COMPREHENSIVE WATER SYSTEM PLAN

Prepared for the:

City of Rosemount
2875 – 145th Street West
Rosemount, MN 55068

August 1, 2007

Prepared by:

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August 1, 2007

Honorable Mayor and City Council
City of Rosemount
2875 – 145th Street West
Rosemount, MN 55068

Re: Comprehensive Water System Plan
City of Rosemount, MN
WSB Project No. 1582-00

Dear Mayor and City Council Members:

Transmitted herewith is the Comprehensive Water System Plan for the above-referenced project. The report is a planning tool to help the City meet its short-term and long-term water demands.

We would be happy to discuss this report with you at your convenience. Please give us a call at 763-541-4800 if you have any questions.

Sincerely,

WSB & Associates, Inc.

Kevin F. Newman

Kevin F. Newman, PE
Project Manager

Enclosure

srb

CERTIFICATION

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed professional engineer under the laws of the State of Minnesota.

Kevin F. Newman, PE

Date: August 1, 2007 Lic. No. 25198

Prepared by:

Joseph C. Ward, PE

Date: August 1, 2007 Lic. No. 45855

Quality Control Review by:

Nancy D. Zeigler, PE

Date: August 1, 2007 Lic. No. 42823

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1.0 EXECUTIVE SUMMARY

This report represents a comprehensive water system plan to help the City of Rosemount meet its short-term and long-term water demands. The report was originally prepared November 4, 2005. This update revises growth projections, both population and development, and dependent infrastructure development schedules. Ultimate water demand and development projections were not revised; therefore, ultimate infrastructure improvements required were not revised.

To estimate existing water system demands and project future demands the ultimate land use plan was used as opposed to the 2030 land use plan. There are differences between the land use plans, however, it was important to size infrastructure for service beyond the 2030 land use plan. The ultimate land use plan included in Figure 1 was used for ultimate system infrastructure sizing.

The existing water distribution system consists of eight wells with limited water treatment at each well site, four elevated storage tanks, and over 100 miles of water main ranging in size from 6 to 16 inches in diameter. Also, the system is broken into two pressure zones, eastern and western, by a pressure reducing valve.

The total well capacity is 7,600 gallons per minute (gpm) and firm capacity, assuming the largest well out of service, of 6,000 gpm. Abandonment of Well No. 3 is scheduled, and once it is taken out of service the total well capacity and firm capacity will be 7,100 gpm and 5,500 gpm, respectively. Each well pumps into the distribution system after treatment with chlorine, fluoride, and polyphosphate.

System storage includes three towers in the western pressure zone and one tower in the eastern pressure zone. The total storage capacity of the existing towers is 3.5 Million Gallons (MG). Western pressure zone towers have capacities of 0.5, 1.0, and 1.5 MG for a total of 3.0 MG. The eastern pressure zone tower has a storage capacity of 0.5 MG.

An extended period simulation (EPS) computer model (WaterCAD v. 6.5) was used to evaluate the existing system's operating pressures and available fire flow based on 2004 water demand. The 2004 average water demand was approximately 2.0 Million Gallons per Day (MGD) and maximum day demand was 5.6 MGD. The modeling results indicate a functional system without a fire event with seven wells in operation and three of the existing towers in service. Although the City currently provides adequate service and fire protection to the vast majority of the City, there are a few deficiencies and future challenges including:

- Limited fire protection in the eastern pressure zone
- The existing system is not capable of serving the proposed Air Cargo facility

In the event that the Air Cargo facility is developed, either additional wells will need to be constructed in the eastern pressure zone or construction of approximately 4 miles of trunk water main will be necessary to serve the development from the western pressure zone. The limited fire protection in the eastern pressure zone will be improved as development is increased. The future trunk mains will serve development as needed and provide fire protection.

Rosemount has been experiencing considerable growth and anticipates growth to continue. Major business development is anticipated with the possibility of constructing an Air Cargo facility in the eastern area.

The quantity and timing of future water demands were estimated in accordance with the City's ultimate land use plan, including the estimated developable acreage and water demand per acre for each land use type (estimated unit water demand). Both average and maximum day demands were estimated. A maximum day to average day demand ratio of 3.0 was used for 2010, 2020, and 2030 design intervals, and 2.5 for ultimate demands. The resulting projected average water demand is 2.82 MGD, 4.65 MGD, 6.54 MGD, and 12.44 MGD in 2010, 2020, 2030, and ultimate development, respectively. These estimates include future industrial users and some existing areas that are presently on individual wells joining the water system.

The water distribution system will expand as development requires service. An ultimate trunk water main system has been developed to provide adequate service to the total City build out as shown in Figure 5. If development occurs quicker than anticipated, construction phasing can be changed. However, the ability of the trunk water main system to provide adequate service and fire flow depends highly on the location of supply. If future supply locations are greatly changed, for instance an inability to develop any wells in the eastern pressure zone, then main sizing may need to be redeveloped to accommodate the changed supply location.

Another variable in future water system phasing is treatment. As the City grows, water customers typically will expect higher quality water. Therefore, water treatment will be proposed in the future and it is only prudent to include it in the City's future plans. Due to the location of these facilities around the City of Rosemount, large transmission mains would not be required to provide service to customers. The ultimate system shown in Figure 5 would include mostly 12-inch distribution mains located on the along section lines. Also, the existing 16-inch loop started by the City in the western pressure zone would be continued throughout the western pressure zone. A 16-inch trunk loop would serve as the backbone of the eastern pressure zone as well.

2.0 INTRODUCTION

The City of Rosemount has experienced considerable growth in recent years and anticipates similar growth to continue. The purpose of the comprehensive water system plan is to provide the City with a plan to serve future development.

The existing water system consists of wells, storage, distribution, and limited treatment facilities at each well location. This water system plan will review existing water system demand and existing system capabilities. The study will also project growth, resulting demand on the system, and recommend future system improvements necessary to meet increased demand. A capital improvement plan will be presented and financing options will be discussed. Flexibility in planning, design, and construction in the term and long term are of high importance, since such flexibility will allow savings in time and money when changes to the water system are necessary.

3.0 GENERAL SYSTEM POLICIES

3.1 Strategic Growth Management

Strategic growth management is a key factor in a community's success as it grows. It is important to promote new commercial and industrial development while also balancing such growth with residential growth. Residential development needs to be guided in terms of amount, type, location, and quality. While accommodating growth, it is also essential that environmental quality in Rosemount is protected. Rosemount's ability to deliver reliable services must be maintained as the City grows and there needs to be an awareness of all services, such as water (distribution system, wells, storage, and treatment), sanitary sewer, storm water, transportation, schools, and other public facilities and services.

Rosemount has exhibited a proactive approach to strategic growth management by the development of an updated Comprehensive Plan, discussed in section four, in conjunction with this Comprehensive Water System Plan. Combining the two plans will allow Rosemount to meet its water service needs well into the future and continue its rapid growth while maintaining a high quality of life.

4.0 LAND USE

4.1 Land Use Breakdown

Figure 1 is the ultimate land use plan for the City of Rosemount. This plan was developed by the City of Rosemount and separates the planning area into fifteen (15) different land use categories. Land use is a critical factor in determining future water demand because different land uses exert different demands on the water system.

4.2 Developable Areas

The area within Rosemount's City limits is approximately 32.2 square miles or 20,600 acres. The existing developed area is approximately 8,900 acres including existing parks, agricultural, and unserviced (residential and industrial) areas. Therefore, there is still much land within City limits with development potential.

Each land use section's total acreage was calculated. Existing developed, whether serviced or unserviced, and undevelopable areas (parks and agriculture) were subtracted to obtain developable acreage. This is identified as "Gross" Developable Acreage because it includes roads and common or public areas potentially included in developments. The Gross Developable Acreage by land use categories is shown in Figure 2 and summarized in Table 1.

TABLE 1
Gross Developable Acreage
City of Rosemount, Minnesota

Land Use	Acres
Urban Resiential[1]	5,262
Medium Density Residential[2]	530
High Density Residential[3]	123
Transition Residential	137
Rural Residential	414
Public/Institutional[4]	0
Business Park[5]	1,817
Commercial[6]	531
General Industrial	1,032
Industrial/Mixed Use	699
Air Cargo[7]	630
Corporate Campus	512
Total	**11,687**

[1] Includes 2,480 acres in the Univ. of Minn. Property
[2] Includes 199 acres in the Univ. of Minn. Property
[3] Includes 40 acres in the Univ. of Minn. Property
[4] Assumes existing Wastewater Facility is not developable
[5] Includes 296 acres in the Univ. of Minn. Property
[6] Includes 49 acres in the Univ. of Minn. Property
[7] If Air Cargo Project is not completed land area will become Urban Residential as shown in Figures 1and 2

4.3 Potential Ultimate Service Area

The potential ultimate service area quantifies gross developable acres in terms of those most likely to develop and when development is anticipated. The potential service area development time frames were discussed with City staff. Projects in the planning stage were taken into account as was a site's location in relation to existing developed areas and existing services.

