENT FLOW PROJECTIONS, 1985-2025

Year	Population Projection[a]	Projected Sewered Population[b]	Projected Effluent Flow[c]		Projected Effluent Flow (Acre-Feet) as Percentage of Population Using a Water Reuse System[d]		
			MGD	Acre-Feet	10%	20%	30%
1985	620,000	527,000	47	53,000	50,000	47,000	43,000
1990	710,100	603,000	54	61,000	57,000	54,000	50,000
2000	921,900	783,600	70	79,000	74,000	69,000	65,000
2010	1,174,900	998,700	90	101,000	95,000	89,000	83,000
2020	1,427,900	1,213,700	109	122,000	115,000	107,000	101,000
2025	1,554,400	1,321,200	119	133,000	125,000	117,000	111,000

[a] Arizona Department of Economic Security, December 1981.
[b] Projected population times 85%.
[c] Projected sewered population times 90 gpcd.
[d] Assumes 35 gpcd total municipal discharge with water reuse system.

Source: Adapted from Tucson Metropolitan Wastewater Reuse Assessment (1983). CH2M Hill/Rubel and Hager. Draft Report, Table 2.2, p. 2.6.

TABLE 4. ESTIMATED MUNICIPAL GROUNDWATER SAVINGS (ACRE-FEET)

Year	Savings (1,000 acre feet)[a]		
	10 percent reuse	20 percent reuse	30 percent reuse
1985	5,000	10,000	16,600
1990	6,600	11,600	18,000
2000	8,300	16,600	23,200
2010	10,000	20,000	29,900
2020	11,600	24,900	34,900
2025	13,300	26,600	36,500

[a] Assumes per capita effluent is 60 percent of per capita residential pumpage.

TABLE 5. OVERDRAFT ESTIMATES AND PROJECTIONS USING WATER REUSE SYSTEM[b]

Year	Overdraft (1,000 acre feet)			
	No reuse	10 percent reuse	20 percent reuse	30 percent reuse
1990	101	94	89	83
2000	99	91	82	76
2010	93	83	73	63
2020	93	81	68	58
2025	89	76	62	53

[b] Assumes reduction of residential effluent flows represent corresponding savings in groundwater pumpage.

The current combined capacity of the Roger Road and Ina road plants is 55 mgd (62,000 acre-feet per year). This capacity will be expanded to 75 mgd (84,000 acre-feet per year) by 1985 and to 85 mgd (95,000 acre-feet per year) by 1995. By incorporating water reuse, effluent flows would decrease to 50,000 acre-feet per year in 1985, assuming that 10 percent of the projected population participates. If 30 percent participates, the current capacity would not be exceeded until 2000, and thus would delay the need for expansion in 1985 and 1995.

An additional consideration to the individual homeowner is a reduction in sewer-use fees. The fee is based on quantity discharge, and a significant reduction in flow would reduce the monthly user fee.

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