Water, Sewer Collection, and Stormsewer Committee Meeting Agenda

Tuesday, May 5, 2015 7:30 a.m.
Sister Bay Fire Station — Large Meeting Room
2258 Mill Road

For additional information check: www.sisterbaywi.info

In order for everyone to hear the discussion please, turn off your cell phone. Thank you.

Call Meeting to Order
Roll Call

1	Chair – Pat Duffy		2	Scott Baker	
3	Shane Solomon			*Village Administrator – Zeke Jackson*	
	Utility Manager – Steve Jacobson			*Utility Supervisor – Mike Schell*	
	Finance Director – Juliana Neuman			*Utility Clerk – Martha Baker*	

Consider a motion to recess until conclusion of Utilities Committee – WWTP meeting
Approval of the Agenda
Approval of minutes as attached
Comments and Correspondence

Discussion Items

1. *Administrative Related Water System Related*
   a. Discussion on proposed water tower
2. *Collection System Related*
   a. New DNR required CMOM draft review for Sister Bay
3. *Stormwater System Related*
   a. None
4. *Extensions*
   a. None
5. *Matters to be placed on a future agenda or referred to a Committee, Official or Employee*

Adjournment

Public Notice

Questions regarding the nature of the agenda items or more detail on the agenda items listed above scheduled to be considered by the governmental body listed above can be directed to Zeke Jackson, Village Administrator at 920-854-4118 or at zeke.jackson@sisterbaywi.gov. It is possible that members of and possibly a quorum of members of other governmental bodies of the municipality may be in attendance at the above-stated meeting to gather information; no action will be taken by any governmental body at the above-stated meeting other than the governmental body specifically referred to above in this notice. Upon reasonable notice, a good faith effort will be made to accommodate the needs of disabled individuals through sign language interpreters or other auxiliary aid at no cost to the individual to participate in public meetings. Due to the difficulty in finding interpreters, requests should be made as far in advance as possible preferably a minimum of 48 hours. For additional information or to request this service, contact the Sister Bay Village Administrator at 854-4118, (FAX) 854-9637, or by writing to the Village Administrator at the Village Administration Building, 2383 Maple Drive, PO Box 769, Sister Bay, WI 54234. Copies of reports and other supporting documentation are available for review at the Village Administration Building during operating hours. (8 a.m. – 4 p.m. weekdays).

I hereby certify that I have posted a copy of this agenda at the following locations:

□ Administration Building □ Library □ Post Office

_____ / _____
Name Date

WATER, SEWER, AND STORMSEWER COMMITTEE MEETING MINUTES

Tuesday, April 14, 2015
Sister Bay Fire Station
2258 Mill Road
(Unapproved Version)

The April 14, 2015 meeting of the Utilities Committee was called to order by Committee Chair Patrick Duffy at 7:05 AM.

Present: Committee Chair Patrick Duffy, and Member Scott Baker.
Staff Members: Village Administrator Zeke Jackson (7:25 AM), Utility Manager Steve Jacobson, Utility Supervisor Mike Schell, Finance Director Juliana Neuman, and Utility Clerk Martha Baker.
Also Present: Peter Sauer (until 7:20 AM)
Absent: Member Shane Solomon.

Consider a motion to recess until conclusion of Utilities Committee – (WWTP) meeting
A quorum was not present for the April 14, 2015 meeting of the Wastewater Treatment Plant Utility Committee meeting. A meeting of the Wastewater Utility Committee was scheduled for May 5, 2015 at 7:00 AM.

Approval of the Agenda:
Motion was made by Duffy, seconded by Baker, to approve the April 14, 2015 agenda as presented. Motion carried – all Ayes.

Approval of the January 6, 2015 meeting minutes:
Motion was made by Baker, seconded by Duffy, to approve the January 6, 2015 minutes as presented. Motion carried – all Ayes.

Public Comments and Correspondence
No comments or correspondence.

Discussion Items
3. <u>Collection System Related</u>
d. New DNR required CMOM draft review for Sister Bay
Robert E. Lee & Associates representative Mark Schuster presented the committee with a draft proposal for the Department of Natural Resources required Capacity Management Operations and Maintenance (CMOM) program. He brought copies for Sister Bay as well as Liberty Grove. The DNR mandates that any wastewater distribution system must have a CMOM in place by July 1, 2016 or permits will not be issued. The CMOM is a continuous working document, the DNR will focus on three main points: 1) Sewer Use Ordinance/s. 2) Emergency Response Plan. 3) Future capacity for the system. He said Sister Bay does a good job of maintaining the system and. Jacobson asked the committee to review the draft and come back with questions at the next meeting.

1. <u>Administrative Related</u>:

a. Wisconsin Public Service Commission water rates

M. Baker presented the committee with the updated rate sheet showing the new water rates. M. Baker posted the new rates on the web-site and at the Administrative Office. She also put a message on the last billing cards telling customers that their next bill would reflect the new rates. She will post the rate sheet at the Library and the Post Office.

b. 2014 Financial Reports

As presented.

c. 2015 Consumer Confidence Report

M. Baker presented the committee with the DNR required 2015 Consumer Confidence Report. She put a hyperlink to the report on the last billing card and upon approval will publish it in the newspaper and submit it to the DNR. Newman asked for a formatting correction. *Motion was made by S. Baker, seconded by Duffy, to approve the report as corrected. Motion passed – all Ayes.*

2. <u>Water System Related</u>:

a. Eight water lateral freeze-ups

Jacobson reported eight water lateral freeze-ups in February.

b. Meter Testing and Replacement Program

.Jacobson said the crew has the meter testing program well under way.

c. New E Series Meters for two-inch and up

Schell showed the committee an information pamphlet from Badger Meter regarding a new type of meter that would be good for large meter replacements. Jacobson said they are less costly to install and much more accurate. Because the meters being used now will eventually be phased out, Schell said it will be cost effective to start ordering them now for replacements

d. New six-inch #3 Well meter

Jacobson said the new six-inch meter has been installed at #3 Well and Energenics will be here next week to calibrate it. They will also calibrate influent and effluent meters at the Plant.

e. New Public Service Commission meter retention requirements

Jacobson told the committee about new regulations from the Public Service Commission regarding meter retention. The PSC has ruled that all meters removed must be stored for testing for at least one billing cycle (ninety days). Our meters will be stored for six months at the storage building on Scandia Drive.

f. New Chlorine Scales for #1 Well and #2 Well

Jacobson said a new chlorine scale has been ordered for the #1 Well and #2 Well.

g. Commercial Cross Connection inspection issues

Jacobson said crew member Lang is doing an excellent job on the residential cross connection inspection program. He told the committee there have been problems getting the commercial inspection paper work from Inspection Specialist Brett Guillette and said the DNR requires the commercial inspections be done soon. Jacobson suggested contacting another company for pricing in the event we need a back-up for getting the work done in a timely fashion.

h. Discussion on proposed water tower
Jacobson presented the committee with written opinion from Village Attorney Randy Nesbitt regarding the use of Impact Fees collected. Jacobson said he sees three alternatives: 1) Build the water tower as designed. 2) Postpone and refund Impact Fees as required on an annual basis. 3) Abandon the project, refund all Impact Fees immediately and begin again with Impact Fees for a new project. He said M. Baker is preparing a spreadsheet with all Impact Fee, interest, and expenditure information going back to 2005. Jacobson will ask for a special committee meeting to discuss the issue once all the information has been compiled. Information will include the Impact Fee Spreadsheet and updated Chapters 4, 5, & 6 of the CUPAC Study. M. Baker will also compile information on the Liberty Grove Utility District #1 Impact Fees. Jackson and Jacobson will ask Attorney Nesbitt what the procedures are for refunding Impact Fees.

3. <u>Collection System Related</u>
a. Four sewer lateral freeze-ups
Jacobson reported there were four sewer lateral freeze-ups in February.

b. Forest Lift Station issues
Schell reported that there were minor repairs made to the Forest Lift Station and it is now working properly. Some of the problems involved loose brackets and check valves.

c. Jack Hammer and Cut-Off Saw purchased for future main valve, manhole and curb stop road repairs
Jacobson said the utility now has a jack-hammer and a cut-off saw.

4. <u>Stormsewer System Related</u>
a. None

5. <u>Extensions</u>
a. Garot project status
Jackson said the Garot project is moving ahead and there is now a signed Development Agreement in place. There was discussion regarding project financing and project inspection.

b. Scandia Good Samaritan project status
Jackson said the Hull Easement has not been obtained. There are several issues that are being worked on, including lighting in the Scandia Good Samaritan parking lot. Jackson does not expect progress on the easement until the Scandia project is complete. Scandia Good Samaritan is expressing concern over lack of access to County Road ZZ.

c. Department of Transportation project status
Jackson reported that the utility line burial project is moving ahead. He said the crews have cut into a junction box and found unexpected wires. Repairs are being made.

1. <u>Administrative Related</u>:

d. Consider a motion to convene into Closed Session pursuant to Wisconsin State Statutes, Section 19.85(1)(c) to discuss personnel and employee benefits
Motion was made by Duffy, seconded by Baker, to convene into Closed Session. Motion passed – all Ayes.

e. Consider a motion to reconvene into Open Session
Motion was made by Baker, seconded by Duffy, to reconvene into Open Session. Motion passed – all Ayes.

F. Consider a motion to take action if necessary
Motion was made by Duffy, seconded by Baker, that after discussion regarding Baker's increased duties and responsibilities, and for performance, to reward her with a raise of pay by $2.50 per hour. Motion passed – all Ayes.

6. <u>Matters to be placed on a future agenda or referred to a Committee, Official, or Employee</u>:
- Schedule meeting of the Utilities Committees for Tuesday, May 5, 2015.
- Jackson and Jacobson will talk to Nesbitt regarding refunding Impact Fees.
- Jackson will send letter regarding mediation to the Town of Liberty Grove.

Adjournment:
A motion was made by Duffy, seconded by Baker, to adjourn the April 14, 2015 meeting of the Water, Sewer, and Stormsewer Utilities Committee at 9:11 AM. Motion carried – all Ayes.

Respectfully submitted,
Martha Baker
Utility Clerk

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CHAPTER 4

WATER REQUIREMENTS

Projections of customer demands serve as the basis for water and sewer system capital improvements planning. Several standard methods were used in this study to project water supply needs based on estimates of population and community growth. This chapter summarizes the methodology used and the results of these projections.

4.1 WATER CONSUMPTION HISTORY

An analysis was made of past water consumption characteristics by reviewing annual pumpage and water sales records for the period from 1988 to 2005. Average and maximum day water consumption during this period, together with the amount of water sold in each customer category, have been analyzed. Projections of future water requirements are based on the results of this analysis coupled with estimates of population and community growth discussed in Chapter 3.

A summary of historical customer water usage and Sister Bay Water Utility pumpage is provided in Table 4-1. Over the 18-year period of data summarized in the table, water usage varied from a low of 44 million gallons per year (MGY) in 1988 to a high of 74 MGY in 2005. Water usage over the 2001-2004 period was relatively stable, averaging 65 MGY with little variation. Water use increased 17 percent in 2005 over 2004 levels.

Average day water utility pumpage over the past 5 years has varied between 192,000 gallons per day (gpd) and 243,000 gpd, averaging 217,000 gpd. Sister Bay Water Utility sales and pumpage trends are graphically illustrated in Figure 4-1.

A recent historical summary of Utility customers served is provided in Table 4-2. Residential customers presently account for 79 percent to the Utility's customers, and 38 percent of total water sales. Commercial water use in 2005 accounted for approximately 45 percent of total sales. Sister Bay presently has no industrial water customers. Public water uses, which also include water sales to LGSD No. 1, account for approximately 17 percent of total demand.

4.1.1 LGSD No. 1 Water Usage

A summary of historical LGSD No. 1 customer water usage is provided in Table 4-3. Over the 9-year period of data summarized in the table, water usage varied from a low of 7 MGY in 2000 to a high of 9.9 MGY in 2005. Water usage by Sanitary District customers has averaged 8.03 MGY over the past five years. Average daily water consumption in 2005 was approximately 22,000 gpd.

A recent historical summary of Utility customers served is also provided in Table 4-3. Residential customers presently account for 81 percent to the District's customers, and 56 percent of the total demand. Commercial water use in 2005 accounted for approximately 44 percent of total sales. LGSD No. 1 does not have any industrial or public authority water customers.

TABLE 4-1

WATER CONSUMPTION HISTORY

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Annual Water Sales (MGY)				System Uses	Total Usage (MGY)	Total Pumpage (MGY)	% Pumpage Metered
	Resi-dential	Com-mercial	Indust-rial	Public*				
1988	13.471	25.044	0.000	5.438	---	43.953	73.070	60.2%
1989	15.290	25.236	0.000	6.090	---	46.615	52.277	89.2%
1990	15.517	23.588	0.000	5.876	---	44.981	51.538	87.3%
1991	17.929	25.520	0.000	6.431	---	49.879	54.872	90.9%
1992	17.330	24.778	0.000	6.391	---	48.500	62.343	77.8%
1993	17.649	26.527	0.000	7.605	---	51.781	66.984	77.3%
1994	19.888	29.570	0.000	8.537	---	57.996	71.106	81.6%
1995	19.514	32.460	0.000	9.170	---	61.144	78.726	77.7%
1996	19.586	30.065	0.000	8.630	---	58.281	75.491	77.2%
1997	21.109	32.461	0.000	9.122	0.904	63.596	68.630	92.7%
1998	24.392	**36.721**	0.000	9.994	1.264	72.371	87.293	82.9%
1999	22.778	34.257	0.000	8.228	1.982	67.245	83.516	80.5%
2000	21.017	28.877	0.000	7.870	1.042	58.806	85.448	68.8%
2001	23.745	31.862	0.000	8.182	1.792	65.581	73.906	88.7%
2002	22.529	32.258	0.000	8.502	1.802	65.091	70.207	**92.7%**
2003	24.454	32.109	0.000	8.767	0.587	65.917	79.459	83.0%
2004	21.910	30.849	0.000	9.239	1.217	63.215	83.764	75.5%
2005	**26.856**	32.259	0.000	**12.163**	**2.761**	**74.039**	**88.653**	83.5%

Maximum Value =

* Public sales include water sales to LGSD No. 1

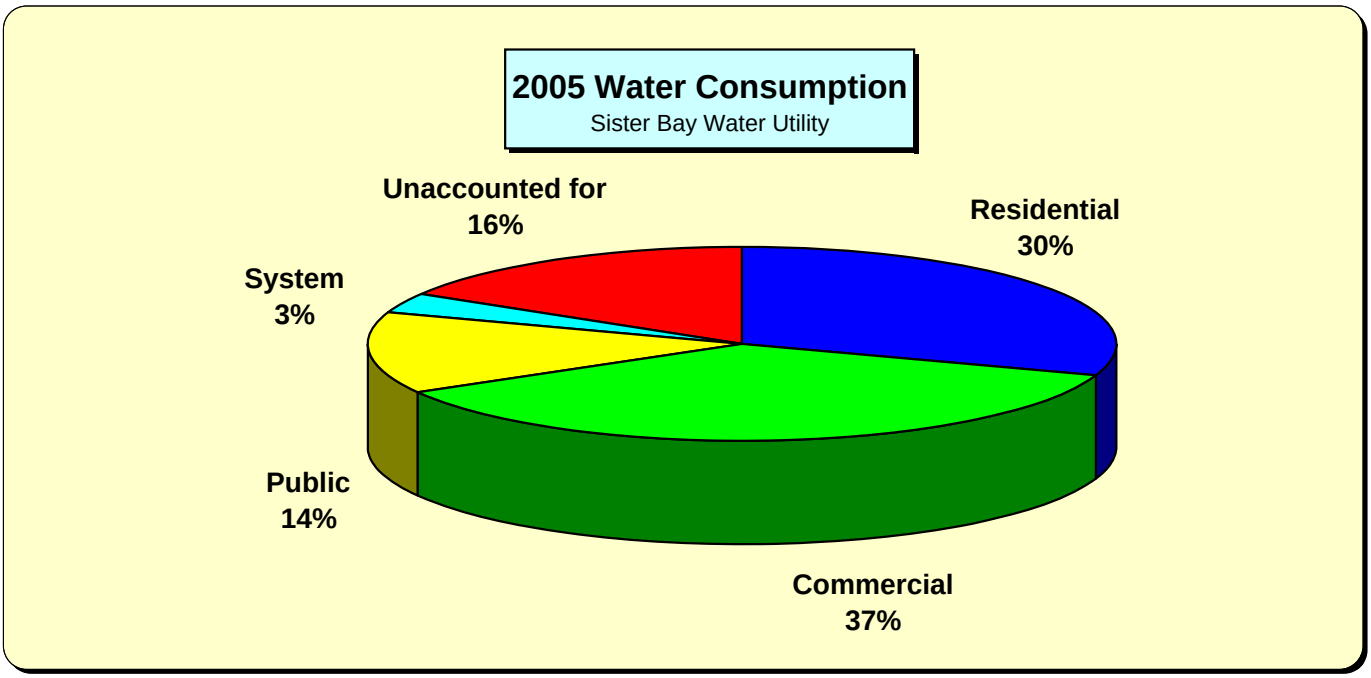


TABLE 4-2

HISTORICAL CUSTOMER SUMMARY

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Number of Customers			
	Residential	Commercial	Public Authority	**Total**
1997	606	166	9	**781**
1998	632	173	9	**814**
1999	655	174	12	**841**
2000	688	175	12	**875**
2001	696	175	12	**883**
2002	703	177	13	**893**
2003	707	179	13	**899**
2004	738	**180**	13	**931**
2005	**750**	**180**	**15**	**945**