Currently, there is approximately 3,000 acres in the south central area of the City used by the University of Minnesota – Rosemount Research Center (UMore Park). UMore Park is bounded by CSAH 42 on the north, 160^{th} Street/City limits on the south, Biscayne Avenue on the west, and extends approximately ¼ mile east beyond Blaine Avenue. This 3,000 acres excludes 165 acres for Dakota County Technical College located in the north central portion of the 3,000 acres. Since the University's plans for UMore Park are unknown, the time frame for development, if ever, is unknown. Therefore, development and water service to this area has only been included in the ultimate service area.

Another unknown serviced area is the proposed Air Cargo facility located in the eastern pressure zone. There has been no specific location proposed, but it would encompass 630 acres somewhere between US 52, CSAH 42, 160^{th} Street/City limits, and Emery Avenue. The time frame for this development is unknown, but it has been included in the 2010 water system model as a conservative measure. The proposed Air Cargo location will be developed as urban residential if the Air Cargo facility is not developed. Although included in the 2010 water system model, the Air Cargo Facility development has not been shown in the 2010 service area in Table 2 and Figure 3.

Potential service areas are shown in Figure 3 and summarized in Table 2. The potential service area is shown for the years 2005, 2010, 2020, 2030, and ultimate development. In addition, residential and non-residential areas are identified. Growth is projected to occur primarily by surrounding the existing western service area then expanding eastward, with the exception of UMore Park.

TABLE 2
Potential Ultimate Service Area
City of Rosemount, Minnesota

	2005 (ac)	2010 (ac)	2020 (ac)	2030 (ac)	Ultimate (ac)
Residential[1]	2,400	3,021	4,750	6,191	8,910
Non-Residential[2]	2,302	3,171	5,255	6,768	7,708
Total	**4,702**	**6,192**	**10,005**	**12,959**	**16,618**

[1] Ultimate residential includes 2,719 acres of potential residential development on the property owned by the Univ. of Minn.

[2] Ultimate non-residential includes 296 acres of potential business park and 49 acres of commercial development on the property owned by the Univ. of Minn.

The 2005 service area shown in Figure 3 and described Table 2 is 4,702 acres. This acreage is the total developed area discussed in section 4.2 of 8,903 (approximately 8,900), less developed unserved (2,412 ac of residential and industrial), and undevelopable areas (1,789 ac). Agricultural, Rural Residential, and Parks were not considered to be part of the ultimate service area.

5.0 EXISTING CONDITIONS

5.1 Current Service Areas

The existing water distribution system for the City of Rosemount is shown in Figure 4. It consists of two pressure zones, western and eastern. The eastern zone has a lower ground elevation than the western, therefore, water supplied from the western zone could cause main breaks in the eastern zone without a reduction in pressure. A pressure reducing valve (PRV) connects the two zones, which allows the eastern zone to maintain a constant downstream pressure regardless of flow supplied from the western zone. In addition, it allows both pressure zones to act as one system relative to facility sizing and fire protection.

The water distribution system currently serves an area of approximately 4,700 acres and consists of both ductile iron and PVC water mains ranging from 6 inches to 16 inches in diameter. The western pressure zone has been developed and consists of an array of mains, generally ductile iron, with a 16-inch loop throughout the pressure zone. The eastern pressure zone is largely undeveloped and is connected to the western pressure zone via 16-inch transmission main and PRV. Mains are sparsely located as are the users.

The 2006 water demand was approximately 2.24 MGD on an average day and 6.37 MGD on the maximum day. Historical water usage is shown in Table 3. The historical water usage shown in Table 3 has been adjusted to correct for a substantial public/institutional meter reading. Details are discussed in 7.1.

5.2 Existing Water System

5.2.1 Current Water Sources

The City of Rosemount currently has eight wells in service. They are designated Well No. 3, Well No. 7, Well No. 8, Well No. 9, Well No. 12, Well No. 14, Well RR No. 1, and Well RR No. 2. Well Nos. 3, 7, 8, 9, 12, and 14 serve the western pressure zone while Well RR Nos. 1 and 2 serve the eastern pressure zone. Locations of the wells are identified on Figure 4.

All wells draw groundwater from the Jordan Aquifer and are then treated with chlorine, fluoride, and polyphosphate in each well house. After treatment, water is pumped into the distribution system. Detailed information for each of the wells is found in Table 4.

The total capacity of the eight Rosemount wells is 7,600 gpm. The firm capacity of the eight wells, which assumes the largest well out of service (Well No. 9), is 6,000 gpm. Abandonment of Well No. 3 is proposed because of the age and condition of the equipment in the well house for Well No. 3. Abandonment of Well No. 3 will decrease the total and firm capacity of the system to 7,100 gpm and 5,500 gpm, respectively. The firm capacity of the western pressure zone alone would be 5,000 gpm once Well No. 3 is abandoned.

To meet the needs of the existing water system, well firm capacity should equal or exceed the maximum day water demand in accordance with AWWA recommendations. The current maximum day demand was 4,424 gpm, which occurred in 2006. Therefore, existing well firm capacity is adequate to supply existing City water demands.

5.2.2 Current Water Treatment

Water treatment is not mandatory for the City of Rosemount. As discussed in section 5.2.1, the only treatment occurs at each well house. Raw water is treated with chlorine, fluoride, and polyphosphate.

TABLE 3
Historical Water Demand
Summary of DNR Report Information Adjusted for Historical Public/Institutional Irrigation Usage
City of Rosemount, Minnesota

Year	Population Served	Annual Water Billed (MG) Residential	Commercial	Public Institutional	Industrial	Total Year Demand (MG)	Average Day Demand (MGD)	Total Water Pumped (MG)	Percent Unmetered (%)	Maximum Day Pumped (MGD)	Maximum Day Pumped (GPM)
1999	11,726	331	33	31	6	401	1.10	447	10.3	2.94	2,042
2000	12,801	408	39	32	9	488	1.34	537	9.1	3.58	2,486
2001	13,452	435	46	34	12	527	1.44	588	10.4	5.10	3,542
2002	14,292	416	47	31	39	533	1.46	594	10.3	4.13	2,868
2003	14,976	545	65	37	37	684	1.87	765	10.6	4.71	3,271
2004	15,922	544	56	37	27	664	1.82	733	9.4	5.56	3,861
2005	17,600	569	41	46	42	698	1.91	762	8.4	6.05	4,201
2006	19,094	721	44	26	27	818	2.24	944	13.3	6.37	4,424

*Average day demand based on total gallons sold per year. Maximum day demand is based on gallons pumped in a day.

TABLE 4
Existing Well Information
City of Rosemount, Minnesota

Well No.	3	7	8	9	12	14	RR 1	RR 2
Year Installed	1962	1976	1990	1997	2005	2006	1989	1990
Service Area	West	West	West	West	West	West	East	East
Casing Depth (ft.)	388	400	389	383	397	431	345	345
Total Depth (ft.)	471	490	498	498	470	496	400	400
Size	12"	16"	18"	24"	24"	18"	10"	10"
Static Water Level (ft.)	92	68	53	50	76	120	75	75.0
Drawdown Level (ft.)	125	104	86	110	113	170	200	200
Capacity (gpm)	500	1,200	1,000	1,600	1,300	1,200	400	400

5.2.3 Current Water Storage

There are four elevated storage facilities serving the City of Rosemount. Of the four existing, three are located in the western pressure zone and the fourth in the eastern. The locations of all the towers are identified on Figure 4.

The Chippendale Tower is a toro ellipsoidal tower with 500,000 gal of available storage located at the northeastern corner of Chippendale Avenue and West 150th Street. The Connemara Tower is a 1,000,000 gal Hydropillar located northeast of the intersection of Connemara Trail and Clover Lane. Another Hydropillar, the Bacardi Tower, is located directly south of the intersection of Bacardi Avenue and West 135th Street. The Bacardi Tower has a storage capacity of 1,500,000 gal. A 500,000 gal spheroid tower serving the eastern pressure zone is located southeast of the intersection of US 52 and East 145th Street.

Since the system is pressurized by the well pumps, elevated water storage floats on system pressure. Each of the towers in the western pressure zone has the same overflow level of 1,105. Specific information on each tower is listed in Table 5.

