DWR EXHIBIT U

City of Wichita Water Demand Projection
Reevaluation, 1997

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Customer and Water Demand Projection Reevaluation

prepared for

THE CITY OF WICHITA

WATER & SEWER DEPT.

1997

92-195-4-012

Burns & McDonnell

1239

WORLDWIDE SERVICES
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ENGINEERS • ARCHITECTS • CONSULTANTS

August 27, 1997

Mr. Jerry Blain, P.E.
Superintendent of Production and Pumpage
Wichita Water & Sewer Department
City Hall - Eighth Floor
455 North Main Street
Wichita, KS 67202

Wichita
Integrated Local Water Supply Plan
Customer and Water Demand Projection Reevaluation
Project No. 92-195-4-012

Dear Mr. Blain,

This letter report reevaluates the customer and water demand projections developed in 1992 and 1993 for the City of Wichita's Water Supply Study which were based largely on records available from 1980 to 1991. The projections of this investigation are influenced by data for 1992 through 1996, implementation of a conservation water rate in 1993, and reclassification of several types of customers.

The findings of this study show average day projected water demands with low range conservation decreased from 125 MGD in the 1993 Study to 112 MGD or about 10 percent. Maximum day projected water demands with low range conservation decreased from 249 MGD in the 1993 Study to 223 MGD. Short-term projections, to year 2010, did not change; therefore, the City should continue implementation of recommended improvements on the current schedule to meet future water supply needs.

If you have questions or comments regarding this letter report, please do not hesitate to contact us.

Sincerely,

Frank L. Shorney, P.E.
Project Manager

L. Jeffery Klein, P.E.
Project Engineer

FLS/LJK/rs386
Enclosure

cc: Mr. David Warren

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CITY OF WICHITA
CUSTOMER AND WATER DEMAND PROJECTION REEVALUATION
PROJECT 92-195-4-012

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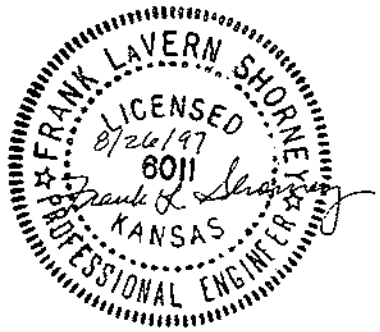
CERTIFICATION(S)



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CUSTOMER AND WATER DEMAND PROJECTION REEVALUATION
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1997

A. General

This letter report describes the City of Wichita's water service area, presents historical water use data, describes potential water use savings from conservation methods, and projects population and water demands with a year 2050 planning horizon. The information presented is updated from earlier projections made in the 1993 Water Supply Study which used existing water use data through 1991. This update uses existing water use data and area development trends through 1996.

B. Service Area

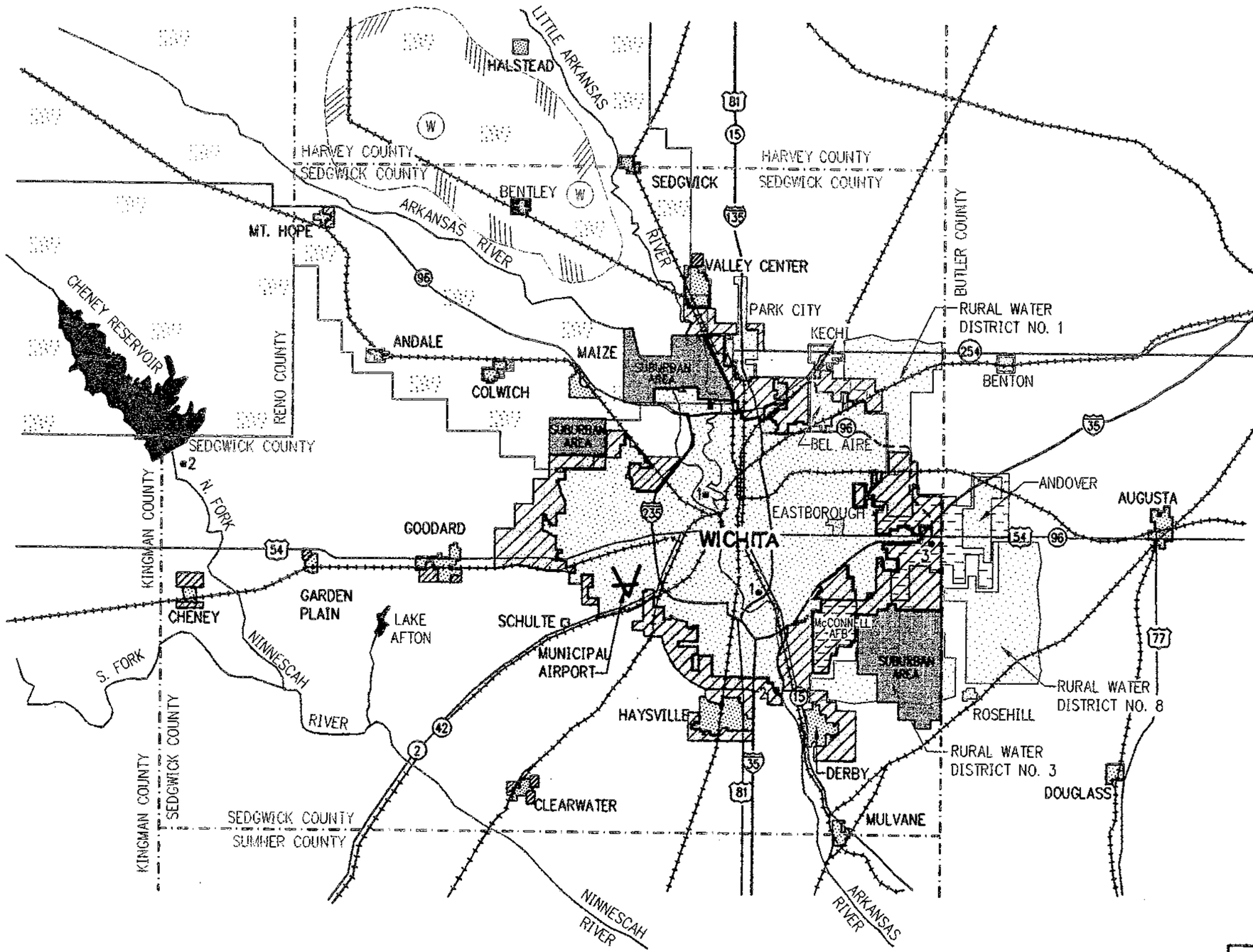
The City of Wichita provides potable water to over 124,000 water customers inside its 140 square-mile corporate area and to 10 wholesale customers and several residential/commercial customers outside the city limits as shown in Figure 1. Untreated well water is also provided to one wholesale customer, the City of Bentley, which is located outside the city limits in the Citys' Equus Beds Well Field.

The water service population is approximately 348,000 . About 316,000 people are served inside the city limits and 32,000 people are served outside the City limits. In the future, the Wichita service area is expected to expand to serve smaller outlying water systems because of the cost and operational complexity of meeting regulations of the Safe Drinking Water Act and encouragement of regionalization of water service by state and federal agencies.

Inside the City, water is provided to customers through individual meters, except for about 200 housing units is southeast Wichita known as the "Planeview" area. Meters are currently being added to customer service lines on these housing units. Customers outside the city limits are either individually metered by the City or metered via wholesale master meters.

In 1996, the average day water demand in the service area was 53.9 million gallons per day (MGD) and maximum day water demand was 97.1 MGD. During the year, water use included 42 percent by residential customers, 23 percent by commercial customers, 11 percent by industrial customers, 2 percent by wholesale customers and 22 percent by all other customer classifications, including lawn service, contract, institutional and unaccounted-for water.

The water service area is provided with treated water from the Central Water Treatment Plant which is located in the City at the confluence of the Little Arkansas River and the Arkansas River. The water plant has treatment capacity of 160 MGD (includes a 30 MGD



NOTE:
PROJECTED GROWTH AREAS FROM INFORMATION PROVIDED BY THE WICHITA-SEDGWICK COUNTY METROPOLITAN AREA PLANNING DEPARTMENT

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Figure 1

CURRENT WATER SYSTEM SERVICE AREA

expansion completed in May 1995). Raw water is supplied to the water plant for treatment from Cheney Reservoir, which is located approximately 20 miles west of the City, and from well fields in the Equus Beds, which are located approximately 16 miles northwest of the City.

Wastewater from the service area is treated in two wastewater treatment plants which are located in the southern portion of the City near the Arkansas River. Wastewater Treatment Plant No. 1 provides 30.6 MGD of primary treatment and discharges to Wastewater Treatment Plant No. 2. Plant No. 2 has 10 MGD of primary treatment capacity and 54.4 MGD of secondary treatment capacity.

Additionally, Sedgwick County operates a 10 MGD wastewater treatment plant in the Four Mile Creek area as shown in Figure 1. This was placed in operation in 1990 and a majority of the plant's capacity is currently unused.

Major transportation arteries which serve the area include Interstate 35, U.S. Highway 81, U.S. Highway 54, and the Atchison Topeka and Santa Fe and the Union and Pacific Railroads. Between years 1992 and 2002, $460 million is scheduled for improvements to State and U.S. highways and interstates in the City and Sedgwick County to relieve congestion and reduce commuting times. Railways continue to be important to local industries by providing an efficient means to move raw materials and manufactured products. Future industrial growth is planned and zoned with consideration of the existing rail system.

Land use in the service area includes a mixture of agriculture, residential, commercial, industrial, parks/recreational and other uses. Agricultural land represents 15 percent of the City's area and 80 percent of the county's area while residential land represents 28 percent of the City's area and 8 percent of the County's area. The City is currently growing to the west and northwest with residential and commercial development. This trend, along with "fill-in" growth within the City, is anticipated to continue through the year 2010 and beyond.

The service area has a stable industrial base, including several large aviation companies (Boeing , Cessna, Lear, and Beech Aircraft), manufacturing, food processors, bottlers, and refineries. McConnell Air Force Base is also served by the city water system. These facilities typically employ large numbers of people and use large quantities of water.

In 1992, the City completed a comprehensive master plan for community development. The study evaluated water, sewer, stormwater, solid waste systems, fire protection, transportation, law enforcement, schools and libraries, medical services, parks, housing neighborhoods, land use planning, community appearance and historic preservation through the year 2010. The 1993 Water Supply Study used this information in water demand projections and this study re-evaluates these projections using the most recent information

available. These studies project growth in the city and surrounding county and provide information to plan facilities necessary to maintain and improve the quality of life and to encourage future economic development in the Wichita area.

C. Historical and Projected Population

1. Historical Population

Historical population data for the City of Wichita, Sedgwick County and the Wichita metropolitan statistical area are shown in Table 1. Population data for the City of Wichita includes the area defined by the city limits; population data for Sedgwick County includes the area defined by the county boundary; and population data for the statistical metropolitan area includes the City of Wichita, in addition to the remaining areas in Sedgwick County and adjoining Butler County.

The City of Wichita's water service area is slightly larger than the city limits and smaller than the county and metropolitan statistical area. The City also supplies water to 10 wholesale customers. The cities of Andover and Eastborough are retail customers outside the City limits with customer meters which are serviced and read by the City of Wichita. All other wholesale customers are served through master meters.

Historical customer data from 1970 to 1996 for the water service area is shown in Table 2. The number of customers has grown from approximately 81,407 in 1970 to 124,710 in 1996 for an average growth rate of 1.65 percent per year.

2. Projected Population

Population projections for the water service area are developed through the use of U.S. Census Bureau data, water department customer data, U.S. Department of Commerce - Bureau of Economic Analysis (OBERS) data, Wichita-Sedgwick County Metropolitan Area Planning Department (MAPD) studies and engineering studies by others. Projections include consideration for the availability of land, water, and sewer systems, current and future transportation plans, zoning, area topography, and socioeconomic factors.

Comparisons of population data from several information sources are shown in Table 3 and Figure 2. In the 1993 Water Supply Study, historical population for the City of Wichita was used to developed lower and upper limits of the population projection range. The lower limit was determined from a linear regression of city population from 1960 to 1990 and resulted in a year 2050 population of 391,000. The upper limit was determined from a linear regression of city population from 1950 to 1990 and resulted in a year 2050 population of 493,000. According to the 1990 Census, the

Table 1

HISTORICAL POPULATION DATA
CITY OF WICHITA, KANSAS, SEDGWICK COUNTY AND METROPOLITAN STATISTICAL AREA

Year	Population Within City (1)	Population Within County (1)	OBERS Population Within Statistical Area (2)
1900	24671	-	-
1910	52450	-	-
1920	72217	92234	-
1930	111110	136330	-
1940	114966	143311	-
1950	168279	222290	-
1960	254698	343231	-
1969	-	-	389400
1970	276554	350694	-
1973	-	-	378700
1978	-	-	400700
1980	279272	366531	-
1983	-	-	428800
1990	304011	403662	-
1994	310236	419177	-
1996	316330	420785	-

Notes:
(1) Data for 1900 through 1994 from U.S. Census Bureau.
(2) Data from U.S. Department of Commerce - Bureau of Economic Analysis, 1985 Regional Projections.
(3) Data for 1996 from MAPD.

Table 2

CUSTOMER RECORDS BY YEAR AND NUMBER OF METERS (1)

Year	Residential	Commercial	Industrial	Lawn Service	Fire Protection	Golf Course	Contract (2)	Institutional	Wholesale	Total Customers
1970	71,011	9,323	168	-	243	-		662	-	81,407
1971	71,448	9,284	167	-	261	-		641	-	81,801
1972	71,939	9,243	164	-	296	-		953	-	82,595
1973	73,115	9,234	158	-	330	-		679	1	83,517
1974	74,182	9,398	162	-	360	-		690	2	84,794
1975	75,513	9,542	159	-	386	-		706	2	86,308
1976	77,171	9,645	155	221	399	-		701	2	88,294
1977	78,368	9,727	155	303	424	-		692	3	89,672
1978	79,785	9,795	151	419	460	-		719	3	91,332
1979	82,203	9,888	147	327	479	-		711	3	93,758
1980	84,610	10,032	149	386	506	-		739	3	96,425
1981	86,571	10,113	146	479	520	-		748	3	98,580
1982	87,623	10,148	144	487	536	-		750	5	99,693
1983	89,039	10,364	140	489	562	-		754	5	101,353
1984	91,082	10,328	137	510	578	-		764	5	103,404
1985	92,105	10,485	134	522	692	-		768	5	104,711
1986	93,414	10,532	134	544	637	-		779	8	106,048
1987	95,469	10,534	135	587	655	-		781	10	108,171
1988	97,003	10,474	133	653	678	-		796	9	109,746
1989	98,220	10,392	167	1,075	692	3		831	10	111,390
1990	99,439	10,309	201	1,496	706	5		866	10	113,032
1991	100,580	10,279	197	2,008	715	5		877	10	114,671
1992	103,978	10,551	129	2,505	692	5		819	11	118,690
1993	104,090	11,067	155	2,462	693		165	905	11	119,548
1994	105,672	11,205	153	2,460	753		163	912	11	121,329
1995	106,767	11,394	122	2,527	758		225	906	11	122,710
1996	108,801	11,414	119	2,475	758		225	906	12	124,710

Note:

(1) Historical data from Wichita Water and Sewer System Annual Reports, 1970 - 1991, and customer records from 1992 to 1996.

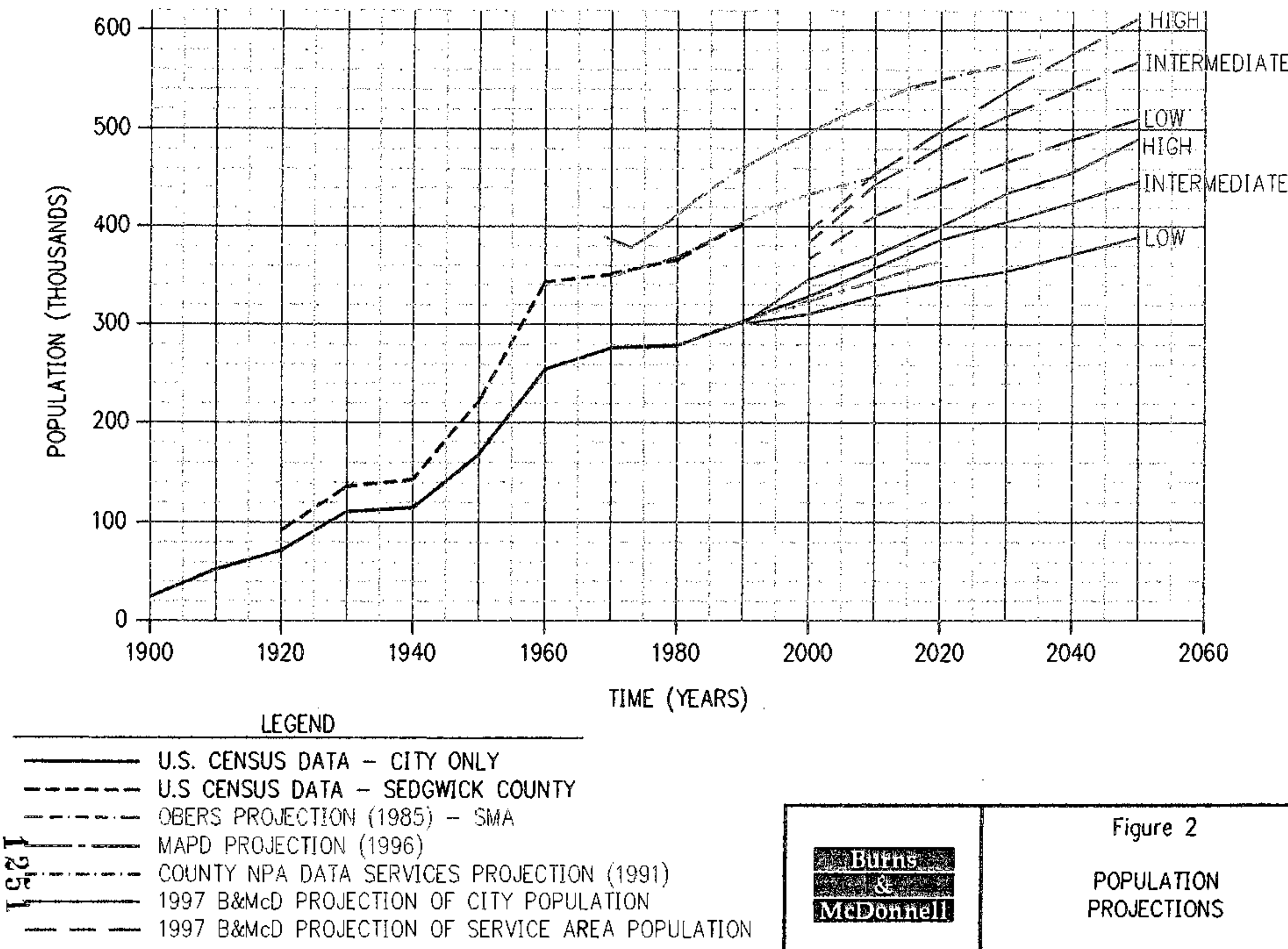
(2) The Contract classification was initiated in 1993 and includes large irrigators such as golf courses, home owners associations and the Parks Department.

Table 3

HISTORICAL AND PROJECTED POPULATION
DATA FOR WICHITA, KANSAS AND SURROUNDING AREA

Year	U.S. Census (1)		MAPD (2)		County: NPA Data Services (3)	OBERS (4)	CDM Water Master Plan (5)	Kansas Water Office (6)		Burns & McDonnell															
										City of Wichita						Ex. Wholesale Customers (7)		Anticipated Wholesale Customers		Service Area Population					
										High		Low		Intermediate						High		Low		Intermediate	
	City	County	City	County				City	County	1993	1997	1993	1997	1993	1997	1993	1997	1993	1997	1993	1997	1993	1997	1993	1997
1900	24,671	-	-	-	-	-	-	-	-																
1910	52,450	-	-	-	-	-	-	-	-																
1920	72,217	92,234	-	-	-	-	-	-	-																
1930	111,110	136,330	-	-	-	-	-	-	-																
1940	114,966	143,311	-	-	-	-	-	-	-																
1950	168,279	222,290	-	-	-	-	-	-	-																
1960	254,698	343,231	-	-	-	-	-	-	-																
1969	-	-	-	-	-	389,400	-	-	-																
1970	276,554	350,694	-	-	349,000	-	-	-	-																
1973	-	-	-	-	-	376,700	-	-	-																
1978	-	-	-	-	-	400,700	-	-	-																
1980	279,272	366,531	279,855	367,670	369,000	-	-	-	-																
1983	-	-	-	-	-	426,600	-	-	-																
1985	-	-	-	-	386,000	-	-	-	-																
1990	304,011	403,662	304,011	403,662	405,000	460,800	331,000	304,011	403,662	304,011	304,011	304,011	304,011	304,011	304,011	31,467	31,467	-	-	335,498	335,498	335,498	335,498	335,498	335,498
1991	-	-	-	-	409,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995	-	-	314,299	417,963	423,000	480,000	358,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	-	-	324,586	432,264	434,000	496,400	385,000	331,672	444,654	345,000	345,000	316,000	316,000	333,000	333,000	35,417	33,693	18,801	18,801	399,218	397,694	370,218	368,694	387,218	385,694
2005	-	-	334,874	446,565	-	513,900	411,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	-	-	345,162	460,866	452,000	-	438,000	357,984	483,922	374,000	374,000	331,000	331,000	363,000	363,000	40,521	39,029	43,537	43,623	458,058	456,652	415,058	413,652	447,058	445,652
2015	-	-	355,430	475,137	-	541,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020	363,935	485,274	365,688	489,363	-	-	-	384,297	523,189	404,000	404,000	346,000	346,000	388,000	388,000	45,504	43,973	52,255	52,652	501,759	500,625	443,759	442,625	485,759	484,625
2030	-	-	-	-	-	-	-	410,609	562,457	433,000	433,000	361,000	361,000	406,000	406,000	49,374	47,850	60,230	60,230	542,604	541,080	470,604	469,080	517,604	516,080	
2035	-	-	-	-	-	574,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2040	-	-	-	-	-	-	-	436,922	601,724	463,000	463,000	376,000	376,000	428,000	428,000	52,444	50,920	64,840	64,840	580,284	578,760	493,284	491,760	545,284	543,760
2050	-	-	-	-	-	-	-	-	-	493,000	493,000	391,000	391,000	448,000	448,000	55,634	54,110	68,150	68,150	616,784	615,260	514,784	513,260	571,784	570,260

Notes:
(1) Historical and estimated U.S. Census Bureau Data for the City of Wichita and Sedgwick County.
(2) Wichita-Sedgwick County Metropolitan Area Planning Department, 1996.
(3) Key Indicators of County Growth, 1970 - 2010, NPS Data Services, 1991 edition.
(4) U.S. Department of Commerce - Bureau of Economic Analysis, 1985 Regional Projections for the Statistical Metropolitan Area.
(5) Water System Master Plan by CDM, 1992, Draft, Service Area Projections.
(6) Sedgwick County Population and Water Demand Projections prepared by the Kansas Water Office, January 7, 1997.
(7) Includes wholesale customers, McConnell AFB, Benefit Districts and individually metered customers outside the City limits.



600
500
400
300
200
100
0
POPULATION (THOUSANDS)
1900
1920
1940
1960
1980
2000
2020
2040
2060
TIME (YEARS)
HIGH
INTERMEDIATE
LOW
HIGH
INTERMEDIATE
LOW
LEGEND
U.S. CENSUS DATA - CITY ONLY
U.S CENSUS DATA - SEDGWICK COUNTY
OBERS PROJECTION (1985) - SMA
MAPD PROJECTION (1996)
COUNTY NPA DATA SERVICES PROJECTION (1991)
1997 B&McD PROJECTION OF CITY POPULATION
1997 B&McD PROJECTION OF SERVICE AREA POPULATION

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Figure 2

POPULATION PROJECTIONS

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City of Wichita had a 1990 population of approximately 304,000 with 2.43 people per housing unit. These projections were reviewed based on growth from 1991 through 1996. These values closely track the intermediate projection; therefore, the population projections in the 1993 study are still considered valid.

Based on evaluation of upper and lower growth scenarios with the OBERS projection to the year 2035, the MAPD 1992 Comprehensive Study, and population projections by others, city population is anticipated to increase by 3,000 people (1,280 residential connections) per year to the year 2015 and then increase by 2,000 people (910 residential connections) per year from 2016 to 2050. This results in year 2010 City population of 363,000 (126,700 residential connections) and a year 2050 city population of 448,000 (165,000 residential customers).

In addition to the City's residential population, the projected service area also includes existing and anticipated wholesale customers and individually metered customers outside the city limits. Table 3 shows the projected growth for the wholesale and individually-metered customers outside the city limits (existing wholesale category) increasing from approximately 31,000 people in 1990 to 54,000 people in 2050.

Anticipated wholesale customers include additional town/areas in Sedgwick County not currently served by the City's water system. Connection of these customers to the system would add about 68,000 people to the year 2050 projected service area.

A service customer and water usage projection computer model was developed in Lotus to help forecast the number of customers, usage and water conservation savings by customer class to the year 2050. Historical data is included in the model from 1970 to 1996 which shows recent trends in customer growth, gallons per meter day usage, and average day and maximum day usage. Customer data from 1970 to 1996 is used in this analysis and customer projections by the model are shown in Table 4 and Figures 3 to 5.

D. Historical and Projected Water Demands

1. Historical Water Use

Historical average daily water use customer class and unaccounted-for water for the water service area from 1970 through 1996 are shown in Table 5. Data prior to 1986, especially unaccounted-for water, is questionable because of suspected errors in the data collection/entry system. Customer classes include residential, commercial, industrial, lawn service, fire protection, contract, institutional, water utility and wholesale.

Table 4

CUSTOMER PROJECTION SUMMARY

Year	Residential	Commercial	Industrial	Lawn Service	Fire Protection	Golf Course	Contract(2)	Institutional	Water Utility	Wholesale	Total Customers
1996	108,801	11,414	119	2,475	758	-	225	906	1	12	124,711
2000	113,900	11,500	125	2,730	782	-	230	920	1	13	130,201
2010	126,700	12,300	130	3,370	864	-	235	1,000	1	16	144,616
2020	137,700	13,000	135	3,920	954	-	240	1,090	1	19	157,059
2030	146,800	13,800	140	4,375	1,054	-	245	1,170	1	22	167,607
2040	155,900	14,600	145	4,830	1,164	-	250	1,250	1	22	178,162
2050	165,000	15,300	150	5,285	1,286	-	255	1,330	1	22	188,629

Note:

(1) Historical data from Wichita Water and Sewer System Annual Reports, 1970 - 1991, and customer records from 1992 to 1996.

(2) The Contract classification was initiated in 1993 and includes large irrigators such as golf courses, home owners associations and the Parks Department.

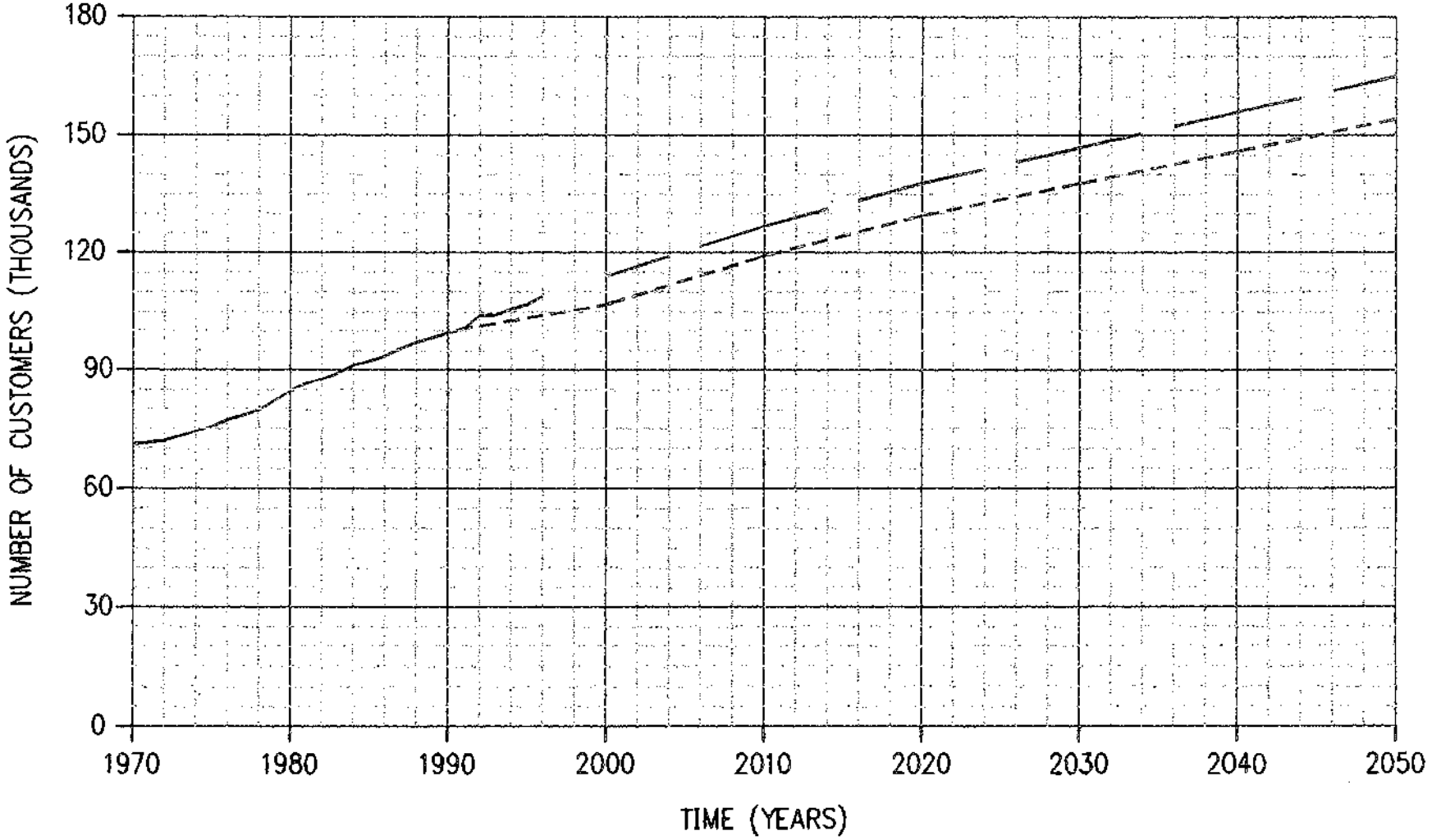

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Figure 3

RESIDENTIAL CUSTOMERS PROJECTION

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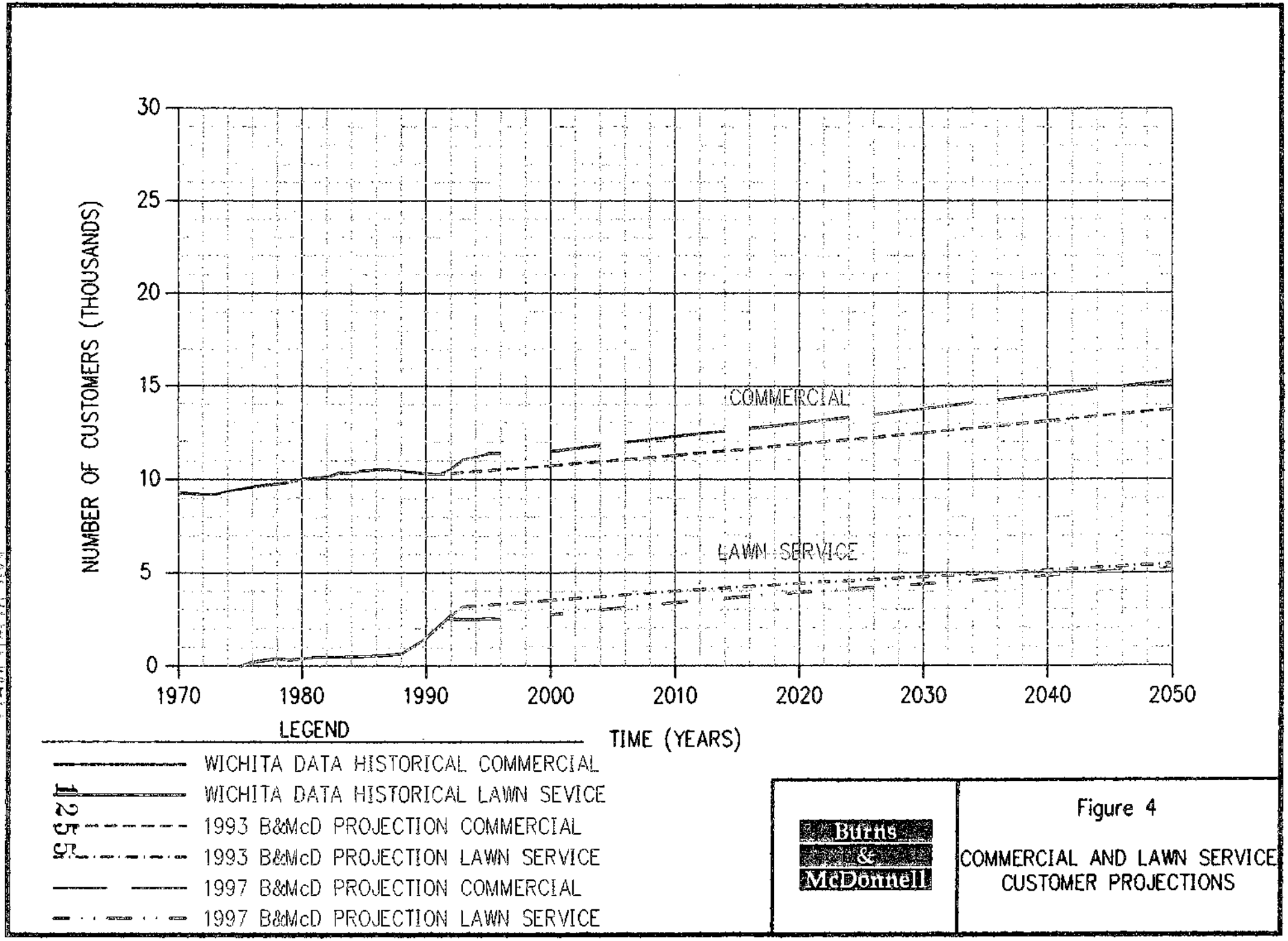

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Figure 4

COMMERCIAL AND LAWN SERVICE CUSTOMER PROJECTIONS

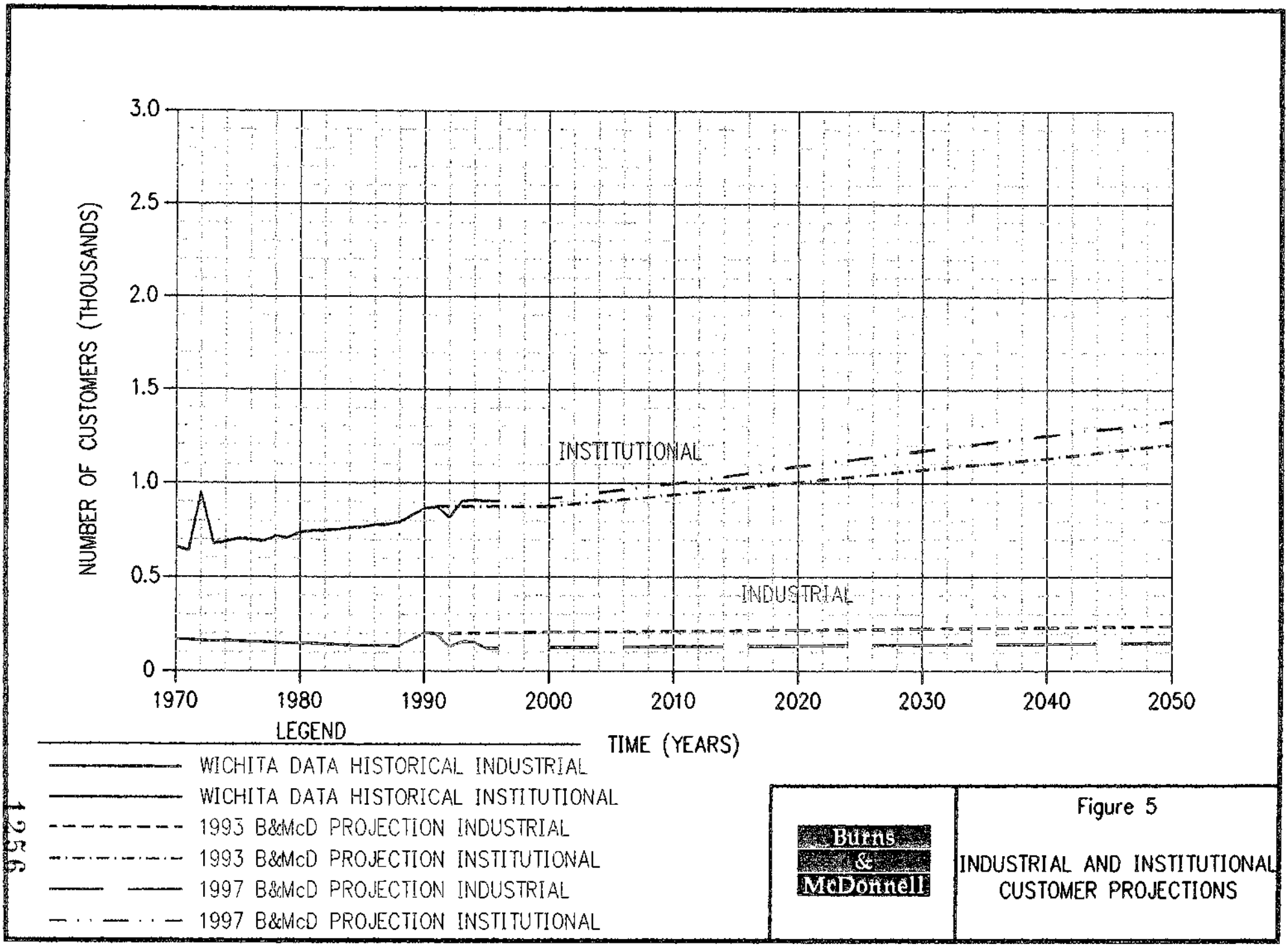


Table 5

HISTORICAL AVERAGE DAY METERED WATER USE IN MGD (1)

Year	Residential	Commercial	Industrial	Lawn Service (2)	Fire Protection	Golf Course (3)	Contract (4)	Institutional	Water Utility	Wholesale (5)	Total Metered Water (6)	Total Pumpage	UAF (7) (%)
1970	15.6	8.4	9.5	-	<0.05	-		2.2	<0.05	-	35.7	37.7	5.3
1971	14.6	8.8	9.2	-	<0.05	-		2.6	<0.05	-	35.2	37.2	5.4
1972	16.0	8.9	9.7	-	<0.05	-		2.2	<0.05	-	36.8	38.2	3.7
1973	16.1	9.8	10.1	-	<0.05	-		2.9	<0.05	<0.05	38.9	39.3	1.0
1974	16.0	10.8	9.6	-	<0.05	-		2.9	<0.05	<0.05	39.3	39.5	0.5
1975	15.4	12.4	8.3	-	<0.05	-		2.8	<0.05	0.2	39.1	39.1	0.0
1976	17.4	10.9	8.0	1.0	<0.05	-		2.5	<0.05	0.1	39.4	39.9	1.3
1977	16.4	11.9	9.2	0.8	<0.05	-		2.3	<0.05	0.2	40.4	40.6	0.5
1978	18.5	13.0	9.5	1.4	<0.05	-		3.4	<0.05	0.2	45.3	45.3	0.0
1979	18.9	13.9	10.8	2.2	<0.05	-		2.4	<0.05	0.2	47.3	47.9	1.3
1980	22.8	15.8	9.5	3.2	<0.05	-		3.2	<0.05	0.3	53.2	53.2	0.0
1981	22.0	16.3	6.4	2.2	<0.05	-		2.7	0.2	0.2	48.9	49.1	0.4
1982	20.5	16.4	6.6	2.4	<0.05	-		3.3	0.2	0.3	48.5	48.6	0.2
1983	23.3	15.4	6.2	4.1	<0.05	-		3.3	0.2	0.4	50.8	51.0	0.4
1984	23.8	15.5	7.5	3.2	<0.05	-		2.5	0.1	0.5	51.5	51.7	0.4
1985	22.5	14.7	7.1	3.0	<0.05	-		2.3	0.1	0.5	48.7	48.8	0.2
1986	21.9	14.1	7.4	3.4	<0.05	-		2.1	0.2	0.6	48.0	48.1	0.2
1987	22.7	15.2	7.4	3.0	<0.05	-		1.9	0.1	0.7	49.5	53.2	7.0
1988	25.0	13.7	8.7	4.5	<0.05	-		2.2	<0.05	0.8	52.6	57.6	8.7
1989	25.0	14.7	8.7	3.7	<0.05	0.1		2.2	<0.05	2.3	54.8	58.4	6.2
1990	26.3	15.4	8.7	5.5	<0.05	0.2		2.2	<0.05	1.2	56.7	64.2	11.7
1991	27.2	16.7	10.1	5.7	<0.05	0.2		1.8	<0.05	1.4	60.2	62.2	3.2
1992	22.8	15.1	7.5	1.9	<0.05	0.9		3.1	0.3	1.2	51.8	55.5	6.6
1993	24.4	11.2	8.6	1.2	<0.05		1.4	1.5	0.2	1.0	48.1	53.9	10.7
1994	25.1	10.3	9.1	6.5	<0.05		2.4	1.6	0.2	1.3	52.0	56.9	8.6
1995	23.1	11.8	6.7	5.2	<0.05		1.4	1.4	0.2	1.2	47.8	51.7	7.5
1996	24.3	12.3	5.9	6.2	<0.05		1.8	1.3	0.2	1.3	49.1	53.9	8.9

Notes:

(1) Historical data from Wichita Water and Sewer System Annual Reports, 1970 - 1991, and customer records from 1992 to 1996.