Maximum Value =

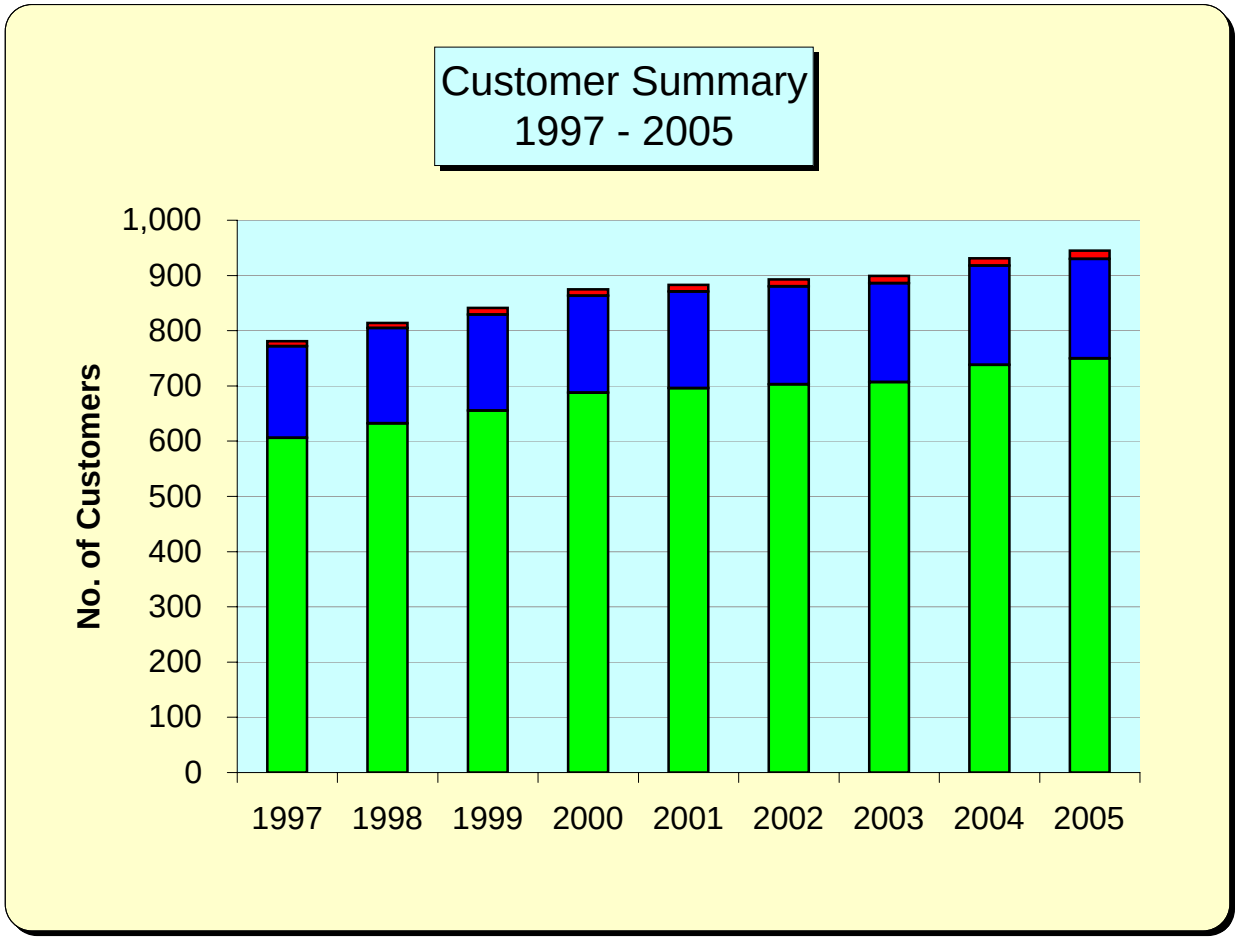


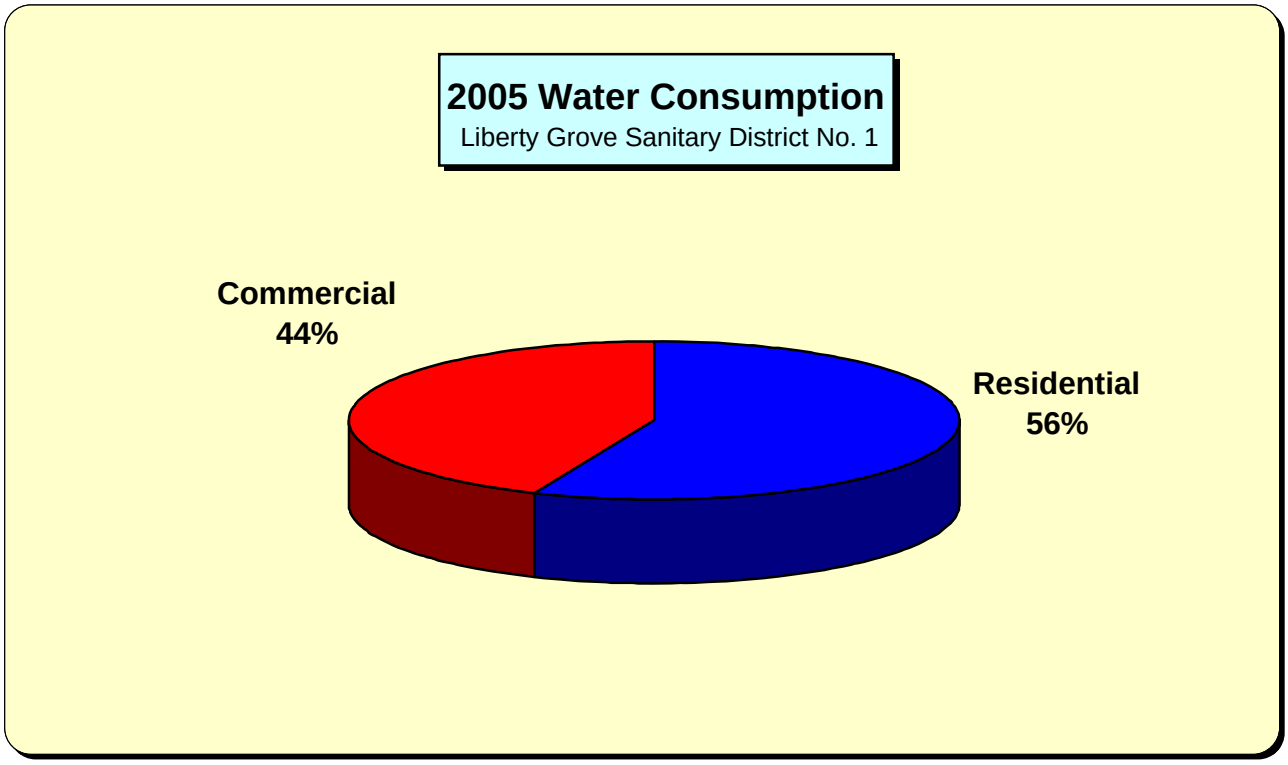
TABLE 4-3

WATER CONSUMPTION HISTORY

LIBERTY GROVE SANITARY DISTRICT NO. 1
TOWN OF LIBERTY GROVE, WISCONSIN

Year	Customers		Water Sales (MGY)		System Uses	Total Usage (MGY)
	Resi-dential	Com-mercial	Resi-dential	Com-mercial		
1997	88	23	3.377	4.246	0.066	7.689
1998	89	23	3.560	**4.968**	0.086	8.614
1999	91	23	3.444	3.807	0.064	7.315
2000	94	23	3.461	3.450	0.123	7.034
2001	96	25	3.987	3.323	0.056	7.366
2002	95	25	3.656	3.686	0.036	7.378
2003	100	25	4.111	3.425	0.049	7.585
2004	109	**26**	4.091	3.794	0.043	7.928
2005	**113**	**26**	**5.496**	4.250	**0.139**	**9.885**

Maximum Value =



4.2 PER CAPITA WATER USAGE

Residential, commercial, and public water usage can be correlated to a community's population. An analysis of per capita water consumption for the Village of Sister Bay for each of these customer classifications was made from the available sales records and is summarized in Table 4-4. Figure 4-2 illustrates the results of this analysis. As indicated in this figure, per capita sales to residential, commercial, and public customers have followed certain trends over the previous 18 years.

The apparent trend in per capita residential water usage illustrated in Figure 4-2 is consistent with observed results for other Wisconsin municipal water utilities. Although per capita residential water usage in the U.S. had consistently increased until the early 1970s, water usage statistics indicate that the increasing rate of per capita consumption has leveled off. This may be due in part to residential customers becoming more aware of water costs, and water conservation measures becoming more common.

The Utility's residential per capita consumption has remained relatively constant over the previous 5 years, averaging 70 gallons per capita per day (gpcd). To project future water needs, average daily water usage for residential customers in the Sister Bay Water Utility planning area was projected to be 70 gpcd throughout the 20-year planning period.

Over the previous 5 years, per capita commercial sales have been relatively constant, varying between 89 and 97 gpcd. For this study, it was projected that future per capita commercial consumption will average approximately 93 gpcd. Since 2001, per capita public sales have averaged 4.0 gpcd. For this study, it was projected that future per capita public consumption will continue to average approximately 4 gpcd.

4.3 LARGE WATER USERS

Water consumption can vary widely on an annual basis depending on the types of large customers served, and the annual level of commercial activity. Fluctuations in water consumption for a particular large customer can be attributed to several factors including:

1. Changes in operating schedules or capacity
2. Changes in large water using processes
3. Changes in the number of persons employed
4. Seasonal variation in irrigation requirements
5. Seasonal changes in business activity
6. Implementation of conservation measures

Table 4-5 summarizes annual water sales to the major Utility water customers over the 2001-2005 period. A review of recent water sales records indicates that the top nine Sister Bay high volume water users consumed 52 percent of the total 2005 commercial water sales. Consequently, any significant changes in water consumption characteristics by these high volume users could have a very large impact on total Utility water requirements.

4.4 UNACCOUNTED-FOR WATER

There is generally a close relationship between the total gallons of water pumped, and the gallons of water metered and sold to water utility customers. Total metered water sales are always less than the amount of pumpage due to several factors, including:

TABLE 4-4

HISTORICAL PER CAPITA USAGE

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Estimated Population	GALLONS PER CAPITA PER DAY				
		Residential	Commercial	Public*	Total Metered	Total Pumpage
1988	653	56.4	104.8	22.8	183.9	305.7
1989	664	63.1	104.1	25.1	192.3	215.7
1990	675	63.0	95.7	23.9	182.6	209.2
1991	696	70.6	100.5	25.3	196.3	216.0
1992	717	66.0	94.4	24.4	184.8	237.6
1993	738	65.5	98.5	28.2	192.2	248.7
1994	759	71.8	106.7	30.8	209.3	256.7
1995	780	68.5	114.0	32.2	214.8	276.5
1996	801	66.8	102.6	29.5	198.9	257.5
1997	822	70.4	108.2	4.8	183.3	228.7
1998	843	79.3	119.3	4.5	203.1	283.7
1999	864	72.2	108.6	2.9	183.8	264.8
2000	886	65.0	89.3	2.6	156.9	264.2
2001	902	72.1	96.8	2.5	171.4	224.5
2002	918	67.2	96.3	3.4	166.9	209.5
2003	934	71.7	94.2	3.5	169.4	233.1
2004	950	63.0	88.7	3.8	155.5	240.9
2005	967	76.1	91.4	6.8	174.3	251.2

* Includes water sales to LGSD No. 1 (1988-1996)

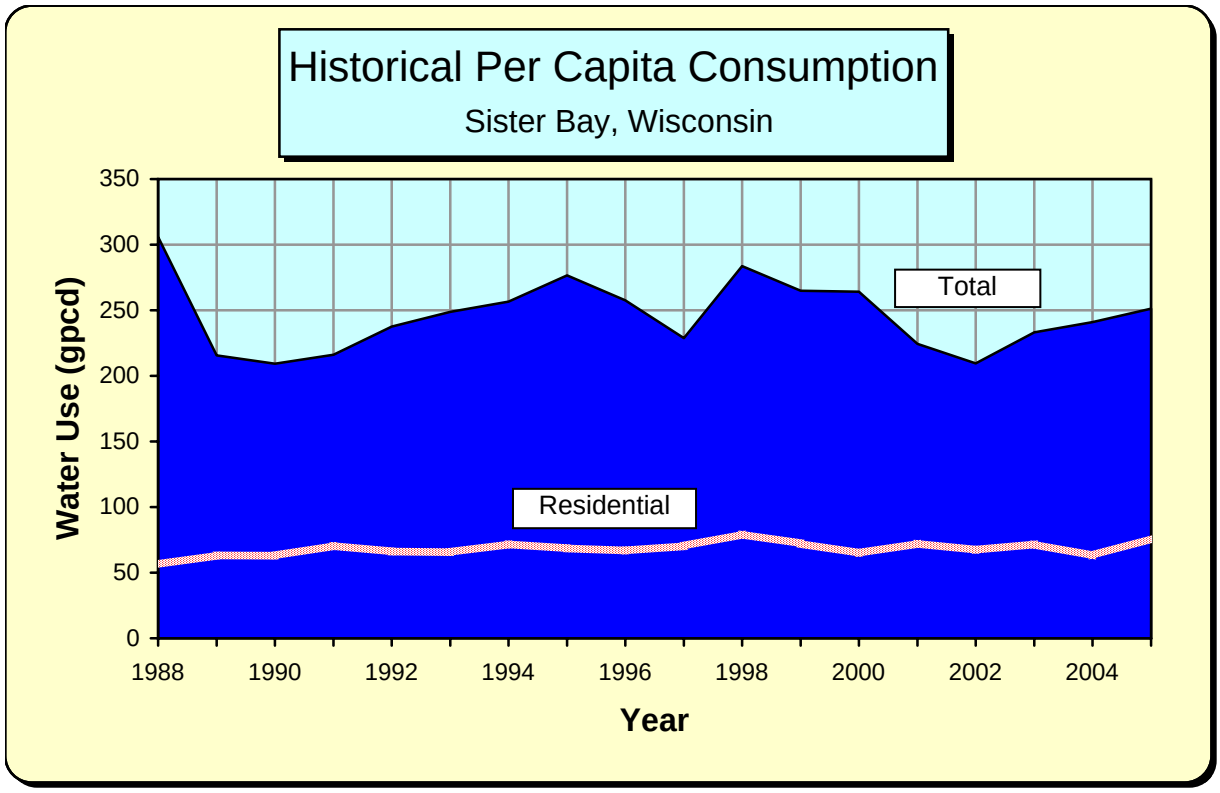


TABLE 4-5

SUMMARY OF LARGEST UTILITY CUSTOMERS
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

		LARGE CUSTOMER CONSUMPTION (MGY)				
2005 Rank	**LARGEST CUSTOMERS**	**2005**	**2004**	**2003**	**2002**	**2001**
1	Scandia Village	4.64	4.59	3.37	4.92	4.73
2	Pheasant Park Owners Association	2.84	2.24	2.40	2.46	1.86
3	Scandanavian Lodge	1.70	1.85	1.82	1.97	1.73
4	Birchwood Lodge	1.47	1.49	2.13	2.19	0.37
5	Al Johnson's Restaurant	1.41	1.29	1.31	1.26	1.56
6	DuNord Properties (LGSD)	1.05	1.07	1.20	1.22	1.29
7	Church-Hill Inn	1.02	1.04	1.06	1.03	1.07
8	Helms Four Seasons Resort	0.87	1.02	1.00	0.97	0.99
9	Final Rinse Laundromat	0.87	0.83	0.87	0.97	0.96
10	Sister Bay Bowl	0.80	0.95	0.70	1.18	0.65
	Total	**16.67**	**16.36**	**15.87**	**18.16**	**15.21**

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1. Unmetered water usage for maintenance purposes such as hydrant flushing and water main repairs
2. Unmetered water usage for fire fighting
3. Inaccuracies in water metering devices
4. Unaccounted-for public water usage
5. Leakage within the distribution system

The difference between total pumpage and total water sales is termed "unaccounted-for" water. The amount of unaccounted-for water is an indication of the condition of the water system and is usually expressed as a percentage. When a distribution system is very old or poorly maintained, the percentage of unaccounted-for water often increases dramatically.