TABLE 5
Existing Elevated Water Storage Facilities
City of Rosemount, Minnesota

Description	Chippendale Tower	Connemara Tower	Bacardi Tower	East Side Tower
Year Erected	1971	1990	2006	2001
Overflow Elev., ft.	1,105	1,105	1,105	1,050
Range, ft.	30	40	40	37.5
Capacity, gal	500,000	1,000,000	1,500,000	500,000

5.2.4 Current Water Distribution and Firefighting Capacity

The existing water distribution system consists of two pressure zones connected by a PRV, as discussed in section 5.1, and over 100 miles of water distribution mains ranging in size from 6 inches to 16 inches (Figure 4). Some mains connecting wells or towers to the distribution system are greater than 16 inches. An extended period simulation (EPS) computer model (WaterCAD v.6.5) was used to evaluate the existing (2004) water system's ability to provide adequate service under a variety of conditions and provide fire protection. The EPS model replicates the daily fluctuation of water demand versus time of day. The EPS model offers a view of time-varying features such as tank levels, water system demand, and pump on and off operation, and available firefighting flow. Figure 6 is a graphical representation of the maximum day hourly water usage that was used to develop the EPS computer model. The development of this curve and other demands is discussed later in section 6.1.

Computer modeling of existing conditions was performed assuming the well pumps were operating at their firm capacity (largest well out of service, Well No. 9) of approximately 4,800 gpm. Well No. 14 and the Bacardi Tower were not included in the existing (2004) system model. The United States Geological Survey (USGS) data and the City GIS system were used to assign elevations to the points in the model. Hydrant flow tests were used to calibrate the model.

Twenty pounds per square inch (psi) of residual pressure at all nodes in the system should be considered a minimum pressure for firefighting needs when reviewing computer modeling outputs. According to the Insurance Services Office (ISO), fire flow demands should be superimposed on the maximum day diurnal demand curve (hourly water usage, Figure 7) after the peak hour demand has occurred. At this point, storage facilities have been used for equalization of demands and would be at a lower level than at other times of the day.

Water Distribution

Figures 10 through 25 show the existing and future system modeling results in the form of contour maps under varying system design conditions. Existing system modeling results included in Figures 10 through 14 show average day pressure contours, peak hour pressure contours, minimum hour pressure contours, and available fire flow contours, respectively. During peak hour conditions, the system exhibits western zone pressures ranging from less than 40 psi to 75 psi, and 45 to 85 psi in the east. Under minimum hour demands western zone pressures range from less than 40 to 82 psi in the west and 48 to 93 psi in the east.

Water distribution mains are typically sized to deliver peak hour demands at pressures in the range of 40-110 psi in accordance with American Water Works Association (AWWA) engineering standards. In addition, it is recommended for pressure fluctuation during the day to remain less than 30 psi.

System modeling indicates existing mains can deliver peak hour demands and minimum hour demands to the City while maintaining pressures above 40 psi and lower than 110 psi, except in the area of Danube Court/Danube Lane. Homeowners in the Danube Court/Danube Lane area have installed individual booster pumps to increase service pressure. There are some small pockets in other areas of the City with pressures slightly lower than 40 psi, however, they are isolated. In addition, there is limited pressure fluctuation of 5-10 psi between peak hour and minimum hour demands. Existing demands are discussed in section 7.

There have been sporadic complaints regarding low pressures according to public works staff. These complaints typically come from a single house and not from several in an area, and are usually caused by soil in the water meter. Once soil is removed from the water meter the pressure problems are corrected for the user. Homes on Clover Lane, in close proximity to the Connemara Tower, complained of low pressures for irrigation systems when they were first constructed. However, individual booster pumps may have been installed to correct this problem.

Fire Protection

For fire protection, distribution mains should be able to deliver greater than 1,500 gpm for residential protection and 3,000 gpm for commercial. WSB met with the City fire marshal to discuss the ISO rating. ISO determines fire insurance rates based on the adequacy of the fire protection system. The ISO ranks cities on a scale from 1 to 10 based on the fire department's communication system (10%), the water supply system (40%), and the fire department (50%), with Class 1 being the highest rating. Class 1 is comprised of the best fire departments, of which there are only about 45 in the United States.

Based on discussions with the City Fire Marshall, buildings in the City of Rosemount that are greater than 12,000 SF require a sprinkler system. Also, buildings are rated the highest if they are within 1,000 feet of a hydrant capable of providing 3,000 gpm for three hours. Flint Hills Resources has their own holding ponds to provide their own fire protection, so the City is not responsible for providing fire protection to Flint Hills Resources.

The western pressure zone exhibits satisfactory fire protection as shown in Figure 13. In the eastern pressure zone, most mains have not been sized to deliver fire flows as it is not developed with the exception of a few industrial businesses. Improvements to the eastern pressure zone, including the tower, were designed and constructed with the understanding that the system would not be able to meet fire flow demands. The water main improvements were constructed to provide a more reliable source of water for consumption to the commercial and residential users in the eastern pressure zone, but not eliminate all the deficiencies. Due to limitations of the existing eastern pressure zone, it was not feasible to meet fire flow demands without major improvements.

5.2.5 Summary of Existing Deficiencies

Existing system deficiencies include:

- Limited fire protection available in the eastern pressure zone

6.0 GROWTH PROJECTIONS

6.1 Projected Residential Growth

Rosemount's 2005 population estimate was 19,418. In the last five years, Rosemount's population has grown 30%, with the bulk of growth occurring in areas receiving water service. According to the 2000 and 1990 censuses, populations were 14,619 and 8,622, respectively. Estimates of the population of the City of Rosemount as published by the State Demographers Office for the years 1991 through 1999 are presented in Table 6, along with the census data and current estimate. Figure 8 is a graphical representation of the population trends.

Population projections based on the City's land use plan are included in Table 6. All population density, residential land use assumptions, and non-residential land use assumptions are discussed in the City's 2030 Comprehensive Plan.

Currently, there is a large amount of property owned by the University of Minnesota in the previously described UMore Park. The property is considered ultimate growth, because there are no current development plans. Most of this property is considered residential in the land use plan.

Much of the property identified for the Air Cargo facility would become residential if the Air Cargo facility is not developed. Population projections do not account for that increase. In the event the Air Cargo project is not constructed, the water demand from the residential and business park, the backup land use, would not vary greatly from the proposed Air Cargo facility due to the associated types of businesses.

TABLE 6
Population Estimates and Projections
City of Rosemount, Minnesota

Year	Total Population	Land Use Population[1]	Serviced Population[2]	Land Use Households	Serviced Households	Land Use Employment	Serviced Employment
1990	8,622						
1991	9,129						
1992	9,750						
1993	10,478						
1994	11,086						
1995	11,721						
1996	12,272						
1997	12,772						
1998	13,146						
1999	13,544		11,726				
2000	14,619		12,801				
2001	15,270		13,452				
2002	16,110		14,292				
2003	16,794		14,976				

TABLE 6
Population Estimates and Projections
City of Rosemount, Minnesota

Year	Total Population	Land Use Population[1]	Serviced Population[2]	Land Use Households	Serviced Households	Land Use Employment	Serviced Employment
2004	17,740		15,922				
2005	19,418		17,600				
2006	20,207		18,389				
2007	20,917		19,099				
2008		21,862	20,044				
2009		22,806	20,988				
2010		23,750	21,932	8,050	7,434	8,400	7,865
2011		24,694	22,903				
2012		25,635	23,871				
2013		26,573	24,836				
2014		27,508	25,798				
2015		28,440	26,757				
2016		29,369	27,713				
2017		30,295	28,666				
2018		31,218	29,616				
2019		32,138	30,563				
2020		33,050	31,502	11,800	11,247	10,100	9,600
2021		33,961	32,440				
2022		34,868	33,374				
2023		35,772	34,305				
2024		36,672	35,232				
2025		37,569	36,156				
2026		38,462	37,076				
2027		39,352	37,993				
2028		40,238	38,906				
2029		41,121	39,816				
2030		42,000	40,725	15,500	15,029	12,220	12,170
Ultimate[3]		85,639	84,358				

[1]Based on land use growth assumptions

[2]Years 1999-2006 based on city figures of 1,818 unserved residents and years 2007-2030 assume uniform total population growth

[3]Ultimate population includes University of Minnesota Property as shown in Figure 1 and construction of the Air Cargo Facility as shown in Figure 1

Table 7 below indicates the ultimate population, units, and acres for future residential development. It is categorized according to its location in the eastern or western pressure zone. The ultimate development characteristics listed below were critical to the ultimate system design. The 2005 Water System Plan included growth projections; however, those projections have been updated for the 2030 Comprehensive Plan and are included in Table 6. Assumptions for the ultimate system development characteristics are listed below.