(2) Classification started in 1976.

(3) Classification started in 1989.

(4) Classification started in 1993 and includes large irrigators such as golf courses, homeowners assoc. and the Parks Department.

(5) Classification started in 1973.

(6) Total metered water adjusted for Lawn Service category which is calculated over 180 days.

(7) UAF is unaccounted-for water. UAF values less than 7% appear to be questionable based on industry norms.

demand2/06/04/97

The percentage of water use by customer classification and unaccounted-for water in 1996 follows:

Classification	Percentage
Residential	42
Commercial	23
Industrial	11
Lawn Service	6
Fire Protection	<1
Contract	2
Institutional	2
Water Utility	<1
Wholesale	2
Unaccounted-for Water	12
Total =	100%

Unaccounted-for water includes treated water which is lost in the system because of pipe leakage, inaccurate meters and unaccounted-for uses. Records show unaccounted-for water ranging 0 percent to 13 percent since 1970. Figures below 7 percent are considered to not be easily attainable and are believed to be caused by inconsistencies associated with reading meters every two months and other data collection/entry errors. City staff believes that a realistic range for unaccounted-for water is 11 to 13 percent. As of July 1992, meters are read on a monthly basis.

The city instituted a water conservation rate structure in 1993. The rate structure and above average rainfall from 1993 through 1996 have resulted in reduced water demands.

2. Projected Water Use

Projected average day water demands for each customer class are shown in Table 6. The computer model for service area customer and water use projections was used to calculate and projected average day usage (refer to computer output tables in

Table 6

AVERAGE DAY DEMAND (MGD) PROJECTION SUMMARY

Year	Residential	Commercial	Industrial	Lawn Service (2)	Fire Protection	Golf Course (3)	Contract (4)	Institutional	Water Utility	Wholesale (5)	Indiv Metered Wholesale Subtractions	Total Metered Water (6)	Total Pumpage	UAF (7) (%)
1996	24.3	12.3	5.9	6.2	<0.05	-	1.8	1.3	0.2	1.3	1.9	49.1	53.9	8.9
2000	34.2	19.6	8.1	9.6	0.1	-	4.6	3.7	0.2	8.2	2.4	78.6	88.0	12.0
2010	38.0	20.9	8.5	11.8	0.1	-	4.7	4.0	0.2	13.4	2.8	90.3	101.2	12.0
2020	41.3	22.1	8.8	13.7	0.1	-	4.8	4.4	0.2	16.2	3.2	99.0	110.9	12.0
2030	44.0	23.5	9.1	15.3	0.1	-	4.9	4.7	0.2	17.9	3.5	105.9	118.6	12.0
2040	46.8	24.8	9.4	16.9	0.1	-	5.0	5.0	0.2	19.1	3.7	112.5	126.0	12.0
2050	49.5	26.0	9.8	18.5	0.1	-	5.1	5.3	0.2	20.1	3.9	118.7	133.0	12.0

Notes:

(1) Historical data from Wichita Water and Sewer System Annual Reports, 1970 - 1991, and customer records from 1992 to 1996.
(2) Classification started in 1976.
(3) Classification started in 1989.
(4) Classification started in 1993 and includes large irrigators such as golf courses, homeowners assoc. and the Parks Department.
(5) Classification started in 1973.
(6) Total metered water adjusted for Lawn Service and Contract categories is calculated over 180 days.
(7) UAF is unaccounted-for water. UAF values less than 7% appear to be questionable based on industry norms.

Appendix B). Input data on customer projections and water usage per meter was used in the projection analysis.

The maximum day demand projection band (Table 10) was determined by applying demand factors of 2.14, 2.0, and 1.8 to the average day demand projections from year 1997 through year 2050. Data from 1960 to 1996 was used to determine these maximum day to average day factors which average 1.8 over the 37-year period and reached a maximum of 2.14 in 1983 as shown in Table 7. The maximum day factor of 2.0 represents the design value used in the 1994 Water System Master Plan and appears to be a reasonable maximum goal for the City. The maximum day water demand was intentionally controlled by the City in 1990 and 1991 through watering restrictions and limiting the pumping of water to conserve water in storage at the water plant.

a. Residential Water Use Projection

Historical and projected water demands for residential customers are shown in Table 8 and Figure 6. Projected usage is determine by applying the projected number of residential customers from Table 4 to projected gallons per day per meter (gpd/meter) water demands. Customer growth is based on 1,280 new customers per year from 1997 to 2015 and 910 new customers per year from 2016 to 2050. This projection reflects the shape of the OBERS population growth curve and averages 1,040 new housing units per year over the study period. By comparison, MAPDs 1992 Comprehensive Plan uses an average of approximately 1,000 new housing units per year through the year 2010.

Historical per capita water use is determined from historical population data and annual residential water consumption records from Table 5. Per capita usage has grown steadily from 1970 to 1991 at an average rate of 1.7 percent per year to 109 gallons per capita per day (gpcd) or 265 gpd/meter in 1990. Based on a linear regression from 1980 to 1991, usage of 146 of gpcd or 355 gpd/meter is estimated in the year 2050 and was used in the 1993 Water Supply Study. The 1980's appears to be the most reasonable time period to evaluate long-term residential water use as it represents the time period when many people had acquired water-using devices such as dishwashers, cloths washers, garbage grinders, and other devices.

Maximum usage occurred in 1991 and was 270 gpd\meter. At that time, water use was artificially restricted due supply reliability issues. Based on usage in 1991, an unrestricted, no conservation impact value of 300 gpd/meter is used in this study for residential usage between the years 2000 through 2050.

b. Commercial Water Use Projection

Historical and projected water usage for commercial customers are shown in Table 8 and Figure 7. The projected demand is based on historical commercial

Table 7

HISTORICAL MAXIMUM DAY/AVERAGE DAY FACTORS (1)

Year (2)	Annual Average Day (MGD)	Maximum Day (MGD)	Maximum Day/ Average Day Factor
1960	24.9	40.1	1.61
1961	24.8	42.5	1.71
1962	27.0	46.6	1.73
1963	29.3	48.8	1.67
1964	30.4	57.9	1.90
1965	30.6	52.1	1.70
1966	34.5	67.5	1.96
1967	33.9	53.5	1.58
1968	35.9	61.9	1.72
1969	35.2	57.1	1.62
1970	37.7	69.9	1.85
1971	36.4	63.3	1.74
1972	38.1	63.1	1.66
1973	39.3	70.8	1.80
1974	38.2	74.5	1.95
1975	38.8	69.7	1.80
1976	39.9	70.9	1.78
1977	40.1	70.0	1.75
1978	45.2	84.3	1.87
1979	48.0	79.5	1.66
1980	53.8	104.1	1.93
1981	49.1	76.3	1.55
1982	48.6	92.0	1.89
1983	49.3	105.5	2.14
1984	51.7	96.7	1.87
1985	48.5	91.6	1.89
1986	48.2	96.4	2.00
1987	53.4	104.0	1.95
1988	57.9	112.3	1.94
1989	58.4	90.9	1.56
1990	64.2	109.5	1.71
1991	62.2	125.7	2.02
1992	55.1	100.5	1.82
1993	53.9	96.0	1.78
1994	56.9	105.3	1.85
1995	51.7	94.4	1.83
1996	53.9	97.1	1.80

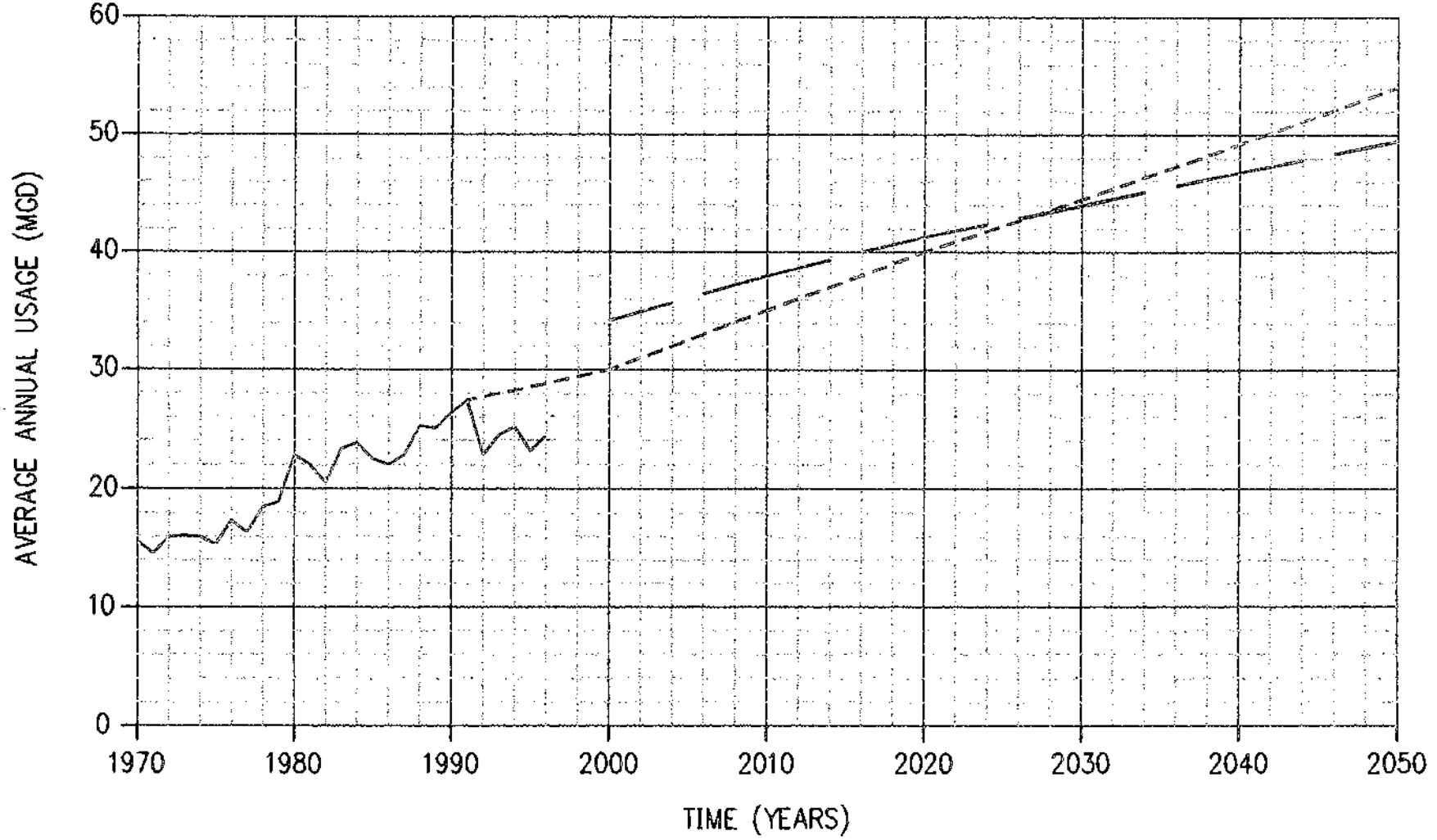
Note:
(1) Data for 1960 - 1985 collected from 1985 C & O report.
Data for 1986 - 1991 collected from Wichita Water and. Sewer Annual Reports, 1986 - 1991.
Data from 1992 - 1996 collected from Wichita Water and Sewer Department.
(2) The maximum day demands in 1990 and 1991 were artificially controlled.

Table 8

SUMMARY OF HISTORICAL AND PROJECTED CUSTOMER AND DEMAND (MGD) DATA

	Residential			Commercial			Industrial			Lawn Service				Institutional		
Year	Customers	Usage	Gal/Cust	Customers	Usage	Gal/Cust	Customers	Usage	Gal/Cust	Customers	Usage (1)	Usage (2)	Gal/Cust(1)	Customers	Usage	Gal/Cust
1970	71,011	15.6	220	9,323	8.4	901	168	9.5	56,548	-	-	-	-	662	2.2	3,323
1971	71,448	14.6	204	9,284	8.8	948	167	9.2	55,090	-	-	-	-	641	2.6	4,056
1972	71,939	16.0	222	9,243	8.9	963	164	9.7	59,146	-	-	-	-	953	2.2	2,308
1973	73,115	16.1	220	9,234	9.8	1,061	158	10.1	63,924	-	-	-	-	679	2.9	4,271
1974	74,182	16.0	216	9,398	10.8	1,149	162	9.6	59,259	-	-	-	-	690	2.9	4,203
1975	75,513	15.4	204	9,542	12.4	1,300	159	8.3	52,201	-	-	-	-	706	2.8	3,966
1976	77,171	17.4	225	9,645	10.9	1,130	155	8.0	51,613	221	1.0	0.5	4,588	701	2.5	3,566
1977	78,368	16.4	209	9,727	11.9	1,223	155	9.2	59,355	303	0.8	0.4	2,677	692	2.3	3,324
1978	79,785	18.5	232	9,795	13.0	1,327	151	9.5	62,914	419	1.4	0.7	3,388	719	3.4	4,729
1979	82,203	18.9	230	9,888	13.9	1,406	147	10.8	73,469	327	2.2	1.1	6,821	711	2.4	3,376
1980	84,610	22.8	269	10,032	15.8	1,575	149	9.5	63,758	386	3.2	1.6	8,405	739	3.2	4,330
1981	86,571	22.0	254	10,113	16.3	1,612	146	6.4	43,836	479	2.2	1.1	4,657	748	2.7	3,610
1982	87,623	20.5	234	10,148	16.4	1,616	144	6.6	45,833	487	2.4	1.2	4,997	750	3.3	4,400
1983	89,039	23.3	262	10,364	15.4	1,486	140	6.2	44,286	489	4.1	2.0	8,294	754	3.3	4,377
1984	91,082	23.8	261	10,328	15.5	1,501	137	7.5	54,745	510	3.2	1.6	6,362	764	2.5	3,272
1985	92,105	22.5	244	10,485	14.7	1,402	134	7.1	52,985	522	3.0	1.5	5,827	768	2.3	2,995
1986	93,414	21.9	234	10,532	14.1	1,339	134	7.4	55,224	544	3.4	1.7	6,337	779	2.1	2,696
1987	95,469	22.7	238	10,534	15.2	1,443	135	7.4	54,815	587	3.0	1.5	5,182	781	1.9	2,433
1988	97,003	25.0	258	10,474	13.7	1,308	133	8.7	65,414	653	4.5	2.2	6,832	796	2.2	2,764
1989	98,220	25.0	255	10,392	14.7	1,415	167	8.7	52,096	1,075	3.7	1.8	3,395	831	2.2	2,647
1990	99,439	26.3	264	10,309	15.4	1,494	201	8.7	43,284	1,496	5.5	2.7	3,660	866	2.2	2,540
1991	100,580	27.2	270	10,279	16.7	1,625	197	10.1	51,269	2,008	5.7	2.8	2,828	877	1.8	2,052
1992	103,978	22.8	220	10,551	15.1	1,427	129	7.5	58,129	2,505	1.9	0.9	741	819	3.1	3,814
1993	104,090	24.4	234	11,067	11.2	1,009	155	8.6	55,466	2,462	1.2	0.6	476	905	1.5	1,641
1994	105,672	25.1	237	11,205	10.3	918	153	9.1	59,576	2,460	6.5	3.2	2,658	912	1.6	1,727
1995	106,767	23.1	217	11,394	11.8	1,038	122	6.7	55,086	2,527	5.2	2.6	2,060	906	1.4	1,560
1996	108,801	24.3	223	11,414	12.3	1,073	119	5.9	49,315	2,475	6.2	3.0	2,498	906	1.3	1,382
2000	113,900	34.2	300	11,500	19.6	1,700	125	8.1	65,000	2,730	9.6	4.7	3500	920	3.7	4,000
2010	126,700	38.0	300	12,300	20.9	1,700	130	8.5	65,000	3,370	11.8	5.8	3500	1000	4.0	4,000
2020	137,700	41.3	300	13,000	22.1	1,700	135	8.8	65,000	3,920	13.7	6.8	3500	1090	4.4	4,000
2030	146,800	44.0	300	13,800	23.5	1,700	140	9.1	65,000	4,375	15.3	7.6	3500	1170	4.7	4,000
2040	155,900	46.8	300	14,600	24.8	1,700	145	9.4	65,000	4,830	16.9	8.3	3500	1250	5.0	4,000
2050	165,000	49.5	300	15,300	26.0	1,700	150	9.8	65,000	5,285	18.5	9.1	3500	1330	5.3	4,000

Notes:
(1) Based on 180 days per year.
(2) Based on 365 days per year.



LEGEND

WICHITA DATA HISTORICAL

1993 B&McD PROJECTION

1997 B&McD PROJECTION

Burns & McDonnell

Figure 6

RESIDENTIAL WATER USAGE PROJECTION

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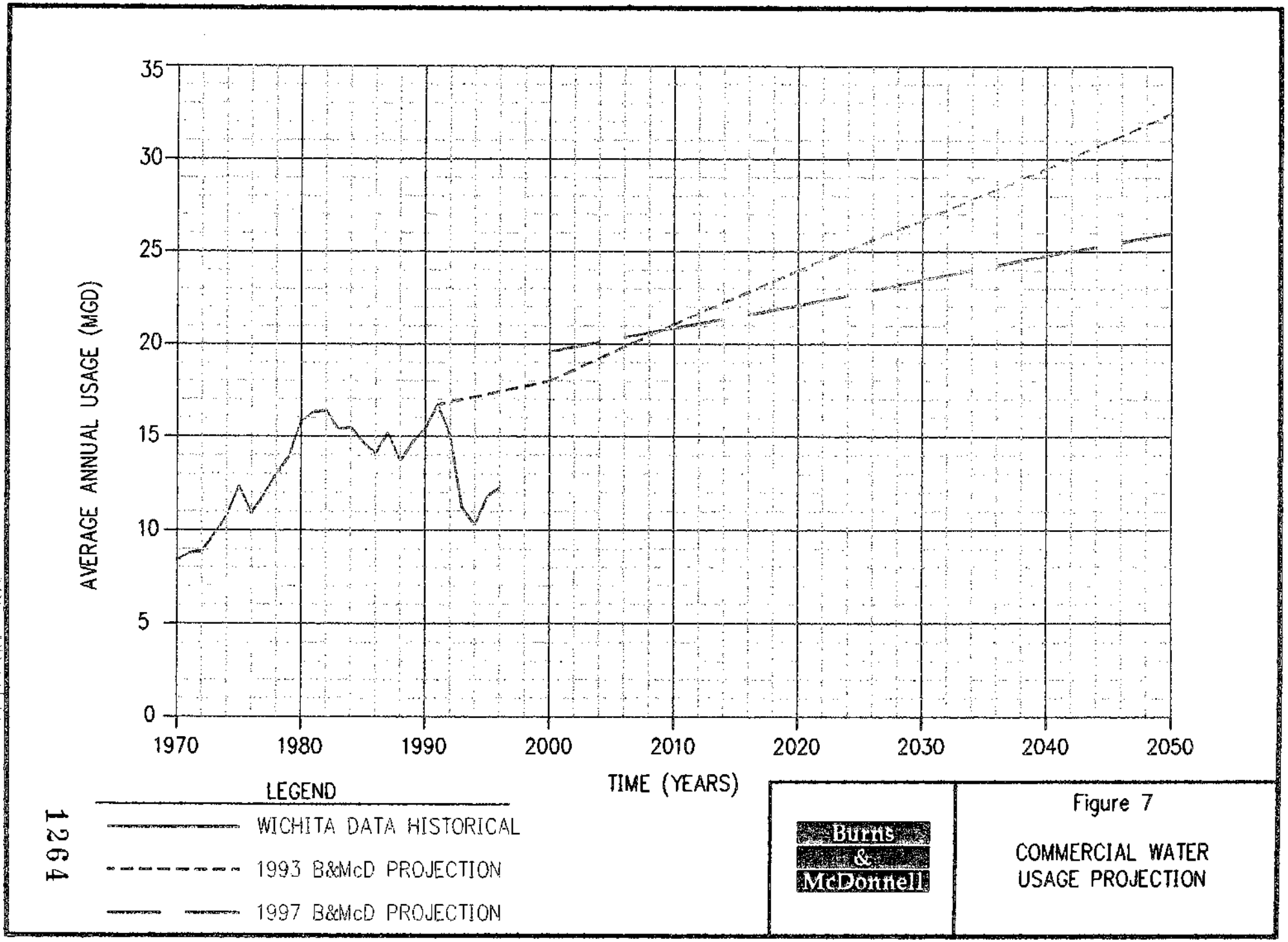


customer growth and water usage from 1970 to 1996. Customer growth is projected in a regression analysis with data from 1970 through 1996. The result of the regression analysis is 15,300 commercial customers in 2050.

Maximum commercial usage occurred in 1991 and was 1,625 gpd\meter. At that time, water use was artificially restricted due to supply reliability issues. Based on this 1991 usage, an unrestricted, no conservation impact value of 1,700 gpd/meter is used in this study for commercial usage between the year 2000 through 2050.

c. Industrial Water Use Projection

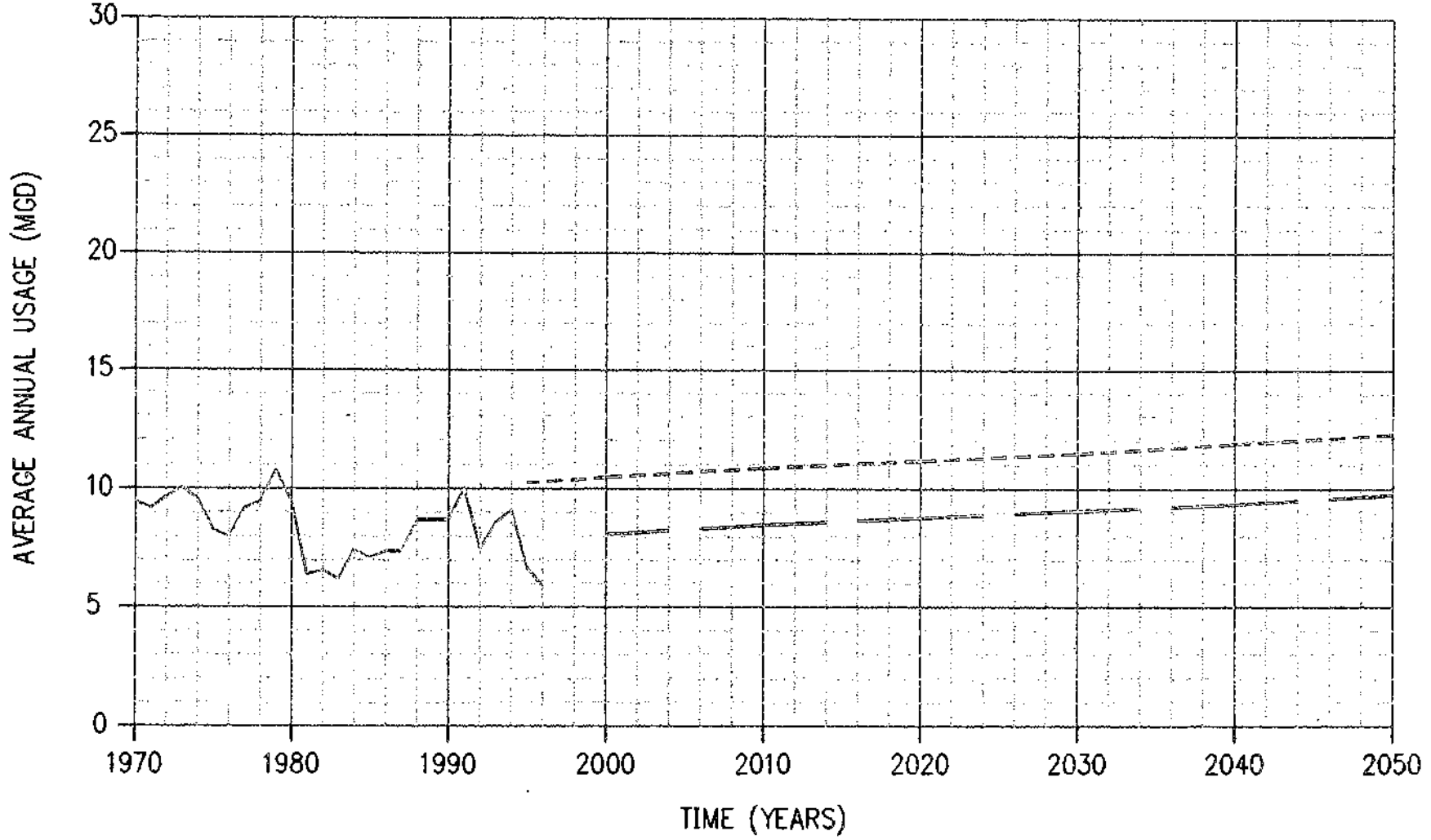
Historical and projected water usage for industrial customers are shown in Table 8 and Figure 8. The number of industrial customers had steadily decreased from 1970 (168 Customers) to 1996 (119 customers) ; however, large customer increases occurred between 1989 and 1991, allowing this water user classification to achieve a level of approximately 200 customers. Since 1993, the definition for the industrial classification has been revised contributing to the reduction in customers to 119 in 1996. Based on discussions with City staff, customer growth is anticipated to increase at a slow rate or approximately 5 customers every 10 years.

Maximum industrial usage occurred in 1988 and was about 65,400 gpd/meter. Since the institution of the conservation rate, many industries have reduced water usage to the average of 50,000 to 60,000 gpd/meter. For this study, usage of 65,000 gpd/meter is used from year 2000 through 2050 to represent no conservation efforts. This results in a year 2050 average day demand of 9.8 MGD.

d. Lawn Service Water Use Projections

Historical and projected water usage for lawn service customer are shown in Table 8 and Figure 9. The lawn service classification includes residential and commercial connections to the distribution pipe network with sprinkler systems. The implementation of the 1993 water conservation rate levelized the growth of this classification. Currently, this classification is only required for larger residential and commercial customers. Customer growth is anticipated to continue at a rate of 5 percent of the residential growth to 5,285 customers in the year 2050.

Reference to Figure 9 shows a rapid increase in water usage since the creation of this water user classification in 1976. Over the first 16 years, 1976 through 1993, the number of customers has increased by a factor of 9 and usage by a



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WICHITA DATA HISTORICAL

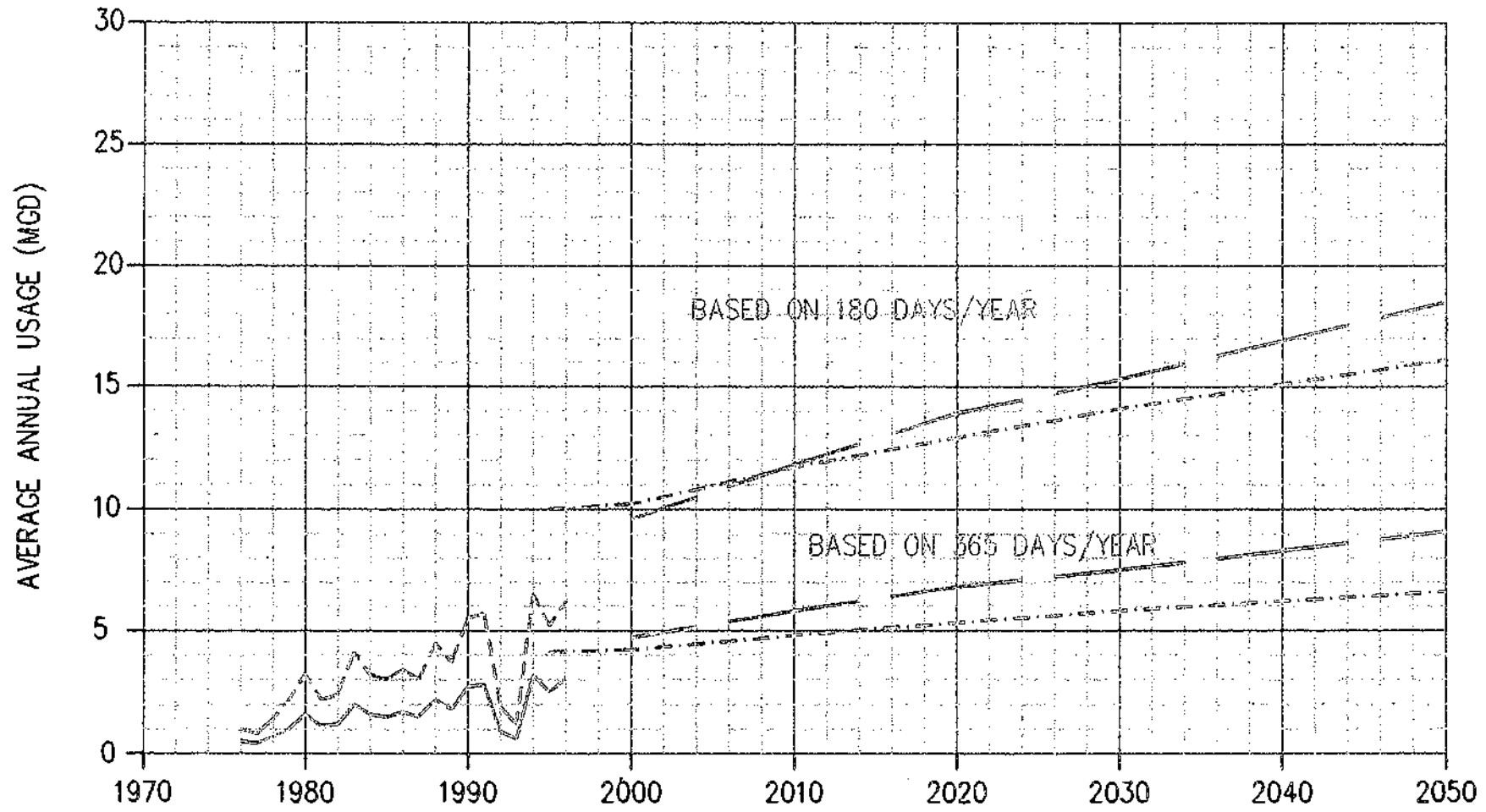
1993 B&McD PROJECTION

1997 B&McD PROJECTION

Burns & McDonnell

Figure 8

INDUSTRIAL WATER USAGE PROJECTION



LEGEND

- WICHITA DATA HISTORICAL (BASED ON 365 DAYS/YEAR)
- WICHITA DATA HISTORICAL (BASED ON 180 DAYS/YEAR)
- 1993 B&McD PROJECTION (BASED ON 150 DAYS/YEAR)
- 1997 B&McD PROJECTION (BASED ON 180 DAYS/YEAR)

Burns & McDonnell

Figure 9

LAWN SERVICE WATER USAGE PROJECTION

factor of 5.5; however, during the last four years, the number of customers has stabilized and usage has declined due to wet weather and the effects of the conservation water rate. As the number of customers increase, the average gpd/meter continues to decrease. The gpd/meter value of 3,500 is used in this study for the year 2000 through 2050. This value of 3,500 gpd/meter reflects no impact of conservation and is based on usage of 2,658 in 1994, a wet year with the conservation rate in place. Applying the projected number of customers with estimated gpd/meter results in an average annual day water use of 9.1 MGD in year 2050. Based on 180 watering days per year, lawn service customers would use 18.5 MGD on an "average" summer day of demand.

e. Fire Protection Water Use Projections

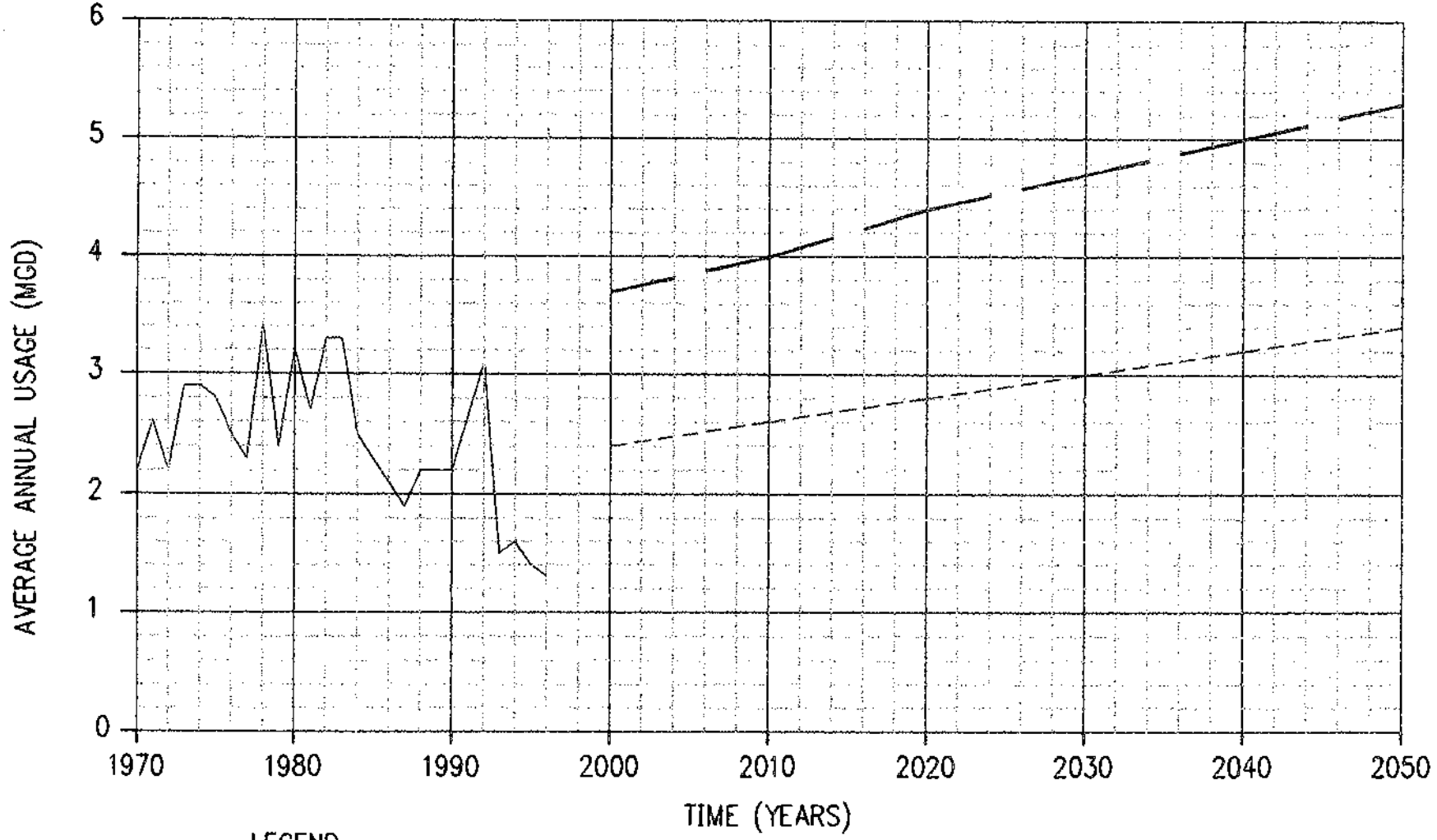
Fire protection usage is a function of the amount of water used to extinguish fires for fire protection customers. From 1970 to 1996, no significant water usage was recorded. This trend of no significant usage is anticipated to continue through the study period. The projected usage for this customer classification is shown in Table 6.

f. Contract Water Use Projections

The contract user classification was added in 1993 and includes large irrigators like golf courses, home owners associations and Parks Department irrigation systems. This classification has increased from 163 customers in 1993 to 225 customers in 1996. Customer growth is projected at five customers per decade based on discussions with city staff. Usage has ranged from an average of about 3,100 gpd/meter to 7,400 gpd/meter based on 365 days per year and 6,200 gpd/meter to 15,000 gpd/meter based on 180 days per year. The maximum of 15,000 gpd/meter over 180 days occurred in 1994 when a higher than average rainfall occurred and a water conservation rate was in effect. A projection of 20,000 gpd/meter over 180 days in use in this study and results in a year 2050 average day demand of 5.1 MGD over 180 days and at 2.5 MGD over 365 days.

g. Institutional Water Use Projections

Historical and projected water uses for institutional customers are shown in Table 8 and Figure 10. Institutional customers include city and county facilities, universities and schools. The number of customers for the classification grew at a rate of 1.1 percent per year from 1970 to 1994. Growth stabilized in 1995 and 1996 due to reclassification of several large users to the contract customers class. A linear regression of customer data from 1970 to 1996 projects 1,330 customers in 2050.