Table 4-1 provided a historical summary of the percentage of total pumpage metered over the past 18 years. The percentage of total Sister Bay pumpage metered has been reported to be as low as 60 percent and as high as 93 percent since 1988. This high degree of fluctuation is often common for small public water utilities, and can be influenced by the factors summarized above. For example, the percentage of total pumpage metered would be expected to decrease in years when unusual problems with leakage or meter stoppage occurred, or when unusually high water demands for fire protection occurred. As a general rule, for small water systems the percentage of total pumpage metered should be maintained above 85 percent, which would correspond to unaccounted-for water amounting to less than 15 percent.

Over the previous 10 years, the Utility has averaged approximately 17 percent unaccounted-for water. For this study, it was assumed that the percentage of total pumpage metered in future years will be maintained at a minimum value of 15 percent.

4.5 VARIATIONS IN CUSTOMER DEMANDS AND PUMPAGE

Seasonal fluctuations in water usage are important factors in the design and sizing of water supply and storage facilities. The seasonal nature of water consumption in the Village of Sister Bay can be demonstrated by an analysis of monthly pumpage variations. The Utility's monthly pumpage variations in 2005 are presented in Table 4-6. In 2005, the maximum monthly pumpage occurred in July, while the minimum monthly pumpage occurred in March.

Maximum daily water demands usually occur during the summer months on hot days when additional water is used for watering lawns, gardening, bathing, and other recreation. The maximum day demand is defined as the amount of water pumped during a single day of the year with the highest water usage, and is often expressed as a ratio of the annual average day pumpage. The maximum day pumpage is of particular importance to water system planning, because water supply facilities are sized to meet this demand.

Table 4-7 presents the average and maximum day pumpage for each year from 1988 to 2005. The maximum day pumpage usually occurs during June, July, or August. The minimum day pumpage typically occurs during winter or early spring. Over the last 18 years, the maximum day pumpage ratio (ratio of maximum to average day pumpage) has varied from a low of approximately 1.98 in 1993 to a high of 3.21 in 2005.

To gain a better understanding of expected fluctuations in customer demands for the Village of Sister Bay; a statistical analysis was performed of historical maximum day pumpage ratios. Table 4-8

TABLE 4-6

SEASONAL PUMPAGE VARIATIONS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Month	2005 Monthly Pumpage (MG)	Percentage of Total Pumpage	Percentage of Average Pumpage
January	5.185	5.8%	70.2%
February	4.826	5.4%	65.3%
March	3.914	4.4%	53.0%
April	4.686	5.3%	63.4%
May	6.149	6.9%	83.2%
June	10.775	12.2%	145.8%
July	16.659	18.8%	225.5%
August	12.270	13.8%	166.1%
September	7.823	8.8%	105.9%
October	7.440	8.4%	100.7%
November	4.475	5.0%	60.6%
December	4.451	5.0%	60.2%
Total	**88.653**	**100.0%**	

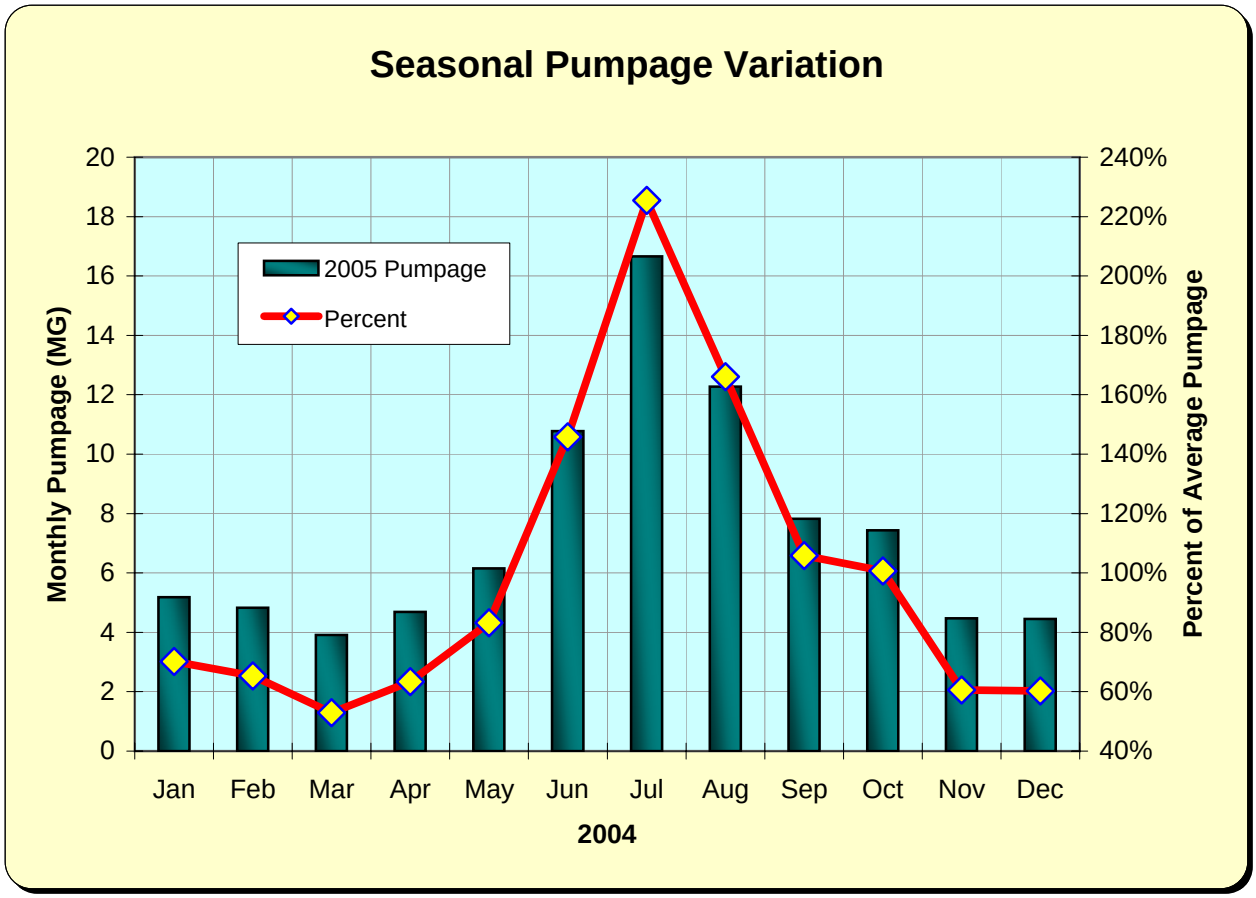


TABLE 4-7

DAILY PUMPAGE VARIATIONS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Avg. Day Pumpage (MGD)	Max. Day Pumpage (MGD)	Ratio of Max. to Avg. Day	Year	Avg. Day Pumpage (MGD)	Max. Day Pumpage (MGD)	Ratio of Max. to Avg. Day
1988	0.200	0.471	2.36	1997	0.188	0.516	2.74
1989	0.143	0.402	2.81	1998	0.239	0.698	2.92
1990	0.141	0.358	2.54	1999	0.229	0.498	2.18
1991	0.150	0.397	2.64	2000	0.234	0.467	1.99
1992	0.170	0.482	2.83	2001	0.202	0.614	3.03
1993	0.184	0.363	1.98	2002	0.192	0.524	2.72
1994	0.194	0.466	2.40	2003	0.218	0.595	2.73
1995	0.216	0.560	2.60	2004	0.229	0.590	2.58
1996	0.206	0.466	2.26	2005	**0.243**	**0.779**	**3.21**

Maximum Value =

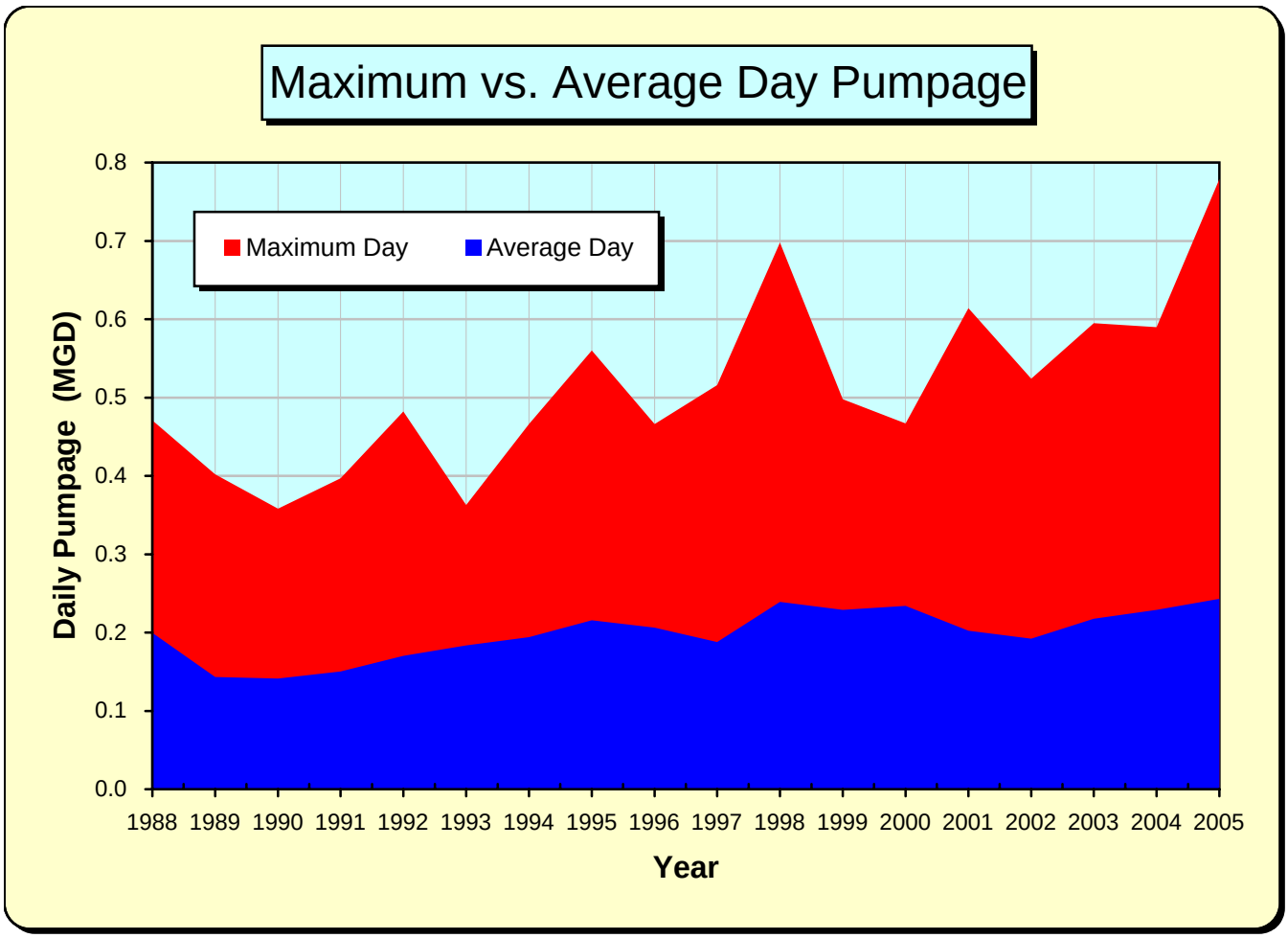


TABLE 4-8

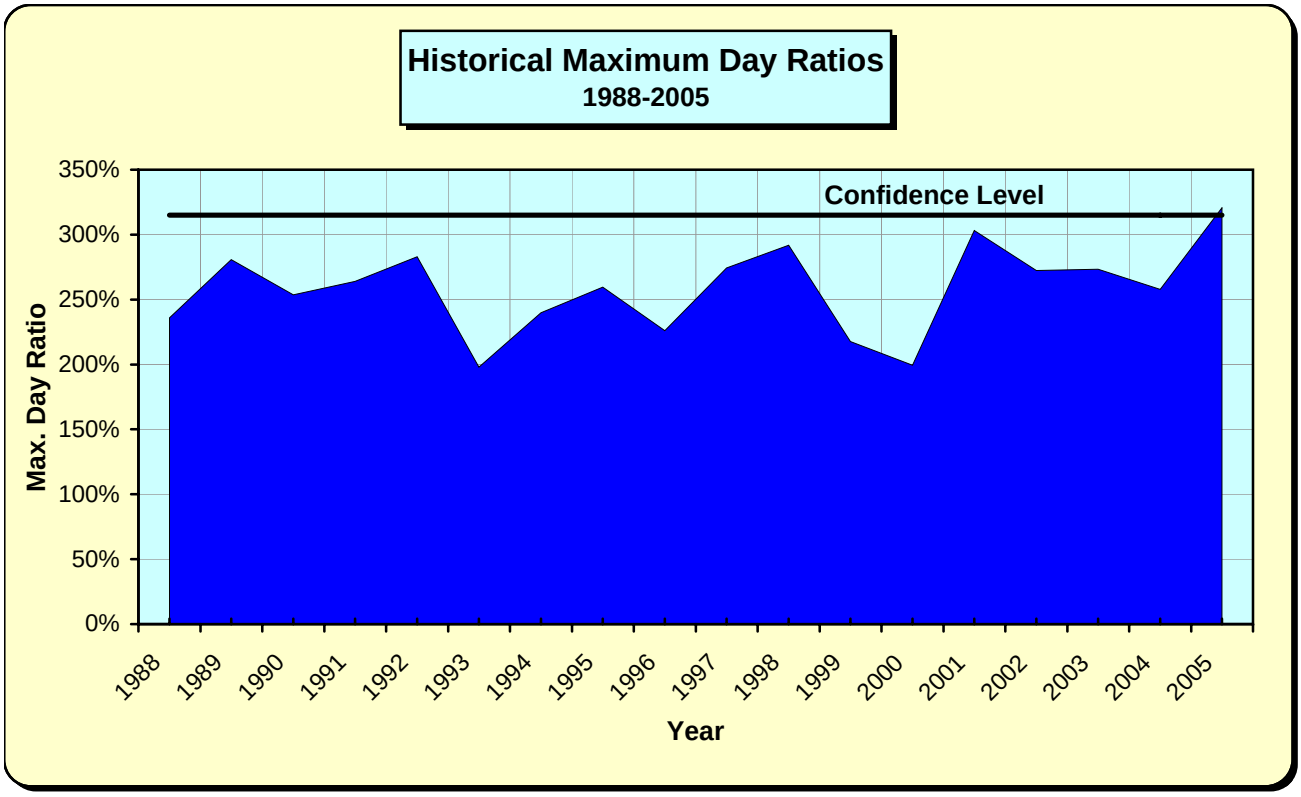
STATISTICAL ANALYSIS:
RATIO OF AVERAGE TO MAXIMUM DAY DEMAND

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

	2001 to 2005	1988 to 2005
Number of years of Data	5	18
Maximum Ratio - Max. to Avg. Day Pumpage	3.21	3.21
Minimum Ratio - Max. to Avg. Day Pumpage	2.58	1.98
Average Ratio Max. to Avg. Day Pumpage	2.86	2.58
Standard Deviation	23%	33%

Confidence Level (%)	Ratio of Max. to Avg. Day Pumpage	Ratio of Max. to Avg. Day Pumpage
80%	3.05	2.86
85%	3.09	2.93
90%	3.15	3.01
95%	3.23	3.12
98%	3.33	3.26
99%	3.39	3.35

Note The "Confidence Level" represents the probability (%) that in any given year, the actual ratio of maximum to average day pumpage will be less than or equal to the ratio indicated in the table. The ratios in the table were determined based on a statistical analysis of historical ratios over each period of analysis, assuming a normal distribution.



summarizes the results of this analysis. Two periods of analysis were examined; the entire period of 1988 to 2005, and the latest 5-year period from 2001 to 2005.