Table 7
Ultimate Residential Development
City of Rosemount, MN

	Acres	**Units**	**Population**
Western Pressure Zone			
Urban Residential	5,875	16,767	50,302
Transition Residential	986	1,972	5,916
High Density Residential	124	1,486	4,458
Medium Density Residential	444	3,108	9,324
Eastern Pressure Zone			
Urban Residential	1,395	4,184	12,552
Medium Density Residential	86	602	1,806
Total City			
Urban Residential	7,270	20,951	62,854
Transition Residential	986	1,972	5,916
High Density Residential	124	1,486	4,458
Medium Density Residential	530	3,710	11,130
Total City	***8,910***	***28,119***	***84,358***

[1] Existing Urban Residential assume 2.6 du/ac, 3.0 people/unit increased through 2010 to Future Urban Residential assume 3.0 du/ac, 3.0 people/unit.

[2] Transition Residential assume 2.0 du/ac, 3.0 people/unit, Existing Transition Residential identified in figure 3 are phased into city service from 2005-2020

[3] Existing High Density Residential assume 10.0 du/ac, 3.0 people/unit. Future High Density Residential assume 12.0 du/ac, 3.0 people/unit.

[4] Medium Density Residential assume 7.0 du/ac, 3.0 people/unit

6.2 Projected Non-Residential Growth

In the past, Rosemount has attracted industrial and public/institutional growth. A major industrial park consisting of Flint Hills Resources, an oil refinery serving much of the upper Midwest, and several smaller industrial users is located west and east of US Highway 52 and north of County Road 42. Dakota Technical College is located one mile east of downtown, and the University of Minnesota owns approximately 3,000 acres south of County Road 42 and east of Biscayne Avenue.

The non-residential growth trend will most likely continue in the future with the potential development of an Air Cargo handling facility in the eastern pressure zone. This development would not consist of one major user, but of many individual office/warehousing businesses (business park) coordinating efforts to transport material to the Minneapolis/St. Paul International Airport.

Flint Hills Resources, Dakota Technical College, and Rosemount Public Schools currently comprise the major non-residential water users for the system. There are growth opportunities for these users and these opportunities have been accounted for by the City in the proposed land use plan. Also, these major users have been included in determining the appropriate water demand per acreage per land use type. For example, Flint Hills Resources uses City water, but they also supply their own water through individual wells located on their property. It is assumed that this combination of usage will continue into the future.

To estimate the quantity and timing of future non-residential demands, a water demand per acre was determined for each land use type (estimated unit water demand) and these factors were combined with gross developable acreage and potential ultimate service area to quantify future water demands.

7.0 EXISTING AND FUTURE WATER DEMANDS

7.1 Estimated Unit Water Demand

Different types of users will exert different demands on the water system. Table 3 shows Rosemount's historical water demand according to residential, commercial, public/institutional, industrial, and unaccounted water usage. Unaccounted water usage may include such losses as flushing water mains, fire fighting, leaks, breaks, and meter inaccuracies. Unaccounted water has remained around 10% of total usage, which is consistent with most cities. Agricultural usage was assumed to be negligible. The vast majority of water usage comes from residential, followed by unaccounted, then commercial, public/institutional, and industrial.

Table 3 does not correspond directly to DNR water usage reports in the public/institutional and total water categories because it has been adjusted for a missed meter reading over an eight-year period. The meter reading was billed for all eight years in the first quarter of 2004. It was known that the reading had been missed for eight years, and was therefore averaged out over that time period to produce a more accurate representation of total and public/institutional water usage.

Water demands for 2003 and 2004 were consistent and are a good representation of existing water demand from the various land use types with the exception of industrial. Industrial usage was consistent between 2002 and 2003, therefore, the average water usage per acre of industrial was determined from these years. The average water usage for each land use type over these periods can be broken down as follows: residential, 91 gallons per capita per day (gpcd); commercial, 785 gallons per acre per day (gpad); public/institutional, 230 gpad; and industrial, 55 gpad.

The residential, commercial, and public/institutional demands are all estimates consistent with other communities; however, the industrial demand is skewed because of the large land area consumed by Flint Hills Resources. Flint Hills Resources uses City water in conjunction with wells on their property to satisfy their total water demand, therefore, they use City water for only a portion of their needs. Water use records for both Flint Hills Resources and Waste Management were reviewed independently and found to be consistent with 55 gpad. Estimated future demands per unit acre of industrial should be more consistent with commercial/business park usage. Residential usage was increased to account for the highest per capita usage year. Estimated usage per acre includes unaccounted for system losses. The following estimates are used in Table 9 for projected water demand: residential, 95 gpcd; commercial, 800 gpad; public/institutional, 250 gpad; future industrial, 800 gpad; and Flint Hills Resources/Waste Management (FHR/WM) 55 gpad.

To estimate the quantity and timing of projected water usage, Table 9 ties the estimated unit water demand to the growth projections included in the 2030 Comprehensive Plan to produce a schedule of projected water usage. Also, Table 9 indicates the ultimate water demand for both pressure zones for each land use type.

TABLE 9
Summary of Projected Water Usage for the City Service Area
City of Rosemount, Minnesota

	Residential			Commerical		Public/Institutional		Business Park		General Industrial		Industrial/Mixed Use		FHR/WM[2]		Corporate Campus					
Year	Total Population	Population Served	Avg. Daily Use at 95 gpcd GPD	Land Area, Acres	Ave. Daily Water Use at 800 gpad GPD	Land Area Acres	Ave. Daily Water Use at 250 gpad GPD	Land Area Acres	Ave. Daily Water Use at 800 gpad GPD	Land Area Acres	Ave. Daily Water Use at 800 gpad GPD	Land Area Acres	Ave. Daily Water Use at 800 gpad GPD	Land Area Acres	Ave. Daily Water Use at 55 gpad GPD	Land Area Acres	Ave. Daily Water Use at 800 gpad GPD	Projected Total Average Daily Use MGD	Projected Maximum Day Demand (3.0, 2.5xavg.) MGD	Projected Peak Hour Demand (1.6xpeak day) MGD	Minimum Hour Demand (0.2xpeak day) MGD
2005	19,418	17,600	1,672,000	120	96,000	443	110,750	95	76,000	40	32,000	0	0	1327	72,985	0	0	2.06	6.18	9.89	1.24
2006	20,207	18,389	1,746,955	140	112,000	443	110,750	130	104,000	65	52,000	0	0	1327	72,985	0	0	2.20	6.60	10.55	1.32
2007	20,917	19,099	1,814,405	160	128,000	443	110,750	165	132,000	90	72,000	0	0	1327	72,985	0	0	2.33	6.99	11.18	1.40
2008	21,862	20,044	1,904,180	180	144,000	443	110,750	200	160,000	115	92,000	0	0	1327	72,985	0	0	2.48	7.45	11.92	1.49
2009	22,806	20,988	1,993,860	200	160,000	443	110,750	235	188,000	140	112,000	0	0	1327	72,985	0	0	2.64	7.91	12.66	1.58
2010	23,750	21,932	2,083,540	220	176,000	443	110,750	270	216,000	165	132,000	35	28,000	1327	72,985	0	0	2.82	8.46	13.54	1.69
2011	24,694	22,903	2,175,785	240	192,000	443	110,750	305	244,000	190	152,000	70	56,000	1327	72,985	0	0	3.00	9.01	14.42	1.80
2012	25,635	23,871	2,267,745	260	208,000	443	110,750	340	272,000	215	172,000	105	84,000	1327	72,985	0	0	3.19	9.56	15.30	1.91
2013	26,573	24,836	2,359,420	280	224,000	443	110,750	375	300,000	240	192,000	140	112,000	1327	72,985	0	0	3.37	10.11	16.18	2.02
2014	27,508	25,798	2,450,810	300	240,000	443	110,750	410	328,000	265	212,000	175	140,000	1327	72,985	0	0	3.55	10.66	17.06	2.13
2015	28,440	26,757	2,541,915	320	256,000	443	110,750	445	356,000	290	232,000	210	168,000	1327	72,985	0	0	3.74	11.22	17.95	2.24
2016	29,369	27,713	2,632,735	340	272,000	443	110,750	480	384,000	315	252,000	245	196,000	1327	72,985	0	0	3.92	11.76	18.82	2.35
2017	30,295	28,666	2,723,270	360	288,000	443	110,750	515	412,000	340	272,000	280	224,000	1327	72,985	0	0	4.10	12.31	19.69	2.46
2018	31,218	29,616	2,813,520	380	304,000	443	110,750	550	440,000	365	292,000	315	252,000	1327	72,985	0	0	4.29	12.86	20.57	2.57
2019	32,138	30,563	2,903,485	400	320,000	443	110,750	585	468,000	390	312,000	350	280,000	1327	72,985	0	0	4.47	13.40	21.44	2.68
2020	33,050	31,502	2,992,690	420	336,000	443	110,750	620	496,000	415	332,000	385	308,000	1327	72,985	0	0	4.65	13.95	22.32	2.79
2021	33,961	32,440	3,081,800	440	352,000	443	110,750	655	524,000	440	352,000	420	336,000	1327	72,985	15	12,000	4.84	14.52	23.24	2.90
2022	34,868	33,374	3,170,530	460	368,000	443	110,750	690	552,000	465	372,000	455	364,000	1327	72,985	30	24,000	5.03	15.10	24.16	3.02
2023	35,772	34,305	3,258,975	480	384,000	443	110,750	725	580,000	490	392,000	490	392,000	1327	72,985	45	36,000	5.23	15.68	25.09	3.14
2024	36,672	35,232	3,347,040	500	400,000	443	110,750	760	608,000	515	412,000	525	420,000	1327	72,985	60	48,000	5.42	16.26	26.01	3.25
2025	37,569	36,156	3,434,820	520	416,000	443	110,750	795	636,000	540	432,000	560	448,000	1327	72,985	75	60,000	5.61	16.83	26.93	3.37
2026	38,462	37,076	3,522,220	540	432,000	443	110,750	830	664,000	565	452,000	595	476,000	1327	72,985	90	72,000	5.80	17.41	27.85	3.48
2027	39,352	37,993	3,609,335	560	448,000	443	110,750	865	692,000	590	472,000	630	504,000	1327	72,985	105	84,000	5.99	17.98	28.77	3.60
2028	40,238	38,906	3,696,070	580	464,000	443	110,750	900	720,000	615	492,000	665	532,000	1327	72,985	120	96,000	6.18	18.55	29.68	3.71
2029	41,121	39,816	3,782,520	600	480,000	443	110,750	935	748,000	640	512,000	699	559,200	1327	72,985	135	108,000	6.37	19.12	30.59	3.82
2030	42,000	40,725	3,868,875	620	496,000	443	110,750	970	776,000	665	532,000	699	559,200	1327	72,985	150	120,000	6.54	19.62	31.39	3.92
Ultimate[1]	***85,639***	***84,358***	***8,014,001***	***674***	***539,200***	***443***	***110,750***	***1855***	***1,484,000***	***1568***	***1,254,400***	***699***	***559,200***	***1327***	***72,985***	***512***	***409,600***	***12.44***	***31.10***	***49.76***	***6.22***
West[3]	71,281	70,000	6,649,962	321	256,800	408	102,000	743	594,400	180	144,000	0	0	0	0	0	0	7.75	19.38	31.00	3.88
East[3]	14,358	14,358	1,364,039	353	282,400	35	8,750	1112	889,600	1388	1,110,400	699	559,200	1327	72,985	512	409,600	4.70	11.75	18.80	2.35
Air Cargo[4]	5,670	5,670	538,650															0.54	1.35	2.16	0.27