Burns & McDonnell

Figure 10

INSTITUTIONAL
WATER USAGE PROJECTION

Reference to Figure 10 shows erratic changes in usage from 1970 to 1996, ranging from 1.3 MGD to 3.8 MGD and gpmd values ranging from 1380 to 4730. For the purpose of this study, a gpmd value of 4000 is used based on the 1992 value of 3800. Water demand is anticipated to increase from 3.7 MGD in 2000 to 5.3 MGD in 2050.

h. Water Utility Water Use Projections

The water department utilizes water for various construction and maintenance activities, including flow testing of the distribution system, pipeline construction and fire hydrant flushing. Historically, a maximum average annual flow of 0.2 MGD has been recorded and is used as the projected water utility usage from 1997 through 2050.

i. Wholesale Water Use Projections

Historical and projected demands by wholesale customers are shown in Table 9 and Figure 11. The City serves 10 wholesale customers, including eight towns and Rural Water Districts (RWD) Nos. 1, 3 and 8. RWD No. 3 disconnected from the City's system in 1995.

Reference to Figure 11 shows a slow, steady increase in water use from 0.03 MGD in 1973 to 1.3 MGD in 1996. During this time period, wholesale customers only used about half of their contracted water supply amount.

Two types of wholesale customers and associated water use are evaluated in this study; existing and anticipated. The existing wholesale customers and their associated use is expected to grow from 31,000 people in the year 1990 to 57,000 people in year 2050 with an average day demand of 9.9 MGD.

Anticipated wholesale customers include additional towns/areas in Sedgwick County not currently served by the City. Connection of these customers to the city water system would make the City a regional water purveyor. Under this scenario, the City would provide raw and potable water to approximately 85 percent of the county by year 2030. Anticipated wholesale customers are projected at approximately 68,000 people with a 10 MGD average day water demand by the year 2050 (refer to Appendix C).

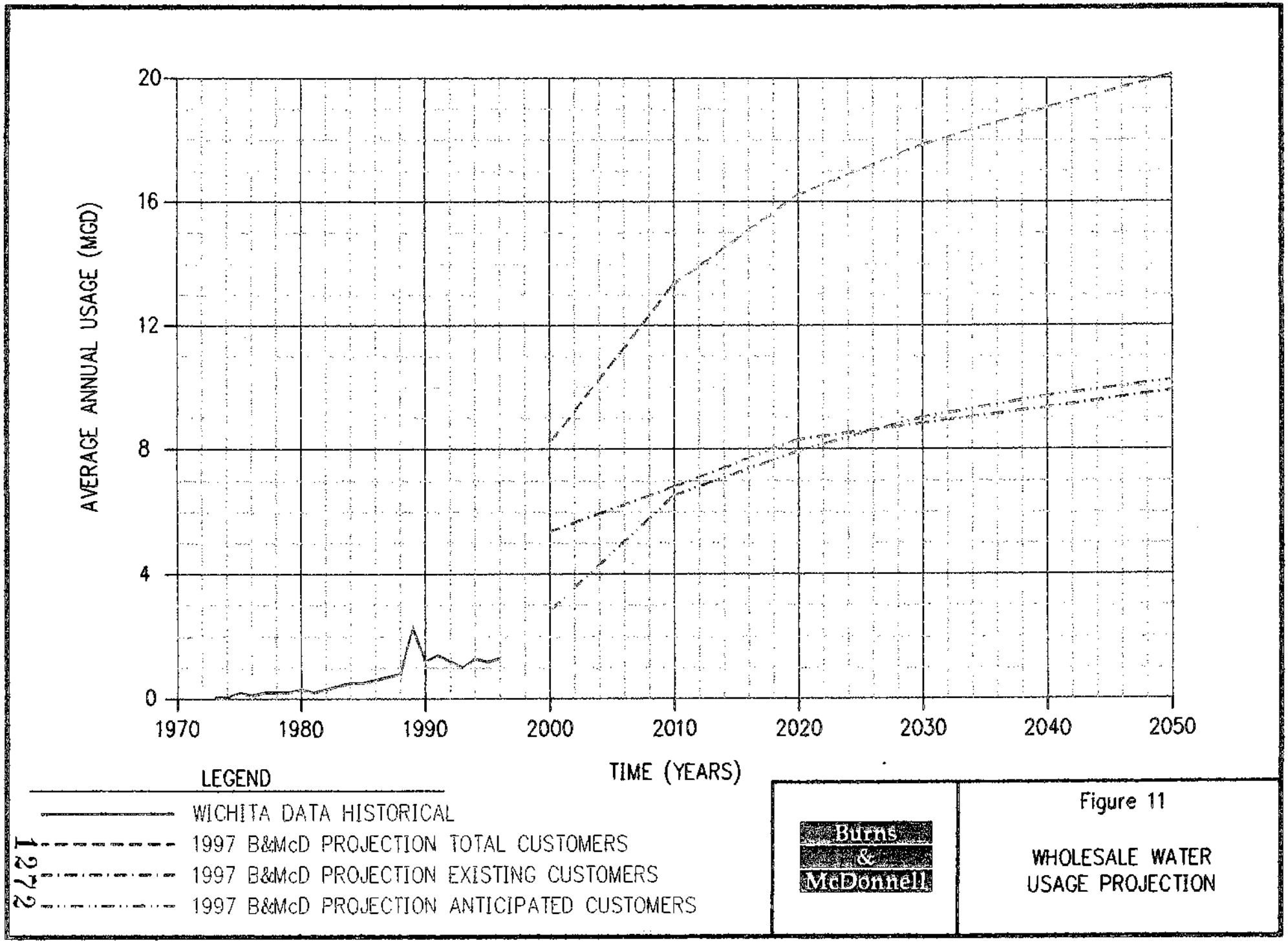
Several existing contracts between the City and wholesale customers include excessive and unused supply capacities. Future wholesale contracts may be rewritten to allocate water supply to the wholesale customers which more closely represent anticipated water use. This will allow the City to better utilize its resources and prevent overbuilding of facilities.

Table 9

HISTORICAL AND PROJECTED
WHOLESALE WATER USE

Year	Existing Wholesale Customers	Anticipated Wholesale Customers	Existing Wholesale Average Annual Daily Demand (MGD) (1)	Anticipated Wholesale Average Annual Daily Demand (MGD) (1)	Total Wholesale Average Annual Daily Demand (MGD) (1)
1970	1	-	0.03	-	0.03
1980	3	-	0.3	-	0.3
1990	10	-	1.2	-	1.2
1996	10	-	1.3	-	1.3
2000	11	4	5.4	2.8	8.2
2010	11	6	6.8	6.5	13.3
2020	11	9	8.3	7.9	16.2
2030	11	11	8.8	9.0	17.8
2040	11	11	9.3	9.7	19.0
2050	11	11	9.9	10.2	20.1

Notes:
(1) MGD is million gallons per day.
(2) Valley Center is anticipated to be a new wholesale customer by the year 2000.
(3) Additional details are included in the Appendix C.



j. Total Water Demand (Without Effects of Water Conservation)

Total historical and projected average day and maximum day water demands (without conservation) for the water service area are shown in Table 10 and Figure 12. Projected demands include water for residential, commercial, industrial, lawn service, fire protection, contract, institutional, water utility and wholesale customer classifications and unaccounted-for water. Unaccounted-for water is assumed to be 12 percent. Table 10 also includes the projections from Wichita's 1993 Water Supply Study for data comparison.

Historical information shown in Figure 12 is from Wichita Water and Sewer System Annual Reports. The high, intermediate and low water use projections are based on the high, intermediate, and low population projections shown in Figure 2.

The total water demand projection shown in Figure 12 does not include the impact of water conservation measures which have been implemented by the City. Since 1990, the City has limited lawn watering to two days per week per customer between 1990 and fall 1994 and has had an active meter repair/replacement program for many years. The City has a public education program on water conservation and has had a water conservation rate in effect since January 1993. The impacts of water conservation measures are discussed hereafter.

E. Water Demand With Conservation

History has shown that the amount of water used by consumers can be influenced by water conservation programs. Water conservation is possible through the continuous use of various management and technological activities; public awareness and education programs; and enforcement efforts. A thorough water conservation program should encourage the most effective use of water resources and the most efficient use of water by water consumers.

1. Conservation Activities

Management activities associated with conservation of water resources may include operating surface water and groundwater supplies to minimize water losses or yield reductions. Groundwater supplies should be managed to reduce aquifer declines and deterioration due to overpumping.

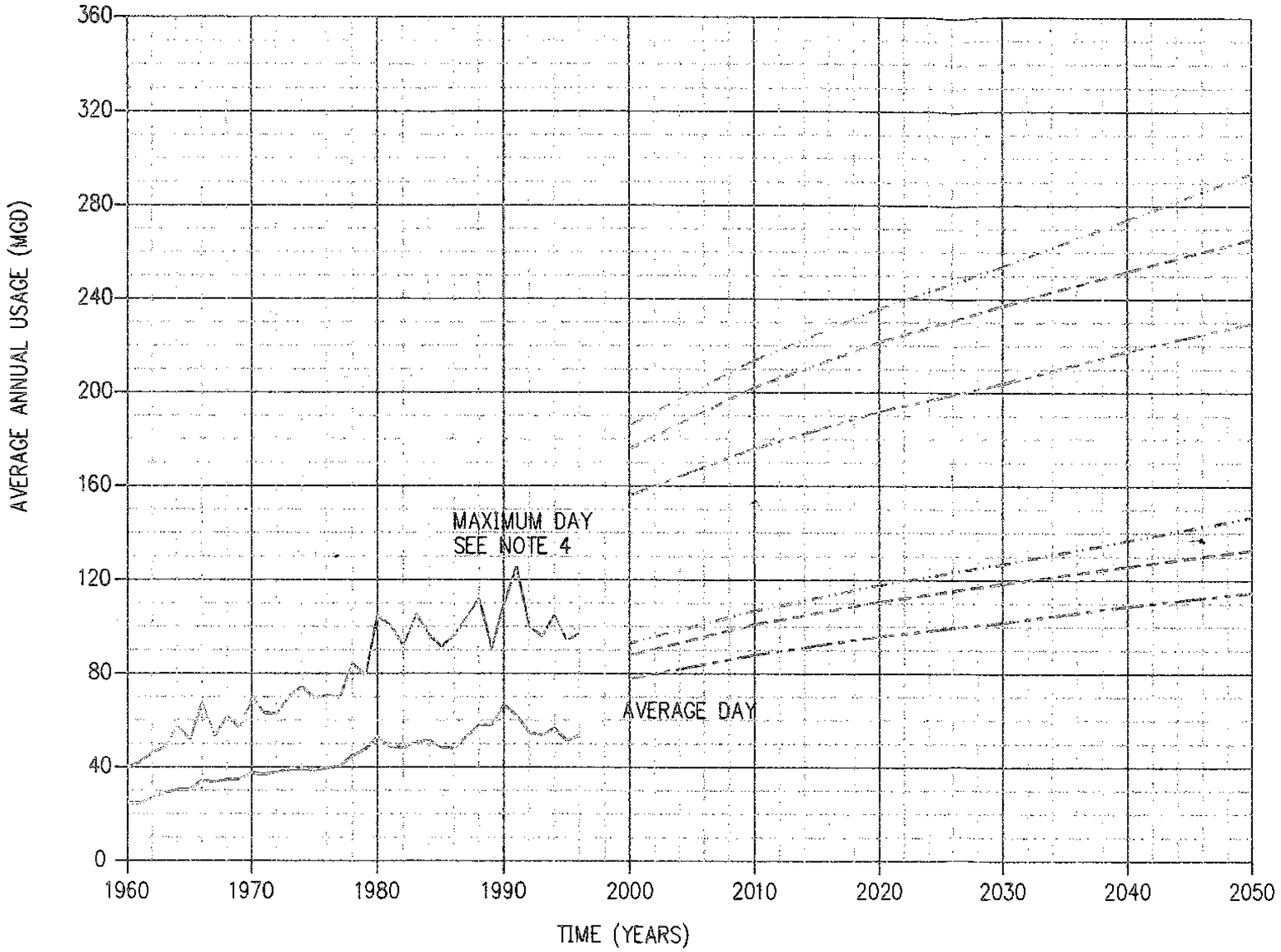
Other management and technological activities may include emphasis on water conservation in water system operation and maintenance activities. For example, the Wichita Water Department has a leak detection program to reduce water distribution system losses and a meter testing and repair program to increase the accuracy of water

Table 10

WATER USAGE PROJECTION
WITHOUT CONSERVATION

Year	Average Day			Maximum Day (2.14 factor)			Maximum Day (2.0 factor)			Maximum Day (1.84 factor)		
	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)
1996	53.9	53.9	53.9	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
2000	78.0	93.0	88.0	166.9	199.0	188.4	156.0	186.0	176.1	143.5	171.1	162.0
2010	88.0	107.0	101.2	188.3	229.0	216.5	176.0	214.0	202.3	161.9	196.9	186.2
2020	96.0	118.0	110.9	205.4	252.5	237.2	192.0	236.0	221.7	176.6	217.1	204.0
2030	102.0	127.0	118.6	218.3	271.8	253.8	204.0	254.0	237.2	187.7	233.7	218.3
2040	109.0	137.0	126.0	233.3	293.2	269.6	218.0	274.0	252.0	200.6	252.1	231.8
2050	115.0	147.0	133.0	246.1	314.6	284.5	230.0	294.0	265.9	211.6	270.5	244.7

Year	1993 Study Average Day			1993 Study Max Day (2.14 factor)			1993 Study Max Day (2.0 factor)			1993 Study Max Day (1.84 factor)		
	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)	Low (MGD)	High (MGD)	Intermediate (MGD)
2000	79.9	89.9	83	171	192.4	177.6	159.8	179.8	166	143.8	161.8	149.4
2010	91.6	101.2	98.3	196	216.6	210.4	183.2	202.4	196.6	164.9	182.2	176.9
2020	102.2	115.5	111.4	218.7	247.2	238.4	204.4	231	222.8	184	207.9	200.5
2030	110.1	127.5	121.1	235.6	272.9	259.2	220.2	255	242.2	198.2	229.5	218
2040	119.2	141	131.9	255.1	301.7	282.3	238.4	282	263.8	214.6	253.8	237.4
2050	128.5	155.1	143	275	331.9	306	257	310.2	286	231.3	279.2	257.4



LEGEND

- WICHITA HISTORICAL DATA
- 1997 B&McD HIGH PROJECTION
- 1997 B&McD LOW PROJECTION
- 1997 B&McD INTERMEDIATE PROJECTION

NOTES:

1. B&McD HIGH PROJECTION IS BASED ON HIGH POPULATION PROJECTION
2. B&McD LOW PROJECTION IS BASED ON LOW POPULATION PROJECTION
3. B&McD INTERMEDIATE PROJECTION IS BASED ON INTERMEDIATE POPULATION PROJECTION
4. MAXIMUM DAY DEMAND IS BASED ON A MAXIMUM DAY AVERAGE DAY FACTOR OF 2.0.

Burns & McDonnell

Figure 12

PROJECTED WATER USE WITHOUT CONSERVATION

quantity monitoring. All meters are tested, repaired or replaced on an eight-year cycle. Additionally, water treatment facilities are operated to minimize water losses through recycle of filter backwash water and recycle of supernatant from treatment basin sludge blowdown. The City also has xeriscaped City facilities, instituted new water conservation rates (inverted block) effective January 1, 1993, and is planning to perform a plumbing fitting retrofit pilot program.

Other programs under consideration may include methods to encourage the recycle and/or treatment and reuse of various industrial and municipal wastewaters in nonpotable reclaimed water systems. Such reclaimed water could be used in cooling, irrigation, or washdown systems where potable quality is not required. The use of zero liquid discharge water management systems in industrial complexes to supplement available water supplies is another method available to conserve water and to reduce or eliminate liquid waste streams.

Public awareness and education programs are frequently used to promote water conservation to water consumers. Wichita has several public awareness and education programs in progress, including radio and television commercials.

Conservation at the consumer level essentially consists of encouraging more efficient use of water. For domestic consumers, this may be achieved by using flow-restricting faucets and showerheads, reducing toilet tank capacity, or restricting lawn watering or car washing activities. For commercial and industrial consumers, water conservation may be achieved by optimizing product or process water and cooling water, reducing landscape watering, recycling or treating and reusing waste streams and installing more efficient sanitary waste handling facilities.

Regulation and enforcement efforts are also needed for an effective water conservation program. The 1992 Energy Conservation Act, requiring installation of water conserving devices, has proven helpful in reducing use whenever new water/sanitary fixtures are required. In critical water shortage situations, prohibition of outdoor water uses for lawn watering and washing cars and reduction of sanitary water for domestic needs may be required. Enforcement of regulations or restrictions by fines or termination of water service is necessary to assure compliance by all water users.

Some water conservation will occur without specific programs because of federal regulations concerning water pollution control. These programs, which may require industrial wastewater pretreatment before discharge to the municipal sewer system, will promote industrial water recycle, treatment and reuse because of economic conditions which influence the relative cost of water and wastewater treatment.

2. Conservation Quantity Evaluations

Two levels of conservation are evaluated in this study, a low and high range. The low range conservatively estimates potential savings from conservation activities and more closely reflects case studies by other cities. The high range estimates potential savings from conservation activities based on theoretical values. The degree of water conservation achieved will be influenced largely by the amount of emphasis the City places on water conservation, including enforcement activities.

Research and case studies have shown the following water conservation factors to be representative and feasible for water systems similar to the Wichita area:

- General Residential:

- Savings due to public education (up to 9 percent) and conservation water rates (6 percent plus) is estimated at 10 percent for the low range and 15 percent for the high range.

- Indoor plumbing fixture retrofit for pre-1995 housing units:

- Case studies (1981-1991) show savings of 5.7 to 9.6 gallons per capita day (gpcd). More recent studies show savings of 8.4 to 9.6 gpcd.

- This study estimates a savings of 8 gpcd or 20 gpd/meter for each housing unit (2.43 people per household) for the low range (based on a 70 percent penetration).

- Based on review of winter usage for Wichita (86 gpcd) and potential indoor usage with retrofitted conservation devices (60 gpcd), a reasonable savings of 12 gpcd or 28 gpd/meter for each housing unit is estimated for the high range (based on a 90 percent penetration).

  References include HUD, Bureau of Reclamation, Metropolitan Water District of Southern California, and the Lower Colorado River Authority.

- Indoor plumbing fixtures for housing units built in 1995 and beyond:

- Plumbing fixtures include 1.6 gallons per flush toilet and 2.5 gpm showerheads and faucets.

- Case studies show low flush toilets save 12 to 24 gpcd over 5 to 6 gallons per flush toilets and 8 to 12 gpcd over 3.5 gallon per flush toilets.

- This study estimates a savings of 13 gpcd or 31 gpd/meter for each post-1995 housing unit for the low range toilet (19 gpd/meter), plus showerhead (10 gpd/meter) plus faucet (2 gpd/meter).

- This study estimates a savings of 26 gpcd or 63 gpd/meter for post-1995 housing units for the high range (water-conserving home uses 60 gpcd while an average home had indoor usage of 86 gpcd in Wichita in 1990 for difference of 26 gpcd).

References include HUD, Bureau of Reclamation, Metropolitan Water District of Southern California, and the Lower Colorado River Authority.

- Outdoor Watering:

- This study estimates a savings of 5 percent of residential lawn watering (20,400 gallons per year per house) and lawn service use (260,000 gallons per year per meter) for the low range and 12 percent for the high range. This is a conservative estimate based on public education, conservation water rates and current watering restrictions. Public education conserves up to 9 percent and increasing water rates conserves approximately 6 percent.

- Reference AWWA.

- Industrial Recycle:

- This study estimates savings of 10 percent for the low range and 30 percent for the high range. Large industrial users have shown savings of 40 percent or more in various technical articles.

- References include AWARE Inc., Whitely, Burdett and Associates, and the Denver Water Department.

- Commercial:

- The commercial user class includes multi-family housing units, whose conservation savings are part of housing unit savings. Multi-family usage was calculated to be approximately 10 percent of total commercial usage. Therefore, savings for the commercial class are based on 90 percent of the total commercial usage.

- This study estimates savings of 10 percent for the low range and 25 percent for the high range of commercial water use and commercial lawn watering (760,000 gallons per year per meter). The literature review shows potential commercial savings of 20 to 39 percent.

- Reference the Bureau of Reclamation.

- Wholesale:

- Wholesale customers are expected to reduce potable water use by 10 percent for the low range and 15 percent for the high range due to public education and conservation water rates.

The following ongoing and planned future conservation activities must be included in the City's conservation program to meet and possibly exceed the savings estimated in this study:

- Review and modify rate structure on an annual basis to help achieve and maintain conservation goals.

- Use of low flush toilets (1.6 gallons per flush) and low flow shower heads and faucets (2.5 gpm) associated with the Energy Conservation Act passed in 1992.

- Continue public education programs.

- Continue leak detection surveys.

- Continue meter repair and replacement programs.

- Continue cooperative efforts with industries.

- Initiate a plumbing fitting retrofit program for housing units built before the low flow plumbing fixture code became effective (this study assumes January 1, 1993).

3. Water Use Projections With Conservation

Projected annual water savings due to water conservation and associated average and maximum day demands are shown in Tables 11 and 12 and Figure 13. These savings assume implementation of conservation measures are gradually undertaken over several years and are fully realized by the year 2000. Tables 11 and 12 and Figure 13 also show projections from Wichita's 1993 Water Supply Study for data comparison. Review of the data shows a 10 percent reduction in your 2050 projections and no reduction in year 2010 projections.

Average day water uses are estimated at 112 MGD in year 2050 with low range conservation measures and 95 MGD with high range conservation measures. Maximum day usages, with a 2.0 maximum day factor, are estimated at 223 MGD in year 2050 with low range conservation measures and 190 MGD with high range conservation measures. Low range conservation is anticipated to reduce demand by approximately 16 percent while high range conservation is anticipated to reduce demand by approximately 29 percent.

Literature on water conservation indicates that 15 percent conservation is an obtainable

Table 11

WATER USE PROJECTIONS WITH
LOW RANGE CONSERVATION (RECOMMENDED)
(MGD)

Year	Average Day Usage	Maximum Day Usage (1)	Number of Occupied Housing Units	Resident General	Resident Indoors Pre 1995	Resident Indoors Post 1995	Resident Watering	Industrial Recycle	Commercial	Wholesale	Subtotal Avg Day Usage	Adjusted Avg Day Usage	Adjusted Max Day Usage	1993 Study Adjusted Avg Day Usage	1993 Study Adjusted Max Day Usage
2000	83.3	166.7	137,691	4.1	0.2	4.0	1.1	0.8	2.4	0.3	12.9	70.4	140.9	71.5	143.0
2010	99.4	198.7	150,491	4.5	0.3	4.3	1.2	0.8	2.6	1.1	14.8	84.6	169.1	85.0	170.0
2020	108.8	217.6	161,491	4.8	0.4	4.4	1.4	0.9	2.8	1.3	16.0	92.8	185.5	96.6	193.2
2030	116.4	232.8	170,591	5.1	0.5	4.6	1.5	0.9	3.1	1.4	17.0	99.4	198.8	105.1	210.2
2040	123.6	247.2	179,691	5.4	0.6	4.7	1.5	0.9	3.3	1.5	18.0	105.7	211.3	114.7	229.4
2050	130.4	260.9	188,791	5.7	0.7	4.8	1.6	1.0	3.5	1.6	18.9	111.6	223.1	124.5	249.0

Note:
(1) Maximum Day to Average Day factor = 2.0.

Table 12

WATER USE PROJECTIONS WITH
HIGH RANGE CONSERVATION
(MGD)

Year	Average Day Usage	Maximum Day Usage	Number of Occupied Housing Units	Resident General	Resident Indoors Pre 1995	Resident Indoors Post 1995	Resident Watering	Industrial Recycle	Commercial	Wholesale	Subtotal Avg Day Usage	Adjusted Avg Day Usage	Adjusted Max Day Usage	1993 Study Adjusted Avg Day Usage	1993 Study Adjusted Max Day Usage
2000	83.3	166.7	135,547	6.1	0.3	7.9	2.7	2.4	5.9	0.5	25.8	57.6	115.1	61.5	123.0
2010	99.4	198.7	147,897	6.7	0.5	8.1	3.0	2.5	6.5	1.6	28.9	70.4	140.9	73.6	147.2
2020	108.8	217.6	158,197	7.1	0.8	8.1	3.3	2.6	7.1	2.0	31.0	77.8	155.6	83.8	167.6
2030	116.4	232.8	166,447	7.5	1.1	8.0	3.5	2.7	7.7	2.2	32.6	83.8	167.6	91.2	182.4
2040	123.6	247.2	174,697	7.9	1.4	7.9	3.7	2.8	8.2	2.3	34.2	89.4	178.9	99.6	199.2
2050	130.4	260.9	182,947	8.2	1.7	7.8	3.9	2.9	8.7	2.4	35.7	94.7	189.5	108.2	216.4

Note:
(1) Maximum Day to Average Day factor = 2.0.

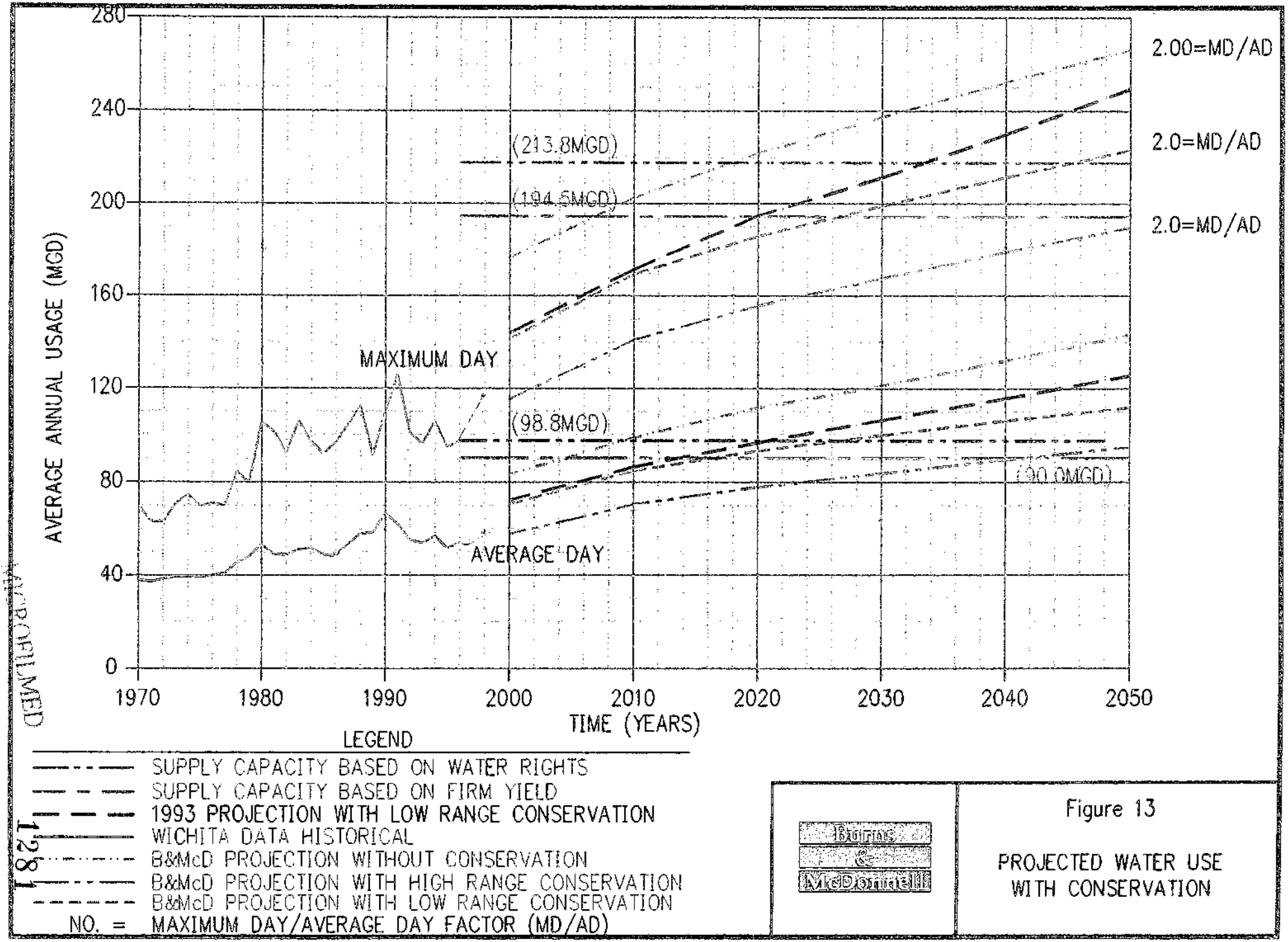


Figure 13

PROJECTED WATER USE
WITH CONSERVATION

goal for most cities and could be a reasonable goal for the City of Wichita. Based on a conservation goal of 16 percent, the average day usage in year 2050 would be 112 MGD and the maximum day usage would be 223 MGD.

F. Summary

For the purpose of this study, the water use projection with low range conservation is recommended to provide a moderate level of flexibility for unforseen events which could effect the water demand projections. Tasks to be accomplished in future engineering studies will evaluate alternatives to supply an average day demand of 112 MGD and a maximum day demand of 223 MGD in the year 2050. These 1997 projections for year 2050 conditions are slightly lower than those projected in the 1993 Water Supply Study. The 1997 projections indicate that implementation of improvements to meet the short-term water supply need between years 2000 and 2020 should not be delayed.

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Appendix A
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Appendix B
Service Area Customer and Usage Projection Model