For the years 1988 to 2005, the average maximum day demand ratio was 2.58, with a standard deviation of 33 percent. In comparison, over the period of 2001 to 2005, the average ratio was 2.86, with a standard deviation of 23 percent. For this study, it was projected that future demand variations will resemble the variations observed over the most recent 5-year period.

Table 4-8 also includes a statistical analysis of expected maximum day pumpage ratios for various normal distribution confidence levels. For example, based on the analysis of the data from 2001 to 2005, there is an 80 percent chance in any given year that the actual maximum day pumpage ratio will be less than or equal to 3.05. Conversely, there is a 20 percent chance the actual ratio will exceed 3.05.

To evaluate future water supply and storage needs, a maximum day pumpage ratio of 3.15 was used for this study. This ratio provides a confidence level of 90 percent based on maximum day pumpage ratios over the past 5 years.

4.6 HOURLY DEMAND FLUCTUATIONS

The hour-to-hour variation of customer demands is also an important characteristic used to evaluate water supply and storage requirements. As with maximum day demands, peak hour demand is often expressed as a ratio of average day demand for the year. The peak hour demand is simply the hour of maximum demand that occurs on the maximum day.

The peak hourly rate for Sister Bay was estimated to be approximately 200 percent of the maximum day rate. This estimate is based on hourly demand fluctuations measured in the Sister Bay water system during field testing. The estimated diurnal water demand curve for the Sister Bay water system as determined for the September 27, 2005, field testing date is summarized in Table 4-9. As indicated in the graph in Table 4-9, Sister Bay water consumption typically peaks at three different times during the day: mid-morning, noon hour and early evening.

This diurnal demand curve is common for small, largely residential communities with little or no large industrial water consumption. This analysis would indicate a peak hour demand to average day pumpage ratio of approximately 6.3.

4.7 WATER CONSUMPTION AND PUMPAGE PROJECTIONS

Future sales and pumpage projections are based on assumptions of water demand, coupled with estimates of future population and community growth. A detailed summary of the individual components of projected water sales and pumpage requirements is provided in Table 4-10. Figure 4-3 illustrates the historical annual water sales along with the future projections.

4.7.1 Residential Sales

Residential sales were projected based on current trends and assumptions regarding future population served and per capita water consumption. By the year 2025, it is estimated that the residential consumption rate will be approximately 70 gpcd, resulting in total residential sales of approximately 36 MGY. The projected 2025 residential consumption will be about 36 percent of total annual sales.

TABLE 4-9

ESTIMATED TIME-OF-DAY DEMAND CURVE

Sister Bay Water Utility
Village of Sister Bay, Wisconsin

Time Period	September 27 2005 Time of Day	System Demand Estimate (MGD)	Percent of Average Demand
1	Midnight - 1 am	0.108	37%
2	1 am - 2 am	0.133	46%
3	2 am - 3 am	0.153	53%
4	3 am - 4 am	0.119	41%
5	4 am - 5 am	0.080	28%
6	5 am - 6 am	0.134	46%
7	6 am - 7 am	0.351	122%
8	7 am - 8 am	0.479	166%
9	8 am - 9 am	0.480	167%
10	9 am - 10 am	0.439	152%
11	10 am - 11 am	0.310	108%
12	11 am - Noon	0.334	116%
13	Noon - 1 pm	0.494	172%
14	1 pm - 2 pm	0.548	190%
15	2 pm - 3 pm	0.455	158%
16	3 pm - 4 pm	0.332	115%
17	4 pm - 5 pm	0.304	105%
18	5 pm - 6 pm	0.326	113%
19	6 pm - 7 pm	0.398	138%
20	7 pm - 8 pm	0.416	144%
21	8 pm - 9 pm	0.288	100%
22	9 pm - 10 pm	0.174	61%
23	10 pm - 11 pm	0.086	30%
24	11 pm - Midnight	0.074	26%
TOTAL DEMAND		**0.288**	

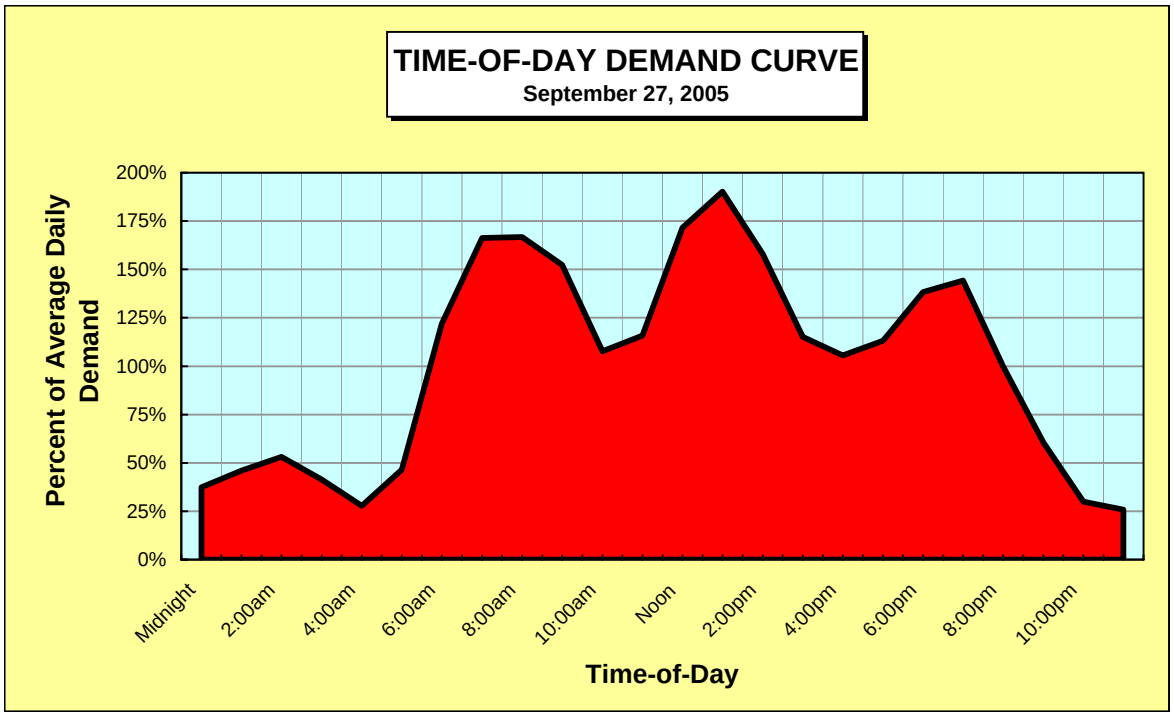


TABLE 4-10

WATER SALES & PUMPAGE PROJECTIONS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Customer Classification	Actual 2005	Projected 2015	Projected 2025
Population Served	967	1,163	1,407
Residential Sales			
Per Capita Sales (gpcd)	76.1	70	70
Annual Sales (MGY)	26.86	29.70	35.90
Public Sales			
Per Capita Sales (gpcd)	6.8	4	4
Annual Sales (MGY)	2.42	1.70	2.10
Commercial Sales			
Per Capita Sales (gpcd)	91.4	93	93
Annual Sales (MGY)	32.26	39.00	48.00
LGSD No. 1 Sales			
Annual Sales (MGY)	9.89	9.50	11.40
System Uses			
Annual Usage (MGY)	2.76	3.30	4.00
TOTAL METERED SALES (MGY)	74.18	**83.20**	**101.40**
Unaccounted-For Water (MGY)	14.48	14.70	17.90
TOTAL PUMPAGE (MGY)	*88.65*	***97.90***	***119.30***

Notes

1. Projections assume no significant changes in consumption patterns of largest Utility customers.
2. Projections assume similar proportional increases in water usage by LGSD No. 1 into the future.
3. Unaccounted-for water was projected at 15% of total pumpage for future years.

4.7.2 Public Sales

Future per capita sales to public customers were projected to be approximately 4 gpcd throughout the planning period. By the year 2025, it is estimated that public sales will be approximately 2.1 MGY, or about 2 percent of total annual sales.

4.7.3 Commercial Sales

Future per capita consumption by commercial customers was projected to be approximately 93 gpcd over the planning period. Total annual sales to commercial customers are projected to reach 48 MGY by 2025, or approximately 48 percent of total annual sales.

4.7.4 LGSD No. 1 Sales

Water use by LGSD No. 1 was projected to increase in proportion to the increase in water sales to existing residential and commercial customers of the Sister Bay Water Utility. By the year 2025, it is estimated that water consumption by LGSD No. 1 will be approximately 13.7 MGY, or about 14 percent of total annual sales.

4.8 SUMMARY OF TOTAL DEMANDS AND PUMPAGE REQUIREMENTS

The total annual metered sales projections previously summarized in Table 4-10 were based on a summation of sales projections for each major customer classification. An allowance was also made for unmetered miscellaneous water usage and losses (unaccounted-for water) to arrive at total pumpage projections.

Table 4-11 summarizes projections of future water needs. Future annual sales are projected to increase from 74 MGY to 104 MGY in 2025. Total annual pumpage should increase to approximately 122 MGY by the year 2025.

Estimates of daily demand fluctuations have also been made based on projections of future annual sales. By the year 2025, average day pumpage is projected to increase to 0.334 mgd, and maximum day pumpage is projected to increase to 1.05 mgd. Future projections of maximum day pumpage are based on a ratio of maximum day to average day of 315 percent.

Peak hour demand was projected in a similar fashion. Peak hour demand was projected by assuming a ratio of peak hour demand to maximum day pumpage of 200 percent. Peak hour demand is projected to increase to a rate of approximately 1,460 gpm by the year 2025.

4.9 WATER NEEDS FOR FIRE PROTECTION

In addition to the water supply requirements for residential, public, commercial, and LGSD customers, water system planning for fire protection needs is an important consideration. In most instances, water main sizes are designed specifically to supply needed fire flow requirements.

Guidelines for determining fire flow requirements are developed based on recommendations offered by the Insurance Services Office (ISO), which is responsible for evaluating and classifying municipalities for fire insurance rating purposes. When a community evaluation is conducted by ISO, the water system is evaluated for its capacity to provide needed fire flow at a specific location and will depend on land use

TABLE 4-11

FUTURE PUMPAGE PROJECTIONS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

	Actual 2005	Projected 2015	Projected 2025
Total Annual Sales (MGY)	74.2	85.1	103.7
Total Annual Pumpage (MGY)	88.7	100.0	122.0
Average Day Pumpage (mgd)	0.243	0.274	0.334
Design Maximum Day Pumpage (mgd)	0.765	0.860	1.050
Design Peak Hour Demand (gpm)	1,060	1,190	1,460

Notes

1. Year 2005, 2015 and 2025 design maximum day pumpage projections were estimated using a ratio of maximum to average day pumpage of 315 percent.
2. Year 2005, 2015 and 2025 design peak hour demand projections were estimated using a ratio of peak hour demand to maximum day pumpage of 200 percent.

characteristics and the types of properties to be protected. In high value districts, fire flow requirements of up to 3,500 gpm can be expected. However, based on consultations with the Sister Bay/Liberty Grove Fire Department, it was agreed that the maximum fire flow requirement of 2,000 gpm for three hours would be used for establishing water supply and storage requirements.

Therefore, for the purposes this study, the basic fire flow requirement for all high density residential and commercial developments was assumed to be 2,000 gpm for 3 hours, and 1,000 gpm for 1 hour for all medium and low density residential developments. Based on current development trends currently expected within the planning area, these basic fire flow requirements are not expected to change over the planning period.

CHAPTER 5

EXISTING WATER SYSTEM FACILITIES

The water system facilities operated and maintained by the Sister Bay Water Utility include:

1. Three groundwater wells and pump stations
2. Two elevated water storage tanks
3. Seven pressure reducing stations
4. Water system controls located in the Wastewater Treatment Plant Administration Building
5. A network of transmission and distribution water mains

The general location and layout of the water system facilities is illustrated in Figure 5-1. A schematic of the water system is illustrated in Figure 5-2. This chapter presents a summary of the design and operating characteristics of the existing water system components.

5.1 EXISTING WELLS

The Sister Bay Water Utility operates three groundwater wells located throughout the Sister Bay area. All of the wells are completed in the deep dolomite aquifer. The rock well yields are reported to range from approximately 450 gpm to 500 gpm. The constructed depths of the deep wells range from 208 to 305 feet. Current specific capacities range from approximately 10 to 16 gpm per foot of drawdown. Table 5-1 summarizes the system supply well data. Table 5-2 presents a summary of the pump and motor data for the Village's supply wells.

5.1.1 Well 1

Well 1 is located on Scandia Road immediately east of STH 42. The well was constructed in 1972 to a total depth of 208 feet. The well contains a 10-inch diameter casing to a depth of 138 feet. The well is grouted to a depth of 138 feet. Well 1's original static water level was reported to be at ground level. Fall 2005 operating conditions included a static water level of 6 feet, with a specific capacity of 10.1 gpm per foot of drawdown.

Well 1 is equipped with a Peerless 6-stage vertical turbine, line shaft pump powered by a 40 horsepower Westinghouse electric motor. The pump is rated for 400 gpm at 250 feet TDH, and is set at 120 feet. Well 1 is pumped directly into the Main Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 1 is disinfected using gas chlorine. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.2 Well 2

Well 2 is located along Smith Drive east of STH 57. The well was constructed in 1972 to a total depth of 305 feet. The well contains a 10-inch diameter casing to a depth of 171 feet. The well is grouted to a depth of 171 feet. Well 2's original static water level was reported to 92 feet below the ground surface.

TABLE 5-1

EXISTING WELL DATA

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

		SUPPLY WELLS		
Well Data		**Well 1**	**Well 2**	**Well 3**
Year Constructed		1972	1972	2000
Depth (feet)		208	305	262
Well Driller		Miller Well & Pump	Miller Well & Pump	Layne Christensen
Casing:	Diameter (in.)	10	10	12
	Depth (ft.)	138	171	171
Formation		Silurian Dolomite	Silurian Dolomite	Silurian Dolomite
Grouted Depth (ft.)		138	171	171
Original Construction:				
Static Water Level (ft.)		0	92	19
Pumping Water Level(ft.)		83	157	56
Drawdown (ft.)		83	65	37
Pumping Rate (gpm)		400	450	500
Specific Capacity (gpm/ft)		4.8	6.9	13.5
September 2005 Conditions:				
Static Water Level (ft.)		6	98	27
Pumping Water Level(ft.)		54	128	55
Drawdown (ft.)		48	30	28
Pumping Rate (gpm)		485	480	455
Specific Capacity (gpm/ft)		10.1	16.0	16.3

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TABLE 5-2

EXISTING WELL PUMP DATA

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

	Supply Wells		
Pump Data	**Well 1**	**Well 2**	**Well 3**
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Manufacturer	Peerless	Peerless	Goulds
Year Installed	1972	1972	2001
Pump Setting (feet)	120	160	180
No. of Stages	6	5	8
Rated Conditions:			
Flow Rate (gpm)	400	400	450
TDH (feet)	250	215	300
Motor Data			
Manufacturer	Westinghouse	U.S. Motors	U.S. Motors
Horsepower	40	30	50
RPM	1800	1800	1800
Voltage	230/460	230/460	230/460
Phase / Cycles	3 / 60	3 / 60	3 / 60
Standby Power:	Yes	Yes	Yes
Type	Generator	Generator	Generator
Fuel	Diesel	Diesel	Diesel
Pump Discharges to:	*Distribution System*	*Distribution System*	*Distribution System*
Pressure Zone:	*Main*	*Main*	*High Level*

C:\Documents and Settings\pplanton\My Documents\Sister Bay copy\[table5-x.xls]Table 5-2

Fall 2005 operating conditions included a static water level of 98 feet, with a specific capacity of 16 gpm per foot of drawdown.