[1]Ultimate Residential population per the 2030 Comprehensive Plan including Univ. of Minnesota property as ultimate development and assumes the Air Cargo facility will be developed
[2]Water use records for Flint Hills Resources and Waste Management indicated 55 gpad, both have been included in this category
[3]Western and Eastern pressure zone population based on land use plan and development characteristics discussed in Section 4 and 6
[4]Water demand for Air Cargo Facility area if developed as residential assumes (3 units/acre, 3 people/unit)

Based on the land use plan, average day water usage is expected to increase to 2.82 mgd by 2010, 4.65 mgd by 2020, 6.54 mgd by 2030, and an ultimate service area usage of 12.44 mgd. Peaking factors and demands are included in Table 9. Water demand estimates include existing industrial users and the future Air Cargo facility, but no other major water users. Also, no major usage changes are anticipated from Flint Hills Resources.

The western and eastern pressure zones water demands are separated for system planning purposes. Certain components of infrastructure can only serve one pressure zone. In addition, the Air Cargo facility water demand is separated in the event it is developed as residential property.

Ultimate water demands were decreased slightly from the 2005 report due to land use changes and a decrease in the unserved population.

7.2 Maximum Day Water Demand

Water consumption will vary greatly over different periods of the year and during different hours of the day. The average daily demand is important for calculating revenues and operating costs. However, maximum day and peak hour demand is necessary for sizing the water supply, treatment, storage, and distribution systems.

A review of the daily water records indicates maximum day water usage of approximately 5.10 mgd in 2001, which equates to a peaking factor (Maximum Day Demand/Average Day Demand ratio) of 3.56. However, the peaking factor has ranged from 3.56 to 2.54 between 2001 and 2006. In some cases, the accuracy of the 2001 peak number as a true peaking factor is somewhat suspect due to the variation in meter reading times from day to day and water main flushing. Daily water usage meter readings may vary by up to two hours each day, which could under or over estimate actual peak day readings. Water main flushing may overestimate peak day water usage if water main flushing continues on a schedule and adequate water reserves are available. Therefore, the availability of water during water main flushing may actually create the illusion of a higher peak day water usage in historical records.

Over the last six years, the average peaking factor for Rosemount has been 2.8 excluding the extremely high year of 2001. In general, as City populations increase, peaking factors decrease due to the increased variety of water usage in a larger City. Based on discussions with City staff, historic water usage, and similar City trends, a peaking factor of 3.0 was used for estimating maximum day demands at the 2010, 2020, and 2030 design intervals. However, the ultimate system peaking factor was assumed to be 2.5, since peaking factors typically decrease with system growth.

To develop a more accurate system model, hourly water usage for the City was studied. Sizing of water distribution mains, storage, and supply are all influenced by the hourly water usage on a maximum day of water usage. Data for system water usage was studied over June of 2005. June 6, 26, and 28 were some of the highest usage days and are shown in Figure 9 as an example. This figure shows the ratio of water used per hour relative to the average for the whole day. Results indicate that the highest demand for water occurs from 5:00 – 8:00 a.m., with an additional peak in use between the hours of 8:00 – 12:00 p.m. During the hours of 5:00 – 8:00 a.m., hourly demand reaches 1.6 times or 60% higher than the average over the entire day.

This data was used to produce a stepwise pattern (Figure 7) for input to the EPS model. Therefore, the system demands were higher during these hours of the day and distribution, supply, and storage were all analyzed for capacity relative to this demand pattern. It is anticipated that as the City grows and industry and population becomes more diverse, the hourly/average demand will decrease. However, to be conservative, this demand pattern was used in each future model.

7.3 Projected Water Demand

The resulting projected water demands for Rosemount, calculated using gross developable acres and the estimated unit water demand as described in this section, is shown in Table 9. These estimates include future residential, commercial, public/institutional, and industrial users. In addition, projected water usage estimates incorporate existing developed transition residential and general industrial currently on individual wells into the City's service area. The projected maximum day demand for design years 2010, 2020, and 2030 is 8.46 mgd, 13.95 mgd, and 19.62 mgd, respectively. The ultimate maximum day demand for the City is estimated at 31.10 mgd.

8.0 FUTURE WATER SYSTEMS

The City has revised their growth projections from the November 4, 2005 Comprehensive Water System Plan, to be included in the 2030 Comprehensive Plan. The infrastructure development schedules have been revised as they are dependent on the projected rate of development, however, the associated design interval water system models were not updated. The ultimate water system model was not revised for this update, because ultimate development projections were not revised.

Since the rate at which improvements are constructed will be dependent on the variable rate of development and resultant water demands, supply, storage, treatment, and distribution needs will be reviewed on an ongoing basis.

8.1 General

Water systems may be comprised of supply, treatment, storage, and distribution. Water treatment for Rosemount consists of chlorination, fluoridation, and polyphosphate at the individual well houses. Water from the Rosemount wells does not exceed any of the Safe Drinking Water Act (SDWA) primary drinking water standards. Therefore, additional treatment is not mandatory. Water from the Rosemount wells does exceed secondary standards for iron and manganese. The Secondary Standards for iron and manganese are 0.3 mg/l and 0.5 mg/l, respectively. Considering the typical water quality from the region, we anticipate future water supply wells to pump to treatment facilities prior to distribution for softening.

Well and treatment plant capacity impact water storage requirements. Diurnal water demand and fire protection requirements also impact water storage needs.

The location of water treatment facilities and water storage facilities impacts distribution system requirements. Diurnal water demand and fire protection requirements also impact distribution system requirements.

City water system needs are met by first providing a water source capable of satisfying maximum day water demand. When the source water is from groundwater, as is the case in Rosemount, the maximum day demand should be satisfied assuming the largest well is temporarily out service (firm capacity). The ultimate water system includes two wells out of service, one in the east pressure zone and one in the west pressure zone for firm capacity.