Table 1

CITY OF WICHITA, KANSAS WATER AND SEWER DEPARTMENT

SERVICE AREA CUSTOMER AND WATER USAGE PROJECTION MODEL - CUSTOMER PROJECTIONS

	RESIDENTIAL (1)			COMMERCIAL			INDUSTRIAL			LAWN SERVICE			FIRE PROTECTION			CONTRACT			INSTITUTIONAL			WATER UTILITY			WHOLESALE (2)			
YEAR	RATE OF GROWTH (%)	ADDIT. CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT. CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT. CUST	TOTAL CUST	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST.	RATE OF GROWTH (%)	ADDIT CUST	TOTAL CUST	TOTAL CUSTOMERS
1986			93,414			10,532			134			$44			637						779			1			6	105,049
1987	2.20	2,055	95,469	0.02	2	10,534	0.75	1	135	7.90	43	587	2.83	18	655				0.26	2	781			1	25.00	2	10	108,172
1988	1.61	1,534	97,003	-0.57	(60)	10,474	-1.48	(2)	133	11.24	66	653	3.51	23	678				1.92	15	796			1	-10.00	(1)	9	109,747
1989	1.25	1,217	98,220	-0.78	(82)	10,392	25.56	34	167	64.62	422	1,075	2.06	14	692				4.40	35	831			1	11.11	1	10	111,386
1990	1.24	1,219	99,439	-0.80	(83)	10,309	20.36	34	201	38.16	421	1,496	2.02	14	706				4.21	35	866			1	0.00	0	10	113,028
1991	1.15	1,141	100,580	-0.29	(30)	10,279	-1.99	(4)	197	34.22	512	2,008	1.27	9	715				1.27	11	877			1	0.00	0	10	114,667
1992	3.38	3,398	103,978	2.65	272	10,551	-29.64	(58)	139	34.00	683	2,505	-3.22	(23)	692				-8.61	(58)	819			1	10.00	1	11	118,696
1993	0.11	112	104,090	4.89	516	11,067	0.30	16	155	17.00	426	2,462	0.14	1	693			165	10.50	86	905			1	0.00	0	11	119,549
1994	1.52	1,582	105,672	1.25	138	11,205	0.30	(7)	153	2.93	50	2,460	8.86	60	753	0.00	0	163	0.77	7	912			1	18.18	2	13	121,332
1995	1.04	1,095	106,767	1.69	189	11,394	0.30	(31)	122	2.93	50	2,527	0.66	5	758	0.00	0	225	-0.65	(6)	906			1	-7.69	(1)	12	122,712
1998	1.91	2,034	108,801	0.18	20	11,414	0.30	(3)	119	1.68	50	2,475	0.00	0	758	0.00	0	225	0.00	0	906			1	2.22	0	12	124,771
1997	1.15	1,255	110,060	0.19	22	11,436	0.30	2	121	2.63	65	2,540	0.77	6	764	0.89	2	227	0.44	4	910			1	2.17	0	13	126,071
1998	1.16	1,275	111,340	0.19	22	11,457	0.30	1	122	2.58	65	2,605	0.77	6	770	0.44	1	228	0.44	4	914			1	2.13	0	13	127,450
1999	1.15	1,275	112,620	0.19	22	11,479	0.30	1	123	2.50	65	2,670	0.77	6	776	0.44	1	229	0.33	3	917			1	2.08	0	13	128,827
2000	1.13	1,275	113,990	0.19	22	11,500	0.30	2	125	2.25	60	2,730	0.77	6	782	0.44	1	230	0.33	3	920			1	2.04	0	13	130,201
2001	1.12	1,280	115,180	0.78	80	11,580	0.30	0	125	2.34	64	2,794	1.00	8	789	0.00	0	230	0.87	8	928			1	2.00	0	14	131,641
2002	1.11	1,280	116,460	0.69	80	11,660	0.30	1	126	2.29	64	2,858	1.00	8	797	0.43	1	231	0.86	8	936			1	1.96	0	14	133,083
2003	1.10	1,280	117,740	0.69	80	11,740	0.30	0	128	2.24	64	2,922	1.00	8	805	0.00	0	231	0.85	8	944			1	1.92	0	14	134,523
2004	1.08	1,280	119,020	0.68	80	11,820	0.30	1	127	2.19	64	2,986	1.00	8	813	0.43	1	232	0.85	8	952			1	1.89	0	14	135,966
2005	1.08	1,280	120,300	0.68	80	11,900	0.30	0	127	2.14	64	3,050	1.00	8	821	0.00	0	232	0.84	8	960			1	1.85	0	15	137,406
2006	1.06	1,280	121,580	0.67	80	11,980	0.30	1	128	2.10	64	3,114	1.00	8	830	0.43	1	233	0.83	8	968			1	1.82	0	15	138,849
2007	1.05	1,280	122,860	0.67	80	12,060	0.30	0	128	2.06	64	3,178	1.00	8	838	0.00	0	233	0.83	8	976			1	1.79	0	15	140,289
2008	1.04	1,280	124,140	0.66	80	12,140	0.30	1	129	2.01	64	3,242	1.00	8	846	0.43	1	234	0.82	8	984			1	1.75	0	15	141,732
2009	1.03	1,280	125,420	0.66	80	12,220	0.30	0	129	1.97	64	3,306	1.00	8	855	0.00	0	234	0.81	8	992			1	1.72	0	16	143,173
2010	1.02	1,280	126,700	0.65	80	12,300	0.30	1	130	1.94	64	3,370	1.00	9	864	0.43	1	235	0.81	8	1,000			1	1.69	0	16	144,616
2011	1.01	1,280	127,980	0.57	70	12,370	0.30	0	130	1.63	55	3,425	1.00	9	872	0.00	0	235	0.90	9	1,009			1	1.68	0	16	146,038
2012	1.00	1,280	129,260	0.57	70	12,440	0.30	1	131	1.61	55	3,480	1.00	9	881	0.43	1	236	0.89	9	1,018			1	1.64	0	17	147,483
2013	0.99	1,280	130,540	0.56	70	12,510	0.30	0	131	1.58	55	3,535	1.00	9	890	0.00	0	236	0.88	9	1,027			1	1.61	0	17	148,896
2014	0.98	1,280	131,820	0.56	70	12,580	0.30	1	132	1.56	55	3,590	1.00	9	898	0.42	1	237	0.88	9	1,036			1	1.78	0	17	150,312
2015	0.97	1,280	133,100	0.56	70	12,650	0.30	0	132	1.53	55	3,645	1.00	9	907	0.00	0	237	0.87	9	1,045			1	1.74	0	18	151,735
2016	0.69	920	134,020	0.55	70	12,720	0.30	1	133	1.51	55	3,700	1.00	9	917	0.42	1	238	0.86	9	1,054			1	1.71	0	18	152,800
2017	0.69	920	134,940	0.55	70	12,790	0.30	0	133	1.49	55	3,755	1.00	9	926	0.00	0	238	0.85	9	1,063			1	1.69	0	18	153,864
2018	0.68	920	135,880	0.55	70	12,860	0.30	1	134	1.46	55	3,810	1.00	9	935	0.42	1	239	0.85	9	1,072			1	1.66	0	18	154,929
2019	0.68	920	136,780	0.54	70	12,930	0.30	0	134	1.44	55	3,865	1.00	9	944	0.00	0	239	0.84	9	1,081			1	1.63	0	19	155,993
2020	0.67	920	137,700	0.54	70	13,000	0.30	1	135	1.42	55	3,920	1.00	9	954	0.42	1	240	0.83	8	1,090			1	1.60	0	19	157,059
2021	0.66	910	138,610	0.62	80	13,080	0.30	0	135	1.17	46	3,966	1.00	10	963	0.00	0	240	0.73	8	1,098			1	1.58	0	19	158,113
2022	0.66	910	139,520	0.61	80	13,160	0.30	1	136	1.16	46	4,012	1.00	10	973	0.42	1	241	0.73	8	1,106			1	1.55	0	20	159,188
2023	0.65	910	140,430	0.61	80	13,240	0.30	0	136	1.15	46	4,058	1.00	10	983	0.00	0	241	0.72	8	1,114			1	1.53	0	20	160,223
2024	0.65	910	141,340	0.60	80	13,320	0.30	1	137	1.13	46	4,104	1.00	10	992	0.41	1	242	0.72	8	1,122			1	1.51	0	20	161,279
2025	0.64	910	142,250	0.60	80	13,400	0.30	0	137	1.12	46	4,150	1.00	10	1,002	0.00	0	242	0.71	8	1,130			1	1.49	0	20	162,333
2026	0.64	910	143,160	0.60	80	13,480	0.30	1	138	1.08	45	4,195	1.00	10	1,012	0.41	1	243	0.71	8	1,138			1	1.46	0	21	163,388
2027	0.64	910	144,070	0.59	80	13,560	0.30	0	138	1.07	45	4,240	1.00	10	1,023	0.00	0	243	0.70	8	1,146			1	1.44	0	21	164,442
2028	0.63	910	144,980	0.59	80	13,640	0.30	1	139	1.06	45	4,285	1.00	10	1,033	0.41	1	244	0.70	8	1,154			1	1.42	0	21	165,497
2029	0.63	910	145,890	0.59	80	13,720	0.30	0	139	1.05	45	4,330	1.00	10	1,043	0.00	0	244	0.69	8	1,162			1	1.40	0	22	166,551
2030	0.62	910	146,800	0.58	80	13,800	0.30	1	140	1.04	45	4,375	1.00	10	1,054	0.41	1	245	0.69	8	1,170			1	1.38	0	22	167,607
2031	0.62	910	147,710	0.58	80	13,880	0.30	0	140	1.05	46	4,421	1.00	11	1,064	0.00	0	245	0.68	8	1,178			1	0.00	0	22	168,661
2032	0.62	910	148,620	0.58	80	13,960	0.30	1	141	1.04	46	4,467	1.00	11	1,075	0.41	1	246	0.68	8	1,186			1	0.00	0	22	169,718
2033	0.61	910	149,530	0.57	80	14,040	0.30	0	141	1.03	46	4,513	1.00	11	1,085	0.00	0	246	0.67	8	1,194			1	0.00	0	22	170,772
2034	0.61	910	150,440	0.57	80	14,120	0.30	1	142	1.02	46	4,559	1.00	11	1,096	0.41	1	247	0.67	8	1,202			1	0.00	0	22	171,829
2035	0.60	910	151,350	0.57	80	14,200	0.30	0	142	1.01	46	4,605	1.00	11	1,107	0.00	0	247	0.67	8	1,210			1	0.00	0	22	172,884
2036	0.60	910	152,260	0.56	80	14,280	0.30	1	143	0.98	45	4,650	1.00	11	1,118	0.40	1	248	0.66	8	1,218			1	0.00	0	22	173,940
2037	0.60	910	153,170	0.56	80	14,360	0.30	0	143	0.97	45	4,695	1.00	11	1,130	0.00	0	248	0.66	8	1,226			1	0.00	0	22	174,995
2038	0.59	910	154,080	0.56	80	14,440	0.30	1	144	0.96	45	4,740	1.00	11	1,141	0.40	1	249	0.65	8	1,234			1	0.00	0	22	176,051
2039	0.59	910	154,990	0.55	80	14,520	0.30	0	144	0.95	45	4,785	1.00	11	1,152	0.00	0	249	0.65	8	1,242			1	0.00	0	22	177,105
2040	0.59	910	155,900	0.55	80	14,600	0.30	1	145	0.94	45	4,830	1.00	12	1,164	0.40	1	250	0.64	8	1,250			1	0.00	0	22	178,162
2041	0.59	910	156,810	0.48	70	14,670	0.30	0	145	0.95	46	4,876	1.00	12	1,176	0.00	0	250	0.64	8	1,258			1	0.00	0	22	179,207
2042	0.59	910	157,720	0.48	70	14,740	0.30	1	146	0.94	46	4,922	1.00	12	1,187	0.40	1	251	0.64	8	1,266			1	0.00	0	22	180,255
2043	0.58	910	158,630	0.47	70	14,810	0.30	0	146	0.93	46	4,968	1.00	12	1,199	0.00	0	251	0.63	8	1,274			1	0.00	0	22	181,301
2044	0.57	910	159,540	0.47	70	14,880	0.30	1	147	0.93	46	5,014	1.00	12	1,211	0.40	1	252	0.63	8	1,282			1	0.00	0	22	182,349
2045	0.57	910	160,450	0.47	70	14,950	0.30	0	147	0.92	46	5,060	1.00	12	1,223	0.00	0	252	0.62	8	1,290			1	0.00	0	22	183,395
2046	0.57	910	161,360	0.47	70	15,020	0.30	1	148	0.89	45	5,105	1.00	12	1,235	0.40	1	253	0.62	8	1,298			1	0.00	0	22	184,442
2047	0.56	910	162,270	0.47	70	15,090	0.30	0	148	0.88	45	5,150	1.00	12	1,248	0.00	0	253	0.62	8	1,306			1	0.00	0	22	185,488
2048	0.56	910	163,180	0.46	70	15,160	0.30	1	149	0.87	45	5,195	1.00	12	1,260	0.40	1	254	0.61	8	1,314			1	0.00	0	22	186,535
2049	0.56	910	164,090	0.46	70	15,230	0.30	0	149	0.87	45	5,240	1.00	13	1,273	0.00	0	254	0.61	8	1,322			1	0.00	0	22	187,581
2050	0.55	910	165,000	0.46	70	15,300	0.30	1	150	0.86	45	5,285	1.00	14	1,287	0.39	1	255	0.61	8	1,330			1	0.00	0	22	188,630

(1) Customers inside city limits. Historical (1986 to 1991) includes about 4,970 individually metered customers outside the city limits. Usage for these customers is shifted to the Wholesale classification in 1992.

(2) Includes individually metered customers outside the city limits and wholesale towns and RWDs from 1992 to 2050.

model5

Table 1 (continued)
CITY OF WICHITA, KANSAS WATER AND SEWER DEPARTMENT

SERVICE AREA CUSTOMER AND WATER USAGE PROJECTION MODEL - AVERAGE DAY USAGE PROJECTIONS

YEAR	RESIDENTIAL (1) TOTAL CUST	RESIDENTIAL (1) GAL PER METER DAY	RESIDENTIAL (1) AVG DAY USAGE (MGD)	COMMERCIAL TOTAL CUST	COMMERCIAL GAL PER METER DAY	COMMERCIAL AVG DAY USAGE (MGD)	INDUSTRIAL TOTAL CUST	INDUSTRIAL GAL PER METER DAY	INDUSTRIAL AVG DAY USAGE (MGD)	LAWN SERVICE TOTAL CUST	LAWN SERVICE GAL PER METER DAY	LAWN SERVICE AVG DAY USAGE (MGD)
1986	93,414	234	21.9	10,532	1,342	14.1	139	54,656	7.4	544	7,604	4.1
1987	95,469	238	22.7	10,534	1,439	15.2	135	54,957	7.4	587	6,218	3.7
1988	97,003	258	25.2	10,474	1,308	13.7	133	65,156	8.7	653	8,198	5.4
1989	98,220	255	25.0	10,392	1,413	14.7	167	52,170	8.7	1,075	4,074	4.4
1990	99,439	264	26.3	10,309	1,491	15.4	201	43,290	8.7	1,496	4,392	6.8
1991	100,580	270	27.2	10,779	1,628	18.7	197	51,304	10.1	2,008	3,393	6.8
1992	101,978	220	22.8	10,551	1,431	15.1	139	53,957	7.5	2,505	878	2.2
1993	104,090	234	24.3	11,067	1,012	11.2	155	55,464	8.6	2,467	569	1.4
1994	105,872	237	25.0	11,205	919	10.3	153	59,477	9.1	2,460	3,171	7.8
1995	106,767	217	23.1	11,394	1,036	11.8	122	54,918	6.7	2,527	2,454	6.2
1996	108,801	223	24.2	11,414	1,078	12.3	119	49,580	5.9	2,475	2,990	7.4
1997	110,060	300	32.8	11,436	1,700	19.4	121	65,000	7.9	2,540	3,500	8.9
1998	111,340	300	33.2	11,457	1,700	19.5	122	65,000	7.9	2,605	3,500	9.1
1999	112,620	300	33.6	11,479	1,700	19.5	123	65,000	8.0	2,670	3,500	9.3
2000	113,900	300	34.0	11,500	1,700	19.8	125	65,000	8.1	2,730	3,500	9.6
2001	115,180	300	34.3	11,580	1,700	19.7	125	65,000	8.1	2,794	3,500	9.8
2002	116,460	300	34.7	11,660	1,700	19.8	126	65,000	8.2	2,858	3,500	10.0
2003	117,740	300	35.1	11,740	1,700	20.0	126	65,000	8.2	2,922	3,500	10.2
2004	119,020	300	35.5	11,820	1,700	20.1	127	65,000	8.3	2,986	3,500	10.5
2005	120,300	300	35.9	11,900	1,700	20.2	127	65,000	8.3	3,050	3,500	10.7
2006	121,580	300	36.2	11,980	1,700	20.4	128	65,000	8.3	3,114	3,500	10.9
2007	122,860	300	36.6	12,060	1,700	20.5	128	65,000	8.3	3,178	3,500	11.1
2008	124,140	300	37.0	12,140	1,700	20.6	129	65,000	8.4	3,242	3,500	11.3
2009	125,420	300	37.4	12,220	1,700	20.8	129	65,000	8.4	3,306	3,500	11.6
2010	126,700	300	37.8	12,300	1,700	20.9	130	65,000	8.5	3,370	3,500	11.8
2011	127,980	300	38.1	12,370	1,700	21.0	130	65,000	8.5	3,425	3,500	12.0
2012	129,260	300	38.5	12,440	1,700	21.1	131	65,000	8.5	3,480	3,500	12.2
2013	130,540	300	38.9	12,510	1,700	21.3	131	65,000	8.5	3,535	3,500	12.4
2014	131,820	300	39.3	12,580	1,700	21.4	132	65,000	8.6	3,590	3,500	12.8
2015	133,100	300	39.7	12,650	1,700	21.5	132	65,000	8.6	3,645	3,500	12.8
2016	134,020	300	39.9	12,720	1,700	21.6	133	65,000	8.6	3,700	3,500	13.0
2017	134,940	300	40.2	12,790	1,700	21.7	133	65,000	8.6	3,755	3,500	13.1
2018	135,860	300	40.5	12,860	1,700	21.9	134	65,000	8.7	3,810	3,500	13.3
2019	136,780	300	40.7	12,930	1,700	22.0	134	65,000	8.7	3,865	3,500	13.5
2020	137,700	300	41.0	13,000	1,700	22.1	135	65,000	8.8	3,920	3,500	13.7
2021	138,610	300	41.3	13,080	1,700	22.2	135	65,000	8.8	3,966	3,500	13.9
2022	139,520	300	41.6	13,160	1,700	22.4	136	65,000	8.8	4,012	3,500	14.0
2023	140,430	300	41.8	13,240	1,700	22.5	136	65,000	8.8	4,058	3,500	14.2
2024	141,340	300	42.1	13,320	1,700	22.6	137	65,000	8.9	4,104	3,500	14.4
2025	142,250	300	42.4	13,400	1,700	22.8	137	65,000	8.9	4,150	3,500	14.5
2026	143,160	300	42.6	13,480	1,700	22.9	138	65,000	9.0	4,195	3,500	14.7
2027	144,070	300	42.9	13,560	1,700	23.1	138	65,000	9.0	4,240	3,500	14.8
2028	144,980	300	43.2	13,640	1,700	23.2	139	65,000	9.0	4,285	3,500	15.0
2029	145,890	300	43.4	13,720	1,700	23.3	139	65,000	9.0	4,330	3,500	15.2
2030	146,800	300	43.7	13,800	1,700	23.5	140	65,000	9.1	4,375	3,500	15.3
2031	147,710	300	44.0	13,880	1,700	23.6	140	65,000	9.1	4,421	3,500	15.5
2032	148,620	300	44.2	13,960	1,700	23.7	141	65,000	9.2	4,467	3,500	15.6
2033	149,530	300	44.5	14,040	1,700	23.9	141	65,000	9.2	4,513	3,500	15.8
2034	150,440	300	44.8	14,120	1,700	24.0	142	65,000	9.2	4,559	3,500	16.0
2035	151,350	300	45.1	14,200	1,700	24.1	142	65,000	9.2	4,605	3,500	16.1
2036	152,260	300	45.3	14,280	1,700	24.3	143	65,000	9.3	4,650	3,500	16.3
2037	153,170	300	45.6	14,360	1,700	24.4	143	65,000	9.3	4,695	3,500	16.4
2038	154,080	300	45.9	14,440	1,700	24.5	144	65,000	9.4	4,740	3,500	16.6
2039	154,990	300	46.1	14,520	1,700	24.7	144	65,000	9.4	4,785	3,500	16.7
2040	155,900	300	46.4	14,600	1,700	24.8	145	65,000	9.4	4,830	3,500	16.9
2041	156,810	300	46.7	14,670	1,700	24.9	145	65,000	9.4	4,876	3,500	17.1
2042	157,720	300	46.9	14,740	1,700	25.1	146	65,000	9.5	4,922	3,500	17.2
2043	158,630	300	47.2	14,810	1,700	25.2	146	65,000	9.5	4,968	3,500	17.4
2044	159,540	300	47.5	14,880	1,700	25.3	147	65,000	9.6	5,014	3,500	17.5
2045	160,450	300	47.8	14,950	1,700	25.4	147	65,000	9.6	5,060	3,500	17.7
2046	161,360	300	48.0	15,020	1,700	25.5	148	65,000	9.6	5,105	3,500	17.9
2047	162,270	300	48.3	15,090	1,700	25.7	148	65,000	9.6	5,150	3,500	18.0
2048	163,180	300	48.6	15,160	1,700	25.8	149	65,000	9.7	5,195	3,500	18.2
2049	164,090	300	48.8	15,230	1,700	25.9	149	65,000	9.7	5,240	3,500	18.3
2050	165,000	300	49.1	15,300	1,700	26.0	150	65,000	9.8	5,285	3,500	18.5

YEAR	FIRE PROTECTION TOTAL CUST	FIRE PROTECTION GAL PER METER DAY	FIRE PROTECTION AVG DAY USAGE (MGD)	CONTRACT TOTAL CUST	CONTRACT GAL PER METER DAY	CONTRACT AVG DAY USAGE (MGD)	INSTITUTIONAL TOTAL CUST	INSTITUTIONAL GAL PER METER DAY	INSTITUTIONAL AVG DAY USAGE (MGD)	WATER UTILITY TOTAL CUST	WATER UTILITY GAL PER METER DAY	WATER UTILITY AVG DAY USAGE (MGD)
1986	637	9	0.01				779	2,747	2.1	1	178,082	0.18
1987	655	21	0.01				781	2,389	1.9	1	90,411	0.09
1988	676	57	0.04				796	2,712	2.2	1	5,479	0.01
1989	692	63	0.04			0.1	831	2,697	2.2	1	16,438	0.02
1990	706	62	0.04			0.2	866	2,585	2.2	1	21,918	0.02
1991	715	65	0.05			0.2	877	2,052	1.8	1	21,000	0.02
1992	892	66	0.05			0.9	819	3,785	3.1	1	200,000	0.20
1993	693	67	0.05	165	10,141	1.7	905	1,657	1.5	1	200,000	0.20
1994	753	67	0.05	183	17,996	2.9	912	1,754	1.6	1	200,000	0.20
1995	758	68	0.05	225	7,496	1.7	808	1,545	1.4	1	200,000	0.20
1996	758	68	0.05	225	9,630	2.2	906	1,435	1.3	1	200,000	0.20
1997	764	69	0.05	227	20,000	4.5	910	4,000	3.6	1	200,000	0.20
1998	770	69	0.05	228	20,000	4.6	914	4,000	3.7	1	200,000	0.20
1999	776	70	0.05	229	20,000	4.6	917	4,000	3.7	1	200,000	0.20
2000	782	70	0.05	230	20,000	4.6	920	4,000	3.7	1	200,000	0.20
2001	789	71	0.06	230	20,000	4.6	928	4,000	3.7	1	200,000	0.20
2002	797	71	0.06	231	20,000	4.6	936	4,000	3.7	1	200,000	0.20
2003	805	72	0.06	231	20,000	4.6	944	4,000	3.8	1	200,000	0.20
2004	813	72	0.06	232	20,000	4.6	952	4,000	3.8	1	200,000	0.20
2005	821	73	0.06	232	20,000	4.6	960	4,000	3.8	1	200,000	0.20
2006	830	73	0.06	233	20,000	4.7	968	4,000	3.9	1	200,000	0.20
2007	838	74	0.06	233	20,000	4.7	976	4,000	3.9	1	200,000	0.20
2008	846	74	0.06	234	20,000	4.7	984	4,000	3.9	1	200,000	0.20
2009	855	75	0.06	234	20,000	4.7	992	4,000	4.0	1	200,000	0.20
2010	864	75	0.06	235	20,000	4.7	1,000	4,000	4.0	1	200,000	0.20
2011	872	76	0.07	235	20,000	4.7	1,009	4,000	4.0	1	200,000	0.20
2012	881	76	0.07	236	20,000	4.7	1,018	4,000	4.1	1	200,000	0.20
2013	890	77	0.07	236	20,000	4.7	1,027	4,000	4.1	1	200,000	0.20
2014	898	77	0.07	237	20,000	4.7	1,036	4,000	4.1	1	200,000	0.20
2015	907	78	0.07	237	20,000	4.7	1,045	4,000	4.2	1	200,000	0.20
2016	917	78	0.07	238	20,000	4.8	1,054	4,000	4.2	1	200,000	0.20
2017	926	79	0.07	238	20,000	4.8	1,063	4,000	4.3	1	200,000	0.20
2018	935	79	0.07	239	20,000	4.8	1,072	4,000	4.3	1	200,000	0.20
2019	944	80	0.08	239	20,000	4.8	1,081	4,000	4.3	1	200,000	0.20
2020	954	80	0.08	240	20,000	4.8	1,090	4,000	4.4	1	200,000	0.20
2021	963	81	0.08	240	20,000	4.8	1,099	4,000	4.4	1	200,000	0.20
2022	973	81	0.08	241	20,000	4.8	1,108	4,000	4.4	1	200,000	0.20
2023	983	82	0.08	241	20,000	4.8	1,114	4,000	4.5	1	200,000	0.20
2024	992	82	0.08	242	20,000	4.8	1,122	4,000	4.5	1	200,000	0.20
2025	1,002	83	0.08	242	20,000	4.8	1,130	4,000	4.5	1	200,000	0.20
2026	1,012	83	0.08	243	20,000	4.9	1,138	4,000	4.6	1	200,000	0.20
2027	1,023	84	0.09	243	20,000	4.9	1,146	4,000	4.6	1	200,000	0.20
2028	1,033	84	0.09	244	20,000	4.9	1,154	4,000	4.6	1	200,000	0.20
2029	1,043	85	0.09	244	20,000	4.9	1,162	4,000	4.6	1	200,000	0.20
2030	1,054	85	0.09	245	20,000	4.9	1,170	4,000	4.7	1	200,000	0.20
2031	1,064	86	0.09	245	20,000	4.9	1,178	4,000	4.7	1	200,000	0.20
2032	1,075	86	0.09	246	20,000	4.9	1,186	4,000	4.7	1	200,000	0.20
2033	1,085	87	0.09	246	20,000	4.9	1,194	4,000	4.8	1	200,000	0.20
2034	1,096	87	0.10	247	20,000	4.9	1,202	4,000	4.8	1	200,000	0.20
2035	1,107	88	0.10	247	20,000	4.9	1,210	4,000	4.8	1	200,000	0.20
2036	1,118	88	0.10	248	20,000	5.0	1,218	4,000	4.9	1	200,000	0.20
2037	1,130	89	0.10	248	20,000	5.0	1,226	4,000	4.9	1	200,000	0.20
2038	1,141	89	0.10	249	20,000	5.0	1,234	4,000	4.9	1	200,000	0.20
2039	1,152	90	0.10	249	20,000	5.0	1,242	4,000	5.0	1	200,000	0.20
2040	1,164	90	0.10	250	20,000	5.0	1,250	4,000	5.0	1	200,000	0.20
2041	1,175	91	0.11	250	20,000	5.0	1,258	4,000	5.0	1	200,000	0.20
2042	1,187	91	0.11	251	20,000	5.0	1,266	4,000	5.1	1	200,000	0.20
2043	1,199	92	0.11	251	20,000	5.0	1,274	4,000	5.1	1	200,000	0.20
2044	1,211	92	0.11	252	20,000	5.0	1,282	4,000	5.1	1	200,000	0.20
2045	1,223	93	0.11	252	20,000	5.0	1,290	4,000	5.2	1	200,000	0.20
2046	1,235	93	0.11	253	20,000	5.1	1,298	4,000	5.2	1	200,000	0.20
2047	1,248	94	0.12	253	20,000	5.1	1,306	4,000	5.2	1	200,000	0.20
2048	1,260	94	0.12	254	20,000	5.1	1,314	4,000	5.3	1	200,000	0.20
2049	1,273	95	0.12	254	20,000	5.1	1,322	4,000	5.3	1	200,000	0.20
2050	1,287	95	0.12	255	20,000	5.1	1,330	4,000	5.3	1	200,000	0.20

YEAR	EX. WHOLESALE MN (2) TOTAL CUST	EX. WHOLESALE MN (2) GAL PER METER DAY	EX. WHOLESALE MN (2) AVG DAY USAGE (MGD)	ANTIC WHOLESALE (3) TOTAL CUST	ANTIC WHOLESALE (3) GAL PER METER DAY	ANTIC WHOLESALE (3) AVG DAY USAGE (MGD)	IRRIGATION ADJUSTM(4) (MGD)	UNACCOUNTED-FOR AVG DAY USAGE (MGD)	UNACCOUNTED-FOR UNACC. FOR (%)	UNACCOUNTED-FOR AVG DAY UNACC (MGD)	AVG DAY USAGE (MGD)
1986	8	71,918	0.6	0	0	0	-2.4	48.0	0.22	9.1	48.1
1987	10	68,575	0.7	0	0	0	-2.2	49.5	7.60	3.8	53.2
1988	9	84,323	0.8	0	0	0	-3.2	52.7	9.29	4.9	57.6
1989	10	226,027	2.3	0	0	0	-2.6	54.8	9.29	5.1	59.8
1990	10	120,000	1.2	0	0	0	-4.0	56.7	9.29	5.3	61.9
1991	10	140,000	1.4	0	0	0	-4.1	60.2	5.90	3.5	63.7
1992	10	120,000	1.2	0	0	0	-1.8	51.2	6.60	3.4	54.6
1993	9	111,111	1.0	0	0	0	-1.8	48.1	10.70	5.1	53.2
1994	9	144,444	1.3	0	0	0	-6.3	51.9	8.60	4.5	56.4
1995	9	133,333	1.2	0	0	0	-4.8	47.7	7.50	3.6	51.3
1996	8	144,444	1.3	0	0	0	-5.6	49.2	8.90	4.4	53.6
1997	8	191,944	1.7	0	0	0	-7.9	71.3	12.00	8.8	79.8
1998	8	239,444	2.2	0	0	0	-8.1	72.3	12.00	8.7	81.0
1999	9	286,944	2.6	0	0	0	-8.2	73.3	12.00	8.8	82.1
2000	9	334,444	3.0	0	0	0	-8.3	74.4	12.00	8.9	83.3
2001	9	345,667	3.1	1	1,199,000	0.7	-8.5	75.8	12.00	9.1	84.9
2002	9	356,889	3.2	1	1,199,000	1.3	-8.6	77.3	12.00	9.3	86.5
2003	9	368,111	3.3	2	1,199,000	2.0	-8.7	78.7	12.00	9.4	88.1
2004	9	379,333	3.4	2	1,199,000	2.6	-8.9	80.1	12.00	9.6	89.7
2005	9	390,556	3.5	3	1,199,000	3.3	-9.0	81.5	12.00	9.8	91.3
2006	9	401,778	3.6	3	1,199,000	3.9	-9.2	83.0	12.00	10.0	93.0
2007	9	413,000	3.7	4	1,199,000	4.6	-9.3	84.4	12.00	10.1	94.5
2008	9	424,222	3.8	4	1,199,000	5.2	-9.4	85.9	12.00	10.3	96.2
2009	9	435,444	3.9	5	1,199,000	5.9	-9.6	87.3	12.00	10.5	97.7
2010	9	446,667	4.0	6	1,090,000	6.5	-9.7	88.7	12.00	10.6	99.4
2011	9	458,778	4.1	6	1,068,000	6.7	-9.8	89.6	12.00	10.7	100.3
2012	9	470,889	4.2	7	1,047,692	6.8	-10.0	90.5	12.00	10.9	101.4
2013	9	483,000	4.3	7	1,028,889	6.9	-10.1	91.4	12.00	11.0	102.3
2014	9	495,111	4.5	7	1,011,429	7.1	-10.2	92.3	12.00	11.1	103.4
2015	9	507,222	4.6	7	985,172	7.2	-10.3	93.2	12.00	11.2	104.3
2016	9	519,333	4.7	8	980,000	7.4	-10.4	94.0	12.00	11.3	105.3
2017	9	531,444	4.8	8	965,806	7.5	-10.5	94.7	12.00	11.4	106.1
2018	9	543,556	4.9	8	952,500	7.6	-10.7	95.6	12.00	11.5	107.0
2019	9	555,667	5.0	8	940,000	7.8	-10.8	96.3	12.00	11.6	107.9
2020	9	567,778	5.1	9	928,235	7.9	-10.9	97.1	12.00	11.7	108.8
2021	9	570,667	5.1	9	914,743	8.0	-11.0	97.8	12.00	11.7	109.5
2022	9	573,556	5.2	9	902,000	8.1	-11.1	98.5	12.00	11.8	110.3
2023	9	578,444	5.2	9	889,946	8.2	-11.2	99.1	12.00	11.9	111.0
2024	9	579,333	5.2	10	878,526	8.3	-11.3	99.9	12.00	12.0	111.8
2025	9	582,222	5.2	10	867,692	8.5	-11.4	100.5	12.00	12.1	112.6
2026	9	585,111	5.3	10	857,400	8.6	-11.5	101.2	12.00	12.1	113.4
2027	9	588,000	5.3	10	847,610	8.7	-11.6	101.9	12.00	12.2	114.1
2028	9	590,889	5.3	11	838,286	8.8	-11.7	102.6	12.00	12.3	114.9
2029	9	593,778	5.3	11	829,395	8.9	-11.8	103.2	12.00	12.4	115.6
2030	9	596,667	5.4	11	820,909	9.0	-11.9	103.9	12.00	12.5	116.4
2031	9	600,222	5.4	11	827,182	9.1	-12.0	104.6	12.00	12.5	117.1
2032	9	603,778	5.4	11	833,455	9.2	-12.1	105.2	12.00	12.6	117.9
2033	9	607,333	5.5	11	839,727	9.2	-12.2	105.8	12.00	12.7	118.5
2034	9	610,889	5.5	11	846,000	9.3	-12.3	106.5	12.00	12.8	119.3
2035	9	614,444	5.5	11	852,273	9.4	-12.4	107.1	12.00	12.9	120.0
2036	9	618,000	5.6	11	858,545	9.4	-12.5	107.8	12.00	12.9	120.7
2037	9	621,556	5.6	11	864,818	9.5	-12.6	108.4	12.00	13.0	121.4
2038	9	625,111	5.6	11	871,091	9.6	-12.7	109.1	12.00	13.1	122.2
2039	9	628,667	5.7	11	877,364	9.7	-12.8	109.7	12.00	13.2	122.9
2040	9	632,222	5.7	11	883,636	9.7	-12.9	110.4	12.00	13.2	123.6
2041	9	636,000	5.7	11	888,182	9.8	-13.0	110.9	12.00	13.3	124.3
2042	9	639,778	5.8	11	892,727	9.8	-13.1	111.6	12.00	13.4	125.0
2043	9	643,556	5.8	11	897,273	9.9	-13.2	112.2	12.00	13.5	125.6
2044	9	647,333	5.8	11	901,818	9.9	-13.3	112.8	12.00	13.5	126.3
2045	9	651,111	5.9	11	906,364	10.0	-13.4	113.4	12.00	13.6	127.0
2046	9	654,889	5.9	11	910,909	10.0	-13.5	114.0	12.00	13.7	127.7
2047	9	658,667	5.9	11	915,455	10.1	-13.6	114.6	12.00	13.8	128.3
2048	9	662,444	6.0	11	920,000	10.1	-13.7	115.2	12.00	13.8	129.1
2049	9	668,222	6.0	11	924,545	10.2	-13.8	115.8	12.00	13.9	129.7
2050	9	670,000	6.0	11	929,091	10.2	-13.9	116.5	12.00	14.0	130.4

(1) Includes usage for customers inside city limits and deducts potential usage by residential lawn service customers
(2) Includes existing individually metered customers outside the city limits and wholesale towns and RWDs
(3) Anticipated wholesale customers
(4) Irrigation Adjustment for Lawn Service and Contract which are based on 180 days per year to 365 days per year

model5

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Table 1 (continued)

CITY OF WICHITA, KANSAS WATER AND SEWER DEPARTMENT

SERVICE AREA CUSTOMER AND WATER USAGE PROJECTION MODEL - USAGE PROJECTIONS WITH CONSERVATION (LOW RANGE)