Well 2 is equipped with a Peerless 5-stage vertical turbine, line shaft pump powered by a 30 horsepower U.S. Motors electric motor. The pump is rated for 400 gpm at 215 feet TDH, and is set at 160 feet. Well 2 is pumped directly into the Main Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 2 is disinfected using gas chlorine. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.3 Well 3

Well 3 is located at the intersection of Hill Road and North Spring Street. The well was constructed in 2001 to a total depth of 262 feet. The well contains a 12-inch diameter casing to a depth of 171 feet. The well is grouted to a depth of 171 feet. Well 3's original static water level was reported to 19 feet below the ground surface. Fall 2005 operating conditions included a static water level of 27 feet, with a specific capacity of 16.3 gpm per foot of drawdown.

Well 3 is equipped with a Gould 8-stage vertical turbine, line shaft pump powered by a 50 horsepower U.S. Motors electric motor. The pump is rated for 450 gpm at 300 feet TDH, and is set at 180 feet. Well 3 is pumped directly into the High Level Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 3 is disinfected using sodium hypochlorite. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.4 Historical Well Performance

The historical performance of each water supply well was analyzed. Available well and pump operating and performance data was collected and reviewed. The performance indicators include static and pumping water levels, pumping rate, and well specific capacity. The performance of each well with respect to each of the performance indicators is graphically summarized in Appendix A.

Seasonal declines in static water levels are apparent in each well due to high pumpage rates in summer. However, no long-term static water level decline trend is noticeable in the graphs of each well. Additionally, no significant well or pump operating concerns were observed during the inspection of the pumping facilities or during a review of the historical well performance information in Appendix A.

5.2 EXISTING BOOSTER PUMP FACILITIES

The Sister Bay Water Utility operates two booster pumping stations that supply water to the High Level Pressure Zone. Table 5-3 presents a summary of the pump and motor data for the Village's booster stations. The following sections briefly summarize the design and operating characteristics of each station.

TABLE 5-3

EXISTING BOOSTER PUMP DATA

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

Pump Data	BOOSTER STATION			
	Sister Bay		***Liberty Grove***	
	Pump 1	Pump 2	Pump 1	Pump 2
Pump Type	Vertical Centrifugal	Vertical Centrifugal	Vertical Centrifugal	Vertical Centrifugal
Manufacturer	Aurora	Aurora	Weinman	Weinman
Rated Conditions:				
Flow Rate (gpm)	500	500	100	100
TDH (ft.)	101.8	101.8	96	96
Pump Discharges to:	*Distribution System*	*Distribution System*	*Distribution System*	*Distribution System*
Pressure Zone:	*High Level*	*High Level*	*High Level*	*High Level*
Pump Motor Data				
Manufacturer	Marathon	Marathon		
Horsepower	20	20	5	5
Phase / Cycles	3 / 60	3 / 60	3 / 60	3 / 60
RPM	1750 - Variable	1750 - Variable	1750 - Variable	1750 - Variable
Standby Power:	Yes	Yes	Yes	Yes
Type	Generator	Generator	Generator	Generator
Fuel	Diesel	Diesel	Diesel	Diesel

5.2.1 Sister Bay Booster Station

The Sister Bay Booster Station is located inside the Well 2 pump station facility. The station is equipped with two identical Aurora vertical centrifugal pumps, powered by a 20 horsepower Marathon electric motor. The pumps are rated for 500 gpm at 102 feet TDH. Both booster pumps are equipped with variable frequency drives. The standby diesel generator that supplies emergency power to the Well 2 pump motor can also supply power to booster pump motors in the event of an emergency. Water levels in the Jungwirth Tower control the operation of the booster pumps.

5.2.2 Liberty Grove Booster Station

The Liberty Grove Booster Station is located inside the Well 3 pump station facility. The station is equipped with two identical Weinmann vertical centrifugal pumps, powered by 5 horsepower electric motors. The pumps are rated for 100 gpm at 96 feet TDH. Both booster pumps are equipped with variable frequency drives. The standby diesel generator that supplies emergency power to the Well 3 pump motor can also supply power to booster pump motors in the event of an emergency. System pressures in the High Level Zone control the operation of the booster pumps.

5.3 EXISTING STORAGE FACILITIES

The Sister Bay Water Utility operates two elevated storage facilities that provide pressure equalization for each pressure zone, provide stored water for fire protection and other emergencies, and provides a means for controlling the well and booster pumps. Table 5-4 presents a summary of the pump and motor data for the Village's booster stations. The following sections briefly summarize the design and operating characteristics of each storage tank.

5.3.1 Highway 57 Standpipe

The standpipe was constructed in 1972 immediately adjacent to Well 2 by the Brown Tank Company. The tank has a water storage volume of 100,000 gallons. The standpipe is 19 feet in diameter and has an overflow elevation of 730 feet USGS (48 feet above ground). The water level in the standpipe is maintained to provide system pressures in the Main Pressure Zone.

5.3.2 Jungwirth Tower

The Jungwirth Tower was constructed in 1996 on Jungwirth Court by the Caldwell Tank Company. The tank has a water storage volume of 150,000 gallons. The tower is approximately 110 feet high, and has an overflow elevation of 826 feet USGS. The water level in the tower is maintained to provide system pressures in the High Level Pressure Zone.

5.4 EXISTING PRESSURE REDUCING STATIONS

The Sister Bay Water Utility operates seven pressure reducing stations that provide additional water to the low level Pressure Zone in the event of a low pressure or fire fighting emergency. Three of the stations are located along the pressure boundary in northern and central Sister Bay. Two stations are located in the western area of the Village and serve the low lying areas to the east of the Jungwirth Tower.

TABLE 5-4

EXISTING ELEVATED STORAGE TANK DATA

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

	Standpipe	Jungwirth Tower
Village Location	NW of STH 57 and Smith Drive	Jungwirth Courth west of N. Highland Road
Pressure Zone Served	Main Zone	High Level Zone
Year Constructed	1972	1996
Constructed By	Brown Tank Co.	Caldwell Tank
Type	Standpipe	Single Pedestal Sphere
Storage Reservoir Material	Steel	Steel
Maximum Storage Volume (gal)	100,000	150,000
Height to Overflow (feet)	48	109.5
Overflow Elevation (feet USGS)	730	826
Base Elevation (feet USGS)	682	716.5
Diameter (feet)	19	40
Head Range (feet)	48	30

The exact pressure settings of the stations is uncertain, but they were designed to open upon a low pressure reading on the downstream side of the valve (Main Pressure Zone side), while also maintaining a required minimum upstream pressure in the High Level Pressure Zone. During the inspections performed for this study, it was observed that the older pressure reducing station located on STH 42 near the intersection of Meadow Lane was not functional.

5.5 WATER DISTRIBUTION SYSTEM

The Village's water distribution system provides a means of transporting and distributing water from the supply sources to Utility customers and other points of usage. The distribution system must be capable of supplying adequate quantities of water at reasonable pressures throughout the service area under a range of operating conditions. Furthermore, the distribution system must be able to provide not only uniform distribution of water during normal and peak demand conditions, but must also be capable of delivering adequate water supplies for fire protection purposes.

The Village of Sister Bay's water system is comprised of approximately 17 miles of water mains ranging in size up to 12 inches in diameter. The current water main size inventory is summarized in Table 5-5. Of the 17 miles of water main, 3 percent are 10 inches in diameter or larger. These large diameter water mains represent the system's primary transmission facilities. The LGSD No. 1 distribution system is comprised of over 4 miles of water mains ranging in size up to 8 inches in diameter. The current water main size inventory is summarized in Table 5-6. Of these 4 miles of water main, 79 percent are 8 inches in diameter.

The 2005 water main inventory based on pipe age for the entire water system (including Liberty Grove Sanitary District) is summarized in Table 5-7. The pipe age summary was developed through the development of the Sister Bay water system computer model. Over 70 percent of the existing distribution system was installed prior to 1990. The entire water distribution system is composed of ductile iron pipe.

5.6 WATER SYSTEM CONTROLS

The water system controls are located in the Control Room at the Sister Bay wastewater treatment plant. The existing controls consist of a computer-based telemetry control panel, allowing operators to operate and control pumps, and monitor and trend elevated tank levels. System well and booster pumps are scheduled and automatically sequenced by operators using a pump selection matrix system that uses water levels in the elevated tanks for pump operating control. Additional well and/or booster pumps are operated based on decreasing water levels in the tanks.

The water level in the Standpipe serves as the primary control for Wells 1 and 2 well pump operation. The Jungwirth Tower serves as the primary control for Well 3 and the Sister Bay and Liberty Grove Booster Station pumps.

TABLE 5-5

WATER MAIN SIZE DISTRIBUTION

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Diameter (inches)	Approximate Total Length[1] (feet)	Percentage of Total
6	11,512	13.9%
8	68,659	82.8%
10	480	0.6%
12	2,269	2.7%
Total	**82,920**	**100.0%**

[1] Source: Sister Bay Water Utility 2004 PSC Annual Report

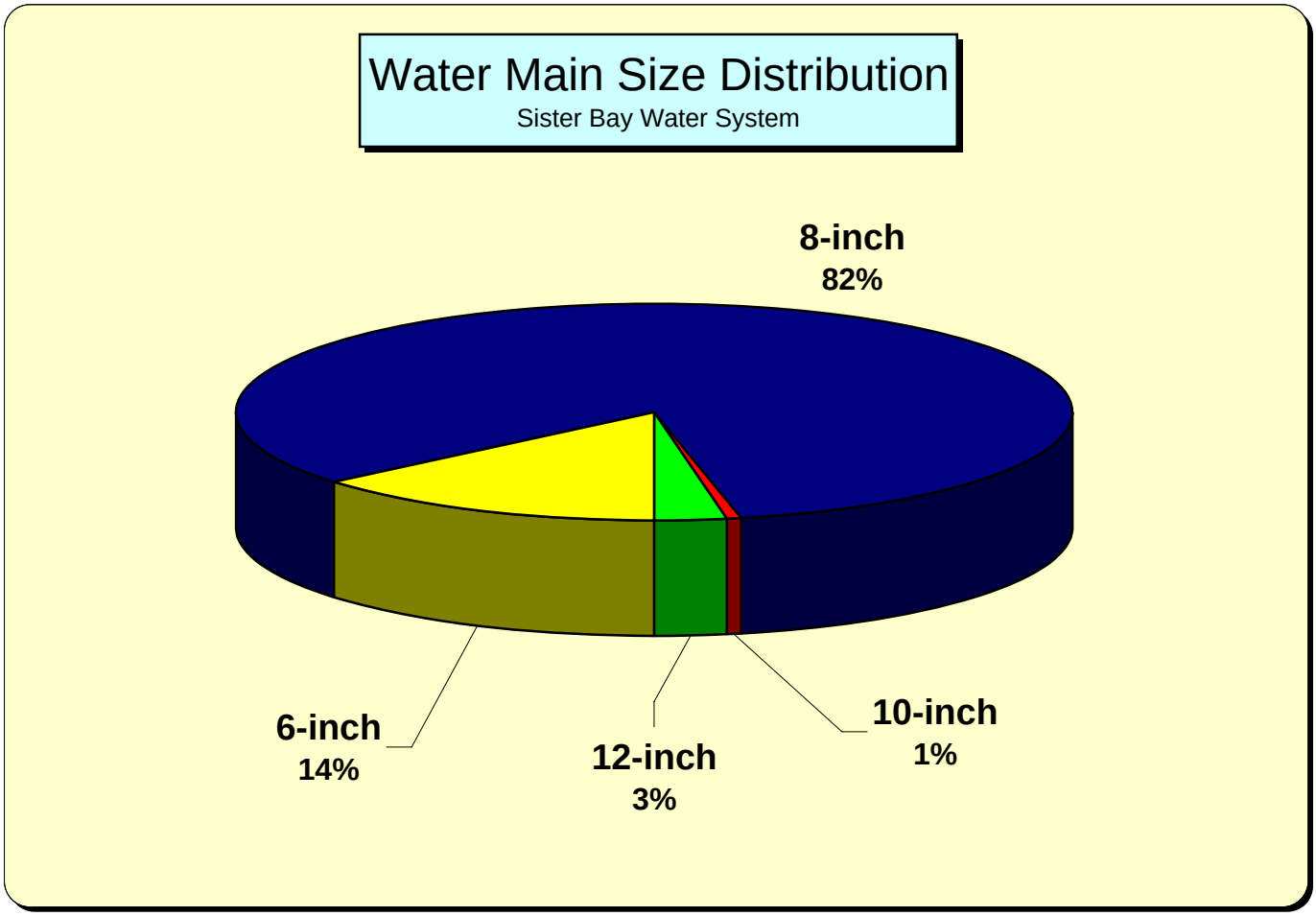


TABLE 5-6

WATER MAIN SIZE DISTRIBUTION

LIBERTY GROVE SANITARY DISTRICT NO. 1
VILLAGE OF SISTER BAY, WISCONSIN

Diameter (inches)	Approximate Total Length[1] (feet)	Percentage of Total
6	4,674	20.8%
8	17,808	79.2%
Total	**22,482**	**100.0%**