If the wells are to pump to a treatment facility, as will probably be the case for Rosemount, the treatment facility or treatment facilities' capacity should equal the maximum day water demand. If more than one treatment facility is providing water to a community, as will be the case for Rosemount, the capacity of the wells supplying each treatment facility shall equal the respective treatment facility capacity.

The storage capacity for a water system is used to satisfy system demands in excess of maximum day demands. These additional demands include peak hour demands and potential fire suppression demands.

8.2 Background

The City of Rosemount is divided into two pressure zones. The eastern and western pressure zones are connected via a PRV. Existing Well Nos. 3, 7, 8, 9, 12, 14, the 1,000,000 gal Connemara Tower, 500,000 gal Chippendale Tower, and the 1,500,000 gal Bacardi Tower are in service in the western pressure zone. The eastern pressure zone is served by Well Nos. RR1, RR2, and a 500,000 gal Tower. Treatment consists of chlorination, fluoridation, and polyphosphate addition.

System water demands are currently much greater in the western pressure zone. Growth projections associated with the City's comprehensive plan indicate water demand in the western pressure zone will be greater and occur sooner than the eastern zone. Based on growth projections, several production wells will be necessary to serve the City of Rosemount in the future. Also, greater water treatment capability will be necessary to serve the growing population and industry.

Considering existing facilities and current and projected water system demands, a water system has been developed that incorporates wells, treatment, storage, and distribution in both pressure zones. Three treatment facilities are anticipated with two in the western zone and one in the eastern zone. Each treatment facility will be a nucleus from which the distribution system and associated storage will radiate. The system will be tied together by 16-inch trunk water mains. Possible locations for the western pressure zone treatment facilities are in the vicinity of Well Nos. 12 and 14. The eastern pressure zone treatment facility could be located to the east of the proposed Air Cargo facility. Ultimately, well water availability and water quality will greatly influence realized treatment facility location and process.

8.3 Water Supply Needs

8.3.1 Future Source Requirements

As previously discussed in section 8.1, the firm capacity of the system's wells should equal the maximum day demands. It is currently not a requirement for the system, but it is prudent planning. Therefore, in the future model, it was assumed the well pumping firm capacity would equal the maximum day demands.

Water demand projections were presented in the Existing and Future Demands section of the report. To determine the necessary number of wells to supply future demands, the highest projected maximum day demand was compared with the adjusted base firm pumping capacity. As discussed in section 5.2, the current firm pumping capacity is 6,000 gpm (8.64 mgd). However, abandonment of Well No. 3 will reduce firm capacity to 5,500 gpm (7.92 mgd). Using this adjusted firm pumping capacity as a basis for future planning, the system will need 23.18 mgd (31.10 mgd maximum day – 7.92 mgd current firm pumping capacity) of additional well capacity to meet the maximum day demands for the ultimate planning period.

Three well field locations are proposed for providing the additional capacity to meet the City's projected ultimate demand. Since the pumping capacity of three of the City's existing wells range from 1,000 gpm to 1,300 gpm, a pumping capacity of 1,000 gpm per well was assumed for future wells. A northwest well field, with a total of seven wells, including Well No. 14, having a combined capacity of approximately 10 mgd is proposed for the western area, along with a southwest well field with a total of four wells, including Well No. 12, having a combined capacity of 6 mgd. An eastern well field with eight wells having a combined capacity of 11.5 mgd is proposed for supplying the projected ultimate maximum day demands for the eastern portion of the City.

Based on growth projections, associated treatment facility construction, and expansion projections, the well construction schedule shown in Table 12 was developed. The schedule in Table 12 was used for the cost analysis which follows.

TABLE 12
Well Development Schedule
City of Rosemount, Minnesota

Well Designation	Year Completed	Location or Pressure Zone	Well Design Capacity (gpm)[1]	System Firm Capacity (gpm)	Total Peak Day Demand (gpm)
Well No. 3	Existing	West	500		
Well No. 7	Existing	West	1,200		
Well No. 8	Existing	West	1,000		
Well No. 9	Existing	West	1,600		
Well No. 12	Existing	West	1,300		
Well RR 1	Existing	East	400		
Well RR 2	Existing	East	400		
Well No. 14	Existing	West (North)	1,200	6,000	4,420
Well No. 15	2008	West (North)	1,000	7,000	5,200
Well No. 3	2009 Out of service			6,500	5,500
Well No. 16,17	2010-2015	West (North)	2,000	8,500	7,800
Well No. 18, 19, 20	2015-2020	West (North)	3,000	11,500	9,700
Well No. 21, 22	2020-2025	East	2,000	13,500	11,700
Well No. 23	2025-2030	East	2,000	14,500	13,600
Well No. 24, 25, 26, 27, 28	Ultimate	East	3,000	19,500	
Well No. 29, 30, 31	Ultimate	West (South)	4,000	22,500	21,600

[1] Assume all future wells will produce 1,000 gpm

Due to the large number of wells that will be needed, and the probability that more than one well could be out of service at the same time due to failure or maintenance, consideration should be given to providing the firm capacity for each well field supplying each water treatment plant. This would require the construction of one additional well in each well field.

8.3.2 Groundwater Modeling

A technical memorandum summarizing the results of a well field study conducted for the City is included in Appendix B.

8.4 Water Treatment Needs

8.4.1 Raw Water Quality

Water from the City's existing wells is, in general, good quality water. The water does not exceed any of the Safe Drinking Water Act (SDWA) Primary Drinking Water Standards, but does exceed Secondary Standards for iron and manganese. The Secondary Standards for iron and manganese are 0.3 mg/l and 0.05 mg/l. Based on sampling and testing information, the iron and manganese concentrations in the raw water from Well No. 12 are 0.453 mg/l and 0.072 mg/l, respectively. The iron and manganese concentrations in the raw water from Well No. 14 are 0.465 mg/l and 0.112 mg/l, respectively.

Although exceeding the Secondary Standards will not impact a consumer's health, the water quality will be undesirable for aesthetic reasons. Excessive iron and manganese concentrations can cause red, black, brown, and yellow colored water. Waters with concentrations above the Secondary Standards will typically cause customer complaints if some form of water treatment is not used. These complaints can be controlled either by sequestering or by removing the iron and manganese.

The City of Rosemount currently uses polyphosphates to sequester iron and manganese. Sequestering does not remove the iron and manganese. The polyphosphates chemically bind with the iron and manganese to reduce the formation of precipitates, which cause, red, black, brown, and yellow water. However, the chemical bond deteriorates with time.

Sequestering, in general, is not recommended for waters with combined iron and manganese concentrations greater than 1 mg/l or for waters with manganese concentrations greater than 0.1 mg/l. At iron and manganese concentrations greater than the recommended limits, sequestering becomes less effective.

The most effective means of controlling red, brown, black, and yellow water caused by iron and manganese is to remove the iron and manganese before it enters the distribution system.

Treatment for iron and manganese is a common practice. The removal of iron and manganese from waters involves two basic processes; oxidation and filtration. The oxidation process involves oxidizing the iron and manganese to insoluble particles, which then can be removed by the filtration process.

8.4.2 Water Treatment Plant Capacity

Three treatment plants are proposed to serve the ultimate demands for the City. These three water treatment plants would each be located near the proposed well fields and sized to match the proposed well field design capacities. A proposed northwestern water treatment plant and southwestern water treatment plant are planned in the western pressure zone. The northwestern plant would be designed to treat 10 mgd to match the proposed firm capacity of the northwest well field, and the southwestern plant would be designed to treat 6 mgd to match the proposed firm capacity of the southwest well field.

An eastern water treatment plant designed to treat 11.5 mgd to match the proposed capacity of the eastern well field is proposed in the eastern pressure zone.

The combined capacity of the three water treatment plants would be 27.5 mgd. At this combined treatment capacity, 100% of the projected ultimate average day demands would be treated water, and approximately 88% of the projected ultimate maximum day demands would be treated water. The remaining portion of the projected ultimate maximum day demand would be provided as untreated water from existing Well Nos. 7, 8, 9, RR1 and RR2.

8.4.3 Water Treatment Alternatives

Two alternatives were evaluated for removal of iron and manganese from the City's water supply. Alternative No. 1 includes a treatment system for each of the proposed plants, which would use pressure aeration for oxidation of the iron and manganese followed by pressure filtration to remove iron and manganese. Alternative No. 2 includes a treatment system for each of the plants, which would use gravity aeration for oxidation of the iron and manganese followed by gravity filtration for removal of iron and manganese. For both of these alternatives, space would be allotted for the basic treatment processes involved with removal of iron and manganese. Unless required, no space is proposed for treatment of radium, nitrate, or arsenic.