YEAR	AVG DAY USE (MGD)	MAX DAY USE(7) (MGD)	No. OF OCCUPIED HOUSING UNITS	RESIDENT GENERAL (1)			RESIDENT INDOORS (2)			RESIDENT OUTDOORS (2)			RESIDENT WATERING (3)			INDUSTRIAL RECYCLE			COMMERCIAL (4)			WHOLESALE (5)			SUBTOTAL AVG DAY SAVINGS (MGD)	SUBTOTAL MAX DAY SAVINGS (MGD)	ADJUSTED AVG DAY USAGE (MGD)	ADJUSTED MAX DAY USAGE (MGD)
				CUFT	% REDUCT	DAILY SAVINGS (MGD)	PRE-1995 CUFT	UNIT SAVINGS (GPHH)	DAILY SAVINGS (MGD)	POST 1995 CUFT	UNIT SAVINGS (GPHH)	DAILY SAVINGS (MGD)	No. OF RESID	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)				
1986	48.1	86.4	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	48.1	86.4
1987	53.2	104.0	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	53.2	104.0
1988	57.6	112.3	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	57.6	112.3
1989	59.9	90.9	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	59.9	90.9
1990	61.9	109.5	123,249	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	61.9	109.5
1991	63.7	125.7	124,390	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	63.7	125.7
1992	54.8	109.2	127,768	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	54.8	109.2
1993	53.2	106.5	127,900	127,900	10.0	3.0	1,279	20.0	0.0	0	0.0	0.0	127,900	5.0	0.9	8.6	0.0	0.0	11.2	0.0	0.0	1.0	0.0	0.0	3.9	7.8	49.3	98.6
1994	56.4	112.8	129,482	129,482	10.0	3.1	2,590	20.0	0.1	0	0.0	0.0	129,482	5.0	1.0	9.1	0.0	0.0	10.5	0.0	0.0	1.3	0.0	0.0	4.1	8.3	52.2	104.5
1995	51.3	102.6	130,577	130,577	10.0	2.9	3,917	20.0	0.1	128,660	31.0	3.9	130,577	5.0	1.0	8.7	10.0	0.7	11.8	10.0	1.4	1.2	10	0.1	10.1	20.2	41.2	82.4
1996	53.5	107.1	132,611	132,611	10.0	3.0	5,304	20.0	0.1	127,307	31.0	3.9	132,611	5.0	1.0	5.9	10.0	0.6	12.3	10.0	1.6	1.3	10	0.1	10.3	20.7	43.2	86.4
1997	79.8	159.6	133,866	133,866	10.0	4.0	6,693	20.0	0.1	127,173	31.0	3.9	133,866	5.0	1.1	7.9	10.0	0.8	19.4	10.0	2.3	1.7	10	0.2	12.4	24.9	67.4	134.8
1998	81.0	161.9	135,141	135,141	10.0	4.1	7,193	20.0	0.1	127,948	31.0	4.0	135,141	5.0	1.1	7.9	10.0	0.8	19.5	10.0	2.3	2.2	10	0.2	12.8	25.7	68.4	136.8
1999	82.1	164.2	136,416	136,416	10.0	4.1	7,680	20.0	0.2	128,723	31.0	4.0	136,416	5.0	1.1	8.0	10.0	0.8	19.5	10.0	2.3	2.6	10	0.3	12.7	25.5	69.4	138.8
2000	83.3	166.7	137,691	137,691	10.0	4.1	8,193	20.0	0.2	129,498	31.0	4.0	137,691	5.0	1.1	8.1	10.0	0.8	19.6	10.0	2.4	3.0	10	0.3	12.9	25.8	70.4	140.9
2001	84.9	169.8	138,971	138,971	10.0	4.2	8,695	20.0	0.2	130,276	31.0	4.0	138,971	5.0	1.1	8.1	10.0	0.8	19.7	10.0	2.4	3.8	10	0.4	13.1	26.2	71.8	143.6
2002	86.5	173.1	140,251	140,251	10.0	4.2	9,133	20.0	0.2	131,058	31.0	4.1	140,251	5.0	1.1	8.2	10.0	0.8	19.8	10.0	2.4	4.5	10	0.5	13.3	26.5	73.3	146.5
2003	88.1	176.2	141,531	141,531	10.0	4.2	9,693	20.0	0.2	131,838	31.0	4.1	141,531	5.0	1.2	8.2	10.0	0.8	20.0	10.0	2.4	5.3	10	0.5	13.5	26.9	74.6	149.3
2004	89.7	179.5	142,811	142,811	10.0	4.3	10,193	20.0	0.2	132,618	31.0	4.1	142,811	5.0	1.2	8.3	10.0	0.8	20.1	10.0	2.5	6.0	10	0.6	13.7	27.3	76.1	152.2
2005	91.3	182.8	144,091	144,091	10.0	4.3	10,693	20.0	0.2	133,398	31.0	4.1	144,091	5.0	1.2	8.3	10.0	0.8	20.2	10.0	2.5	6.8	10	0.7	13.9	27.7	77.5	154.9
2006	93.0	185.9	145,371	145,371	10.0	4.4	11,193	20.0	0.2	134,178	31.0	4.2	145,371	5.0	1.2	8.3	10.0	0.8	20.4	10.0	2.5	7.5	10	0.8	14.0	28.1	78.9	157.8
2007	94.5	189.0	146,651	146,651	10.0	4.4	11,693	20.0	0.2	134,958	31.0	4.2	146,651	5.0	1.2	8.3	10.0	0.8	20.5	10.0	2.5	8.3	10	0.8	14.2	28.4	80.3	160.6
2008	96.2	192.3	147,931	147,931	10.0	4.4	12,193	20.0	0.2	135,738	31.0	4.2	147,931	5.0	1.2	8.4	10.0	0.8	20.6	10.0	2.6	9.1	10	0.9	14.4	28.8	81.7	163.5
2009	97.7	195.4	149,211	149,211	10.0	4.5	12,693	20.0	0.3	136,518	31.0	4.2	149,211	5.0	1.2	8.4	10.0	0.8	20.8	10.0	2.6	9.8	10	1.0	14.6	29.2	83.1	166.2
2010	99.4	198.7	150,491	150,491	10.0	4.5	13,193	20.0	0.3	137,298	31.0	4.3	150,491	5.0	1.2	8.5	10.0	0.8	20.9	10.0	2.6	10.6	10	1.1	14.8	29.6	84.6	169.1
2011	100.3	200.7	151,771	151,771	10.0	4.6	13,693	20.0	0.3	138,078	31.0	4.3	151,771	5.0	1.3	8.5	10.0	0.8	21.0	10.0	2.6	10.8	10	1.1	14.9	29.9	85.4	170.8
2012	101.4	202.7	153,051	153,051	10.0	4.6	14,193	20.0	0.3	138,858	31.0	4.3	153,051	5.0	1.3	8.5	10.0	0.8	21.1	10.0	2.7	11.0	10	1.1	15.1	30.1	86.3	172.6
2013	102.3	204.7	154,331	154,331	10.0	4.6	14,693	20.0	0.3	139,638	31.0	4.3	154,331	5.0	1.3	8.5	10.0	0.9	21.3	10.0	2.7	11.3	10	1.1	15.2	30.4	87.1	174.3
2014	103.4	206.8	155,611	155,611	10.0	4.7	15,193	20.0	0.3	140,418	31.0	4.4	155,611	5.0	1.3	8.6	10.0	0.9	21.4	10.0	2.7	11.5	10	1.2	15.3	30.7	88.0	176.1
2015	104.3	208.7	156,891	156,891	10.0	4.7	15,693	20.0	0.3	141,198	31.0	4.4	156,891	5.0	1.3	8.6	10.0	0.9	21.5	10.0	2.7	11.8	10	1.2	15.5	30.9	88.9	177.7
2016	105.3	210.5	157,811	157,811	10.0	4.7	16,193	20.0	0.3	141,618	31.0	4.4	157,811	5.0	1.3	8.6	10.0	0.9	21.6	10.0	2.7	12.0	10	1.2	15.6	31.2	89.7	179.4
2017	106.1	212.2	158,731	158,731	10.0	4.8	16,693	20.0	0.3	142,038	31.0	4.4	158,731	5.0	1.3	8.6	10.0	0.9	21.7	10.0	2.8	12.3	10	1.2	15.7	31.4	90.4	180.8
2018	107.0	214.1	159,651	159,651	10.0	4.8	17,193	20.0	0.3	142,458	31.0	4.4	159,651	5.0	1.3	8.7	10.0	0.9	21.9	10.0	2.8	12.5	10	1.3	15.8	31.6	91.2	182.4
2019	107.9	215.7	160,571	160,571	10.0	4.8	17,693	20.0	0.4	142,878	31.0	4.4	160,571	5.0	1.3	8.7	10.0	0.9	22.0	10.0	2.8	12.8	10	1.3	15.9	31.8	92.0	183.9
2020	108.8	217.6	161,491	161,491	10.0	4.8	18,193	20.0	0.4	143,298	31.0	4.4	161,491	5.0	1.4	8.8	10.0	0.9	22.1	10.0	2.8	13.0	10	1.3	16.0	32.1	92.8	185.5
2021	109.5	219.0	162,401	162,401	10.0	4.9	18,693	20.0	0.4	143,708	31.0	4.5	162,401	5.0	1.4	8.8	10.0	0.9	22.2	10.0	2.9	13.1	10	1.3	16.1	32.2	93.4	186.8
2022	110.3	220.6	163,311	163,311	10.0	4.9	19,193	20.0	0.4	144,118	31.0	4.5	163,311	5.0	1.4	8.8	10.0	0.9	22.4	10.0	2.9	13.3	10	1.3	16.2	32.4	94.1	188.2
2023	111.0	222.1	164,221	164,221	10.0	4.9	19,693	20.0	0.4	144,528	31.0	4.5	164,221	5.0	1.4	8.8	10.0	0.9	22.5	10.0	2.9	13.4	10	1.3	16.3	32.6	94.7	189.4
2024	111.8	223.7	165,131	165,131	10.0	5.0	20,193	20.0	0.4	144,938	31.0	4.5	165,131	5.0	1.4	8.9	10.0	0.9	22.6	10.0	2.9	13.6	10	1.4	16.4	32.8	95.4	190.9
2025	112.6	225.1	166,041	166,041	10.0	5.0	20,693	20.0	0.4	145,348	31.0	4.5	166,041	5.0	1.4	8.9	10.0	0.9	22.8	10.0	3.0	13.7	10	1.4	16.5	33.0	96.1	192.1
2026	113.4	226.7	166,951	166,951	10.0	5.0	21,193	20.0	0.4	145,758	31.0	4.5	166,951	5.0	1.4	9.0	10.0	0.9	22.9	10.0	3.0	13.8	10	1.4	16.6	33.2	96.8	193.5
2027	114.1	228.2	167,861	167,861	10.0	5.0	21,693	20.0	0.4	146,168	31.0	4.5	167,861	5.0	1.4	9.0	10.0	0.9	23.1	10.0	3.0	14.0	10	1.4	16.7	33.4	97.4	194.8
2028	114.9	229.8	168,771	168,771	10.0	5.1	22,193	20.0	0.4	146,578	31.0	4.5	168,771	5.0	1.4	9.0	10.0	0.9	23.2	10.0	3.0	14.1	10	1.4	16.8	33.6	98.1	196.2
2029	115.6	231.2	169,681	169,681	10.0	5.1	22,693	20.0	0.5	146,988	31.0	4.6	169,681	5.0	1.4	9.0	10.0	0.9	23.3	10.0	3.0	14.3	10	1.4	16.9	33.8	98.7	197.4
2030	116.4	232.8	170,591	170,591	10.0	5.1	23,193	20.0	0.5	147,398	31.0	4.6	170,591	5.0	1.5	9.1	10.0	0.9	23.5	10.0	3.1	14.4	10	1.4	17.0	34.0	99.4	198.8
2031	117.1	234.2	171,501	171,501	10.0	5.1	23,693	20.0	0.5	147,808	31.0	4.6	171,501	5.0	1.5	9.1	10.0	0.9	23.6	10.0	3.1	14.5	10	1.5	17.1	34.2	100.0	200.0
2032	117.9	235.7	172,411	172,411	10.0	5.2	24,193	20.0	0.5	148,218	31.0	4.6	172,411	5.0	1.5	9.2	10.0	0.9	23.7	10.0	3.1	14.8	10	1.5	17.2	34.4	100.7	201.3
2033	118.5	237.1	173,321	173,321	10.0	5.2	24,693	20.0	0.5	148,628	31.0	4.6	173,321	5.0	1.5	9.2	10.0	0.8	23.8	10.0	3.1	14.7	10	1.5	17.3	34.6	101.2	202.5
2034	119.3	238.6	174,231	174,231	10.0	5.2	25,193	20.0	0.5	149,038	31.0	4.6	174,231	5.0	1.5	9.2	10.0	0.9	24.0	10.0	3.1	14.8	10	1.5	17.4	34.8	101.9	203.8
2035	120.0	240.0	175,141	175,141	10.0	5.3	25,693	20.0	0.5	149,448	31.0	4.6	175,141	5.0	1.5	9.2	10.0	0.9	24.1	10.0	3.2	14.9	10	1.5	17.5	35.0	102.5	205.0
2036	120.7	241.5	176,051	176,051	10.0	5.3	26,193	20.0	0.5	149,858	31.0	4.6	176,051	5.0	1.5	9.3	10.0	0.9	24.3	10.0	3.2	15.0	10	1.5	17.6	35.2	103.2	206.3
2037	121.4	242.8	176,961	176,961	10.0	5.3	26,693	20.0	0.5	150,268	31.0	4.7	176,961	5.0	1.5	9.3	10.0	0.9	24.4	10.0	3.2	15.1	10	1.5	17.7	35.3	103.7	207.5
2038	122.2	244.3	177,871	177,871	10.0	5.3	27,193	20.0	0.5	150,678	31.0	4.7	177,871	5.0	1.5	9.4	10.0	0.9	24.5	10.0	3.2	15.2	10	1.5	17.8	35.5	104.4	208.8
2039	122.9	245.7	178,781	178,781	10.0	5.4	27,693	20.0	0.6	151,088	31.0	4.7	178,781	5.0	1.5	9.4	10.0	0.9	24.7	10.0	3.3	15.3	10	1.5	17.9	35.7	105.0	210.0
2040	123.6	247.2	179,691	179,691	10.0	5.4	28,193	20.0	0.6	151,498	31.0	4.7	179,691	5.0	1.5	9.4	10.0	0.9	24.8	10.0	3.3	15.4	10	1.5	18.0	35.9	105.7	211.3
2041	124.3	248.5	180,601	180,601	10.0	5.4	28,693	20.0	0.6	151,908	31.0	4.7	180,601	5.0	1.6	9.4	10.0	0.9	24.9	10.0	3.3	15.5	10	1.5	18.0	36.1	106.2	212.4
2042	125.0	250.0	181,511	181,511	10.0	5.4	29,193	20.0	0.6	152,318	31.0	4.7	181,511	5.0	1.6	9.5	10.0	0.9	25.1	10.0	3.3	15.6	10	1.6	18.1	36.3	106.8	213.7
2043	125.6	251.2	182,421	182,421	10.0	5.5	29,693	20.0	0.6	152,728	31.0	4.7	182,421	5.0	1.6	9.5	10.0	0.9	25.2	10.0	3.3	15.7	10	1.6	18.2	36.5	107.4	214.8
2044	126.3	252.7	183,331	183,331	10.0	5.5	30,193	20.0	0.6	153,138	31.0	4.7	183,331	5.0	1.6	9.6	10.0	1.0	25.3	10.0	3.4	15.7	10	1.6	18.3	36.7	108.0	216.0
2045	127.0	254.0	184,241	184,241	10.0	5.5	30,693	20.0	0.6	153,548	31.0	4.8	184,241	5.0	1.6	9.6	10.0	1.0	25.4	10.0	3.4	15.8	10	1.6	18.4	36.8	108.6	217.1
2046	127.7	255.4	185,151	185,151	10.0	5.6	31,193	20.0	0.6	153,958	31.0	4.8	185,151	5.0	1.6	9.6	10.0	1.0	25.5	10.0	3.4	15.8	10	1.6	18.5	37.0	109.2	218.4
2047	128.3	256.7	186,061	186,061	10.0	5.6	31,693	20.0	0.6	154,368	31.0	4.8	186,061	5.0	1.6	9.6	10.0	1.0	25.7	10.0	3.4	15.9	10	1.6	18.5	37.2	109.7	219.5
2048	129.1	258.1	186,971	186,971	10.0	5.6	32,193	20.0	0.6	154,778	31.0	4.8	186,971	5.0	1.6	9.7	10.0	1.0	25.8	10.0	3.4	16.1	10	1.6	18.7	37.4	110.4	220.7
2049	129.7	259.4	187,881	187,881	10.0	5.6	32,693	20.0	0.7	155,188	31.0	4.8	187,881	5.0	1.6	9.7	10.0	1.0	25.9	10.0	3.5	16.2	10	1.6	18.8	37.6	110.9	221.8
2050	130.4	260.9	188,791	188,791	10.0	5.7	33,193	20.0	0.7	155,598	31.0	4.8	188,791	5.0	1.6	9.8	10.0	1.0	26.0	10.0	3.5	16.3	10	1.6	18.9	37.7	111.5	223.1

(1) Residential General includes savings due to conservation water rates and public education (2) Residential Indoors includes savings due to conservation plumbing fixtures (3) Residential Watering includes savings due to watering restrictions

(4) Commercial includes savings on commercial and commercial sprinkler system use due to conservation water rates and public education (5) Wholesale includes savings on existing and anticipated wholesale use due to conservation water rates and public education

(6) Maximum day/average day factor = 2.00

model5

1290

Table 1 (continued)

CITY OF WICHITA, KANSAS WATER AND SEWER DEPARTMENT

SERVICE AREA CUSTOMER AND WATER USAGE PROJECTION MODEL - USAGE PROJECTIONS WITH CONSERVATION (HIGH RANGE)

YEAR	AVG DAY USE (MGD)	MAX DAY USE (MGD)	No. OF OCCUPIED HOUSING UNITS	RESIDENT GENERAL (1)			RESIDENT INDOORS (2)			RESIDENT INDOORS (2)			RESIDENT WATERING (3)			INDUSTRIAL RECYCLE			COMMERCIAL (4)			WHOLESALE (5)			SUBTOTAL AVG DAY SAVINGS (MGD)	SUBTOTAL MAX DAY SAVINGS (MGD)	ADJUSTED AVG DAY USAGE (MGD)	ADJUSTED MAX DAY USAGE (MGD)
					% REDUCT	DAILY SAVINGS (MGD)	POST 1995 CUST	UNIT SAVINGS (GPHD)	DAILY SAVINGS (MGD)	POST 1995 CUST	UNIT SAVINGS (GPHD)	DAILY SAVINGS (MGD)	No. OF RESID CUST	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)	AVG DAY USAGE (MGD)	% REDUCT	DAILY SAVINGS (MGD)				
1986	48.1	96.4	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	48.1	96.4
1987	53.2	104.0	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	53.2	104.0
1988	57.6	112.3	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	57.6	112.3
1989	59.9	90.9	NA	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	59.9	90.9
1990	61.9	169.5	123,249	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	61.9	109.5
1991	63.7	125.7	124,432	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	63.7	125.7
1992	54.6	109.2	125,667	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	54.6	109.2
1993	53.2	108.5	126,902	126,902	15.0	4.6	1,268	0.0	0.0	0	0.0	0.0	127,900	12.0	2.7	8.6	0.0	0.0	11.2	0.0	0.0	1.0	0.0	0.0	8.8	13.2	48.8	93.2
1994	56.4	112.8	128,137	128,137	15.0	4.6	2,563	0.0	0.0	0	0.0	0.0	129,482	12.0	2.5	9.1	0.0	0.0	10.3	0.0	0.0	1.3	0.0	0.0	7.0	14.0	49.4	98.7
1995	51.3	102.6	129,372	129,372	15.0	4.2	3,881	0.0	0.1	125,491	63.0	7.9	130,577	12.0	2.4	6.7	30.0	2.0	11.8	25.0	3.6	1.2	15	0.2	20.4	40.9	30.8	61.7
1996	53.6	107.1	130,607	130,607	15.0	4.4	5,224	28.0	0.1	125,383	63.0	7.9	132,611	12.0	2.5	5.9	30.0	1.8	12.3	25.0	3.9	1.5	15	0.2	20.8	41.6	32.9	65.5
1997	79.8	159.5	131,842	131,842	15.0	5.9	6,592	28.0	0.2	125,250	63.0	7.9	133,866	12.0	2.6	7.9	30.0	2.4	19.4	25.0	5.8	1.7	15	0.3	25.0	49.8	54.9	108.7
1998	81.0	161.9	133,077	133,077	15.0	6.0	7,592	28.0	0.2	125,485	63.0	7.9	135,149	12.0	2.6	7.9	30.0	2.4	19.5	25.0	5.8	2.2	15	0.3	25.2	50.5	55.7	111.5
2000	83.3	166.7	135,547	135,547	15.0	6.1	9,592	28.0	0.3	125,720	63.0	7.9	136,416	12.0	2.7	8.0	30.0	2.4	19.5	25.0	5.8	2.8	15	0.4	25.5	51.0	56.8	113.3
2001	84.9	169.8	136,782	136,782	15.0	6.2	10,592	28.0	0.3	126,190	63.0	7.9	138,971	12.0	2.7	8.1	30.0	2.4	19.7	25.0	5.9	3.8	15	0.5	26.1	52.1	58.8	117.7
2002	86.5	173.1	138,017	138,017	15.0	6.2	11,592	28.0	0.3	126,425	63.0	8.0	140,253	12.0	2.7	8.2	30.0	2.5	19.8	25.0	6.0	4.5	15	0.7	26.4	52.8	60.1	120.3
2003	88.1	176.2	139,252	139,252	15.0	6.3	12,592	28.0	0.4	126,660	63.0	8.0	141,534	12.0	2.8	8.2	30.0	2.5	20.0	25.0	6.1	5.1	15	0.8	26.7	53.4	61.4	122.8
2004	89.7	179.5	140,487	140,487	15.0	6.3	13,592	28.0	0.4	126,895	63.0	8.0	142,819	12.0	2.8	8.3	30.0	2.5	20.1	25.0	6.1	6.0	15	0.9	27.0	54.1	62.7	125.4
2005	91.3	182.6	141,722	141,722	15.0	6.4	14,592	28.0	0.4	127,130	63.0	8.0	144,093	12.0	2.8	8.3	30.0	2.5	20.2	25.0	6.2	6.8	15	1.0	27.3	54.7	64.0	127.9
2006	93.0	185.9	142,957	142,957	15.0	6.4	15,592	28.0	0.4	127,365	63.0	8.0	145,371	12.0	2.9	8.3	30.0	2.5	20.4	25.0	6.3	7.5	15	1.1	27.7	55.3	65.3	130.6
2007	94.5	189.0	144,192	144,192	15.0	6.5	16,592	28.0	0.5	127,600	63.0	8.0	146,651	12.0	2.9	8.3	30.0	2.5	20.5	25.0	6.3	8.3	15	1.2	28.0	55.9	66.5	133.1
2008	96.2	192.3	145,427	145,427	15.0	6.5	17,592	28.0	0.5	127,835	63.0	8.1	147,931	12.0	2.9	8.4	30.0	2.5	20.6	25.0	6.4	9.1	15	1.4	28.3	56.8	67.9	135.7
2009	97.7	195.4	146,662	146,662	15.0	6.6	18,592	28.0	0.5	128,070	63.0	8.1	149,211	12.0	3.0	8.4	30.0	2.5	20.8	25.0	6.5	9.8	15	1.5	28.5	57.2	69.1	138.2
2010	99.4	198.7	147,897	147,897	15.0	6.7	19,592	28.0	0.5	128,305	63.0	8.1	150,491	12.0	3.0	8.5	30.0	2.5	20.9	25.0	6.5	10.6	15	1.6	28.9	57.9	70.4	140.9
2011	100.3	200.7	149,132	149,132	15.0	6.7	20,592	28.0	0.6	128,540	63.0	8.1	151,779	12.0	3.0	8.5	30.0	2.5	21.0	25.0	6.6	10.8	15	1.6	29.2	58.3	71.2	142.3
2012	101.4	202.7	150,367	150,367	15.0	6.8	21,592	28.0	0.6	128,775	63.0	8.1	153,051	12.0	3.1	8.5	30.0	2.6	21.1	25.0	6.6	11.0	15	1.7	29.4	58.8	72.0	144.0
2013	102.3	204.7	151,602	151,602	15.0	6.8	22,592	28.0	0.6	129,010	63.0	8.1	154,335	12.0	3.1	8.5	30.0	2.6	21.3	25.0	6.7	11.3	15	1.7	29.6	59.2	72.7	145.4
2014	103.4	206.8	152,837	152,837	15.0	6.9	23,592	28.0	0.7	129,245	63.0	8.1	155,619	12.0	3.1	8.6	30.0	2.6	21.4	25.0	6.8	11.5	15	1.7	29.9	59.7	73.5	147.0
2015	104.3	208.7	154,072	154,072	15.0	6.9	24,592	28.0	0.7	129,480	63.0	8.2	156,899	12.0	3.1	8.6	30.0	2.6	21.5	25.0	6.8	11.8	15	1.8	30.1	60.2	74.3	148.5
2016	105.3	210.5	154,897	154,897	15.0	7.0	25,592	28.0	0.7	129,305	63.0	8.1	157,811	12.0	3.2	8.6	30.0	2.6	21.6	25.0	6.9	12.0	15	1.8	30.3	60.5	75.0	150.0
2017	106.1	212.2	155,722	155,722	15.0	7.0	26,592	28.0	0.7	129,130	63.0	8.1	158,735	12.0	3.2	8.6	30.0	2.6	21.7	25.0	6.9	12.3	15	1.8	30.4	60.9	75.7	151.3
2018	107.0	214.1	156,547	156,547	15.0	7.0	27,592	28.0	0.8	128,955	63.0	8.1	159,651	12.0	3.2	8.7	30.0	2.6	21.9	25.0	7.0	12.5	15	1.9	30.6	61.3	76.4	152.8
2019	107.9	215.7	157,372	157,372	15.0	7.1	28,592	28.0	0.8	128,780	63.0	8.1	160,579	12.0	3.2	8.7	30.0	2.6	22.0	25.0	7.0	12.8	15	1.9	30.8	61.6	77.1	154.1
2020	108.8	217.6	158,197	158,197	15.0	7.1	29,592	28.0	0.8	128,605	63.0	8.1	161,491	12.0	3.3	8.8	30.0	2.6	22.1	25.0	7.1	13.0	15	2.0	31.0	62.0	77.8	155.6
2021	109.5	219.0	159,022	159,022	15.0	7.2	30,592	28.0	0.9	128,430	63.0	8.1	162,401	12.0	3.3	8.8	30.0	2.6	22.2	25.0	7.2	13.1	15	2.0	31.1	62.3	78.4	156.7
2022	110.3	220.6	159,847	159,847	15.0	7.2	31,592	28.0	0.9	128,255	63.0	8.1	163,319	12.0	3.3	8.8	30.0	2.7	22.4	25.0	7.2	13.3	15	2.0	31.3	62.6	79.0	158.0
2023	111.0	222.1	160,672	160,672	15.0	7.2	32,592	28.0	0.9	128,080	63.0	8.1	164,221	12.0	3.3	8.8	30.0	2.7	22.5	25.0	7.3	13.4	15	2.0	31.5	62.9	79.8	159.1
2024	111.8	223.7	161,497	161,497	15.0	7.3	33,592	28.0	0.9	127,905	63.0	8.1	165,131	12.0	3.3	8.9	30.0	2.7	22.6	25.0	7.3	13.6	15	2.0	31.8	63.3	80.2	160.4
2025	112.6	225.1	162,322	162,322	15.0	7.3	34,592	28.0	1.0	127,730	63.0	8.0	166,041	12.0	3.4	8.9	30.0	2.7	22.8	25.0	7.4	13.7	15	2.1	31.8	63.6	80.8	161.5
2026	113.4	226.7	163,147	163,147	15.0	7.3	35,592	28.0	1.0	127,555	63.0	8.0	166,951	12.0	3.4	9.0	30.0	2.7	22.9	25.0	7.4	13.8	15	2.1	32.0	63.9	81.4	162.8
2027	114.1	228.2	163,972	163,972	15.0	7.4	36,592	28.0	1.0	127,380	63.0	8.0	167,861	12.0	3.4	9.0	30.0	2.7	23.1	25.0	7.5	14.0	15	2.1	32.1	64.2	82.0	163.9
2028	114.9	229.8	164,797	164,797	15.0	7.4	37,592	28.0	1.1	127,205	63.0	8.0	168,771	12.0	3.4	9.0	30.0	2.7	23.2	25.0	7.5	14.1	15	2.1	32.3	64.6	82.8	165.2
2029	115.6	231.2	165,622	165,622	15.0	7.5	38,592	28.0	1.1	127,030	63.0	8.0	169,681	12.0	3.5	9.0	30.0	2.7	23.3	25.0	7.6	14.3	15	2.1	32.4	64.9	83.2	166.3
2030	116.4	232.8	166,447	166,447	15.0	7.5	39,592	28.0	1.1	126,855	63.0	8.0	170,591	12.0	3.5	9.1	30.0	2.7	23.5	25.0	7.7	14.4	15	2.2	32.6	65.2	83.8	167.6
2031	117.1	234.2	167,272	167,272	15.0	7.5	40,592	28.0	1.1	126,680	63.0	8.0	171,501	12.0	3.5	9.1	30.0	2.7	23.6	25.0	7.7	14.5	15	2.2	32.8	65.5	84.3	168.7
2032	117.9	235.7	168,097	168,097	15.0	7.6	41,592	28.0	1.2	126,505	63.0	8.0	172,411	12.0	3.5	9.2	30.0	2.7	23.7	25.0	7.8	14.6	15	2.2	32.9	65.9	84.9	169.9
2033	118.5	237.1	168,922	168,922	15.0	7.6	42,592	28.0	1.2	126,330	63.0	8.0	173,321	12.0	3.5	9.2	30.0	2.7	23.9	25.0	7.8	14.7	15	2.2	33.1	66.2	85.5	170.9
2034	119.3	238.6	169,747	169,747	15.0	7.6	43,592	28.0	1.2	126,155	63.0	7.9	174,231	12.0	3.6	9.2	30.0	2.8	24.0	25.0	7.9	14.8	15	2.2	33.2	66.5	86.1	172.1
2035	120.0	240.0	170,572	170,572	15.0	7.7	44,592	28.0	1.2	125,980	63.0	7.9	175,141	12.0	3.6	9.2	30.0	2.8	24.1	25.0	7.9	14.9	15	2.2	33.4	66.8	86.6	173.2
2036	120.7	241.5	171,397	171,397	15.0	7.7	45,592	28.0	1.3	125,805	63.0	7.9	176,051	12.0	3.6	9.3	30.0	2.8	24.3	25.0	8.0	15.0	15	2.3	33.6	67.1	87.2	174.4
2037	121.4	242.8	172,222	172,222	15.0	7.7	46,592	28.0	1.3	125,630	63.0	7.9	176,961	12.0	3.6	9.3	30.0	2.8	24.4	25.0	8.0	15.1	15	2.3	33.7	67.4	87.7	175.4
2038	122.2	244.3	173,047	173,047	15.0	7.8	47,592	28.0	1.3	125,455	63.0	7.9	177,871	12.0	3.7	9.4	30.0	2.8	24.5	25.0	8.1	15.2	15	2.3	33.9	67.7	88.3	176.6
2039	122.9	245.7	173,872	173,872	15.0	7.8	48,592	28.0	1.4	125,280	63.0	7.9	178,781	12.0	3.7	9.4	30.0	2.8	24.7	25.0	8.1	15.3	15	2.3	34.0	68.0	88.8	177.7
2040	123.6	247.2	174,697	174,697	15.0	7.9	49,592	28.0	1.4	125,105	63.0	7.9	179,691	12.0	3.7	9.4	30.0	2.8	24.8	25.0	8.2	15.4	15	2.3	34.2	68.4	89.4	178.9
2041	124.3	248.5	175,522	175,522	15.0	7.9	50,592	28.0	1.4	124,930	63.0	7.9	180,601	12.0	3.7	9.4	30.0	2.8	24.9	25.0	8.3	15.5	15	2.3	34.3	68.6	89.9	179.9
2042	125.0	250.0	176,347	176,347	15.0	7.9	51,592	28.0	1.4	124,755	63.0	7.9	181,511	12.0	3.7	9.5	30.0	2.8	25.1	25.0	8.3	15.6	15	2.3	34.5	69.0	90.5	181.0
2043	125.6	251.2	177,172	177,172	15.0	8.0	52,592	28.0	1.5	124,580	63.0	7.8	182,421	12.0	3.8	9.5	30.0	2.8	25.2	25.0	8.4	15.7	15	2.3	34.6	69.2	91.0	182.0
2044	126.3	252.7	177,997	177,997	15.0	8.0	53,592	28.0	1.5	124,405	63.0	7.8	183,331	12.0	3.8	9.6	30.0	2.9	25.3	25.0	8.4	15.7	15	2.4	34.8	69.6	91.6	183.1
2045	127.0	254.0	178,822	178,822	15.0	8.0	54,592	28.0	1.5	124,230	63.0	7.8	184,241	12.0	3.8	9.6	30.0	2.9	25.4	25.0	8.5	15.8	15	2.4	34.9	69.8	92.1	184.3
2046	127.7	255.4	179,647	179,647	15.0	8.1	55,592	28.0	1.6	124,055	63.0	7.8	185,151	12.0	3.8	9.6	30.0	2.9	25.5	25.0	8.5	15.9	15	2.4	35.1	70.2	92.6	185.2
2047	128.3	256.7	180,472	180,472	15.0	8.1	56,592	28.0	1.6	123,880	63.0	7.8	186,061	12.0	3.9	9.6	30.0	2.9	25.7	25.0	8.6	16.0	15	2.4	35.2	70.4	93.1	186.2
2048	129.1	258.1	181,297	181,297	15.0	8.2	57,592	28.0	1.6	123,705	63.0	7.8	186,971	12.0	3.9	9.7	30.0	2.9	25.8	25.0	8.6	16.1	15	2.4	35.4	70.8	93.7	187.4
2049	129.7	259.4	182,122	182,122	15.0	8.2	58,592	28.0	1.6	123,530	63.0	7.8	187,881	12.0	3.9	9.7	30.0	2.9	25.9	25.0	8.7	16.2	15	2.4	35.5	71.0	94.2	188.4
2050	130.4	260.9	182,947	182,947	15.0	8.2	59,592	28.0	1.7	123,355	63.0	7.8	188,791	12.0	3.9	9.8	30.0	2.9	26.0	25.0	8.7	16.3	15	2.4	35.7	71.4	94.7	189.5

(1) Residential General includes savings due to conservation water rates and public education. (2) Residential Indoors includes savings due to conservation plumbing fixtures. (3) Residential Watering includes savings due to watering restrictions.

(4) Commercial includes savings on commercial and commercial sprinkler system use due to conservation water rates and public education. (5) Wholesale includes savings on existing and anticipated wholesale use due to conservation water rates and public education.

(6) Maximum day/average day factor = 2.00

model5

1291

Appendix C
Wholesale Customer and Usage Projections

Table A1

HISTORICAL AND PROJECTED POPULATION
DATA FOR PUBLIC WATER SUPPLIERS IN SEDGWICK COUNTY

Public Water Supplier	1990	2000	2010	2020	2030	2040	2050
1. Existing Wholesale - Individual Meters							
Andover	4,047	5,990	8,050	9,810	10,840	11,400	11,980
Eastborough	896	896	917	936	940	950	960
Oaklawn	3,240	3,950	4,360	4,820	5,070	5,330	5,600
Other Indiv Meters	4,500	4,870	5,280	5,720	6,190	6,700	7,260
Subtotal	12,683	15,706	18,607	21,286	23,040	24,380	25,800
2. Existing Wholesale - Master Meters							
Bel Aire	3,695	4,562	5,428	6,234	7,100	7,880	8,700
Bentley	360	490	490	563	460	460	460
Benton	669	820	990	1,210	1,340	1,480	1,630
Kechi	517	746	975	1,158	1,450	1,680	1,860
Park City	5,050	5,719	6,389	7,042	7,800	8,200	8,620
Rose Hill	2,338	2,850	3,150	3,480	3,660	3,840	4,040
Sedgwick RWD No. 1	755	755	755	755	755	755	755
Sedgwick RWD No. 3	1,172	1,172	1,172	1,172	1,172	1,172	1,172
Sedgwick RWD No. 8	1,016	1,016	1,016	1,016	1,016	1,016	1,016
McConnell AFB	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Subtotal	18,572	21,130	23,365	25,630	27,753	29,483	31,253
3. Anticipated Customers By Year 2010							
Colwich	1,091	1,459	1,721	1,968	2,210	2,320	2,440
Derby	14,699	18,629	22,560	26,156	28,920	31,940	33,580
Goddard	1,804	2,181	2,558	2,912	3,280	3,450	3,620
Haysville	8,364	9,638	10,540	11,635	11,550	12,140	12,760
Maize	1,520	1,746	1,972	2,191	2,410	2,530	2,660
Valley Center	3,624	3,948	4,272	4,592	4,920	5,240	5,570
Subtotal	31,102	37,601	43,623	49,454	53,290	57,620	60,630
4. Anticipated Customers By Year 2030							
Andale	566	594	622	650	680	710	730
Cheney	1,560	1,716	1,872	2,025	2,070	2,170	2,290
Clearwater	1,875	2,066	2,257	2,443	2,490	2,620	2,760
Garden Plain	731	803	817	831	840	850	860
Mount Hope	805	819	833	847	860	870	880
Subtotal	5,537	5,998	6,401	6,796	6,940	7,220	7,520
5. Potential Customers							
Sedgwick	132						
Mulvane	3,466						
Viola	185						
Butler RWD No. 5	305						
Butler RWD No. 8	14						
Harvey RWD No. 1	45						
Sedgwick RWD No. 2	524						
Sedgwick RWD No. 4	794						
Sumner RWD No. 5	39						
Subtotal	5,504	0	0	0	0	0	0
Total	73,398	80,435	91,996	103,166	111,023	118,703	125,203
City of Wichita	304,011	333,000	363,000	388,000	408,000	428,000	448,000
City Service Area	335,266	388,637	448,595	467,768	519,023	546,703	573,203
County Service Area	403,662	438,580	460,940	495,000	523,000	550,000	576,000

Table A2

HISTORICAL AND PROJECTED DEMAND
DATA FOR PUBLIC WATER SUPPLIERS IN SEDGWICK COUNTY

Public Water Supplier	1990	2000	2010	2020	2030	2040	2050
1. Existing Wholesale - Individual Meters							
Andover	0.61	0.90	1.21	1.47	1.63	1.71	1.80
Eastborough(2)	0.13	0.13	0.14	0.14	0.14	0.14	0.14
Oaklawn (5)(6)	0.49	0.59	0.65	0.72	0.76	0.80	0.84
Other Indiv Meters (6)	0.68	0.73	0.79	0.86	0.93	1.01	1.09
Subtotal	1.90	2.36	2.79	3.19	3.46	3.66	3.87
2. Existing Wholesale - Master Meters							
Bel Aire (1)(2)	0.38	0.45	0.81	0.94	1.07	1.18	1.31
Bentley (2)	0.05	0.07	0.07	0.08	0.07	0.07	0.07
Benton (1)(2)	0.07	0.08	0.09	0.18	0.20	0.22	0.24
Kechi (1)(2)	0.07	0.12	0.17	0.19	0.22	0.25	0.28
Park City (1)(2)	0.69	1.02	1.39	1.96	2.11	2.21	2.33
Rose Hill (1)	0.41	0.55	0.77	1.04	0.99	1.04	1.09
Sedgwick RWD No. 1	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Sedgwick RWD No. 3 (3)	0.18	-	-	-	-	-	-
Sedgwick RWD No. 8	0.15	0.15	0.15	0.15	0.15	0.15	0.15
McConnell AFB (5)	0.35	0.45	0.45	0.45	0.45	0.45	0.45
Subtotal	2.47	3.01	4.02	5.11	5.37	5.69	6.03
3. Anticipated Customers By Year 2010							
Colwich (2)	0.16	0.22	0.26	0.30	0.33	0.35	0.37
Derby (2)	2.20	2.79	3.38	3.92	4.34	4.79	5.04
Goddard (2)	0.27	0.33	0.38	0.44	0.49	0.52	0.54
Haysville(2)	1.25	1.45	1.58	1.75	1.73	1.82	1.91
Maize (2)	0.23	0.26	0.30	0.33	0.36	0.38	0.40
Valley Center(2)	0.54	0.59	0.64	0.69	0.74	0.79	0.84
Subtotal	4.67	5.64	6.54	7.42	7.99	8.64	9.09
4. Anticipated Customers By Year 2030							
Andale (2)	0.08	0.09	0.09	0.10	0.10	0.11	0.11
Cheney (2)	0.23	0.26	0.28	0.30	0.31	0.33	0.34
Clearwater (2)	0.28	0.31	0.34	0.37	0.37	0.39	0.41
Garden Plain (2)	0.11	0.12	0.12	0.12	0.13	0.13	0.13
Mount Hope (2)	0.12	0.12	0.12	0.13	0.13	0.13	0.13
Subtotal	0.83	0.90	0.96	1.02	1.04	1.08	1.13
Existing & Anticipated Wholesale Service Area	4.37	8.18	13.35	16.23	17.86	19.07	20.13
Total Wholesale Service Area	9.86	11.90	14.31	16.74	17.86	19.07	20.13

Notes:
(1) Based on contract maximums with Wchita.
(2) MAPD 1991 Housng Study Report 1990 - 2010.
(3) Service with RWD No. 3 terminated in 1995. Thier service provided by El Dorado.
(4) Based on 150 gallons per capita day for residential and commercial usage.
(5) Not classified as a wholeale customer.
(6) Individually metered customers in Sedgwick County.

Table A3

SUMMARY OF HISTORICAL AND PROJECTED CUSTOMER AND DEMAND DATA
INCLUDES POTENTIAL IMPACTS OF WATER CONSERVATION

Year	Residential			Commercial			Industrial			Lawn Service				Institutional			Contract	Water Utility	Wholesale	Total Metered Water (6)	Total Pumpage	UAF (7) (%)
	Customers	Usage	Gal/Cust	Customers	Usage	Gal/Cust	Customers	Usage	Gal/Cust	Customers	Usage (1)	Usage (2)	Gal/Cust(1)	Customers	Usage	Gal/Cust						
2000	113,900	28.5	250	11,500	13.8	1,200	125	6.9	55,000	2,730	8.7	3.6	3200	920	1.8	2,000	4.6	0.2	3.0	60.7	68.0	12.0
2010	126,700	31.7	250	12,300	14.8	1,200	130	7.2	55,000	3,370	10.8	4.4	3200	1000	2.0	2,000	4.7	0.2	10.5	73.9	82.8	12.0
2020	137,700	34.4	250	13,000	15.6	1,200	135	7.4	55,000	3,920	12.5	5.2	3200	1090	2.2	2,000	4.8	0.2	13.0	81.3	91.1	12.0
2030	146,800	36.7	250	13,800	16.6	1,200	140	7.7	55,000	4,375	14.0	5.8	3200	1170	2.3	2,000	4.9	0.2	14.4	87.2	97.6	12.0
2040	155,900	39.0	250	14,600	17.5	1,200	145	8.0	55,000	4,830	15.5	6.4	3200	1250	2.5	2,000	5.0	0.2	15.4	92.6	103.7	12.0
2050	165,000	41.3	250	15,300	18.4	1,200	150	8.3	55,000	5,285	16.9	7.0	3200	1330	2.7	2,000	5.1	0.2	16.2	97.7	109.5	12.0

Lawn Service and Contract are adjusted by a factor of 0.49 to convert usage from a 180 day basis to a 365 day basis.

DWR EXHIBIT V

Memorandum of Understanding

Approved by City Council August 31, 2004

Approved / Accepted By City Council
This AUG 31 2004

Memorandum of Understanding
between
Equus Beds Groundwater Management District No. 2
and
The City of Wichita, Kansas
Regarding
Wichita's Proposed Aquifer Storage and Recovery Project, Phase 1

Background

As part its Integrated Local Water Supply Plan, the City of Wichita (City) proposed to install an aquifer storage and recovery (ASR) project (the Project) in the vicinity of the City's well field located in parts of Harvey and Sedgwick Counties. The Project calls for the diversion of up to 100 million gallons per day (MGD) of above-base-flow water from the Little Arkansas River when available. The water is to be stored in the aquifer until needed in times of extended dry periods. The Project provides a benefit to all users of the aquifer by helping to protect the well field area from migration of salt-water from the Arkansas River and the Burrton brine contamination area and by helping to overcome the dewatering of the aquifer from over-appropriation.

The Equus Beds Groundwater Management District No. 2 (GMD2) provides local management of the aquifer.

In review of water appropriation applications for Phase 1 of the Project, GMD2 expressed concerns about the installation and operation of the project. The City and representatives of GMD2 agreed to meet and address those concerns.

The purpose of this Memorandum of Understanding is to document agreements made between the City and GMD2 as to the installation and operation of Phase 1 of the Project.

Items of Understanding:

1. **Issue:** The conceptual Plan is to develop both direct surface water diversions and diversions using bank storage water from induced infiltration. The initial conceptual plan was for installation of 75 MGD of bank storage facilities and 25 MGD of direct surface water diversion. With recent advances in water treatment technology, development of additional surface supplies appears to be feasible.