[1] Source: Liberty Grove Sanitary District No. 1 2004 PSC Annual Report

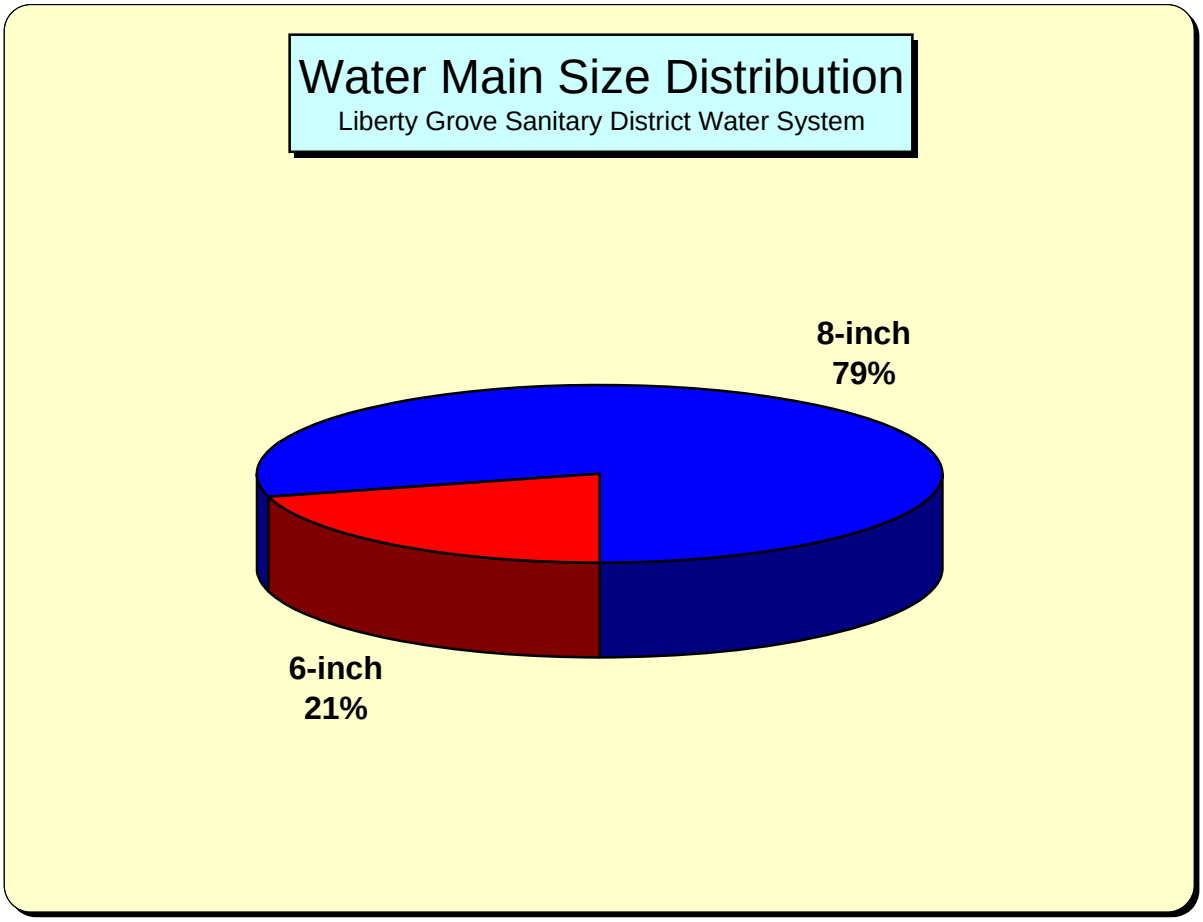


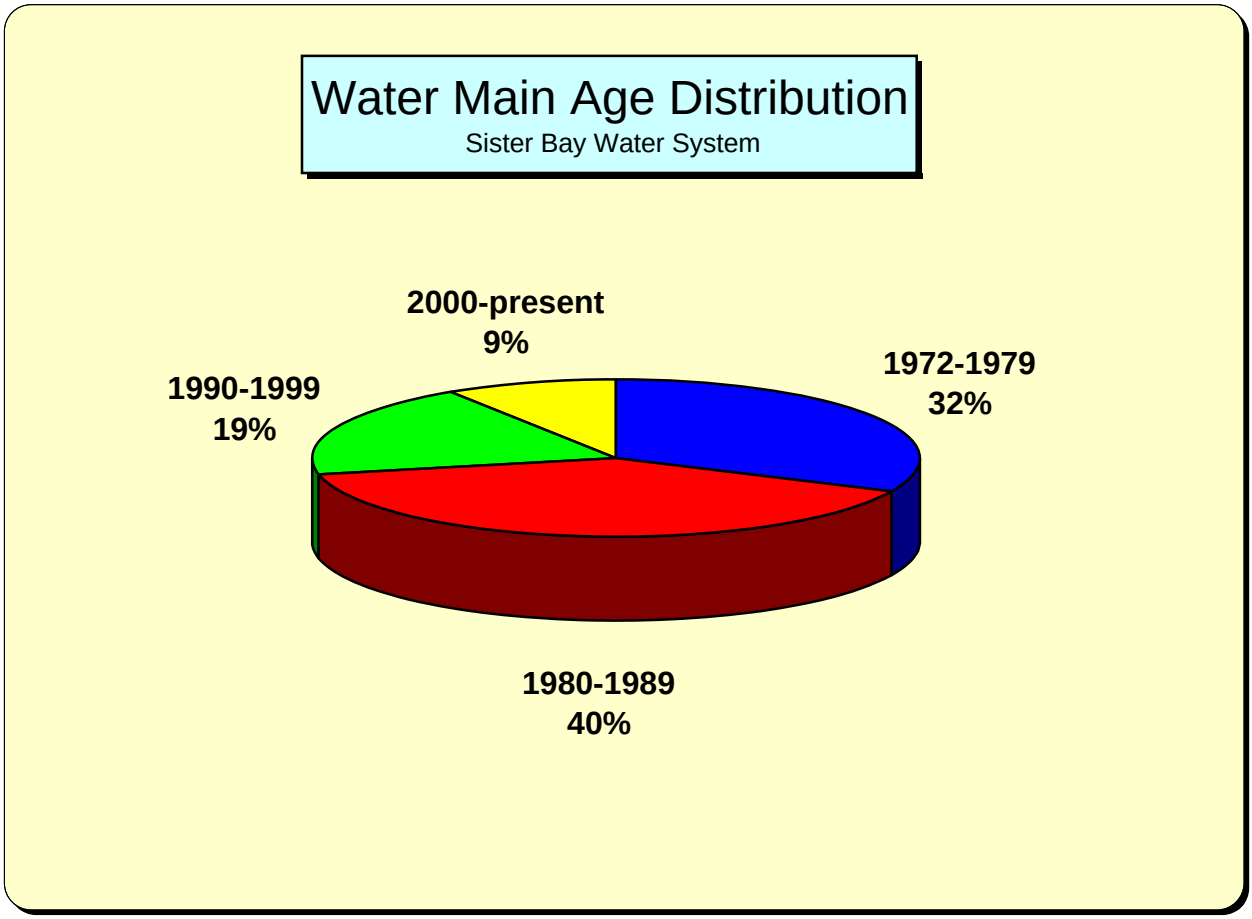
TABLE 5-7

WATER MAIN AGE DISTRIBUTION

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Pipe Material	Approximate Total Length[1] (feet)	Percentage of Total
1972-1979	37,127	31.9%
1980-1989	46,153	39.7%
1990-1999	22,515	19.3%
2000-present	10,584	9.1%
Total	**116,379**	**100.0%**

[1] Source: 2005 Sister Bay water system computer model (including Liberty Grove S.D.)



CHAPTER 6

WATER SYSTEM EVALUATION

An important component of this study was the evaluation of the existing water system and performing a deficiency analysis. This chapter summarizes the findings from this evaluation.

6.1 EXISTING SYSTEM DEFICIENCY ANALYSIS

Water systems are analyzed, planned, and designed primarily through the application of basic hydraulic principles. Some important factors that must be considered when performing this analysis include:

1. The location and capacity of supply facilities
2. The location, sizing, and design of storage facilities
3. The location, magnitude, and variability of customer demands
4. Water system geometry and geographic topography
5. Minimum and maximum pressure requirements
6. Land use characteristics with respect to fire protection needs
7. Other operational criteria which define the manner in which the system can most efficiently be operated

For this study, an evaluation of the Sister Bay water system was performed to determine the adequacy of the system to supply existing and future water needs and to supply water for fire protection purposes.

The system was evaluated based on the following criteria:

1. Pressure
2. Flow Capacity
3. Reliability
4. Supply
5. Storage

The water system evaluation was based on compliance with Wisconsin State code requirements and standard water industry engineering practice.

6.2 WATER SYSTEM COMPUTER MODEL

A computer model was developed of the Village's water distribution system. The Sister Bay system was modeled using *H_2OMap*, a pipe network program developed by MWH Soft. Individual system water pipe roughness coefficients were estimated based on the diameter and types of pipe materials, and approximate age of each section of water main using roughness aging curves developed from field testing of the Sister Bay system.

The Sister Bay water system model was calibrated using results of flow testing performed for this study in Fall 2005. Table 6-1 summarizes flow testing results. During the model calibration process, pumping rates, customer demands, and tower water levels were set to the field conditions, and pipe roughness coefficients were adjusted until the calibrated system model adequately simulated field test data.

TABLE 6-1

SYSTEM FLOW TEST RESULTS

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

Date of Testing: September 26 & 27, 2005

Test No.	Hyd. No.	Flowing Hydrant Street	Flowing Hydrant Street	Flow (gpm)	Hyd. No.	Residual Hydrant Street	Residual Hydrant Street	Static (psi)	Residual (psi)
F-1	254	North end of Hillcrest Drive Cul-de-sac		420	316	First Hydrant south of flowing		55	41
F-2	314	North end of Beach Road		508	34	Beach Road	Bayview Road	84	62
F-3	18	Bay Shore Drive - 3rd Hydrant south of Waters End Road		750	16	Bay Shore Drive - 4th Hydrant south of Waters End Road		59	38
F-4	96	Trillium Lane east of Birchwood Dr.		780	62	Birchwood Drive west of Trillium Ln.		83	59
F-5	157	North end of West Little Sister Road		828	155	1st Hydrant south of flowing		87	57
F-6	101	Bay Shore Drive west of Forest Lane		1,108	97	Bay Shore Drive	Meadow Lane	67	51
F-7	329	West end of Sunnyside Road		922	317	Sunnyside Road	Sunnyside Ct.	45	40
F-8	223	Cherrywood Lane	Koessl Lane	1,632	125	2nd Hydrant north of flowing		45	34
F-9	318	Last Hydrant east of WWTP		922	186	1st Hydrant west of flowing		82	52
F-10	245	East of Smith Drive		953	241	2nd Hydrant west of flowing		60	51
F-11	13	Mill Road	South Spring Dr.	998	37	Mill Road	Park Lane	48	38

C:\Documents and Settings\pplanton\My Documents\Projects\Sister Bay copy\[Table 6-1.xls]Results

6.3 WATER SYSTEM PRESSURES

The Sister Bay water system model was used to evaluate existing water distribution system characteristics and identify deficiencies with respect to pressures and flow capacities. Water system pressure will vary around the service area based on differences in topographic elevations, as well as supply rates and customer demands. In general, as customer demands increase, pressures will decrease. Areas higher in topographic elevation will also tend to exhibit lower water system pressures.

A water distribution system must be designed to provide pressures within a range of minimum and maximum allowable conditions. When system pressure is too low, customers may complain of inadequate water supply, customer meters may tend to record inaccurately, and fire protection will be limited. Pressures that are too high can cause problems with system operation and maintenance, and will tend to cause higher consumption rates by customers. High water system pressures can also increase the amount of water loss, as leakage rates will increase with increases in system pressure.

The Wisconsin Administrative Code requires that municipal water systems be designed with a minimum pressure of 35 psi and a maximum pressure of 100 psi at all locations in the service area under normal operating conditions. Furthermore, water systems are required to be operated so that under fire flow conditions, the residual pressure in the system will not fall below 20 psi at any location.

Highest system pressures, between 80 and 90 psi, typically occur in low topographic elevation areas of the HLPZ in the far western portions of the Village along the Green Bay shoreline, and in areas along Woodcrest Road and Scandia Road. The lowest system pressures (30 to 40 psi) can occur in the Main Pressure Zone along the pressure zone boundary near the Highway 42 and 57 intersection. Pressures in the LGSD No. 1 can range between 40 and 80 psi. The lowest pressures in the District are typically in the far eastern and northeaster portion of the service area.

Figure 6-1 illustrates ranges of water system pressures throughout the Village for a current typical peak hour demand condition. As indicated in the figure, peak hour system pressures can vary between 30 and 90 psi.

6.4 FIRE FLOW CAPACITIES

Water system planning for fire protection is an important consideration. In most instances, water main sizes are designed specifically to supply desired fire flows. Guidelines for determining fire flow requirements are provided by the ISO. ISO is the insurance service organization responsible for evaluating and classifying municipalities for fire insurance rating purposes.

Fire protection needs vary with the physical characteristics of each building to be protected. For example, needed fire flows for a specific building can vary from 500 gpm to as high as 12,000 gpm, depending on habitual classifications, separation distances between buildings, height, materials of construction, size of the building, and the presence or absence of building sprinklers. Municipal fire insurance ratings are partially based on the Village's ability to provide needed fire flows up to 3,500 gpm. If a specific building has a needed fire flow greater than this amount, the community's fire insurance rating will only be based on the water system's ability to provide 3,500 gpm.

Table 6-2 shows typical fire flow requirements for various land uses. The requirements shown in the table are only intended as a general guideline. The actual needed fire flow for a specific building can vary considerably as discussed above. The minimum fire flow requirements used as a basis for evaluating the

TABLE 6-2

TYPICAL FIRE FLOW REQUIREMENTS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Land Use	Range of Needed Fire Flows (gpm)
Single & Two-Family:	
Over 100 feet Building Separation	500
31 to 100 feet Building Separation	750
11 to 30 feet Building Separation	1,000
10 feet or Less Building Separation	1,500
Multiple Family Residential Complexes	2,000 to 3,000+
Average Density Commercial	1,500 to 2,500+
High Value Commercial	2,500 to 3,500+
Light Industrial	2,000 to 3,500
Heavy Industrial	2,500 to 3,500+
Other Commercial, Industrial & Public Buildings	Up to 12,000

C:\Documents and Settings\pplanton\My Documents\Projects\Sister Bay copy\[table6_x.xls]Table 6-2

Sister Bay water system were 1,000 gpm in medium and low density residential areas, and 2,000 gpm in all high density residential and commercial development areas.

Figure 6-2 illustrates the estimated available fire flow throughout the Village for a typical maximum day water demand while maintaining a residual pressure of 20 psi throughout the system. In general, the majority of the Village is well protected with minimum fire flows of 2,000 gpm or higher in most high density residential and commercial areas. Areas with lower available flows are primarily located on the far northeastern extremity of the system in the HLPZ, where available fire flows are less than 1,000 gpm. There is a small isolated area in the northeast corner of the HLPZ (LGSD No. 1) where available fire flows are less that the code required minimum of 500 gpm at 20 psi. The hydraulic strength of the distribution system is limited in this area, resulting in limited available fire flows.

Figure 6-3 identifies areas where fire flow deficiencies currently exist. Deficiencies were identified where the basic Sister Bay/Liberty Grove Fire Department guidelines were not met for a particular land use as determined from the planning area land use map. The primary areas identified with fire flow deficiencies include the low flow areas in the LGSD and several locations in the HLPZ with high density residential development.

6.4.1 Pipe Velocities, Head Loss, and Flow Carrying Capacity

Pipe flow velocities within the distribution system are typically well below 1 foot per second (fps) under average demand conditions. Even during periods of higher demand, flow velocities typically do not exceed 5 fps anywhere in the system. Water main pipe segments that have high flow velocities or head losses have limited flow or transmission capacity caused by the limited number and/or sizes of water mains.

6.5 SUPPLY RELIABILITY

For any water utility to serve its customers and protect the public welfare, water system facilities, equipment, and distribution systems must be reliable under all operating conditions. Reliability of utility service comprises a large part of the Water Utility's investment in plant and equipment.

Wisconsin Administrative Code requires all pumping stations to be served by a power supply from at least two independent electrical substations, or from a standby, auxiliary power source dedicated to water supply use. As a general rule, the Utility should be able to reliably supply average day customer demands and maintain adequate fire protection using auxiliary power sources.

From a review of the alternative power and supply sources available, the system can supply approximately 2.1 mgd using standby power sources in the event of an emergency or other power interruption. Therefore, the system has sufficient auxiliary power to meet current needs and projected year 2025 average day pumpage requirements. It will be important for the Utility to continue to maintain a water supply capacity provided with auxiliary sources of power to meet a minimum of an average day water demand throughout the planning period.

6.6 WATER SUPPLY AND STORAGE

A critical step in long-range planning for the Sister Bay water system was identifying the future needs of the service area coupled with an assessment of water supply and storage requirements. Water supply and storage needs are closely related. The primary criteria used in determining required supply rates and

storage volumes include maximum and peak demands, operational characteristics, and fire protection needs.

6.6.1 Reliable Supply Capacity

It is frequently necessary to take a well pump out of service for periods of several days to several weeks for maintenance. Therefore, the reliable supply capacity of a water system is the total available delivery rate with the largest pumping unit out of service. For example, under present operating conditions, the existing wells have a combined total capacity of approximately 1,440 gpm as shown in Table 6-3. However, the reliable capacity of the supply wells is approximately 950 gpm with the largest unit (Well 1) out of service.

For evaluating a municipal water system, reliable supply capacity should at least equal maximum day pumpage requirements, assuming adequate storage is available. If this criterion is met, supply facilities will have adequate capacity to replenish storage during off peak hours, while depletion of available storage occurs during peak demand hours. Using this criteria, and projections of future water supply needs, Table 6-4 summarizes minimum future supply needs.

The water utility currently has adequate supply capacity, as the existing reliable capacity (1.37 mgd) is larger than the current design maximum day pumpage of 0.77 mgd. Figure 6-4 compares historical water supply capacities with historical maximum day pumpage requirements. As illustrated in the figure, the utility should have adequate reliable supply capacity to meet current maximum day demands in the system.