For Alternative No. 1, raw water from the production wells will be pumped to the pressure aerators for oxidation of iron and manganese. Following the pressure aerators, water will flow under pressure to the pressure filters for removal of iron and manganese floc. Under normal operation, flow from the production wells will be split evenly between the individual aerators and pressure filters. Four (4) chemical feed systems are proposed, including liquid chlorine (sodium hypochlorite), potassium permanganate, fluoride (fluorosilicic acid), and polyphosphate. After filtration, the water will be fluoridated and chlorinated and then discharged to the distribution system. Continued feeding of polyphosphate following treatment is recommended to provide corrosion control in the distribution system. Potassium permanganate will be fed to the raw water after aeration for regeneration of the manganese greensand, which is one layer of the filter media. Finished water from the individual pressure filter cells will be used for backwashing the filters. Filter backwash water will be discharged to two below grade, cast-in-place, concrete backwash reclaim tanks for reuse and settling of solids. Settled solids will be periodically pumped to the sanitary sewer. Clarified backwash water will be recycled to the filter influent lines.

The estimated capital costs for Alternative No. 1 treatment plants at each of the three water treatment plant locations are summarized below. A breakdown of these cost are included in Appendix A.

- Cost for 10 MGD Northwest Water Treatment Plant: $8,600,000
- Cost for 6 MGD Southwest Water Treatment Plant: $6,226,000
- Cost for 11.5 MGD Eastern Water Treatment Plant...................$9,405,000

For Alternative No. 2, raw water from the production wells will be pumped to gravity aerators for oxidation of iron and manganese. Following the aerator(s), water will flow by gravity to the gravity filters for removal of iron and manganese floc. Under normal operation, the flow from the aerators will be split evenly between the proposed gravity filters. After filtration, the water will flow to a below grade, cast-in-place, concrete clearwell. Four (4) chemical feed systems are proposed, including liquid chlorine (sodium hypochlorite), potassium permanganate, fluoride (fluorosilicic acid), and polyphosphate. Finished water from the clearwell will be chlorinated and fluoridated before being pumped to the distribution system. Continued feeding of polyphosphate following treatment is recommended to provide corrosion control in the distribution system. Potassium permanganate will be fed to the raw water after aeration for regeneration of the manganese greensand, which is one layer of the filter media.

Finished water from the clearwell will also be used for backwashing the filters. Filter backwash water will be discharged to two below grade, cast-in-place, concrete backwash reclaim tanks for reuse and settling of solids. Settled solids will be periodically pumped to the sanitary sewer. Clarified backwash water will be recycled to the filter influent lines.

The estimated capital costs for Alternative No. 2 treatment plants at each of the three water treatment plant locations are summarized below. A breakdown of these cost are included in Appendix A

- Cost for 10 MGD Northwest Water Treatment Plant: $9,928,000
- Cost for 6 MGD Southwest Water Treatment Plant: $7,110,000
- Cost for 11.5 MGD Eastern Water Treatment Plant:................$10,538,000

The City has identified potential locations for proposed northwestern and southwestern water treatment plants. Figure 26 shows a conceptual layout for a 10 mgd pressure filter plant constructed at the northwestern plant site and Figure 27 shows a conceptual layout for a 10 mgd gravity filter plant constructed at the same location. Figure 28 shows a conceptual layout for a 6 mgd pressure filter plant constructed at the southwestern plant site and Figure 29 shows a conceptual layout for a 6 mgd gravity filter plant constructed on the same site. No sites have been identified for an eastern water treatment plant and therefore conceptual layouts have not been included in this report.

Methods of phasing construction of the building and the equipment for the proposed water treatment facilities should be incorporated in the planning, design, and construction of all water treatment improvements. Flexibility should be inherent in all efforts to allow for changing regulations and variations in source water quality.

TABLE 13
Water Treatment Needs
City of Rosemount, Minnesota

Well Designation	Year Completed	Well Field Location[2]	Well Design Capacity (gpm)[1]	Well Field Capacity (mgd)	Treatment Plant Capacity (mgd)
Well No. 14	2006	West (North)	1,200	1.7	
Well No. 15	2008	West (North)	1,000	3.2	
Well No. 16,17	2010-2015	West (North)	2,000	6.0	
Northwest WTP	**2010-2015**				**6.0**
Well No. 18, 19, 20	2015-2020	West (North)	3,000	10.4	
Northwest WTP Expansion	**2015-2020**				**10.4**
Well No. 21, 22	2020-2025	East	2,000	2.9	
East WTP	**2020-2025**				**5.8**
Well No. 23	2025-2030	East	1,000	4.3	
Well No. 24,25,26,27,28	2030-Ultimate	East	5,000	11.5	
East WTP Expansion	**2030-Ultimate**				**11.5**
Well No. 12	2005	West (South)	1,300	1.8	
Well No. 29,30,31	Ultimate	West (South)	3,000	6.2	
Southwest WTP	**Ultimate**				**6.2**

[1] Assume all future wells will produce 1,000 gpm
[2] Assumes Air Cargo Facility will be served by transmission mains

8.5 Water Storage Needs

Sufficient storage capacity must be available to provide storage to balance peak demands with water production capacity and to meet emergency needs. Equalization storage is required to meet water system demands in excess of delivery capability and is sized to provide demands in excess of the maximum demand up to the peak hour demand.

Typically, a water utility provides emergency storage to supply fire flow requirements recommended by the ISO. As discussed in section 5, the maximum fire flow recommended for Rosemount is 3,000 gpm available for a duration of 3 hours.

Table 14 quantifies the amount of water storage required to meet diurnal flow variations and limited fire suppression requirements during a maximum day event for the years 2010, 2020, 2030, and ultimate build out. Table 14 is based on an evaluation of past diurnal demands for Rosemount and fire suppression capabilities of approximately 3000 gpm for a 3-hour period.

The approximate location of storage facilities is based on distribution system extent at year of need and distribution system layout and sizing to meet system demands and limited fire suppression needs.

A combination of elevated and ground storage facilities is shown for the future water system. An evaluation of elevated storage versus ground storage is recommended before planning for the design and construction of new storage facilities. In general, the capital cost for construction of elevated storage will be more expensive than ground storage. However, because of the additional pumping and power requirements, operation and maintenance cost for ground storage will be more expensive then elevated storage. Elevated storage operates without relying on pumping or other powered facilities and is a more reliable source of water for distribution in the event of a power failure. For ground storage facilities, a back-up power supply is required to operate the high service booster pumps during a power outage.

TABLE 14
Projected Water Storage Needs
City of Rosemount, Minnesota

Design Year	2005	2010	2020	2030	Ultimate
Average Day Water Demand (mgd)	2.06	2.82	4.65	6.54	12.44
Peak Day Water Demand (mgd)	6.18	8.46	13.95	19.62	31.10
Peak Day Water Demand (gpm)	4,420	5,875	9,688	13,625	21,597
Well Firm Capacity (gpm)	6,000	6,500	11,500	14,500	22,500
Required Fire Fighting Rate (gpm)	3,000	3,000	3,000	3,000	3,000
Required Fire Fighting Duration (hours)	3	3	3	3	3
Total Coincident Demand (gpm)	9,000	9,500	14,500	17,500	25,500
Required Fire Fighting Storage (gal)	540,000	540,000	540,000	540,000	540,000
Equalization Storage (gal)	764,000	1,016,000	1,674,000	2,355,000	3,732,000
Emergency/Reserve Storage (gal)	756,000	1,264,000	2,436,000	3,645,000	8,168,000
Total Storage Needed (gal)	2,060,000	2,820,000	4,650,000	6,540,000	12,440,000
Existing Storage (gal)	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
Additional Storage Needed (gal)	**-1,440,000**	**-680,000**	**1,150,000**	**3,040,000**	**8,940,000**

[1]Assume all future wells will produce 1,000 gpm
[2]Assumes Air Cargo Facility will be served by transmission mains

Table 15 presents the storage facility construction schedule and is based on meeting the water demands associated with peak hour flows and fire suppression needs.

The schedule was used for the cost analysis which follows in a subsequent section.