   Commitment: Based on current technology the City will develop at least 60 MGD of direct surface water diversions for recharge based on a 100 MGD ASR system and the City is committed to a four-year review period of the bank storage wells constructed in Phase 1 before the installation of any other bank storage wells

2. **Issue:** The City's initial plans are for bank storage wells to be screened in the lower parts of aquifer because of water quality and well efficiency concerns. The

GMD2 is concerned about screening the bank storage wells in the lower aquifer zone. The GMD2 consultant has suggested a test of the upper aquifer zone.

Commitment: The City will install one shallow test well at one diversion well site to determine the approximate yield, water quality and connectivity to river. The test plan will be developed in consultation with GMD2.

3. **Issue:** As addressed in item 2, the City's initial plans were for the bank storage diversion wells to be screened in the lower parts of the aquifer because of water quality and efficiency concerns. The GMD2 consultant recommended also screening the upper aquifer zones to alleviate GMD2 concerns about the diversion wells being screened only in the lower aquifer zone.

Commitment: The City will design bank storage diversion wells screened in the upper as well as the lower sand zones. If the upper sand zone adversely affects water quality to an unacceptable amount, the City may seal it after consultation with GMD2.

4. **Issue:** To provide additional protection against possible negative impacts of the diversion wells, GMD2 suggested that the City initially install and operate the diversion wells under a three (3) to five (5) year term permit.

Commitment: If deemed appropriate and acceptable to the DWR, the City will agree to the establishment of a special condition on the diversion well appropriations that requires a review by the DWR and GMD2 of all of the data collected from the diversion well sites prior to the end of the first four (4) years of operation. After receiving comments from GMD2, such review by DWR would, at minimum, determine if: 1) the aquifer at the diversion wells is connected to the river, 2) the deep aquifer is connected to the shallow aquifer, and, 3) the diversion wells are inducing river water into the aquifer at a rate sufficient to support the pumping of the diversion wells. Based on such review and findings, DWR could require that the City modify the operation of the diversion well(s), or discontinue pumping from the diversion well(s) or, continue the Project.

5. **Issue:** The City recognizes that GMD2 will incur extraordinary expense to monitor and review the Project. GMD2 asked that in light of budgetary constraints the City provide GMD2 with financial assistance during the special condition period referred to in 4 above.

Commitment: The City will provide a grant of up to $20,000 per year for a period not to exceed four (4) years. This grant is in addition to and a not substitute for GMD2 land and groundwater assessments owed by the City.

6. **Issue:** One objective of the Project is to retard the eastward movement of the Burrton saltwater contamination. Phase I has multiple objectives including beginning to build a hydraulic barrier to the Burrton contamination. Additional phases are required to fully implement the hydraulic barrier.

Commitment: At the end of four (4) years of operation of the Project, the City in consultation with GMD2, will re-evaluate the design and placement of recharge facilities near the Burrton contamination plume to determine if more effective plume control will be needed in the Project.

7. **Issue:** GMD2 has requested a number of monitoring wells to be located on property where the City has no right of entry. Additionally, GMD2 has requested water quality sampling of domestic wells near the diversion and recharge facilities where the City has no right of entry.

Commitment: GMD2 will assist the City by obtaining permission for right of entry to sites for the Project monitoring facilities including but not limited to monitoring well sites and access to domestic wells for water quality sampling.

8. **Issue:** GMD2 and the City are committed to maintaining water quality in the Project area.

Commitment: The quality of the recharge water injected into the aquifer through the proposed ASR wells will meet USEPA/KDHE ~~all~~ drinking water standards and will not degrade the ambient use of water in the basin storage area.

9. **Issue:** GMD2 and the City are committed to protecting domestic water wells from changes in water quality standards.

Commitment: If water quality in existing or future domestic wells meets the then current drinking water standards and the water quality is subsequently changed by the Project such that the water no longer meets the then current drinking water standards, the City will provide and install a home water treatment system to bring the water back to drinking water standards or provide other appropriate remedies to replace the domestic water supply with water that meets the drinking water standard without additional cost to the resident.

10. The commitments made by the City and GMD2 as set forth in this Memorandum of Understanding are subject to the requirements of State law and regulations, and the orders of DWR. In the event that any commitment is in conflict with such law, regulation or order, the law, regulation or order controls. In such event, the City and GMD2 agree to enter into good faith discussions to seek amendment of the commitments consistent with the law, regulation or order.

11. It is the intent of the parties that the provisions of this Memorandum of Understanding are not intended to violate the Kansas Cash Basis Law (K.S.A. 10-12101, et seq.), the Kansas Budget Law (K.S.A. 79-2925), or other laws or regulations addressing the budgeting, funding, or expenditures of the respective governmental entities. Therefore, notwithstanding anything to the contrary herein contained, the parties obligations under this Memorandum of Understanding are to be construed in a manner that assures that each party is at all time in conformance of such laws or regulations.

12. It is agreed by the parties that in addition to the above terms, conditions and commitments, the recommendations of GMD2 on the Project will be modified to include the changes in Attachment "A" which is made a part hereof by reference.

13. GMD2 recommends approval of the Project with conditions referenced in this Memorandum of Understanding and GMD2 recommendations as modified by the Memorandum of Understanding.

The parties have each approved this Memorandum of Understanding on the dates designated below, and it is effective as of the latter date of approval.

Signed:

Date: 9-14-04

Equus Beds Groundwater Management District No. 2

By: Bob Seiler

Bob Seiler, President
Board of Directors

Date: 8-31-04

City of Wichita, Kansas

By: Carlos Mayans

Carlos Mayans
Mayor

City of Wichita, Kansas
ATTEST:

Karen Sublett

Karen Sublett, City Clerk

Approved as to Form

Gary E. Rebenstorf

Gary E. Rebenstorf
Director of Law

Attachment "A"
Memorandum of Understanding
Between
Equus Beds Groundwater Management District No. 2
And
The City of Wichita, Kansas
Regarding
Wichita's Aquifer Storage and Recovery Project, Phase 1
Modifications to GMD2 Staff Recommendations
On
Applications 45569 to 45576

Bank Storage Applications Nos. 45569, 45570, 45571, 45572, 45573, 45574, 45575:

Staff Recommendation No.

7) stream flow data collected from the USGS gage at Highway 50 (Halstead) shall be used to determine flow conditions and bank storage well utilization and shall be based on stream flow adjusted for intervening base flow nodes and currently existing surface water rights;

8) DELETE (No longer germane with modification made to 7 above.)

17) ADD: The drawdown limit in any zone, shallow or deep, will not exceed ten (10') feet at a distance 660 feet from the point of diversion on either side of the Little Arkansas River;

19) ADD – The pumping rate of each bank storage well shall not exceed a maximum of 1,000 gallons per minute;

21) (Applications Nos. 45569 & 45575)

20) (Applications Nos. 45570, 45571, 45572, 45573, 45574) the applicant shall submit a water level and water quality monitoring plan for review and comment by GMD2 and approval by the Chief Engineer, DWR.

24) (Applications Nos. 45569, 45570 & 45575)

23) (Applications Nos. 45571, 45572, 45573, 45574) the applicant shall submit a well field operation, monitoring and reporting plan for review and comment by GMD2 and approval by the Chief Engineer, DWR.

25) (Applications Nos. 45569, 45570 & 45575)

24) Applications Nos. 45571, 45572, 45573, 45574) the operational plan shall include utilization of monitoring wells and the stream flow monitoring gage in an automated system; and

Aquifer Storage and Recovery Applications No. 45567

1) the City will provide GMD2 the actual distance from the proposed point of diversion to the nearest non domestic water wells substantiating that the proposed point of diversion complies with Well Spacing Regulation K.A.R. 5-22-2. The distances shall be either surveyed by a state-licensed surveyor or engineer, or scaled from an aerial photograph by qualified Harvey County Farm Service Agency staff

2) the basin storage area shall be defined in compliance with K.A.R. 5-1-1 (k).....

6) the index water levels are established in compliance with K.A.R. 5-1-1 (oo).....

8) the lowest index water level shall be determined per K.A.R. 5-12-1(b)(2) and the highest index water level shall be 1425 feel msl (17.6 feet bls), based on the pre-development water level for index well no. 5 as determined from Kansas Geological Survey Bulletin No. 79 (1949);

16) a monitoring well network is installed at the applicant's expense to monitor the aquifer storage and recovery site as show on Attachment 45567-A(r), and shall include existing monitoring well site IW05;

20) before installation of the proposed ASR well, the applicant shall submit a water level and water quality monitoring plan to GMD2 for review and comment and to the Chief Engineer, DWR for approval;

24, 25 and 26) DELETE (This is a GMD2 action not an Applicant action and should not be a part of the conditions for the Applicant.)

Aquifer Storage and Recovery Applications No. 45568

1) the basin storage area shall be defined in compliance with K.A.R. 5-1-1 (k).....

5) the index water levels are established in compliance with K.A.R. 5-1-1 (oo).....

7) the lowest index water level shall be determined per K.A.R. 5-12-1(b)(2) and the highest index water level shall be 1425 feel msl (17.6 feet bls), based on the pre-development water level for index well no. 5 as determined from Kansas Geological Survey Bulletin No. 79 (1949);

15) a monitoring well network is installed at the applicant's expense to monitor the aquifer storage and recovery site as show on Attachment 45567-A(r), and shall include existing monitoring well site IW05;

19) before installation of the proposed ASR well, the applicant shall submit a water level and water quality monitoring plan to GMD2 for review and comment and to the Chief Engineer, DWR for approval;

23, 24 and 25) DELETE (This is a GMD2 action not an Applicant action and should not be a part of the conditions for the Applicant.)

Aquifer Storage and Recovery Applications No. 45576

1) the basin storage area shall be defined in compliance with K.A.R. 5-1-1 (k).....

5) the index water levels are established in compliance with K.A.R. 5-1-1 (oo).....

7) the lowest index water level shall be determined per K.A.R. 5-12-1(b)(2) and the highest index water level shall be 1427.5 feel msl (22 feet bls), based on the pre-development water level for index well no. 2 as determined from Kansas Geological Survey Bulletin No. 79 (1949);

15) a monitoring well network is installed at the applicant's expense to monitor the aquifer storage and recovery site as show on Attachment 45576-A(r), and shall include existing monitoring well site IW02;

19) before installation of the proposed ASR well, the applicant shall submit a water level and water quality monitoring plan to GMD2 for review and comment and to the Chief Engineer, DWR for approval;

23, 24 and 25) DELETE (This is a GMD2 action not an Applicant action and should not be a part of the conditions for the Applicant.)

DWR EXHIBIT W

Amended Application, File No. 45567

EXHIBIT
DWR "W"
PENGAD 800-631-6989

THE STATE OF KANSAS

F.O. 2
GMD 2
MEETS
K.A.R.5-3-1
USE MUN
GS G
Co. HV
By JP
Date 7/3/03

KANSAS DEPARTMENT OF AGRICULTURE
Jamie Clover Adams, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

File Number 45567
This item to be completed by the Division of Water Resources.

WATER RESOURCES
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DEC 16 2003
KS DEPT OF AGRICULTURE

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

Filing Fee Must Accompany the Application
(Please refer to Fee Schedule attached to this application form.)

ASR Project - RRW 3

To the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture, 109 SW 9th Street, Second Floor, Topeka, KS 66612-1283:

1. Name of Applicant (Please Print): City of Wichita, Water & Sewer Dept.
   Address: 455 N. Main
   City: Wichita State KS Zip Code 67202
   Telephone Number: (316) 268-4504

2. The source of water is: G surface water in _____ (stream)
   OR ✓ groundwater in Equus Beds, Arkansas River (drainage basin)

   Certain streams in Kansas have minimum target flows established by law or may be subject to administration when water is released from storage for use by water assurance district members. If your application is subject to these regulations on the date we receive your application, you will be sent the appropriate form to complete and return to the Division of Water Resources.

3. The maximum quantity of water desired is 4,000 acre-feet OR _____ gallons per calendar year,
   to be diverted at a maximum rate of 1,200 gallons per minute OR _____ cubic feet per second.

   Once your application has been assigned a priority, the requested maximum rate of diversion and maximum requested quantity of water under that priority number can NOT be increased. Please be certain your requested maximum rate of diversion and maximum quantity of water are appropriate and reasonable for your proposed project and are in agreement with the Division of Water Resources' requirements.

4. The water is intended to be appropriated for (Check use intended):
   (a) G Artificial Recharge (c) G Irrigation Use (e) G Recreational Use (g) G Water Power use
   (b) G Industrial Use (d) ✓ Municipal Use (f) G Stockwatering Use

YOU MUST COMPLETE AND ATTACH ADDITIONAL DIVISION OF WATER RESOURCES FORM(S) PROVIDING INFORMATION TO SUBSTANTIATE YOUR REQUEST FOR THE AMOUNT OF WATER FOR THE INTENDED USE REFERENCED ABOVE.

For Office Use Only: Code REG Fee $ [illegible] TR # _____ Receipt Date [illegible] Check # [illegible]

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12:53PM
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DWR 1-100 (Revised 6/24/02)

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File No. 45567

12. Furnish the following well information if the proposed appropriation is for the use of groundwater. If the well has not been completed, give information obtained from test holes, if available.

Information below is from: Test holes ✓ Well as completed G Drillers log attached G

Well location as shown in paragraph No.	(A)	(B)	(C)	(D)
Date Drilled	11/12/02			
Total depth of well	189			
Depth to water bearing formation	33			
Depth to static water level	28.5			
Depth to bottom of pump intake pipe	—			

13. The relationship of the applicant to the proposed place where the water will be used is that of agent.
(owner, tenant, agent or otherwise)

14. The owner(s) of the property where the water is used, if other than the applicant, is (please print):

(name, address and telephone number)

(name, address and telephone number)

15. The undersigned states that the information set forth above is true to the best of his/her knowledge and that this application is submitted in good faith.

Dated at Wichita, Kansas, this 2nd day of July (month), 2003 (year)

(Applicant Signature)

APPLICANT(S) SOCIAL SECURITY IDENTIFICATION NUMBER(S)

By Gerald T. Blain
(Agent or Officer Signature)

48-6000653
and/or
APPLICANT(S) TAXPAYER I.D. NO.(S)

Gerald T. Blain
(Agent or Officer - Please Print)

Assisted by _____ _____
(office/title)

WATER RESOURCES
Date: RECEIVED

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PRELIMINARY

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9. If you are planning to impound water, please contact the Division of Water Resources for assistance, prior to submitting the application. Please attach a reservoir area capacity table and inform us of the total acres of surface drainage area above the reservoir.

   Have you also made an application for a permit for construction of this dam and reservoir with the Division of Water Resources? G Yes G No

   ! If yes, show the Water Structures permit number here _____

   ! If no, explain here why a Water Structures permit is not required _____

10. The application must be supplemented by a U.S.G.S. topographic map, aerial photograph or a detailed plat showing the following information. On the topographic map, aerial photograph, or plat, identify the center of the section, the section lines or the section corners and show the appropriate section, township and range numbers. Also, please show the following information:

   (a) The location of the proposed point(s) of diversion (wells, stream-bank installations, dams, or other diversion works) should be plotted as described in Paragraph No. 5 of the application, showing the North-South distance and the East-West distance from a section line or southeast corner of section.

   (b) If the application is for groundwater, please show the location of any existing water wells of any kind within ½ mile of the proposed well or wells. Identify each existing well as to its use and furnish the name and mailing address of the property owner or owners. If there are no wells within ½ mile, please advise us.

   (c) If the application is for surface water, the names and addresses of the landowner(s) ½ mile downstream and ½ mile upstream from your property lines must be shown.

   (d) The location of the proposed place of use should be shown by crosshatching on the topographic map, aerial photograph or plat.

   (e) Show the location of the pipelines, canals, reservoirs or other facilities for conveying water from the point of diversion to the place of use.

   A 7.5 minute U.S.G.S. topographic map may be obtained by providing the section, township and range numbers to: Kansas Geological Survey, 1930 Constant, Campus West, University of Kansas, Lawrence, Kansas 66047.

11. List any application, appropriation of water, water right, or vested right file number that covers the same diversion points or any of the same place of use described in this application. Also list any other recent modifications made to existing permits or water rights in conjunction with the filing of this application.

Part of City of Wichita's ASR project. Water will be withdrawn from this well only when recharge credits are available.

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File No. 45567

5. The location of the proposed wells, pump sites or other works for diversion of water is:

Note: For the application to be accepted, the point of diversion location must be described to at least a 10 acre tract, unless you specifically request 60 days in which to locate the site within a quarter section tract. Any request for an extension of time in which to locate the point of diversion shall include a contract with a well driller or a contractor for the necessary test holes.

(A) One in the SW * NW quarter of the SW * NW quarter of the SW * NW quarter of Section 24 * 25, more particularly described as being near a point 5124 105 * feet North and 5272 5,195 * feet West of the Southeast corner of said section, in Township 23 South, Range 3 East/West (circle one), Harvey County, Kansas.

(B) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

(C) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

(D) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

If the source of supply is groundwater, a separate application shall be filed for each proposed well or battery of wells, except that a single application may include up to four wells within a circle with a quarter (¼) mile radius in the same local source of supply which do not exceed a maximum diversion rate of 20 gallons per minute per well and which are operated by means of submersible pumps.

A battery of wells is defined as two or more wells connected to a common pump by a manifold; or not more than four wells in the same local source of supply within a 300 foot radius circle which are being operated by pumps not to exceed a total maximum diversion rate of 800 gallons per minute and which supply water to a common distribution system.

6. The proposed project for diversion of water will consist of one recharge/recovery well
(number of wells, pumps or dams, etc.)
and (was)(will be) completed (by) March 1, 2004
(Month/Day/Year - each was or will be completed)

7. The first actual application of water for the proposed beneficial use was or is estimated to be 06/01/10
(Mo/Day/Year)

8. Will pesticide, fertilizer, or other foreign substance be injected into the water pumped from the diversion works?

Yes G No ✓ If "yes", a check valve shall be required.

All chemigation safety requirements must be met including a chemigation permit and reporting requirements.

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JUL 03 2006

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USGS 5 km E of Burrton, Kansas, United States 01 Jul 1978

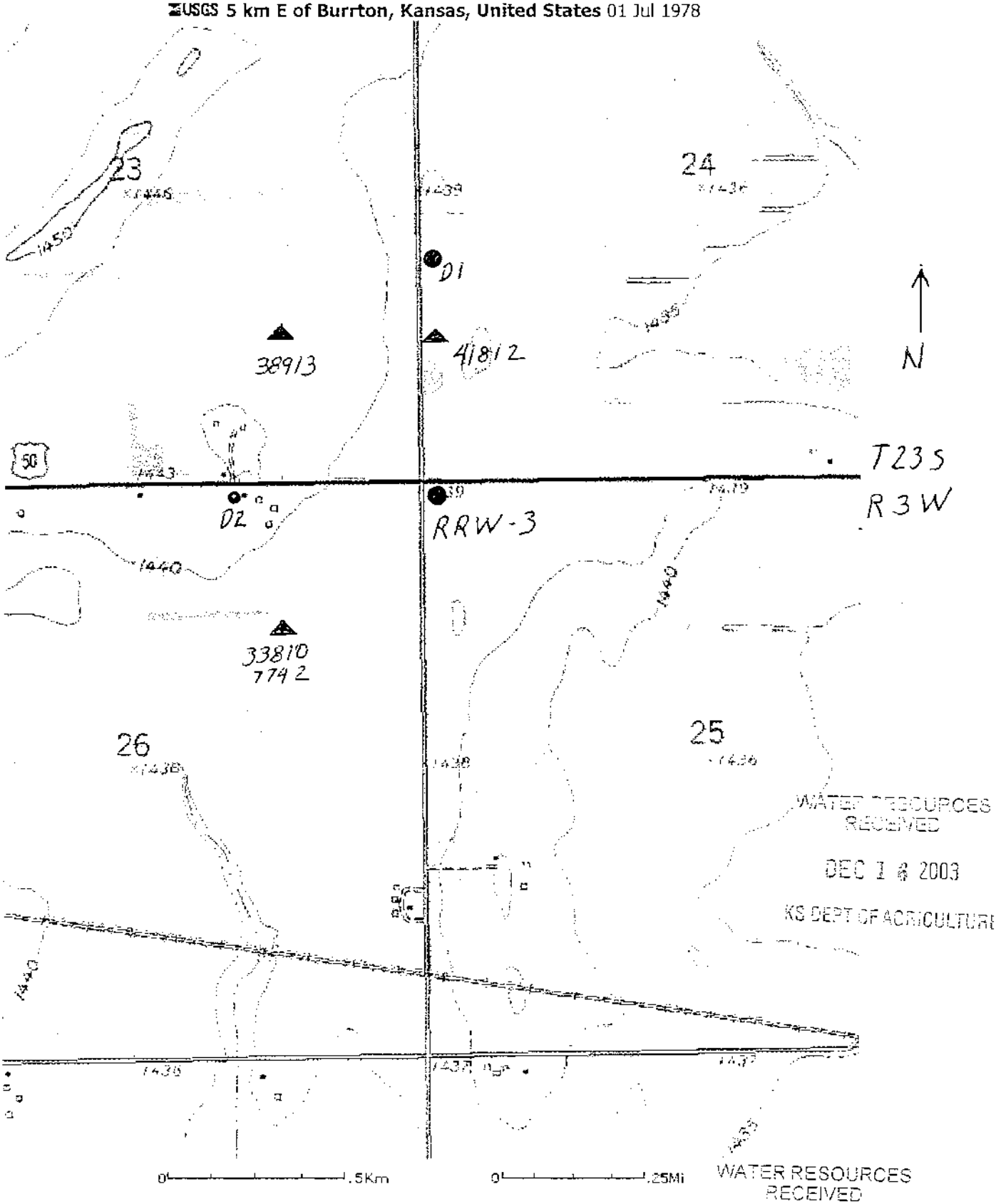

Image courtesy of the U.S. Geological Survey

Recharge and Recovery Well No. 3
5124 ft. N. and 5272 ft. W. of SE Corner of Sec. 25, T 23 S, R 3 W.

Diversions within 1/2 mile:

Irrigation Wells –

7742 & # 33810
Mark Ellingson
13816 W. US Hwy 50
Halstead, KS 67056

38913
William and Margaret Bergkamp
419 S. Golden Prairie Rd.
Halstead, KS 67056

37898
Joe and Joanna Bergkamp
2004 S. Willow Lake Rd.
Halstead, KS 67056

41812
Gordon Schmidt
10320 Wheat State Rd.
Inman, Ks67546

Domestic Wells

D1
Clarence Troxel
732 S. Willow Lake Rd
Halstead, KS 67056

D2 (possible site)
Mark Ellingson
13816 W. US Hwy 50
Halstead, KS 67056

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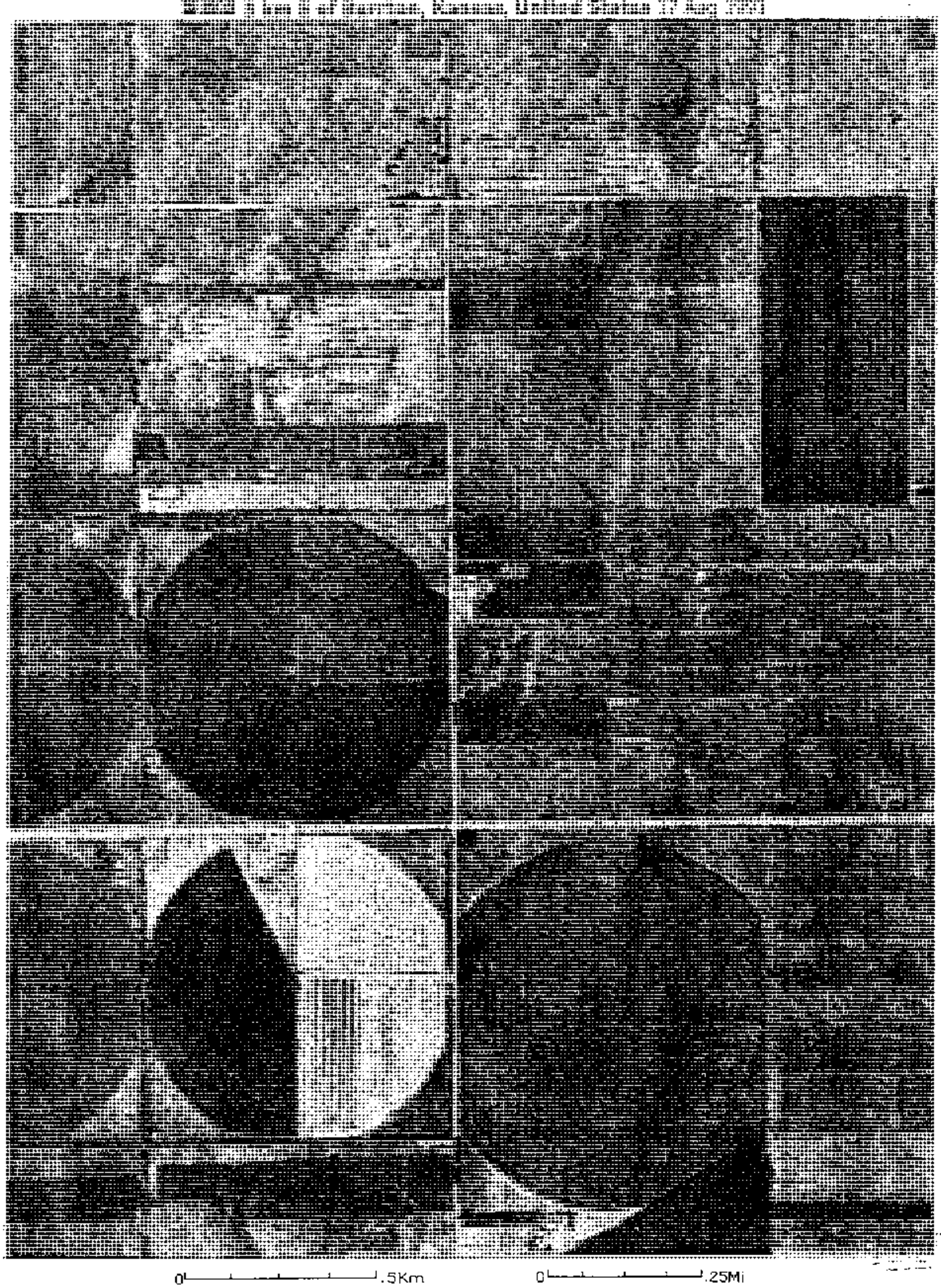
[illegible] km E of [illegible], Kansas, United States [illegible]



N

T 23S
R 3W

Image courtesy of the U.S. Geological Survey

MUNICIPAL (PUBLIC WATER SUPPLY) APPLICATION
SUPPLEMENTAL INFORMATION SHEET

NAME _____
(Please Print)

Application File Number _____
(assigned by DWR)

SECTION 1: PRESENT WATER USE SUMMARY (IF NO PREVIOUS MUNICIPAL WATER USE HAS BEEN UTILIZED, PROCEED TO SECTION 3)
NOTE: WORKSHEET FOR WATER PUMPED, PURCHASED, AND SOLD BY YOUR WATER DISTRIBUTION SYSTEM.

Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Below Explanation)
TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

UNACCOUNTED FOR WATER = TOTAL WATER - ACCOUNTED FOR WATER

Column 1: The amount of raw water diverted from all of your points of diversion.

Column 2: The amount of water purchased wholesale from all other public water supply systems or the Kansas Water Office.

Column 3: The amount of water sold wholesale to all other public water supply systems.

Column 4: The amount of water sold retail to all industrial, pasture, stockwater, feedlot, and bulk water service connections. Include the amount of water sold to all farmsteads using at least 200,000 gallons of water per year.

Column 5: The amount of water sold retail to your residential and commercial customers and to industries and farmsteads using less than 200,000 gallons of water per year.

Column 6: The amount of water used that is metered at individual service connections and supplied free, such as for public service, treatment processes, and connections receiving free water.

Column 7: The amount of remaining water used. The gallons reported in this column are found by adding the numbers in Columns 1 and 2 and subtracting the numbers in Columns 3, 4, 5, and 6.

UNACCOUNTED FOR WATER

Use the following to calculate your distribution system's Unaccounted For Water:
Start with the amount in Column 1 and add the amount in Column 2, then subtract the amounts in Columns 3, 4, 5, and 6 leaving an amount of water representing your unaccounted for water to enter in Column 7.

Use the following to calculate the percent Unaccounted For Water versus the Total Water of your system:

$$\text{Percent Unaccounted For Water} = \frac{\text{Unaccounted For Water}}{\text{Total Water (Columns 1,2)}} \times 100$$

If this number exceeds 20%, please explain the large amount of unaccounted for water and describe any steps being taken to reduce it.

SECTION 2: PAST WATER USE
COMPLETE THE FOLLOWING TABLE FROM YOUR PAST WATER USE RECORDS.

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Above Explanation)
20 years ago							
15 years ago							
10 years ago							
5 years ago							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 3: PROJECTED FUTURE WATER NEEDS

PLEASE COMPLETE THE FOLLOWING TABLE SHOWING YOUR FUTURE WATER REQUIREMENTS FOR THE NEXT 20 YEARS:

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Explanation on other side)
Year 5							
Year 10							
Year 15							
Year 20							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 4: POPULATION AND SERVICE CONNECTIONS

ESTIMATE THE NUMBER OF PERSONS DIRECTLY SERVED BY YOUR WATER DISTRIBUTION SYSTEM

PAST POPULATION - PROVIDE INFORMATION BELOW:
(CENSUS BUREAU INFORMATION)

LAST 20 YEARS	POPULATION
20 years ago	
15 years ago	
10 years ago	
5 years ago	
Last Year	

PROJECTED FUTURE POPULATION

ESTIMATE FUTURE POPULATION AND SUBSTANTIATE NUMBERS ON SEPARATE ATTACHMENTS

NEXT 20 YEARS	POPULATION
Year 5	
Year 10	
Year 15	
Year 20	

Provide number of current active service connections:

_____ Residential _____ Industrial _____ Other (specify) _____

_____ Commercial _____ Pasture/ Stockwater/ Feedlot _____ Total

SECTION 5: PRESENT GALLONS PER PERSON PER DAY

CALCULATE YOUR GALLONS PER PERSON PER DAY

Water in Columns 5,6, and 7 ÷ Population ÷ 365 Days/Year = Gallons per Person per Day

_____ ÷ _____ ÷ 365 Days/Year = _____ GALLONS PER PERSON PER DAY.

Amount of water in Columns 5,6, and 7 of Section 1

Population from Last Year of Section 4

SECTION 6: AREA TO BE SERVED

Describe the area to be served or provide the legal description of the location where the water is to be used including any other city of water supply system (i.e. Rural Water District): within the boundaries of the City of Wichita.

* DWR DP 7/3/03

You may attach additional information you believe will assist in informing the Division of the ne r your request.

2004 S. Willow Lake Road
Halstead, KS 67056
November 5, 2004

Mr. David L. Pope, Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

RE: Case No. 04 WATER 2869 Applications to Appropriate Water, File No's 45,567; 45,568; 45,569; 45,570; 45,571; 45,572; 45,573; 45,574; 45,575; 45,576.

Dear Mr. Pope:

I have two concerns regarding the City of Wichita's applications to operate an Aquifer Storage and Recovery Project.

1. The City does not own or have the legal right to all of the property where permits are being considered for approval. I, along with several of my siblings own the property in Section 25, Township 23S, Range 3W, in Harvey County, that is being considered for approval. I know that the City of Wichita may provide information documenting how and when it intends to obtain such access, but no matter "how you cut the cake", if the City does not own it, then the application request should be denied totally.

2. To the best of my knowledge, the application numbers that the City are filing for are for a recharge well and a retrieval well. My suggestion is for the permit for the recharge well, only, to be approved. Once the water level is at a sufficient level in the recharge well, then approve the retrieval permit. Let's not get the cart ahead of the horse! It's always better to go slow, than to go too fast.

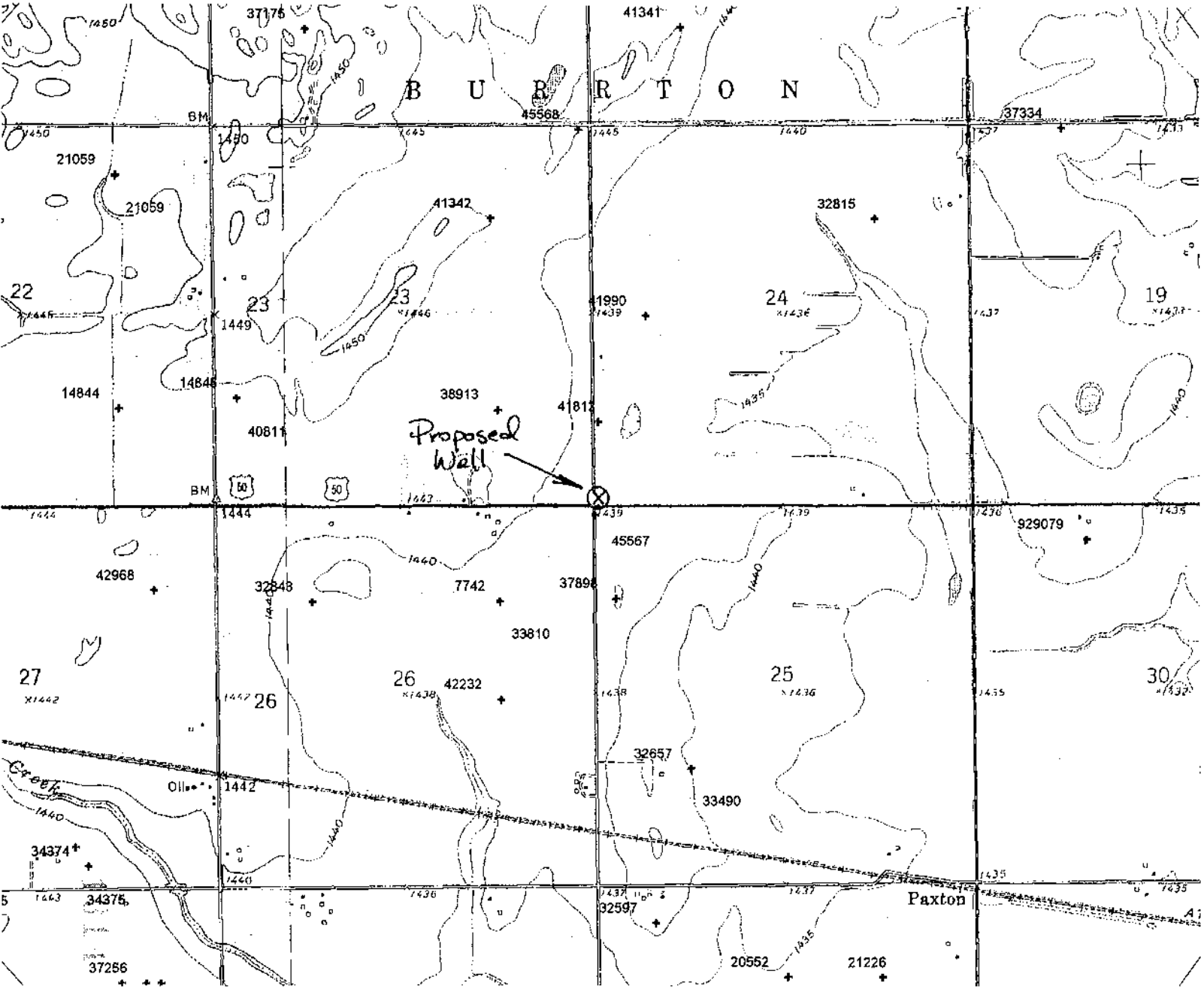
My desire is to participate in the hearing proceedings as a witness. I look forward to hearing from your office regarding the upcoming proceedings. If you have any questions, I can be reached at the above address; my phone number is (620) 463-2242.

Thank you.

Sincerely,

Joe Bergkamp

File No. 45,567 24-23s-03w (105n,5195w)



This map was created by WIMAS on Nov 22, 2004 and represents water right conditions as of Nov 19, 2004.

KAK

DWR EXHIBIT X

Amended Application, File No. 45,569

EXHIBIT
DWR "X"
PENGAD 800-631-6989

F.O. 2
GMD 2
MEETS
K.A.R.5-3-1
USE ART 5
Co. HV
By SP
Date 7/3/03

THE STATE OF KANSAS

KANSAS DEPARTMENT OF AGRICULTURE
Jamie Clover Adams, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

File Number 45569
This item to be completed by the Division of Water Resources.

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

Filing Fee Must Accompany the Application
(Please refer to Fee Schedule attached to this application form.)

WATER RESOURCES RECEIVED
DEC 16 2003
KS DEPT OF AGRICULTURE

ASR Project DW-2

To the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture, 109 SW 9th Street, Second Floor, Topeka, KS 66612-1283:

1. Name of Applicant (Please Print): City of Wichita, Water & Sewer Dept.
   Address: 455 N. Main
   City: Wichita State KS Zip Code 67202
   Telephone Number: (316) 268-4504
2. The source of water is: ✓ surface water in Little Arkansas River (stream)
   OR G groundwater in _____ (drainage basin)

   Certain streams in Kansas have minimum target flows established by law or may be subject to administration when water is released from storage for use by water assurance district members. If your application is subject to these regulations on the date we receive your application, you will be sent the appropriate form to complete and return to the Division of Water Resources.
3. The maximum quantity of water desired is 1,500 acre-feet OR _____ gallons per calendar year,
   to be diverted at a maximum rate of 1,500 gallons per minute OR _____ cubic feet per second.

   Once your application has been assigned a priority, the requested maximum rate of diversion and maximum requested quantity of water under that priority number can NOT be increased. Please be certain your requested maximum rate of diversion and maximum quantity of water are appropriate and reasonable for your proposed project and are in agreement with the Division of Water Resources' requirements.
4. The water is intended to be appropriated for (Check use intended):
   (a) ✓ Artificial Recharge (c) G Irrigation Use (e) G Recreational Use (g) G Water Power use
   (b) G Industrial Use (d) G Municipal Use (f) G Stockwatering Use

YOU MUST COMPLETE AND ATTACH ADDITIONAL DIVISION OF WATER RESOURCES FORM(S) PROVIDING INFORMATION TO SUBSTANTIATE YOUR REQUEST FOR THE AMOUNT OF WATER FOR THE INTENDED USE REFERENCED ABOVE.