Figure 6-5 compares Sister Bay water supply capacities with historical and projected maximum day pumpage requirements. As illustrated in Figure 6-5, the Utility has sufficient reliable supply capacity to meet current and future water needs throughout the planning period.

6.6.2 Water Storage Needs

In addition to providing water for fire protection, system storage is used as a “cushion” to equalize fluctuations in customer demands, establish and maintain water system pressures, provide operational flexibility for water supply facilities, and improve water supply reliability. The primary criteria used in this study for evaluating storage volume needs includes average and peak demands, water supply capacities, and fire protection needs.

In general, storage facilities should be adequately sized to provide sufficient quantities of water for fire protection on days of maximum customer demands. Although storage requirements for fire protection are not anticipated to change over the planning period of this study, peak hour demands and reliable supply capacities will change as the Village grows and improvements are implemented.

Figure 6-6 illustrates general categories of system storage. As customer demands exceed supply capacities during peak hour conditions, these excess demands must be met by depleting available storage. The amount of storage depleted is referred to as equalizing storage for peak hour requirements. Storage should also be available for fire protection purposes. To assure a reliable supply for fire protection, this reserve storage should not be utilized to meet peak hour requirements.

In some instances, it may be desirable to provide additional reserve storage for other purposes. Reserve storage may be needed as a safety factor in emergencies or where customer demands are unpredictable

TABLE 6-3

RELIABLE SUPPLY CAPACITY

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

Supply Source	***Current Minimum Operating Capacities***	
Well Pumps:	**(gpm)**	**(MGD)**
Well 1	490	0.71
Well 2	480	0.69
Well 3	470	0.68
Total Supply Capacity	1,440	2.07
Less: Largest Supply Unit	490	0.71
RELIABLE SUPPLY CAPACITY	**950**	**1.37**

Notes

1. Approximate minimum operating capacities of well pumps based on current available operating data.

C:\Documents and Settings\pplanton\My Documents\Projects\Sister Bay copy\[table6_x.xls]TABLE 6-3

TABLE 6-4

RECOMMENDED SUPPLY CAPACITY

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

	Actual 2005	Projected 2015	Projected 2025
Total Annual Pumpage (MGY)	89	100	122
Average Day Pumpage (MGD)	0.24	0.27	0.33
Design Maximum Day Pumpage (MGD)	0.77	0.86	1.05
Existing Reliable Supply Capacity (MGD)	1.37	1.37	1.37
ADDITIONAL CAPACITY REQUIRED (MGD)	**None**	**None**	**None**
ADDITIONAL CAPACITY REQUIRED (gpm)	***0***	***0***	***0***

Note

Design maximum day pumpage requirements were estimated based on 315% of average day pumpage.

* The above figures are based on the pumps running 24 hours per day.

C:\Documents and Settings\pplanton\My Documents\Projects\Sister Bay copy\Report\Chapter 6\[table6_x.xls]TABLE 6-4

and fluctuate widely. Additional storage may also be desired where a Utility wishes to take advantage of off peak electrical rates for pumping. Additional reserve storage of approximately 10 to 15 percent is usually provided to allow an operating range for well and booster pump operation.

Three primary criteria were used to develop a relationship between supply capacities and optimum storage volumes for the Village of Sister Bay:

1. Reliable supply capacity should at least equal projected maximum day pumpage requirements.

2. Total available storage should be capable of meeting fire protection needs, assuming reliable supply capacity is just adequate to meet maximum day requirements. A base fire flow of 2,000 gpm for three hours was used.

3. Reliable supply capacity, plus available storage volume, should equal or exceed fire flow requirements plus maximum day requirements.

6.6.3 Available Storage Capacity

Total available system storage was calculated based on the effective storage volume available from the elevated tank and standpipe. The effective storage volume of the elevated storage tanks is the volume in storage above the lowest water level that could by maintained and provides minimum required pressures in the system. Under normal conditions, system pressures are required to be maintained above 35 psi. Under emergency conditions, pressures may be reduced to 20 psi.

Figure 6-7 illustrates this relationship between standpipe storage volume and required minimum water levels needed for establishing system pressures. Effective peak hour operating storage and emergency storage volumes for the Sister Bay system have been determined based on minimum required system pressures in the distribution system.

The effective storage volume from the standpipe is summarized in Table 6-5. Under normal operating conditions, the standpipe water level can drop approximately 4 feet below the overflow level before system pressures can fall below the required minimum 35 psi at the highest ground elevations served by the Main Pressure Zone. Therefore, the maximum effective peak hour storage volume of the standpipe is approximately 9,000 gallons. During fire flow or emergency situations, the standpipe water level can drop an additional 35 feet, resulting in an additional 73,000 gallons of water available. Therefore, the maximum total effective storage volume of the 0.1 MG standpipe is approximately 0.082 MG.

6.6.4 Supply and Storage Requirements

The amount of water storage required is related to available supply capacity. As supply capacity is increased, the amount of storage required decreases. This relationship is illustrated in Figure 6-8, which is a plot of supply and optimum storage requirements for the Sister Bay water system in the years 2005 and 2025. Optimum storage requirements were estimated assuming future supply capacities would just equal maximum day demands.

A point is plotted on the graph in Figure 6-8 that represents existing conditions where Sister Bay supply facilities have a reliable capacity of 950 gpm, and the total storage available is 0.232 MG. To comply with the design criteria specified earlier, the point that corresponds to actual reliable supply and storage capacities should fall on or above the supply-storage curves indicated in this figure. As illustrated in the

TABLE 6-5

EFFECTIVE STANDPIPE VOLUME

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

Design Volume (gallons)	100,000
Diameter (feet)	19
Head Range (feet)	48
Storage volume per foot (gallons)	2,100
Overflow elevation (feet USGS)	730
Highest elevation served in Main Zone (feet USGS)	645
Hydraulic Grade Elevation needed to provide minimum 35 psi to all areas	726
Maximum Effective Peak Hour Storage Volume (gallons)	9,000
Hydraulic Grade Elevation needed to provide minimum 20 psi to all Main Zone areas	691
Additional Effective Fire Protection and Emergency Storage Volume (gallons)	73,000
Total Effective Storage Volume (gallons)	**82,000**

Notes

1. Effective peak hour storage is considered the volume available which will continue to maintain pressures in the distribution system at a minimum of 35 psi.
2. Effective fire protection and emergency storage is considered the volume available which will continue to maintain pressures in the distribution system of a minimum of 20 psi.

figure, while the Utility currently has adequate reliable supply capacity, there is inadequate water storage volume available to meet present and future system needs. Current and projected Sister Bay supply and storage needs are summarized in Table 6-6.

6.7 SUMMARY

This chapter summarized the findings from evaluation of the Sister Bay water system. Major findings from this evaluation include the following:

1. Under all normal operation conditions, the system provides pressures between 30 and 90 psi. There is only a very small isolated area where distribution system pressures can fall below the minimum required 35 psi. There are no locations in the existing water service area where pressures can exceed the maximum 100 psi.

2. There are several large areas within the HLPZ where available fire flows are below recommended minimum flows.

3. The system can adequately supply water to meet average day customer demands in using standby power generating equipment throughout the planning period.

4. The Utility has adequate reliable water supply capacity to meet current and projected future supply needs throughout the planning period.

5. The Utility has inadequate water storage volumes available to meet current and projected future storage needs.

TABLE 6-6

SUPPLY AND STORAGE NEEDS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

SUPPLY REQUIREMENTS	**Actual 2005**	**Projected 2015**	**Projected 2025**
Recommended Reliable Supply Capacity (gpm)	530	600	730
Present Maximum Day Reliable Supply Capacity (gpm)	950	950	950
Additional Capacity Required (gpm)	**None**	**None**	**None**

STORAGE REQUIREMENTS	**Actual 2005**	**Projected 2015**	**Projected 2025**
Peak Hour Equalizing Requirements (gallons)	97,000	109,000	133,000
Optimum Fire Protection Needs (gallons)	360,000	360,000	360,000
Reserve Storage (gallons; 10% of Total)	50,000	52,000	54,000
Total Optimum Storage Requirements (gallons)	**507,000**	**521,000**	**547,000**
Total Storage Capacity (gallons):			
Jungwirth Tower	150,000	150,000	150,000
Hwy 57 Standpipe	82,000	82,000	82,000
Total	**232,000**	**232,000**	**232,000**
Additional Capacity Required (gallons)	***275,000***	***289,000***	***315,000***

Notes

1. Peak hour storage is storage required to meet demands which exceed the reliable supply capacity. Future peak hour equalizing storage requirements were calculated assuming the available supply is equal to the maximum day demand rate.
2. Reserve storage is storage required to provide a start/stop range for well pump operation and an emergency reserve storage supply.

CHAPTER 7

RECOMMENDED WATER SYSTEM IMPROVEMENTS

This chapter summarizes recommended water system improvements. The following categories of improvements are discussed:

- Water storage improvements
- Water service to outlying areas
- Distribution system improvements
- Distribution system expansion

Based on projected growth planned for the Sister Bay Water Utility service area, the water system will require improvements to accommodate future service needs and address existing system deficiencies.

7.1 WATER STORAGE IMPROVEMENTS

To address the system's existing storage deficiency, the Water Utility currently requires an additional 0.15 MG of water storage volume. Based on projected water demand growth over the planning period and to meet the water storage needs of the planning area, the Utility will require an additional 0.25 MG of water storage volume by the year 2025. The additional recommended water storage volume needed is illustrated in Figure 7-1.

In general, a water utility has three types of storage facilities to choose from when additional water storage is required. Storage facility alternatives include:

- Clearwell Storage
- Ground Storage
- Elevated Storage

Storage located adjacent to the water supply or treatment facilities is generally defined as clearwell storage. Clearwell storage is provided to meet peak demands which exceed water supply and/or treatment production rates and to allow production facilities to operate at a constant rate which results in more uniform and efficient operation.

Ground storage is simply storage located on or beneath the ground. It is generally located within the distribution system network to provide equalization of system pressures and to supply peak or fire flow water demands. For the Sister Bay system, water from ground storage facilities would be required to be pumped into the distribution system.

Sister Bay currently utilizes an elevated tank and a standpipe to provide water system storage. Advantages of elevated storage include an increase in system reliability and reducing the need to construct large size mains to the system extremities. In contrast to ground storage, elevated storage provides increased reliability for fire protection and for emergencies during power outages or other pumping interruptions.

For this study, two types of storage, elevated and ground level, were considered suitable alternatives for addressing the planning area's additional storage needs. Table 7-1 summarizes the primary advantages and disadvantages of these two alternative storage types.

7.1.1 Alternative 1 - Ground Storage and Booster Pump Station

Alternative 1 involves the construction of a new 250,000 ground storage tank and booster pumping station. Ground storage is typically less costly to construct and maintain than elevated storage. However, a ground storage reservoir will require the Utility to construct and operate a booster pumping station. Therefore, operating costs would be higher with this option, because the stored water must be re-pumped into the distribution system.

A primary advantage of implementing a ground reservoir and pump station would be the ability of the booster pumps to overcome the limited hydraulic capacity of existing distribution system, especially in the LGSD No. 1 area. In addition, the ground reservoir approach could be constructed in phases (separate reservoirs) that would provide the Utility with the flexibility to add additional ground storage volume in the future to meet growing planning area needs. Water stored in ground reservoirs is less likely to be subjected to freezing problems compared to elevated storage. Finally, a ground storage tank could be constructed in two segments that would allow one-half of the reservoir to be removed from service for maintenance (or for seasonal operational needs), while the other half continues to function for the system.

7.1.2 Alternative 2 - Water Tower (Elevated Storage) in High Level Zone

Alternative 2 involves construction of a new 250,000 gallon water tower in the northern or central part of the High Level Pressure Zone. The primary advantages of this alternative include added reliability of elevated storage versus ground storage, lower operating costs incurred using elevated storage, and simple control methodologies needed to operate the system. This alternative should not significantly impact existing pump operating procedures of the Utility. To provide the greatest benefit to the identified lower pressure and lower fire flow areas, a new elevated tank should ideally be located close to the northeastern portion of the existing distribution system, serving the High Level Pressure Zone. A second elevated tank serving the HLPZ would work in conjunction with the existing Jungwirth Water Tower to establish pressure for the HLPZ, and provide a reliable supply of water held in storage to meet the additional water storage needs of the Utility. The additional water provided by this storage facility would be available in the Main Pressure Zone through the existing interzone PRV stations.

The primary disadvantages of constructing an additional elevated storage facility in Sister Bay would be higher capital and maintenance costs compared to costs for the same storage in a ground level facility, and concerns regarding potential water stagnation and freezing problems. Operation of a second, larger volume water tower will be problematical for the Utility, as the current average daily demand in the HLPZ is estimated to less than 0.15 mgd, while the total volume of elevated storage operated in the zone would be would be 0.40 MG.

Of even greater concern for operation of two HLPZ elevated tanks would be the current minimum-day HLPZ demand of less than 0.10 mgd, or less than one-quarter of the proposed elevated water storage volume including a third elevated tank. The potential for significant water freezing problems in elevated tanks rises sharply when winter season elevated tank turnover exceeds 2-3 days; it would be over 4 days with the addition of a new 250,000 gallon elevated tank.

TABLE 7-1

GROUND AND ELEVATED STORAGE COMPARISONS
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Advantages of Adding Additional Elevated Storage	Advantages of Adding Ground Storage
• Reliability of emergency supplies • Better water system pressure equalization which helps minimize pressure variations and reduce surging • Can be located based on water system hydraulics to minimize or eliminate need for large diameter system mains • May be possible to take advantage of off-peak electric rates to reduce pumping costs	• Lower initial construction costs (may be offset by cost of booster pumping facilities) • Lower maintenance costs • Less significant visual impact on surrounding properties • Usually less susceptible to freezing problems

Disadvantages of Adding Additional Elevated Storage	Disadvantages of Adding Ground Storage
• Available flow capacity limited by capacity of distribution system mains to transport water from tank to area of need • More susceptible to freezing problems during winter months • Significant visual impact • Higher cleaning and painting costs	• Higher operating costs associated with need to pump stored water into system and inefficiencies in dual pumping systems • Available delivery rates limited by capacity of booster pumping equipment • Pressure variations may occur when booster pumps are operated

Finally, the limited hydraulic capacity of the northern portion of the Sister Bay distribution system does not lend itself to the easy siting of a new water tower. A tower located in the northern part of the existing service area would provide minimal benefits to the southern portion of the distribution system without significant transmission main improvements. Similarly, a new tower located in the southern part of the existing service area would provide minimal benefits to the northern portion of the distribution system without significant transmission main improvements.

7.1.3 Alternative 3 - Water Tower (Elevated Storage); Combined Pressure Zones

Alternative 3 is similar to Alternative 2, and involves construction of a new 250,000 gallon water tower in the northern or central part of the High Level Pressure Zone to address the existing and future system water storage deficiency. However, in addition to the added elevated storage, Alternative 3 would also eliminate the two pressure zone system operation, by combining both pressure zones into a single zone.

Combining the pressure zones into a single zone would require the following:

- Abandon the existing seven PRV stations located on the boundary between the pressure zones
- Open all closed water main isolation valves located on the existing pressure zone boundary
- Modify Well 1 pump equipment to allow well pump to operate against the additional 90+ feet of head
- Operate the existing Hwy 57 Standpipe as a ground reservoir

The primary advantages of this storage improvement alternative are the same as Alternative 2, (greater reliability, lower operating costs, simple system control operations), but also address the water storage turnover concerns of Alternative 2. The greater demand of the combined zones would significantly reduce turnover concerns. In addition, the weak system hydraulic concerns of the northern distribution system would be eliminated by combining the pressure zones, and significantly increased available fire flows throughout the central and northern system area. Operation and maintenance of the PRV stations would also be eliminated.

The Alternative 3 water tower is still recommended to be located in the northern or central part of the existing water service area (similar to Alternative 2), and would work in conjunction with the existing Jungwirth Water Tower to establish pressure for the entire water distribution system. The standpipe would no longer establish pressure for the system, but would need to be operated as a ground reservoir.