TABLE 15
Water Storage Construction Schedule
City of Rosemount, Minnesota

Storage Improvement	Total Storage	Total Storage Req'd	Year Completed	Pressure Zone	Location
Chippendale Tower (0.5 MG)			Existing	West	CSAH 42/Chippendale Ave.
Conamera Tower (1.0 MG)			Existing	West	800' East of Conamera Trail/Shannon Pkwy.
East Tower (0.5 MG)			Existing	East	Southeast of US 52/CSAH 42
Bacardi Tower (1.5 MG)	3.5 MG	2.48 MG	Existing	West	800' South of CR 38/Bacardi Ave.
Northwest WTP Ground Storage (2.0 MG)	5.5 MG	3.74 MG	2015	West	CR 38/Bacardi Ave.
Elevated Storage (1.0 MG)	6.5 MG	5.61 MG	2025	East	1/2 Mile east of PRV and 1/4 Mile North of CSAH 42
East WTP Ground Storage (2.0 MG)	8.5 MG	6.54 MG	2030	East	1/2 Mile North of Emery Ave. E/160th St.E
Elevated Storage (1.0 MG)			Ultimate	East	1/2 Mile North of Emery Ave. E/160th St.E
Elevated Storage (1.5 MG)			Ultimate	West	3/4 Mile east of Biscayne Ave. and 3000' North of 160th St.
Southwest WTP Ground Storage (1.5 MG)	12.5 MG	12.44 MG	Ultimate	West	South of Boulder Trail/Business Pkwy.

8.6 Trunk Water Main Looping

The ability to transport flow between water sources, water storage, and water demand is a key element in providing an economically responsible and reliable water system. A good distribution system makes each element of the water system more effective across the entire water system service area, reducing the cost for redundant individual facilities. Water main looping also provides for redundant flow paths across the distribution system so a reliable water source exists regardless of a single break in a water main.

The ultimate proposed trunk water main system and piping grid system is presented in Figure 5. The system consists primarily of 12-inch water main along section lines. Trunk mains were distributed to serve each particular development in accordance with the land use plan, therefore, mains serving smaller demand land use locations are smaller than 12-inch. Demands were estimated for each of the land use types and locations and applied at each of the locations. In addition, the City has already begun a 16-inch trunk main loop. This loop was continued throughout the western pressure zone and another 16-inch loop was created to serve the eastern pressure zone. The amount of looping and redundancy presented in this figure provide adequate operating pressures and available fire flow capacity to serve each land use type appropriately.

Water system modeling for the design year intervals was not updated based on the August 1, 2007 updated growth projections. Therefore, the infrastructure included in the design interval models does not reflect the updated growth projections and subsequent phasing of trunk water main improvements.

Phasing of the trunk improvements was determined by conducting computer modeling at key years including 2010, 2015, 2025, and the ultimate service area. Figure 6 shows phasing for the proposed ultimate trunk water main system. Modeling results are presented in Figures 14 through 25. Figures include peak hour (of maximum day) pressure contours, available fire flow contours, and minimum hour pressure contours. Projected water demand and projected wells, water treatment, and water storage capacity were used in the modeling. Water mains were added to meet demands as they are projected to develop, unless they were needed earlier to meet desirable system pressures and fire flows. Upgrades to existing water mains are proposed as they are needed.

In the year 2015, an additional PRV will be necessary to provide water to the eastern pressure zone. This PRV will provide redundancy to the system in the event one is taken out of service for maintenance. Also, in this year, demands in the eastern zone require more transmission capacity since the water treatment plant is not slated for development until the year 2025.

Pressure contours show some areas having less than 3,000 gpm fire flows on the proposed future trunk mains. These lower fire flows are caused by dead ends in the trunk main system at the borders of the eastern and western pressure zones. Additional mains may be necessary in these areas in the future for water main looping; however, as more 8-inch mains are constructed and looped to serve individual homes it may become unnecessary to loop the trunk mains.

Air Cargo Facility

Due to the unknown schedule of development for the Air Cargo facility, WSB modeled potential alternatives for providing water to this area. The two options include:

1. Begin developing wells in the Air Cargo facility vicinity
2. Construct transmission mains from the western pressure zone to the Air Cargo facility

As discussed in section 7, demands from the Air Cargo facility are expected to be similar to a business park or industrial/mixed use development. The potential service options were modeled as a part of the 2010 system. In this scenario, the only new development in the eastern pressure zone would be the Air Cargo facility.

To serve the development with transmission mains, another 16-inch main would need to be installed from the existing PRV to the intersection of CSAH 42 and Emery Avenue and is recommended. The total length for this transmission main would be approximately 4 miles. Although this option seems expensive for the immediate future, ultimate system demands will require a 12-inch main be constructed along this same route. Therefore, the only cost difference would be to upsize this main.

9.0 CAPITAL IMPROVEMENT AND UPKEEP PROGRAM

The cost of improvements, including construction cost and annual operation, maintenance and replacement costs have been estimated and used in developing a Capital Improvement Program. As discussed previously, population and development projections have been revised in accordance with the 2030 Comprehensive Plan. The proposed infrastructure construction timeframes shown below have not been updated to reflect the revised population and development projections. However, the estimated costs to complete the ultimate system and estimated project costs remain unaffected. The schedule of improvements for the next 20 years and their estimated construction cost are presented in Table 16. Improvements are categorized in 5, 10, 15 and 20-year increments. Improvements include wells, water treatment, water storage, and trunk water mains.

TABLE 16
Capital Improvement Plan

Improvement	**Engineer's Opinion of Probable Project Cost** **2005 dollars**
0-5 Years	
• Well No. 15, 16, 17 (Northwest)	3,660,000
• 12-inch, 18-inch, & 24-inch Raw Water Piping from Wells to WTP	1,900,000
• 8-inch trunk main (27,695 ft. total /East 0 ft & West 27,695 ft)	1,523,000
• 12-inch trunk main (88,028 ft. total /East 35,220 ft & West 52,808 ft)	6,602,000
• 16-inch trunk main (52,245 ft. total /East 37,800 ft & West 14,445 ft)	4,963,000
• Northwest Water Treatment Plant	9,928,000
6-10 Years	
• Northwest Water Treatment Plant Ground Storage (2.0 MG)	2,100,000
• Well No. 18, 19, 20 (Northwest)	3,660,000
• 12-inch & 18-inch Raw Water Piping from Wells to WTP	1,400,000
• 8-inch trunk main (17,739 ft. total /East 4,459 ft & West 13,280 ft)	976,000
• 12-inch trunk main (48,044 ft. total /East 23,227 ft & West 24,817 ft)	3,603,000
• 16-inch trunk main (13,667 ft. total /East 0 ft & West 13,667 ft)	1,298,000
• Pressure Reducing Valve Station	150,000
• East Side Elevated Storage (1.0 MG)	2,520,000
11-20 Years	
• East Water Treatment Plant Ground Storage (2.0 MG)	2,100,000
• Well No. 21, 22, 23, & 24 (East)	4,880,000
• 12-inch, 18-inch, & 24-inch Raw Water Piping from Wells to WTP	1,100,000
• 8-inch trunk main (14,057 ft. total /East 14,057 ft & West 0 ft)	773,000
• 12-inch trunk main (92,552 ft. total /East 92,552 ft & West 0ft)	6,941,000
• 16-inch trunk main (10,580 ft. total /East 10,580 ft & West 0 ft)	1,005,000
• Eastside Water Treatment Plant	10,538,000

Improvement	**Engineer's Opinion of Probable Project Cost** **2005 dollars**
Ultimate	
• Well No. 25, 26, 27 (Southwest)	3,660,000
• 12-inch & 18-inch Raw Water Piping from Wells to WTP	1,400,000
• Well No. 28, 29, 30, 31 (East)	4,880,000
• 12-inch, 18-inch, & 24-inch Raw Water Piping from Wells to WTP	1,100,000
• Southwest Water Treatment Plant	7,110,000
• East Side Elevated Storage (1.0 MG)	2,520,000
• West Side Elevated Storage (1.5 MG)	3,150,000
• Southwest Water Treatment Plant Ground Storage (1.5 MG)	1,790,000
• 8-inch trunk main (38,201 ft. total /East 24,789 ft & West 13,412 ft)	2,101,000
• 12-inch trunk main (92,327 ft. total /East 9,350 ft & West 82,977 ft)	6,925,000
• 16-inch trunk main (29,922 ft. total /East 0 ft & West 29,922 ft)	2,843,000

Notes:

1. Costs are for budgeting purposes only, and are subject to change as projects are studied, designed and constructed.
2. Trunk main costs shown are for the total cost. In many cases oversizing cost will apply instead of the entire construction cost. In most cases oversizing cost is that above 8-inch. However, in some commercial/industrial areas, the oversizing cost may be that above 12-inch.
3. Project Costs include 20% for contingency and 20% for engineering, legal and administrative costs.

Operation, maintenance, and replacement (OM&R) costs are not included in the capital improvement program, but have been estimated and will be included in the calculation of user rates that follows. Planning for a system's operation, maintenance and replacement is equally as important as planning for capital improvements.