For Office Use Only: Code FEE Fee $ 500 TR # _____ Receipt Date _____ Check # _____

WATER RESOURCES RECEIVED
JUL 03 2003
12:56pm
KS DEPT OF AGRICULTURE

DWR 1-100 (Revised 6/2003)

WATER RESOURCES
RECEIVED

DEC 1 6 2003

KS DEPT OF AGRICULTURE

File No. 45569

5. The location of the proposed wells, pump sites or other works for diversion of water is:

Note: For the application to be accepted, the point of diversion location must be described to at least a 10 acre tract, unless you specifically request 60 days in which to locate the site within a quarter section tract. Any request for an extension of time in which to locate the point of diversion shall include a contract with a well driller or a contractor for the necessary test holes.

(A) One in the ~~SW~~ NW * quarter of the SW quarter of the ~~SE~~ NW * quarter of Section 8, more particularly described as being near a point ~~512~~ 3,665 * feet North and ~~2465~~ 5,195 * feet West of the Southeast corner of said section, in Township 23 South, Range 2 East/(West) (circle one), Harvey County, Kansas.

(B) One in the ______ quarter of the ______ quarter of the ______ quarter of Section ______, more particularly described as being near a point ______ feet North and ______ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), ____________ County, Kansas.

(C) One in the ______ quarter of the ______ quarter of the ______ quarter of Section ______, more particularly described as being near a point ______ feet North and ______ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), ____________ County, Kansas.

(D) One in the ______ quarter of the ______ quarter of the ______ quarter of Section ______, more particularly described as being near a point ______ feet North and ______ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), ____________ County, Kansas.

If the source of supply is groundwater, a separate application shall be filed for each proposed well or battery of wells, except that a single application may include up to four wells within a circle with a quarter (¼) mile radius in the same local source of supply which do not exceed a maximum diversion rate of 20 gallons per minute per well and which are operated by means of submersible pumps.

A battery of wells is defined as two or more wells connected to a common pump by a manifold; or not more than four wells in the same local source of supply within a 300 foot radius circle which are being operated by pumps not to exceed a total maximum diversion rate of 800 gallons per minute and which supply water to a common distribution system.

6. The proposed project for diversion of water will consist of one bank storage well
(number of wells, pumps or dams, etc.)

and (was)(will be) completed (by) March 1, 2004.
(Month/Day/Year - each was or will be completed)

7. The first actual application of water for the proposed beneficial use was or is estimated to be 03/01/04
(Mo/Day/Year)

8. Will pesticide, fertilizer, or other foreign substance be injected into the water pumped from the diversion works?

Yes G No G ✓ If "yes", a check valve shall be required.

All chemigation safety requirements must be met including a chemigation permit and reporting requirements.

WATER RESOURCES
RECEIVED

JUL 0 3 2003

KS DEPT OF AGRICULTURE

* [illegible] 11-18-2003
Change per [illegible]
[illegible]
[illegible]

1316

MICROFILMED

 File No. 45569

9. If you are planning to impound water, please contact the Division of Water Resources for assistance, prior to submitting the application. Please attach a reservoir area capacity table and inform us of the total acres of surface drainage area above the reservoir.

   Have you also made an application for a permit for construction of this dam and reservoir with the Division of Water Resources? G Yes ☑ No

   ! If yes, show the Water Structures permit number here _____

   ! If no, explain here why a Water Structures permit is not required Will use bank storage well to induce river infiltration

10. The application must be supplemented by a U.S.G.S. topographic map, aerial photograph or a detailed plat showing the following information. On the topographic map, aerial photograph, or plat, identify the center of the section, the section lines or the section corners and show the appropriate section, township and range numbers. Also, please show the following information:

   (a) The location of the proposed point(s) of diversion (wells, stream-bank installations, dams, or other diversion works) should be plotted as described in Paragraph No. 5 of the application, showing the North-South distance and the East-West distance from a section line or southeast corner of section.

   (b) If the application is for groundwater, please show the location of any existing water wells of any kind within ½ mile of the proposed well or wells. Identify each existing well as to its use and furnish the name and mailing address of the property owner or owners. If there are no wells within ½ mile, please advise us.

   (c) If the application is for surface water, the names and addresses of the landowner(s) ½ mile downstream and ½ mile upstream from your property lines must be shown.

   (d) The location of the proposed place of use should be shown by crosshatching on the topographic map, aerial photograph or plat.

   (e) Show the location of the pipelines, canals, reservoirs or other facilities for conveying water from the point of diversion to the place of use.

   A 7.5 minute U.S.G.S. topographic map may be obtained by providing the section, township and range numbers to: Kansas Geological Survey, 1930 Constant, Campus West, University of Kansas, Lawrence, Kansas 66047.

11. List any application, appropriation of water, water right, or vested right file number that covers the same diversion points or any of the same place of use described in this application. Also list any other recent modifications made to existing permits or water rights in conjunction with the filing of this application.

Part of City of Wichita's ASR project. Well will operate only during above base flow events when river flow exceeds 42 cfs April-Sept. and 20 cfs Oct-March as measured at USGS gage at Highway 50.

WATER RESOURCES
RECEIVED

DEC 16 2003

KS DEPT OF AGRICULTURE

File No. 45569

12. Furnish the following well information if the proposed appropriation is for the use of groundwater. If the well has not been completed, give information obtained from test holes, if available.

Information below is from: Test holes ☑ Well as completed ☐ Drillers log attached ☑

Well location as shown in paragraph No.	(A)	(B)	(C)	(D)
Date Drilled	08/26/02			
Total depth of well	148'			
Depth to water bearing formation	9'			
Depth to static water level	4.7'			
Depth to bottom of pump intake pipe	NA			

13. The relationship of the applicant to the proposed place where the water will be used is that of agent
(owner, tenant, agent or otherwise)

14. The owner(s) of the property where the water is used, if other than the applicant, is (please print):

(name, address and telephone number)

(name, address and telephone number)

15. The undersigned states that the information set forth above is true to the best of his/her knowledge and that this application is submitted in good faith.

Dated at Wichita, Kansas, this 2nd day of July (month), 2003 (year).

(Applicant Signature)

APPLICANT(S) SOCIAL SECURITY IDENTIFICATION NUMBER(S)

By Gerald T. Blain
(Agent or Officer Signature)

48-6000653
and/or
APPLICANT(S) TAXPAYER I.D. NO.(S)

Gerald T. Blain
(Agent or Officer - Please Print)

Assisted by _____ (office/title) Date: _____

WATER RESOURCES
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JUL 03 2003

KS DEPT OF AGRICULTURE

MICROFILMED

Diversion Well No. 2
512 ft. N. and 2405 ft. W. of SE Corner of Sec. 8, T 23 S, R 2 W.

Diversions within 1/2 mile:

Irrigation Wells – none

Domestic Wells

D1- Renee R. Martin
14800 NW 12th St.
Burrton, KS 67020

D2 - Steve Bayless
14903 NW. 12th St.
Burrton, KS 67020

D3 - Larry Spragg
14515 NW 12th St.
Burrton, KS 67020

Properties within ½ mile upstream and downstream

Douglas R. Unruh
1715 N. Old Settlers Rd.
Halstead, KS 67056

Wilbert H. Penner
14935 NW 24th St.
Burrton, KS 67020

Ivan J. Schirer
14430 W 1st St.
Halstead, KS 67056

Renee R. Martin
14800 NW 12th St.
Burrton, KS 67020

Robert F. Ross
14301 NW 12th St.
Burrton, KS 67020

Send To Printer Back To TerraServer Change to 11x17 Print Size Show Grid Lines Change to Landscape

USGS 47 km NW of Wichita, Kansas, United States 01 Jul 1978

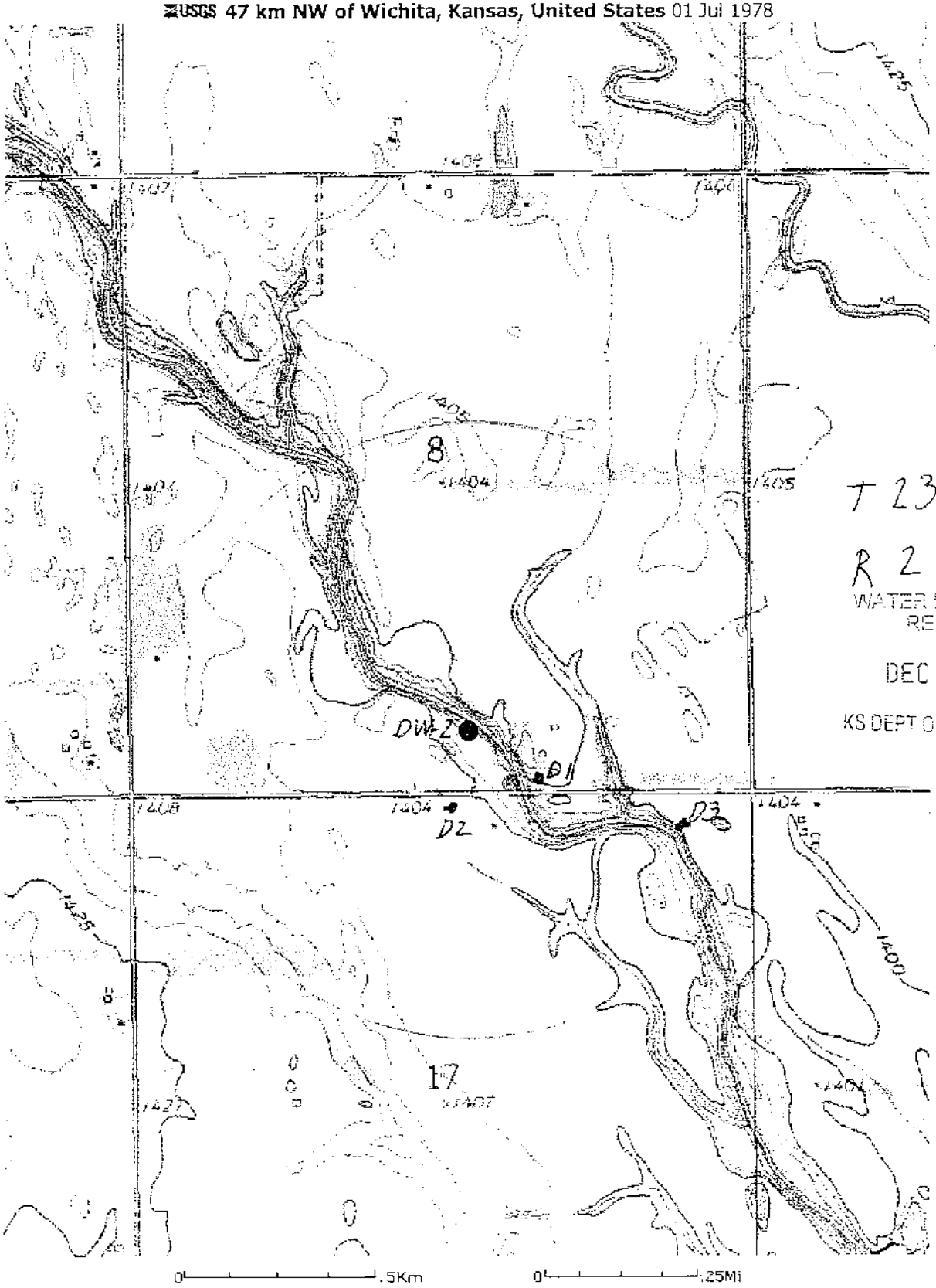
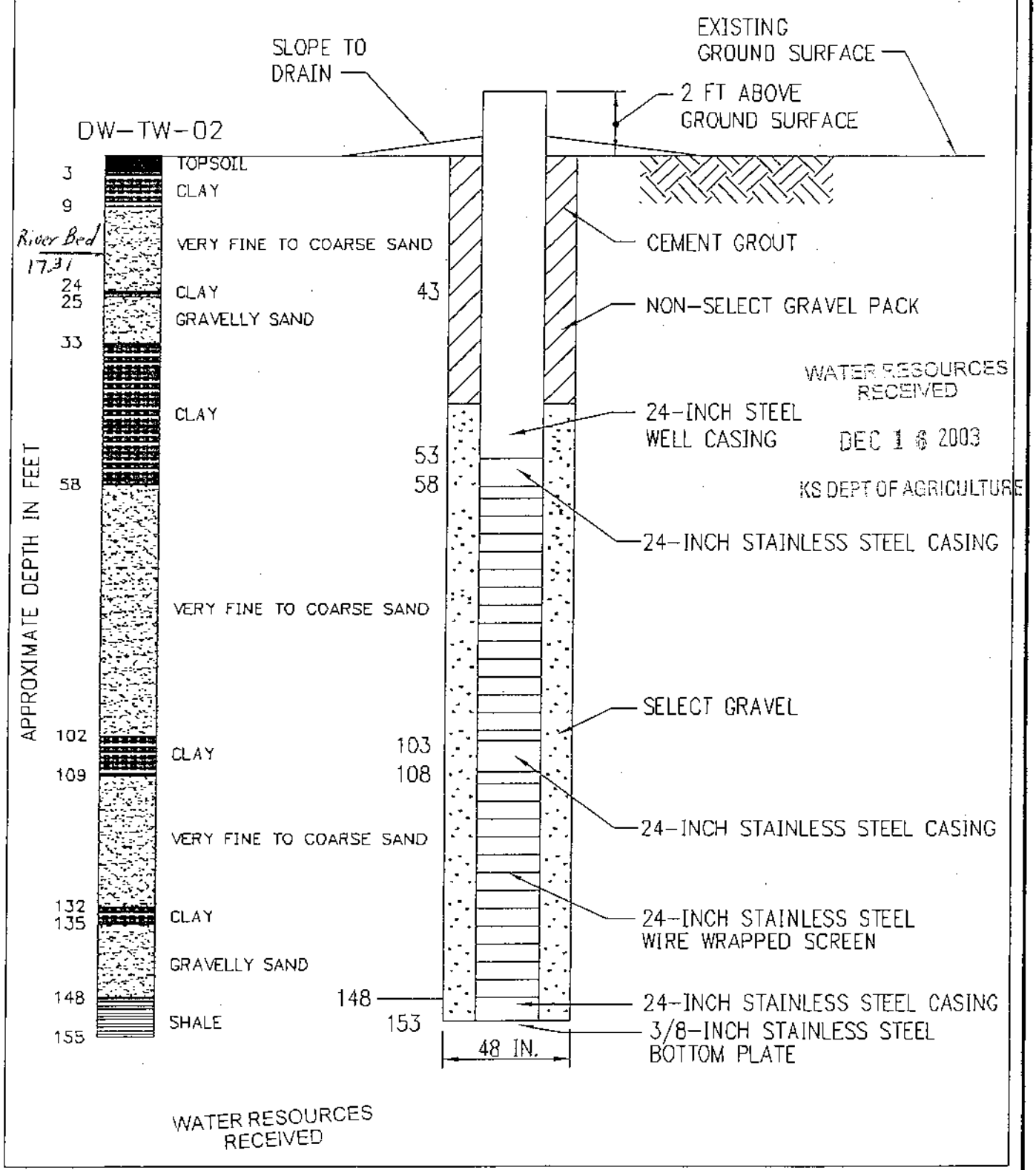


Image courtesy of the U.S. Geological Survey

1330

MICROFILMED



WATER RESOURCES RECEIVED
DEC 16 2003
KS DEPT OF AGRICULTURE

WATER RESOURCES RECEIVED
JUL 03 2003
KS DEPT OF AGRICULTURE

NOTE: FINAL DESIGN TO BE BASED ON PILOT HOLE FOR DIVERSION WELL.

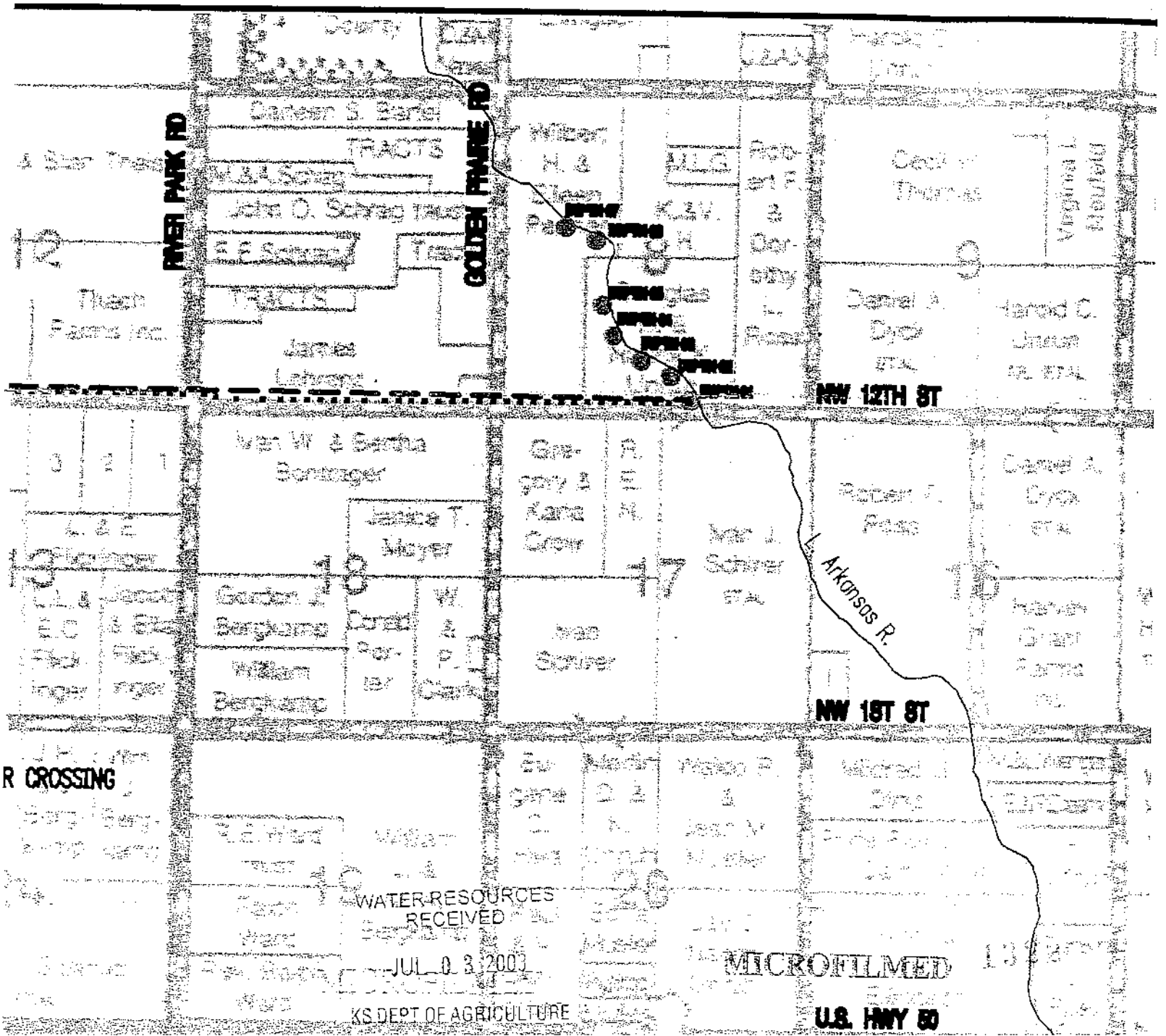
Burns & McDonnell

CITY OF WICHITA

PRELIMINARY DESIGN
DIVERSION WELL
DW-02 1321

MICROFILMED

J:\WICH \29886 ASR-P1\diverswell02.DWG 06/11/03



NAME _____
(Please Print)

MUNICIPAL (PUBLIC WATER SUPPLY) APPLICATION
SUPPLEMENTAL INFORMATION SHEET

Application File Number
_____
(assigned by DWR)

SECTION 1: PRESENT WATER USE SUMMARY (IF NO PREVIOUS MUNICIPAL WATER USE HAS BEEN UTILIZED, PROCEED TO SECTION 3)
NOTE: WORKSHEET FOR WATER PUMPED, PURCHASED, AND SOLD BY YOUR WATER DISTRIBUTION SYSTEM.

Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Below Explanation)
TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

UNACCOUNTED FOR WATER = TOTAL WATER - ACCOUNTED FOR WATER

Column 1: The amount of raw water diverted from all of your points of diversion.

Column 2: The amount of water purchased wholesale from all other public water supply systems or the Kansas Water Office.

Column 3: The amount of water sold wholesale to all other public water supply systems.

Column 4: The amount of water sold retail to all industrial, pasture, stockwater, feedlot, and bulk water service connections. Include the amount of water sold to all farmsteads using at least 200,000 gallons of water per year.

Column 5: The amount of water sold retail to your residential and commercial customers and to industries and farmsteads using less than 200,000 gallons of water per year.

Column 6: The amount of water used that is metered at individual service connections and supplied free, such as for public service, treatment processes, and connections receiving free water.

Column 7: The amount of remaining water used. The gallons reported in this column are found by adding the numbers in Columns 1 and 2 and subtracting the numbers in Columns 3, 4, 5, and 6.

UNACCOUNTED FOR WATER

Use the following to calculate your distribution system's Unaccounted For Water:
Start with the amount in Column 1 and add the amount in Column 2, then subtract the amounts in Columns 3, 4, 5, and 6 leaving an amount of water representing your unaccounted for water to enter in Column 7.

Use the following to calculate the percent Unaccounted For Water versus the Total Water of your system:

$$\text{Percent Unaccounted For Water} = \frac{\text{Unaccounted For Water}}{\text{Total Water (Columns 1,2)}} \times 100$$

If this number exceeds 20%, please explain the large amount of unaccounted for water and describe any steps being taken to reduce it.

SECTION 2: PAST WATER USE
COMPLETE THE FOLLOWING TABLE FROM YOUR PAST WATER USE RECORDS.

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Above Explanation)
20 years ago							
15 years ago							
10 years ago							
5 years ago							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 3: PROJECTED FUTURE WATER NEEDS

PLEASE COMPLETE THE FOLLOWING TABLE SHOWING YOUR FUTURE WATER REQUIREMENTS FOR THE NEXT 20 YEARS:

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Explanation on other side)
Year 5							
Year 10							
Year 15							
Year 20							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 4: POPULATION AND SERVICE CONNECTIONS

ESTIMATE THE NUMBER OF PERSONS DIRECTLY SERVED BY YOUR WATER DISTRIBUTION SYSTEM

PAST POPULATION - PROVIDE INFORMATION BELOW:
(CENSUS BUREAU INFORMATION)

LAST 20 YEARS	POPULATION
20 years ago	
15 years ago	
10 years ago	
5 years ago	
Last Year	

PROJECTED FUTURE POPULATION

ESTIMATE FUTURE POPULATION AND SUBSTANTIATE NUMBERS ON SEPARATE ATTACHMENTS

NEXT 20 YEARS	POPULATION
Year 5	
Year 10	
Year 15	
Year 20	

Provide number of current active service connections:

_____ Residential _____ Industrial _____ Other (specify) _____

_____ Commercial _____ Pasture/ Stockwater/ Feedlot _____ Total

SECTION 5: PRESENT GALLONS PER PERSON PER DAY

CALCULATE YOUR GALLONS PER PERSON PER DAY

Water in Columns 5,6, and 7 ÷ Population ÷ 365 Days/Year = Gallons per Person per Day

_____ ÷ _____ ÷ 365 Days/Year = _____ GALLONS PER PERSON PER DAY.

Amount of water in Columns 5,6, and 7 of Section 1

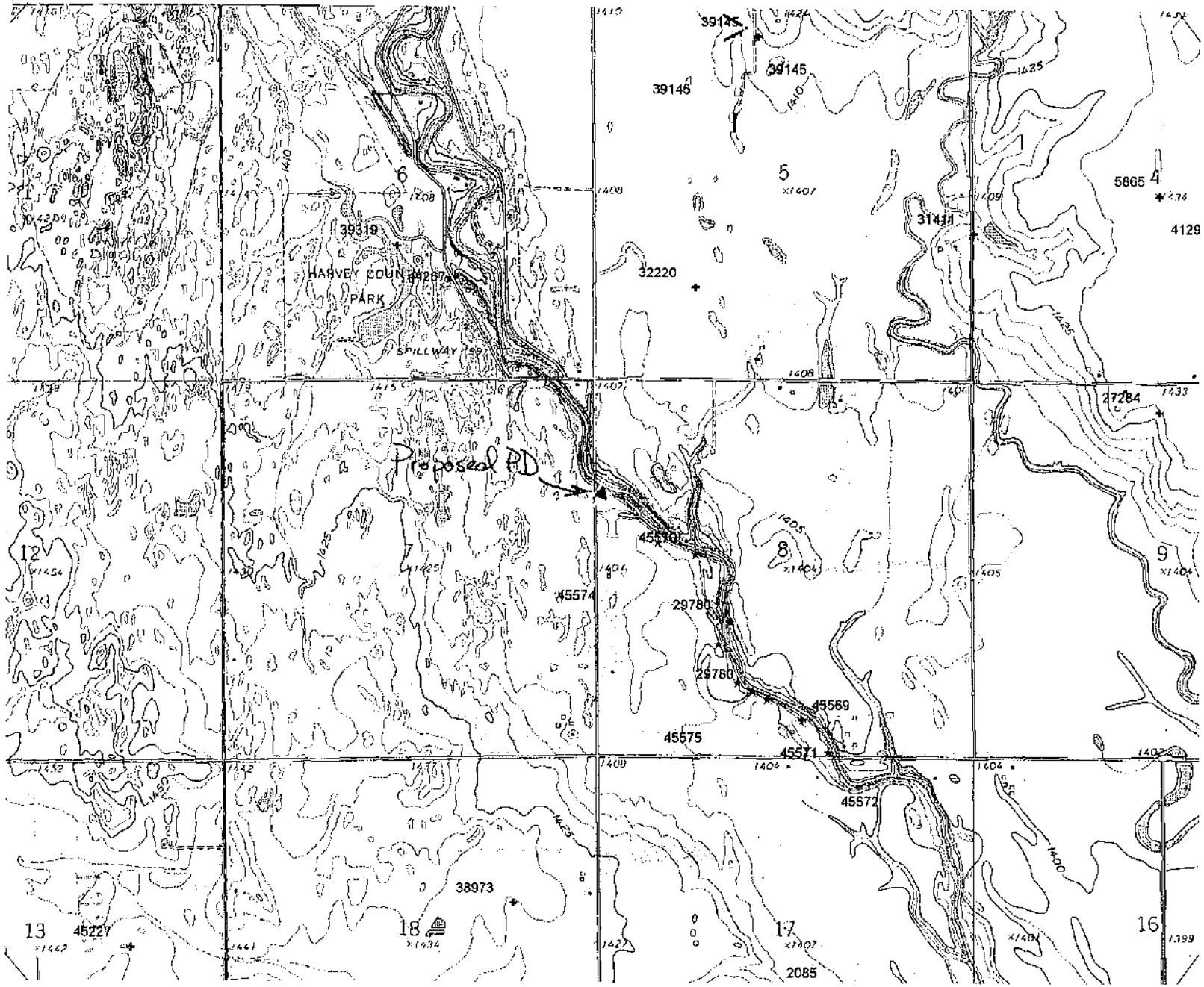
Population from Last Year of Section 4

SECTION 6: AREA TO BE SERVED

Describe the area to be served or provide the legal description of the location where the water is to be used including any other city of water supply system (i.e. Rural Water District): Within the boundaries of the City of Wichita * DWR/JP 7/3/03

You may attach additional information you believe will assist in informing the Division of the ne[illegible]or your request.

File No. 45,569 08-23s-02w (3665n,5195w)



This map was created by WIMAS on Nov 22, 2004 and represents water right conditions as of Nov 19, 2004.

KAK

DWR EXHIBIT Y

Amended Application, File No. 45,572

EXHIBIT
DWR "Y"
PENGAD 800-631-6989

WATER RESOURCES
RECEIVED
DEC 16 2003
KS DEPT OF AGRICULTURE

F.O. 2
GMD 2
MEETS
K.A.R.5-3-1
USE ART
S
Co. HV
By SP
Date 7/3/03

THE STATE OF KANSAS

KANSAS DEPARTMENT OF AGRICULTURE
Jamie Clover Adams, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

File Number 45572
This item to be completed by the Division of Water Resources.

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

Filing Fee Must Accompany the Application
(Please refer to Fee Schedule attached to this application form.)

ASR Project DW-1

To the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture, 109 SW 9th Street, Second Floor, Topeka, KS 66612-1283:

1. Name of Applicant (Please Print): City of Wichita, Water & Sewer Dept.
   Address: 455 N. Main
   City: Wichita State KS Zip Code 67202
   Telephone Number: (316) 268-4504
2. The source of water is: ☑ surface water in Little Arkansas River (stream)
   OR G groundwater in _____ (drainage basin)

   Certain streams in Kansas have minimum target flows established by law or may be subject to administration when water is released from storage for use by water assurance district members. If your application is subject to these regulations on the date we receive your application, you will be sent the appropriate form to complete and return to the Division of Water Resources.
3. The maximum quantity of water desired is 1,500 acre-feet OR _____ gallons per calendar year,
   to be diverted at a maximum rate of 1,200 gallons per minute OR _____ cubic feet per second.

   Once your application has been assigned a priority, the requested maximum rate of diversion and maximum requested quantity of water under that priority number can NOT be increased. Please be certain your requested maximum rate of diversion and maximum quantity of water are appropriate and reasonable for your proposed project and are in agreement with the Division of Water Resources' requirements.
4. The water is intended to be appropriated for (Check use intended):
   (a) ☑ Artificial Recharge (c) G Irrigation Use (e) G Recreational Use (g) G Water Power use
   (b) G Industrial Use (d) G Municipal Use (f) G Stockwatering Use

YOU MUST COMPLETE AND ATTACH ADDITIONAL DIVISION OF WATER RESOURCES FORM(S) PROVIDING INFORMATION TO SUBSTANTIATE YOUR REQUEST FOR THE AMOUNT OF WATER FOR THE INTENDED USE REFERENCED ABOVE.

For Office Use Only: Code REG Fee $ 500- TR # _____ Receipt Date 7-3-03 Check # 2018449

WATER RESOURCES
RECEIVED
1:01PM
JUL 03 2003
KS DEPT OF AGRICULTURE

DWR 1-100 (Revised 6/24/02)

MICROFILMED

7-15-03 1326
RD

WATER RESOURCES
RECEIVED

DEC 1 6 2003

KS DEPT OF AGRICULTURE
File No. 45572

5. The location of the proposed wells, pump sites or other works for diversion of water is:

Note: For the application to be accepted, the point of diversion location must be described to at least a 10 acre tract, unless you specifically request 60 days in which to locate the site within a quarter section tract. Any request for an extension of time in which to locate the point of diversion shall include a contract with a well driller or a contractor for the necessary test holes.

(A) One in the ~~SE~~ NW* quarter of the SW quarter of the ~~SE~~ NW* quarter of Section 8, more particularly described as being near a point ~~660~~ 3515* feet North and ~~2637~~ 4,860* feet West of the Southeast corner of said section, in Township 23 South, Range 2 East/West (circle one), Harvey County, Kansas.

(B) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

(C) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

(D) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range ____ East/West (circle one), _____ County, Kansas.

If the source of supply is groundwater, a separate application shall be filed for each proposed well or battery of wells, except that a single application may include up to four wells within a circle with a quarter (¼) mile radius in the same local source of supply which do not exceed a maximum diversion rate of 20 gallons per minute per well and which are operated by means of submersible pumps.

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6. The proposed project for diversion of water will consist of one bank storage well
(number of wells, pumps or dams, etc.)

and (was)(will be) completed (by) March 1, 2004
(Month/Day/Year - each was or will be completed)

7. The first actual application of water for the proposed beneficial use was or is estimated to be 03/01/04
(Mo/Day/Year)

8. Will pesticide, fertilizer, or other foreign substance be injected into the water pumped from the diversion works?

Yes G No ✓ If "yes", a check valve shall be required.

All chemigation safety requirements must be met including a chemigation permit and reporting requirements.

WATER RESOURCES
RECEIVED

JUL 0 3 2003

KS DEPT OF AGRICULTURE

*WJC/DWR 11-18-2004
change per memo of the
City of Wichita for modification
of permit application

MICROFILMED

MICROFILMED

 File No. 45572

9. If you are planning to impound water, please contact the Division of Water Resources for assistance, prior to submitting the application. Please attach a reservoir area capacity table and inform us of the total acres of surface drainage area above the reservoir.

   Have you also made an application for a permit for construction of this dam and reservoir with the Division of Water Resources? G Yes G No

   ! If yes, show the Water Structures permit number here _____

   ! If no, explain here why a Water Structures permit is not required will use bank storage well to induce river infiltration

10. The application must be supplemented by a U.S.G.S. topographic map, aerial photograph or a detailed plat showing the following information. On the topographic map, aerial photograph, or plat, identify the center of the section, the section lines or the section corners and show the appropriate section, township and range numbers. Also, please show the following information:

   (a) The location of the proposed point(s) of diversion (wells, stream-bank installations, dams, or other diversion works) should be plotted as described in Paragraph No. 5 of the application, showing the North-South distance and the East-West distance from a section line or southeast corner of section.

   (b) If the application is for groundwater, please show the location of any existing water wells of any kind within ½ mile of the proposed well or wells. Identify each existing well as to its use and furnish the name and mailing address of the property owner or owners. If there are no wells within ½ mile, please advise us.

   (c) If the application is for surface water, the names and addresses of the landowner(s) ½ mile downstream and ½ mile upstream from your property lines must be shown.

   (d) The location of the proposed place of use should be shown by crosshatching on the topographic map, aerial photograph or plat.

   (e) Show the location of the pipelines, canals, reservoirs or other facilities for conveying water from the point of diversion to the place of use.

   A 7.5 minute U.S.G.S. topographic map may be obtained by providing the section, township and range numbers to: Kansas Geological Survey, 1930 Constant, Campus West, University of Kansas, Lawrence, Kansas 66047.

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Part of City of Wichita's ASR project. See attached letter. Well will operate only during above base-flow events, river flow exceeding 42 cfs April - Sept. and 20 cfs Oct - March as measured at USGS gage at Highway 50.

WATER RESOURCES
RECEIVED

DEC 1 6 2003

KS DEPT OF AGRICULTURE

File No. 45572

12. Furnish the following well information if the proposed appropriation is for the use of groundwater. If the well has not been completed, give information obtained from test holes, if available.

Information below is from: Test holes ✓ Well as completed G Drillers log attached ✓

Well location as shown in paragraph No.	(A)	(B)	(C)	(D)
Date Drilled	8/22/02			
Total depth of well	152			
Depth to water bearing formation	8			
Depth to static water level	3			
Depth to bottom of pump intake pipe	4/k			

13. The relationship of the applicant to the proposed place where the water will be used is that of agent (owner, tenant, agent or otherwise).

14. The owner(s) of the property where the water is used, if other than the applicant, is (please print):

(name, address and telephone number)

(name, address and telephone number)

15. The undersigned states that the information set forth above is true to the best of his/her knowledge and that this application is submitted in good faith.

Dated at Wichita, Kansas, this 2nd day of July (month), 2003 (year).

(Applicant Signature)

APPLICANT(S) SOCIAL SECURITY IDENTIFICATION NUMBER(S)

By Gerald T. Blain
(Agent or Officer Signature)

48-6000653
and/or
APPLICANT(S) TAXPAYER I.D. NO.(S)

Gerald T. Blain
(Agent or Officer - Please Print)

Assisted by WATER RESOURCES RECEIVED (office/title) Date:

JUL 0 3 2003

KS DEPT OF AGRICULTURE

MICROFILMED

MICROFILMED

Diversion Well No. 1
69 ft. N. and 2037 ft. W. of SE Corner of Sec. 8, T 23 S, R 2 W.

Diversions within 1/2 mile:

Irrigation Wells – none

Domestic Wells

D1- Renee R. Martin
14800 NW 12th St.
Burton, KS 67020

D2 - Steve Bayless
14903 NW. 12th St.
Burton, KS 67020

D3 - Robert Ross
14301 NW 12th St.
Burrton, KS 67020

D4 - Larry Spragg
14515 NW 12th St.
Burrton, KS 67020

Properties within ½ mile upstream and downstream

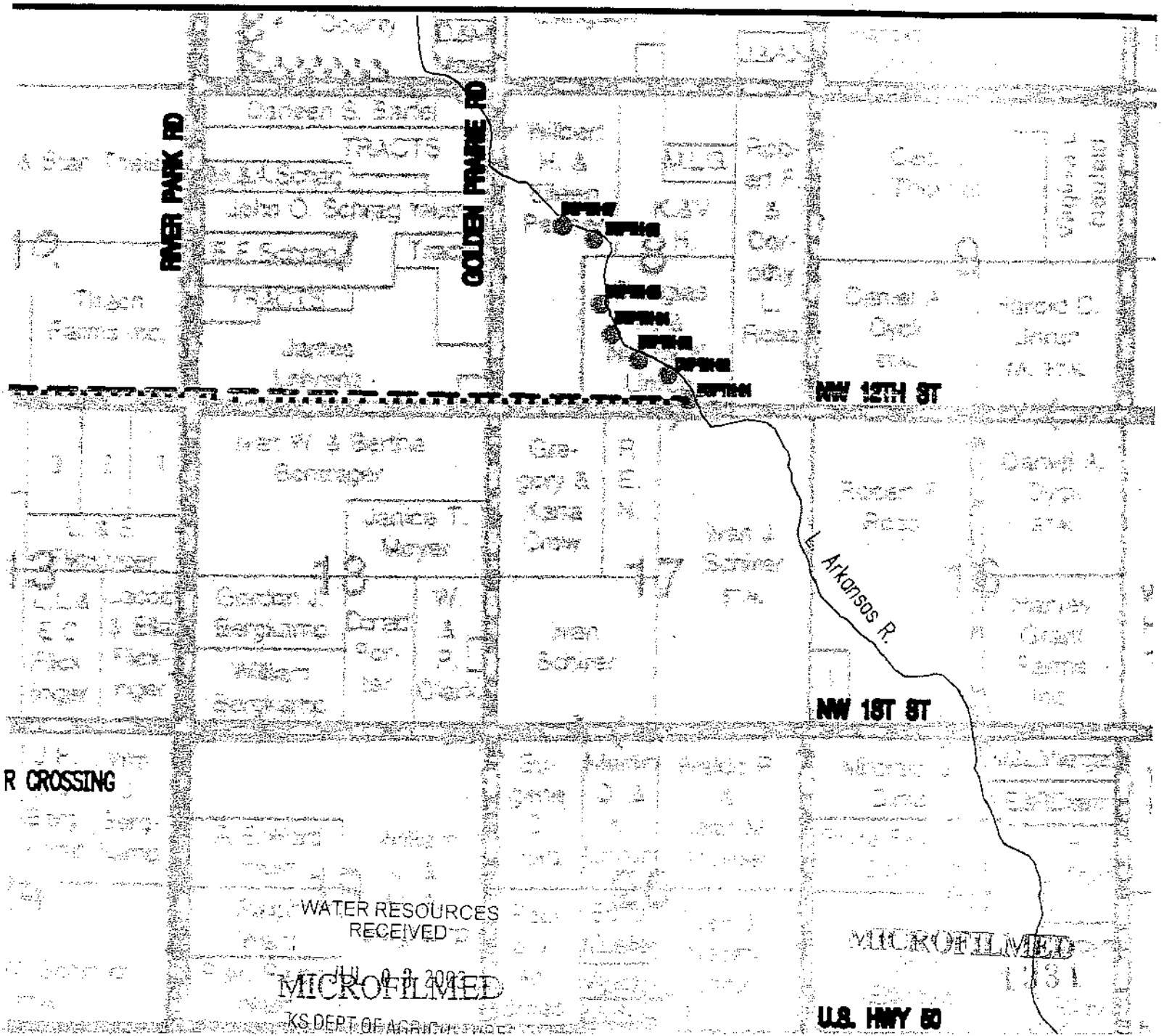
Douglas R. Unruh
1715 N. Old Settlers Rd.
Halstead, KS 67056

Wilbert H. Penner
14935 NW 24th St.
Burrton, KS 67020

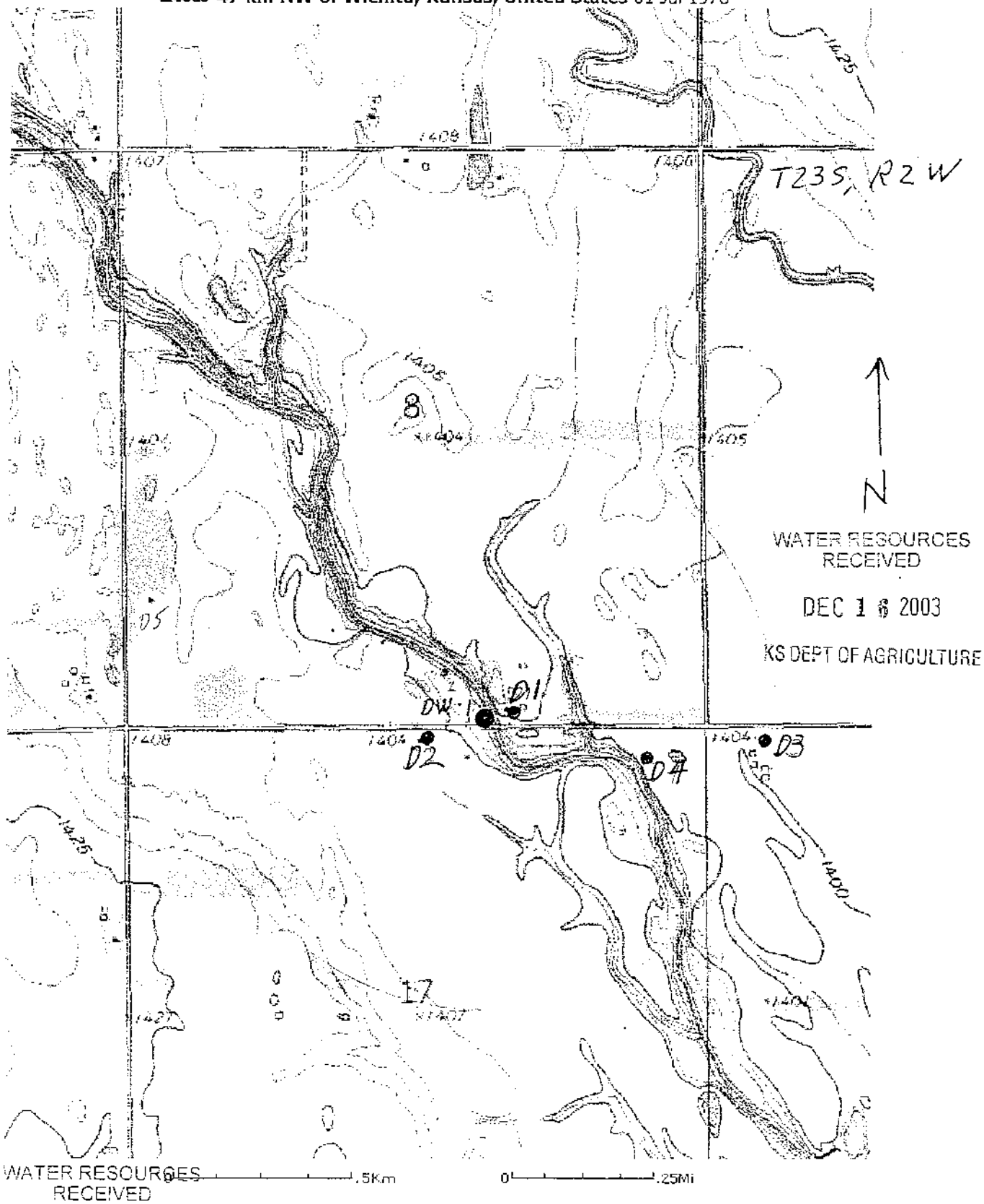
Ivan J. Schirer
14430 W 1st St.
Halstead, KS 67056

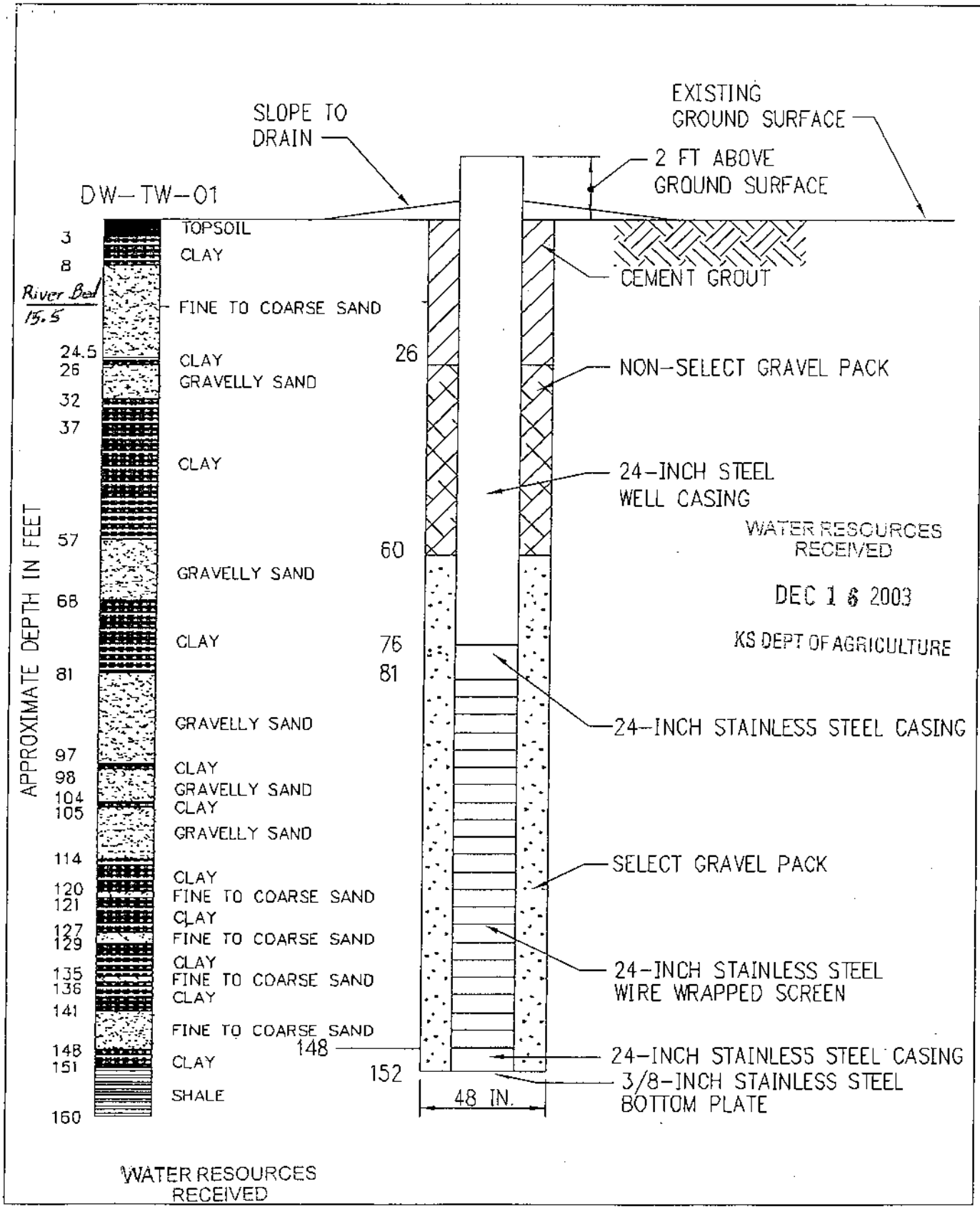
Robert F. Ross
14301 NW 12th St.
Burrton, KS 67020

Renee R. Martin
14800 NW 12th St.
Burrton, KS 67020



USGS 47 km NW of Wichita, Kansas, United States 01 Jul 1978





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DEC 16 2003
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WATER RESOURCES RECEIVED
JUL 08 2003
KS DEPT OF AGRICULTURE

NOTE: FINAL DESIGN TO BE BASED ON PILOT HOLE FOR DIVERSION WELL.

Burns & McDonnell

CITY OF WICHITA
PRELIMINARY DESIGN
DIVERSION WELL
DW-01

J:\WICHI\29886 ASR-P1\diverswelldes.DWG 06/11/03

NAME _____
(Please Print)

MUNICIPAL (PUBLIC WATER SUPPLY) APPLICATION
SUPPLEMENTAL INFORMATION SHEET

Application File Number
_____
(assigned by DWR)

SECTION 1: PRESENT WATER USE SUMMARY (IF NO PREVIOUS MUNICIPAL WATER USE HAS BEEN UTILIZED, PROCEED TO SECTION 3)
NOTE: WORKSHEET FOR WATER PUMPED, PURCHASED, AND SOLD BY YOUR WATER DISTRIBUTION SYSTEM.

Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Below Explanation)
TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

UNACCOUNTED FOR WATER = TOTAL WATER - ACCOUNTED FOR WATER

Column 1: The amount of raw water diverted from all of your points of diversion.

Column 2: The amount of water purchased wholesale from all other public water supply systems or the Kansas Water Office.

Column 3: The amount of water sold wholesale to all other public water supply systems.

Column 4: The amount of water sold retail to all industrial, pasture, stockwater, feedlot, and bulk water service connections. Include the amount of water sold to all farmsteads using at least 200,000 gallons of water per year.

Column 5: The amount of water sold retail to your residential and commercial customers and to industries and farmsteads using less than 200,000 gallons of water per year.

Column 6: The amount of water used that is metered at individual service connections and supplied free, such as for public service, treatment processes, and connections receiving free water.

Column 7: The amount of remaining water used. The gallons reported in this column are found by adding the numbers in Columns 1 and 2 and subtracting the numbers in Columns 3, 4, 5, and 6.

UNACCOUNTED FOR WATER

Use the following to calculate your distribution system's Unaccounted For Water:
Start with the amount in Column 1 and add the amount in Column 2, then subtract the amounts in Columns 3, 4, 5, and 6 leaving an amount of water representing your unaccounted for water to enter in Column 7.

Use the following to calculate the percent Unaccounted For Water versus the Total Water of your system:

$$\text{Percent Unaccounted For Water} = \frac{\text{Unaccounted For Water}}{\text{Total Water (Columns 1,2)}} \times 100$$

If this number exceeds 20%, please explain the large amount of unaccounted for water and describe any steps being taken to reduce it.

SECTION 2: PAST WATER USE
COMPLETE THE FOLLOWING TABLE FROM YOUR PAST WATER USE RECORDS.

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Above Explanation)
20 years ago							
15 years ago							
10 years ago							
5 years ago							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 3: PROJECTED FUTURE WATER NEEDS

PLEASE COMPLETE THE FOLLOWING TABLE SHOWING YOUR FUTURE WATER REQUIREMENTS FOR THE NEXT 20 YEARS:

	Column 1 Raw Water Diverted Under Your Rights	Column 2 Water Purchased From All Sources	Column 3 Water Sold to Other Public Water Suppliers	Column 4 Water Sold to Your Industrial, Stock, and Bulk Customers	Column 5 Water Sold to Your Residential and Commercial Customers	Column 6 Other Metered Water	Column 7 Remaining Water Used (See Explanation on other side)
Year 5							
Year 10							
Year 15							
Year 20							
	TOTAL WATER = Columns 1 + 2		ACCOUNTED FOR WATER = Columns 3 + 4 + 5 + 6				UNACCOUNTED FOR WATER

SECTION 4: POPULATION AND SERVICE CONNECTIONS

ESTIMATE THE NUMBER OF PERSONS DIRECTLY SERVED BY YOUR WATER DISTRIBUTION SYSTEM

PAST POPULATION - PROVIDE INFORMATION BELOW:
(CENSUS BUREAU INFORMATION)

LAST 20 YEARS	POPULATION
20 years ago	
15 years ago	
10 years ago	
5 years ago	
Last Year	

PROJECTED FUTURE POPULATION

ESTIMATE FUTURE POPULATION AND SUBSTANTIATE NUMBERS ON SEPARATE ATTACHMENTS

NEXT 20 YEARS	POPULATION
Year 5	
Year 10	
Year 15	
Year 20	

Provide number of current active service connections:

_____ Residential _____ Industrial _____ Other (specify) _____

_____ Commercial _____ Pasture/ Stockwater/ Feedlot _____ Total

SECTION 5: PRESENT GALLONS PER PERSON PER DAY

CALCULATE YOUR GALLONS PER PERSON PER DAY

Water in Columns 5,6, and 7 ÷ Population ÷ 365 Days/Year = Gallons per Person per Day

_____ ÷ _____ ÷ 365 Days/Year = _____ GALLONS PER PERSON PER DAY.

Amount of water in Columns 5,6, and 7 of Section 1

Population from Last Year of Section 4

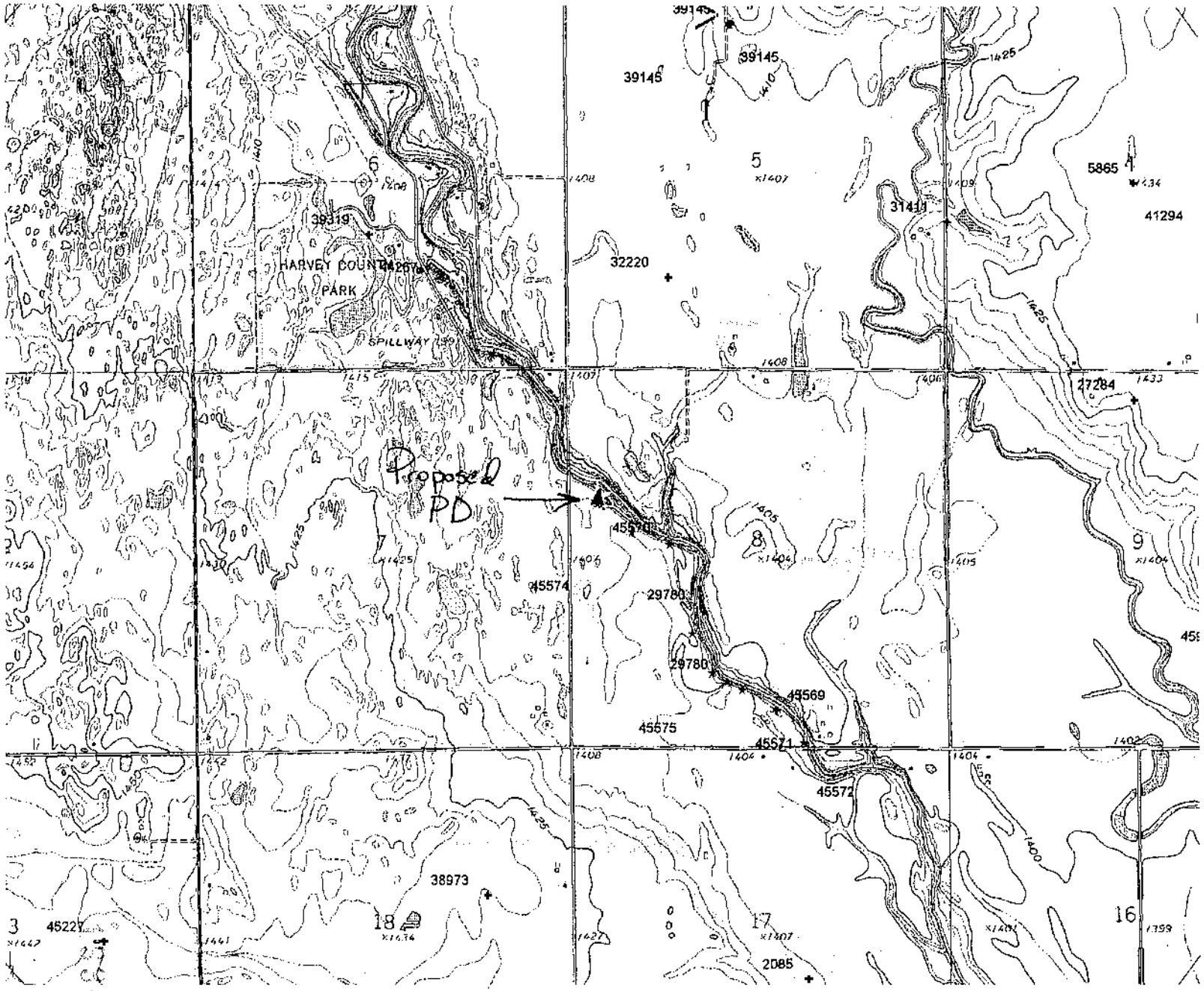
SECTION 6: AREA TO BE SERVED

Describe the area to be served or provide the legal description of the location where the water is to be used including any other city of water supply system (i.e. Rural Water District): _____

Within the boundaries of the City of Wichita DWE/SP 7/3/03

You may attach additional information you believe will assist in informing the Division of the need for your request.

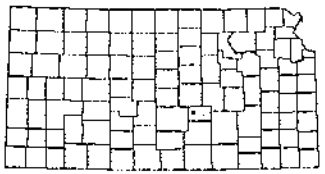
File No. 45,572 08-23s-02w (3515n,4860w)



PD

- Ground Water
- Surface Water
- Hydrology

Index Map



This map was created by WIMAS on Nov 22, 2004 and represents water right conditions as of Nov 19, 2004.

KAK

DWR EXHIBIT Z

Application, File No. 46,081

EXHIBIT
DWR "Z"
PENGAD 800-631-6989

COPY

THE STATE OF KANSAS

F.O. 2
GMD 2
MEETS
K.A.R.5 3
USE MUN
G/S G
Co. HV
By LI
Date 11/19/04

KANSAS DEPARTMENT OF AGRICULTURE
Jamie Clover Adams, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

File Number 46,081
This item to be completed by the Division of Water Resources.

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

Filing Fee Must Accompany the Application
(Please refer to Fee Schedule attached to this application form.)

WATER RESOURCES RECEIVED
NOV 19 2004
KS DEPT OF AGRICULTURE

ASR Project RW-1

To the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture, 109 SW 9th Street, Second Floor, Topeka, KS 66612-1283:

1. Name of Applicant (Please Print): City of Wichita, Water & Sewer Dept.
   Address: 455 N. Main
   City: Wichita State KS Zip Code 67202
   Telephone Number: (316) 268-4504

2. The source of water is: G surface water in _____ (stream)
   OR ☑ groundwater in Equus Beds, Arkansas River Basin (drainage basin)

   Certain streams in Kansas have minimum target flows established by law or may be subject to administration when water is released from storage for use by water assurance district members. If your application is subject to these regulations on the date we receive your application, you will be sent the appropriate form to complete and return to the Division of Water Resources.

3. The maximum quantity of water desired is 43 acre-feet OR _____ gallons per calendar year,
   to be diverted at a maximum rate of 1,500 gallons per minute OR _____ cubic feet per second.

   Once your application has been assigned a priority, the requested maximum rate of diversion and maximum requested quantity of water under that priority number can NOT be increased. Please be certain your requested maximum rate of diversion and maximum quantity of water are appropriate and reasonable for your proposed project and are in agreement with the Division of Water Resources' requirements.

4. The water is intended to be appropriated for (Check use intended):
   (a) G Artificial Recharge (c) G Irrigation Use (e) G Recreational Use (g) G Water Power use
   (b) G Industrial Use (d) ☑ Municipal Use (f) G Stockwatering Use

YOU MUST COMPLETE AND ATTACH ADDITIONAL DIVISION OF WATER RESOURCES FORM(S) PROVIDING INFORMATION TO SUBSTANTIATE YOUR REQUEST FOR THE AMOUNT OF WATER FOR THE INTENDED USE REFERENCED ABOVE.

For Office Use Only: Code REG Fee $_____ TR # _____ Receipt Date _____ Check # _____

DWR 1-100 (Revised 6/24/02)

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11:51 AM
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0037

File No. 46,081

5. The location of the proposed wells, pump sites or other works for diversion of water is:

   Note: For the application to be accepted, the point of diversion location must be described to at least a 10 acre tract, unless you specifically request 60 days in which to locate the site within a quarter section tract. Any request for an extension of time in which to locate the point of diversion shall include a contract with a well driller or a contractor for the necessary test holes.

   (A) One in the NW quarter of the NW quarter of the NW quarter of Section 36, more particularly described as being near a point 5170 feet North and 5170 feet West of the Southeast corner of said section, in Township 23 South, Range 3 East/(West) (circle one), Harvey County, Kansas.

   (B) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range _____ East/West (circle one), _____ County, Kansas.

   (C) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range _____ East/West (circle one), _____ County, Kansas.

   (D) One in the _____ quarter of the _____ quarter of the _____ quarter of Section _____, more particularly described as being near a point _____ feet North and _____ feet West of the Southeast corner of said section, in Township _____ South, Range _____ East/West (circle one), _____ County, Kansas.

   If the source of supply is groundwater, a separate application shall be filed for each proposed well or battery of wells, except that a single application may include up to four wells within a circle with a quarter (¼) mile radius in the same local source of supply which do not exceed a maximum diversion rate of 20 gallons per minute per well and which are operated by means of submersible pumps.

   A battery of wells is defined as two or more wells connected to a common pump by a manifold; or not more than four wells in the same local source of supply within a 300 foot radius circle which are being operated by pumps not to exceed a total maximum diversion rate of 800 gallons per minute and which supply water to a common distribution system.

6. The proposed project for diversion of water will consist of one recharge well (number of wells, pumps or dams, etc.).

   and (was) (will be) completed (by) November 30, 2005 (Month/Day/Year - each was or will be completed).

7. The first actual application of water for the proposed beneficial use was or is estimated to be 03/01/06 (Mo/Day/Year)

8. Will pesticide, fertilizer, or other foreign substance be injected into the water pumped from the diversion works?

   Yes ☐ No ☑ If "yes", a check valve shall be required.

   All chemigation safety requirements must be met including a chemigation permit and reporting requirements.

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File No. 46,081

9. If you are planning to impound water, please contact the Division of Water Resources for assistance, prior to submitting the application. Please attach a reservoir area capacity table and inform us of the total acres of surface drainage area above the reservoir.

   Have you also made an application for a permit for construction of this dam and reservoir with the Division of Water Resources? G Yes G No

   ! If yes, show the Water Structures permit number here _____

   ! If no, explain here why a Water Structures permit is not required _____

10. The application must be supplemented by a U.S.G.S. topographic map, aerial photograph or a detailed plat showing the following information. On the topographic map, aerial photograph, or plat, identify the center of the section, the section lines or the section corners and show the appropriate section, township and range numbers. Also, please show the following information:

   (a) The location of the proposed point(s) of diversion (wells, stream-bank installations, dams, or other diversion works) should be plotted as described in Paragraph No. 5 of the application, showing the North-South distance and the East-West distance from a section line or southeast corner of section.

   (b) If the application is for groundwater, please show the location of any existing water wells of any kind within ½ mile of the proposed well or wells. Identify each existing well as to its use and furnish the name and mailing address of the property owner or owners. If there are no wells within ½ mile, please advise us.

   (c) If the application is for surface water, the names and addresses of the landowner(s) ½ mile downstream and ½ mile upstream from your property lines must be shown.

   (d) The location of the proposed place of use should be shown by crosshatching on the topographic map, aerial photograph or plat.

   (e) Show the location of the pipelines, canals, reservoirs or other facilities for conveying water from the point of diversion to the place of use.

   A 7.5 minute U.S.G.S. topographic map may be obtained by providing the section, township and range numbers to: Kansas Geological Survey, 1930 Constant, Campus West, University of Kansas, Lawrence, Kansas 66047.

11. List any application, appropriation of water, water right, or vested right file number that covers the same diversion points or any of the same place of use described in this application. Also list any other recent modifications made to existing permits or water rights in conjunction with the filing of this application.

Part of City of Wichita's ASR project. Water will be used to maintain recharge well and can only be withdrawn when recharge credits are available.

WATER RESOURCES
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NOV 19 2004
KS DEPT. OF AGRICULTURE

File No. 46,081

12. Furnish the following well information if the proposed appropriation is for the use of groundwater. If the well has not been completed, give information obtained from test holes, if available.

Information below is from: Test holes ☑ Well as completed ☐ Drillers log attached ☐

Well location as shown in paragraph No.	(A)	(B)	(C)	(D)
Date Drilled	07-15-03			
Total depth of well	244			
Depth to water bearing formation	16			
Depth to static water level	30			
Depth to bottom of pump intake pipe	—			

13. The relationship of the applicant to the proposed place where the water will be used is that of agent (owner, tenant, agent or otherwise)

14. The owner(s) of the property where the water is used, if other than the applicant, is (please print):

(name, address and telephone number)

(name, address and telephone number)

15. The undersigned states that the information set forth above is true to the best of his/her knowledge and that this application is submitted in good faith.

Dated at Wichita, Kansas, this 3rd day of November (month) 2004 (year)

(Applicant Signature)

APPLICANT(S) SOCIAL SECURITY IDENTIFICATION NUMBER(S)

By Gerald T. Blain
(Agent or Officer Signature)

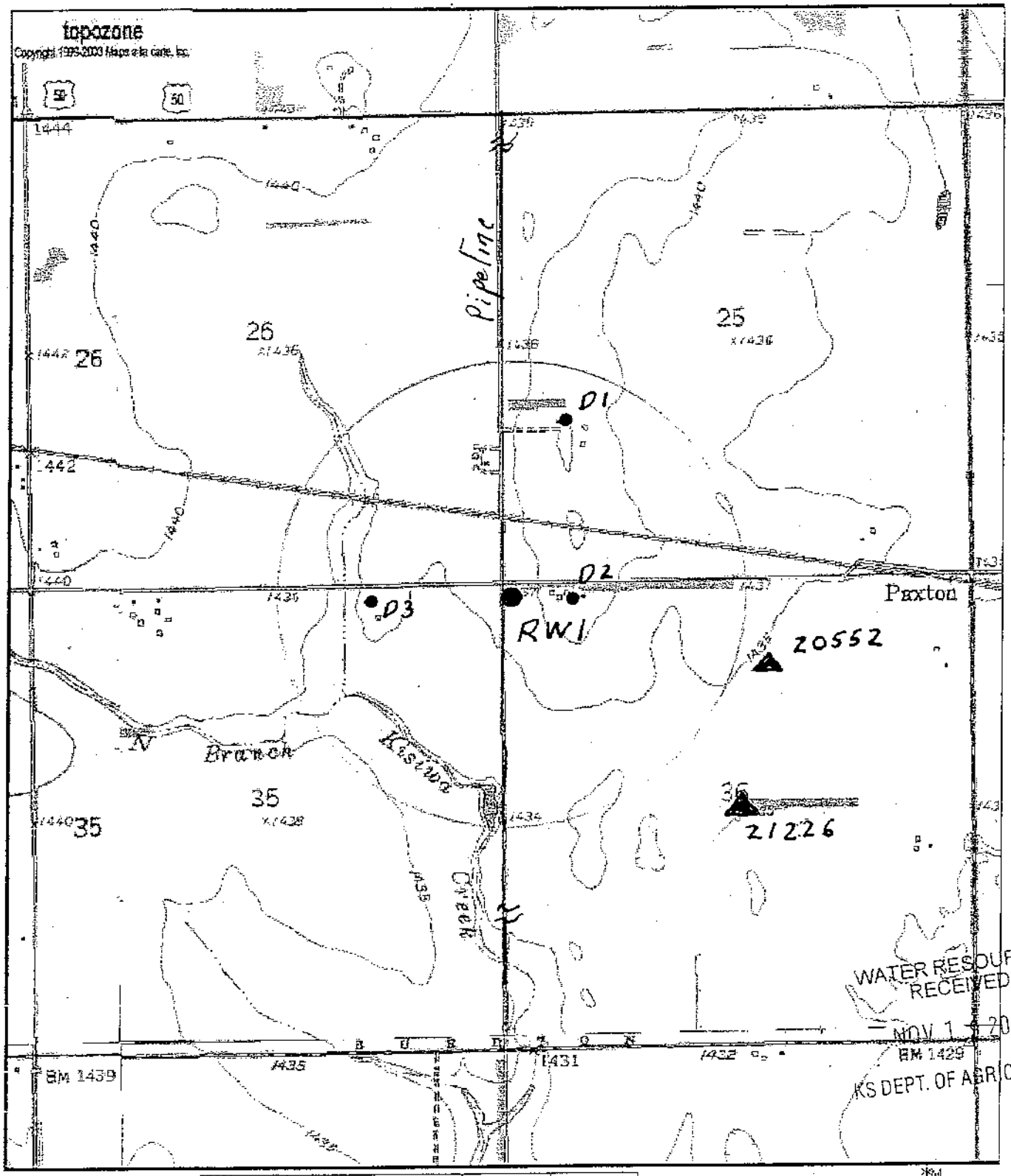
48-6000653
and/or
APPLICANT(S) TAXPAYER I.D. NO.(S)

Gerald T. Blain
(Agent or Officer - Please Print)

Assisted by _____ (office/title) Date: _____

WATER RESOURCES RECEIVED
NOV 19 2004
KS DEPT. OF AGRICULTURE

File No. 46,081



T 23 S
R 3 W

Map center is UTM 14 622012E 4208266N (WGS84/NAD83)
Halstead quadrangle
Projection is UTM Zone 14 NAD83 Datum

M=5.361
G=0.856

1341

46,081

Recharge Well No. 1
5,170 ft. N. and 5,170 ft. W. of SE Corner of Sec. 36, T 23 S, R 3 W.

Diversions within 1/2 mile:

Irrigation Wells –

21226
Leo & Edna Koehn Trust
8935 SW 24th St.
Halstead, KS 67056

20552
Marvin and Betty Baehr
Address not available

Domestic Wells

D1
Joe and Joanna Bergkamp
2004 S. Willow Lake Rd.
Halstead, KS

D2
Larry Koehn
8935 SW 24th St.
Halstead, KS 67056

D3
JC Welch
18307 SW 24th St.
Burrton, KS 67020

46,081

Send To Printer Back To TerraServer Change to 11x17 Print Size Show Grid Lines Change to Landscape

[redacted] 10 km NE of Wichita, Kansas, United States 17 Aug 1991

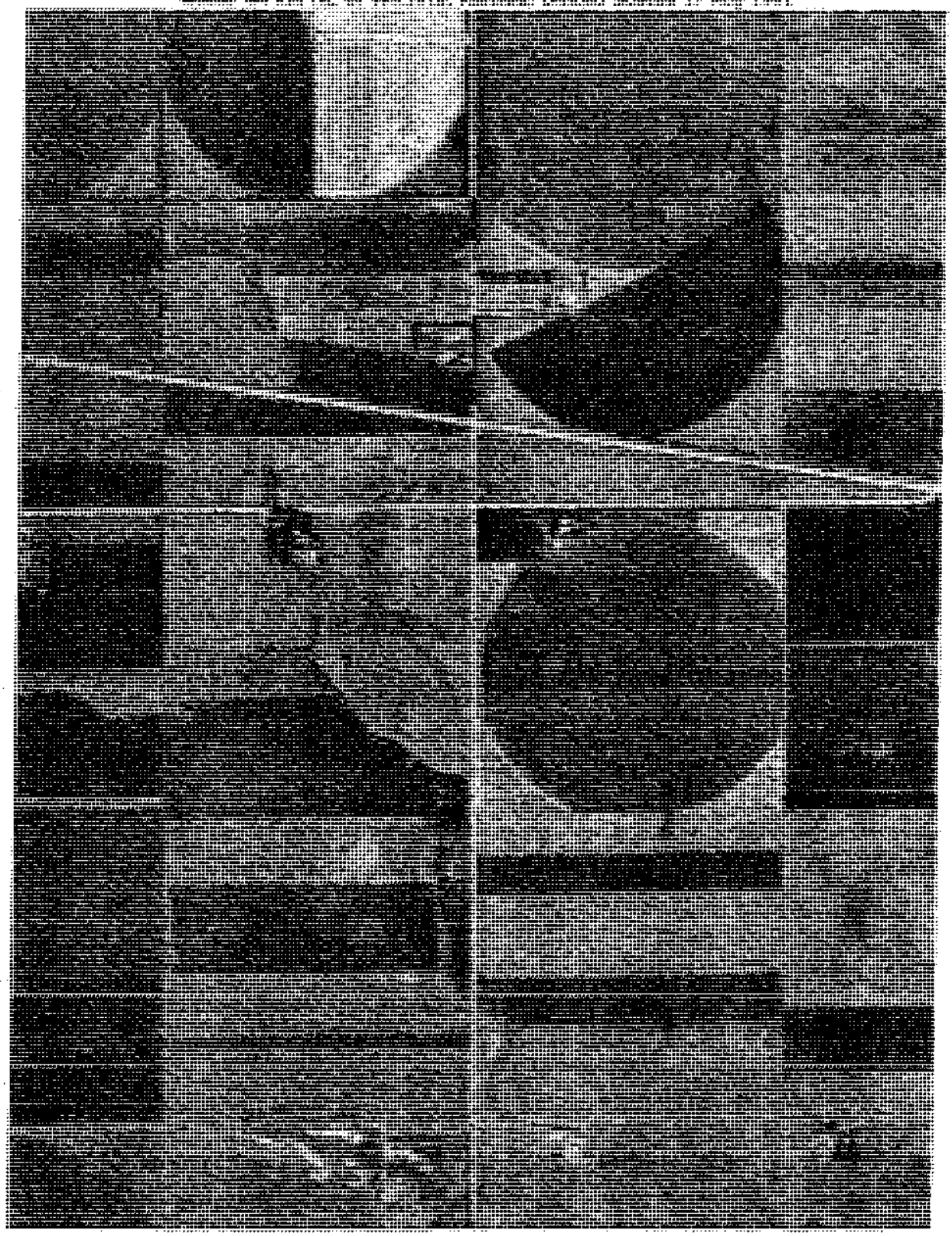


Image courtesy of the U.S. Geological Survey

1343

GARY E. REBENSTORF
City Attorney
JOE ALLEN LANG
First Assistant City Attorney
JAY C. HINKEL
Assistant City Attorney
City Hall - 13th Floor
455 North Main
Wichita, Kansas 67202
(316) 268-4681

BEFORE THE CHIEF ENGINEER OF THE DIVISION OF WATER RESOURCES,
KANSAS DEPARTMENT OF AGRICULTURE

IN THE MATTER OF THE CITY OF WICHITA'S APPLICATIONS TO OPERATE AN AQUIFER STORAGE RECOVERY PROJECT IN HARVEY COUNTY, KANSAS.	)	Case No. 04 WATER 2869 Application to Appropriate Water File No's 45,567; 45,568; 45,569; 45,570; 45,571; 45,572; 45,573; 45,574; 45,575; and 45,576

AND

WICHITA ASR PROJECT RW-1	)	Application to Appropriate Water File No. 46,081

MOTION OF THE CITY OF WICHITA
TO CONSOLIDATE APPLICATIONS

COMES NOW the City of Wichita, the applicant herein, and moves for consolidation of the Permit Application for Recharge Well 1 (RW-1) of the Wichita ASR Project with the applications in Case No. 04 WATER 2869. In support of its motion, the City of Wichita states as follows:

Filed simultaneously with this Motion is the original of the Application for Permit to Appropriate Water for Beneficial Use (ASR Project, RW-1) pursuant to K.A.R. 5-12-1. As stated in Section 3 of the City of Wichita's Motion for Modification of the Permit Applications (served November 5, 2004), the City of Wichita requests this permit to install a recharge well

Respectfully Submitted,

THE CITY OF WICHITA, KANSAS

By: _____

Gary E. Rebenstorf
Director of Law and City Attorney
Joe Allen Lang
First Assistant City Attorney
Jay C. Hinkel
Assistant City Attorney
455 N. Main, 13th Floor
Wichita, Kansas 67202
316-268-4681
316-268-4335 (Fax)

CERTIFICATE OF SERVICE

I hereby certify that the above and foregoing was sent on this 18th day of November, 2004, by U.S. Mail, postage prepaid, to the following:

Originals:
David L. Pope, P.E.
Hearing Officer, Chief Engineer and Director
Division of Water Resources
Kansas Department of Agriculture
109 SW 9th St, 2nd Floor
Topeka, KS 66612-1283

Copies:
Mike Dealy
Equus Beds GMD No. 2
313 Spruce Street
Halstead, KS 67056

Leland E. Rolfs
Department of Agriculture
109 SW 9th St, 4th Floor
Topeka, KS 66612

Joe Bergkamp
2004 South Willow Lake Rd
Halstead, KS 67056

Ronald Neuway
903 N. Willow Lake Rd
Burrton, KS 67020

Joe Allen Lang