The primary disadvantage of combining the pressure zones into a single zone would be the increased normal operating pressure throughout the Main Zone distribution system area. Pressures would increase between 35 to 40 psi in the existing Main Zone service area. Pressures in the lowest lying areas along the Green Bay shoreline would be increased to between 95 and 105 psi; but still be maintained largely below the DNR Code required maximum pressure of 100 psi. The higher available system pressures would generate significantly higher available fire flows throughout the existing Main Zone service area.

7.1.4 Storage Alternative Evaluation

The three storage improvement alternatives were screened for feasibility. Each alternative plan was evaluated with respect to each other on the basis of functional water utility operational standards. The results of this initial screening are summarized in the table below. For the terminology used in the table, a “marginal” rating indicates that, although the alternative may meet minimum criteria, it is clearly inferior

to the other alternatives, or is of doubtful long-term suitability. An "adequate" rating describes an alternative which more than meets the minimum criteria, but which exhibits either long-term unsuitability, or is not as desirable as other plans. Those alternatives that provide superior performance with the capability of meeting or exceeding all anticipated criteria, including long-term suitability, were rated as "superior".

Functional Standard	Alternative No. 1	Alternative No. 2	Alternative No. 3
System Pressure	Adequate	Superior	Adequate
Fire Flows	Adequate	Adequate	Superior
System Hydraulics	Adequate	Adequate	Superior
Water Storage Turnover	Adequate	Marginal	Adequate
Reliability	Adequate	Superior	Superior
Operational Flexibility	Adequate	Adequate	Superior
Operating Cost	Marginal	Superior	Superior
Maintenance Cost	Superior	Marginal	Marginal
System Control	Marginal	Adequate	Superior

Based on the preliminary screening of the three storage improvement alternatives, Alternative Nos. 1 and 3 are clearly superior to Alternative No. 2. Therefore, further evaluations of Alternatives No. 1 and 3 were performed, and are summarized below.

7.1.4.1 Storage Alternative No. 1 Evaluation

The criteria used to evaluate the location for a recommended ground storage reservoir/booster pump facility for Sister Bay included the following:

- Land availability
- Proximity to large water mains
- Compatibility with distribution system hydraulics
- Proximity to areas with high fire protection needs
- Proximity to future growth areas
- Compatibility of reservoir aesthetics with surrounding land uses
- Impact of future reservoir maintenance activities on surrounding property

Based on a review of potential planning area site alternatives using the above criteria, the recommended location for a new 0.25 MG ground reservoir and associated booster pump station is adjacent to the Sister Bay wastewater treatment facility on Village-owned land. This location is superior to all other potential reservoir site alternatives with respect to the siting criteria.

A new booster pump station associated with a new ground reservoir should be designed with an overall pumping capacity of 2,000 gpm with multiple pumping units (3 minimum). To minimize/eliminate

pressure surging of the system during pump startup, all pump motors should include variable frequency drive units.

Figure 7-2 illustrates computer simulated 2025 water system peak hour pressures throughout the planning area assuming Alternative No. 1 is implemented. As indicated in the figure, the majority of the future service area can be adequately served by the existing HLPZ water system. Only two future service areas cannot be served adequately with a minimum pressure of 35 psi under all normal operating conditions. These areas include higher elevation land south and west of Country Lane in the far southwestern corner of the planning area; and the corridor along STH 42 northeast of LGSD No. 1. A higher pressure plane is needed in these areas to ensure that all customers can be provided with a minimum water pressure of 35 psi under all normal operating conditions as required by Wisconsin Administrative Code, Chapter NR 811.

Figure 7-3 illustrates computer simulated 2025 water system available fire flows throughout the planning area assuming Alternative No. 1 is implemented. Available fire flows were modeled assuming a minimum system residual pressure of 20 psi. Future transmission main extensions were included in the Year 2025 system model. Significant transmission main improvements would be required to serve areas north of LGSD No. 1.

As indicated in Figure 7-3, and very similar to the modeling results illustrated in Figure 7-2, the majority of the future service area can be adequately served by the existing HLPZ water system. Only two future service areas cannot be served adequately with the minimum recommended fire flows under a Year 2025 maximum day demand condition. These areas include higher elevation land south and west of Country Lane in the far southwestern corner of the planning area; and the corridor along STH 42 northeast of LGSD No. 1 and north of Seaquist Road. These areas also cannot be served with adequate pressures.

To adequately serve these areas in the future with the minimum recommended fire flows, a higher pressure plane is needed and adequate booster pumping capacity required.

A preliminary budget estimate for the Alternative No. 1 ground reservoir and booster pump station improvements is $1,075,000. Table 7-2 summarizes a preliminary budget estimate for the Alternative No. 1 water storage improvements.

7.1.4.2 Storage Alternative No. 3 Evaluation

The same criteria used to evaluate the location for a recommended ground storage reservoir were used for siting a new elevated storage tank. Based on a review of potential planning area site alternatives using the storage tank siting criteria, the recommended location for a new 0.25 MG water tower is also adjacent to the Sister Bay wastewater treatment facility on Village-owned land. This location is superior to all other potential water tower site alternatives with respect to the siting criteria.

Figure 7-4 illustrates computer simulated 2025 water system peak hour pressures throughout the planning area assuming Alternative No. 3 is implemented. As indicated in the figure, the majority of the future service area could be adequately served by the combined, single pressure zone water system. There would be only one future service area could not be served adequately with a minimum pressure of 35 psi under all normal operating conditions with Storage Alternative No. 3 implemented. This area includes the higher elevation land south and west of Country Lane in the far southwestern corner of the planning area. The vast majority of the corridor along STH 42 northeast of LGSD No. 1 could be adequately served with Alternative No. 3, with the exception of the small area in the extreme, far northeastern corner

TABLE 7-2

PRELIMINARY BUDGET ESTIMATE
GROUND RESERVOIR & BOOSTER PUMP STATION
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Description	**Estimated Cost**
Land Acquisition	See Note Below
250,000 gallon Ground Reservoir	$375,000
Booster Pump Station	$425,000
Site Work Allowance	$25,000
Total Estimated Construction Cost	$825,000
Administrative, Engineering, Financing, Legal, & Construction Contingency Costs (30%)	$250,000
Total Estimated Project Cost	**$1,075,000**

Note: Reservoir site property owned by Village.

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of the future service area. Due to the limited area involved, it is not cost effective to provide service to this area, and service is not recommended at this time. Normal system operating pressures between 90 and 100 psi could be expected in low lying areas along the Green Bay shoreline.

Figure 7-5 illustrates computer simulated 2025 water system available fire flows throughout the planning area assuming Alternative No. 3 is implemented. Available fire flows were modeled assuming a minimum system residual pressure of 20 psi. Future transmission main extensions were included in the Year 2025 system model.

As indicated in Figure 7-5, the majority of the existing and future service area would have a significant increase in available fire flows from the distribution system. Only the future service area southwest of Country Lane could not be served adequately with the minimum recommended fire flows under a Year 2025 maximum day demand condition. This area also cannot be served with adequate pressures.

To adequately serve this area in the future with the minimum recommended fire flows, a higher pressure plane is needed and adequate booster pumping capacity required.

A preliminary budget estimate for the Alternative No. 3 elevated water storage tank improvements is $995,000. This estimate includes a very short 12 inch water main that would be required to connect the recommended water tower to the existing water system, and pump modifications for the Well 1 pump. The general location recommended for the new water tower is adjacent to the wastewater treatment plant. Table 7-3 summarizes a preliminary budget estimate for the Alternative No. 3 water storage improvements.

7.1.5 Recommendations

7.1.5.1 Water Storage Approach

Alternative No. 3 is the recommended storage alternative for the Sister Bay water system. Reliability is a primary advantage of elevated storage. Because water in storage is directly connected to the water system, no mechanical devices are required to deliver water from storage to the system when it is needed.

Alternative No. 3 has additional operational and hydraulic advantages over Alternative No. 1. Increased system pressures in low lying areas of the existing Main Zone will approach the DNR Code maximum, but will allow fire flows to be greatly increased in areas where greater fire flows are needed and higher property values exist. The Utility can eliminate the operation of all seven PRV stations, and no significant changes in equipment or operation would be required at Wells 2 and 3. The Utility should consider installing individual PRVs on all customer water services in low elevations areas immediately adjacent to Green Bay. Finally, Alternative No. 3 is estimated to be less costly to implement.

Therefore, it is recommended that a new water tower be constructed to serve the Sister Bay water system to meet the current and future storage needs of the planning area.

7.1.5.2 Water Storage Location

The new tower location adjacent to the wastewater treatment plant is the recommended site of the new elevated water storage tank. However, the comparative analysis described in Section 7.1.4 was performed looking at service levels within the entire Year 2025 planning area, assuming the needed future transmission mains are in place.

TABLE 7-3

PRELIMINARY BUDGET ESTIMATE: ALTERNATIVE NO. 3
ELEVATED WATER STORAGE TANK
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Description	**Estimated Cost**
250,000 gallon Elevated Tank	$700,000
Site Work Allowance	$25,000
Well 1 Pump Modifications	$40,000
Total Estimated Construction Cost	$765,000
Administrative, Engineering, Financing, Legal, & Construction Contingency Costs (30%)	$230,000
Total Estimated Project Cost	**$995,000**

Note: Tower site property owned by Village.

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Many of the transmission mains in the northern section of the future service area may not be constructed for many years. Therefore, to better understand the probable impacts of a second water tower serving the current water system, additional computer modeling of the existing water system was performed. Two other potential tower sites were also modeled to evaluate any significant differences on existing system pressures and fire flows using the two vs. one pressure zone approach. The anticipated hydraulic impacts to the current system are graphically illustrated in the figures in Appendix E.

As illustrated in the figures in Appendix E, there are no significant differences in anticipated water system pressures between the three different tower locations using either pressure zone approach. However, as illustrated previously in Figure 7-5, anticipated fire flows throughout the entire water system are all considerably higher using the combined pressure zone approach.

A new water tower located near the wastewater treatment plant will provide the following system benefits:

- System pressures and fire flows in the LGSD No. 1 area would be increased.
- Elimination of pressure fluctuations in the LGSD No. 1 service area.
- Higher needed fire flows in high density and commercial development areas would be provided.
- Land acquisition and associated costs are eliminated. Land is available (Village-owned property).
- Site is in close proximity to largest system water mains.
- Site is very compatibility with existing and proposed future distribution system hydraulics.
- Site is near areas with high fire protection needs and near future growth areas.
- Water tower aesthetics are compatible with surrounding land uses (park and wastewater plant buildings).
- There would be minimal impact of future tower maintenance activities on surrounding private property. Park open space adjacent to the wastewater treatment plant is ideal for construction and future maintenance of a water tower.

Therefore, based on these reasons, it is recommended that the Village construct the proposed new water tower on Village-owned park land adjacent to the wastewater treatment plant.

7.1.5.3 Water Storage Volume

Based on the supply and storage analysis performed for this study, the Water Utility needs an additional 250,000 gallons of storage or an additional 1,500 gpm of supply capacity (or a combination of both) to meet the projected system supply and storage needs by the end of the 2025 planning period. Implementing an additional 1,500 gpm of new supply capacity (3 new supply wells) is not a cost effective approach for meeting these projected requirements.

Providing all of the needed storage for the 20-year planning period in the new water tower is not recommended. Implementation of a new 250,000 gallon water tower will create significant operational problems in the winter months, when the overall system demand falls to below 150,000 gallons per day, while the Utility would be operating 400,000 gallons of elevated storage, plus the 100,000 gallons stored in the Standpipe. Tank water freezing problems due to lack of water turnover will be a major concern for

the Utility following the construction of the new water tower, even with taking the Standpipe out of service in the winter months.

A more operationally feasible approach to address long-term storage needs for the planning area and address shorter-term operational concerns would be to construct a smaller, 150,000 gallon water tower. The increasing supply and storage needs of the system should be evaluated immediately after placing the new tower into service, and then regularly evaluated at a minimum of every 3 years.

As noted above, the additional supply/storage needs can be met by implementing a new supply well project or by adding additional ground storage. A suitable site for additional ground storage is adjacent to the Standpipe. This site is already adequately equipped to pump water from the Standpipe into the distribution system. The Utility recently had the Highway 57 Standpipe inspected to determine any maintenance needs and its current structural condition. The inspection report indicated that the 34-year old Standpipe is in excellent condition. With proper regular maintenance, this storage facility should serve the water system throughout the planning period of this study. Therefore, replacing the Standpipe with a larger ground storage facility is probably not cost effective during the planning period. Adding a second ground storage reservoir at the site is one recommended alternative.

A second alternative that could be considered following the completion of the new water tower project is implementing a new water supply well. It is usually not cost-effective to increase a municipal water system's supply capacity when there already exists sufficient capacity to meet current or projected maximum day system demands. Given the Sister Bay Water Utility's very large seasonal water demand variation between summer and winter, implementing additional supply over storage may be more operationally cost effective than constructing and maintaining additional water storage capacity. Potential distribution system water quality concerns from operating excessive storage volumes would not exist; but other operational issues would also have to be addressed in operating a 4th water supply well (wellhead protection planning and zoning issues, potential contamination concerns, additional sampling requirements, routine well and pump maintenance, etc.). Figure 7-6 illustrates the water supply and storage improvements recommended to be implemented during the planning period of this study.

It is recommended that the Utility construct a second 150,000 gallon water tower adjacent to the Village's wastewater treatment plant. Table 7-4 summarizes the budget estimate for the recommended water tower storage and combined pressure zone improvement project.

It is also recommended that the Utility plan for a future 100,000 gallon ground reservoir adjacent to the Standpipe, and begin looking for potential Well 4 sites. The Utility should plan on budgeting $350,000 for a future 100,000 gallon ground reservoir project. To minimize interference effects between the existing wells and a future Well 4, it is recommended that future well sites be planned in the western and/or southwestern areas of the Village of Sister Bay. A possible site for future Well 4 could be on Village-owned property immediately adjacent to the Jungwirth Tower. The Utility should plan on budgeting $800,000 for a future Well 4 project.

7.2 WATER SERVICE TO OUTLYING AREAS

The recommended combined pressure zone distribution system would be adequate to serve areas with ground elevations ranging up to approximately 730 feet USGS. The ground elevations proposed to be served in the outlying planning area range up to over 750 feet USGS. The combined pressure zone could only adequately serve future development within the planning area with topographic elevations less than

TABLE 7-4

PROJECT BUDGET ESTIMATE
ELEVATED WATER STORAGE TANK
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Description	Estimated Cost
150,000 gallon Elevated Tank	$620,000
Site Work Allowance	$25,000
Well 1 Pump Modifications	$40,000
Total Estimated Construction Cost	$685,000
Administrative, Engineering, Financing, Legal, & Construction Contingency Costs (30%)	$210,000
Total Estimated Project Cost	**$895,000**

Note: Tower site property owned by Village.

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730 feet USGS. For the Sister Bay Water Utility to serve areas with elevations greater than 730 feet USGS, additional hydraulically separate higher level pressure zones will need to be created.

The Sister Bay water system computer model created for this study was expanded to simulate Year 2025 conditions, including transmission main extensions and 2025 water demand equivalent to full development of the planning area. Full development was assumed to occur using one level greater development density as indicated on the Study Area Land Use Map previously illustrated in Figure 2-1.

7.2.1 Future System Pressures

Figure 7-4 illustrated computer simulated 2025 water system peak hour pressures throughout the planning area. As indicated in the figure, the majority of the future service area can be adequately served by the combined pressure zone water system. Only one major future service areas could not be served adequately with a minimum pressure of 35 psi under all normal operating conditions. This area includes higher elevation land south and west of Country Lane in the far southwestern corner of the planning area. A higher pressure plane is needed in this area to ensure that all customers can be provided with a minimum water pressure of 35 psi under all normal operating conditions as required by Wisconsin Administrative Code, Chapter NR 811.

7.2.2 Future System Fire Flows

Figure 7-5 illustrated computer simulated 2025 water system available fire flows throughout the planning area. Available fire flows were modeled assuming a minimum system residual pressure of 20 psi. Future transmission main extensions were included in the Year 2025 system model. Significant transmission main improvements were assumed to serve LGSD No. 1 and the northern planning area.

As indicated in Figure 7-5, and very similar to the modeling results illustrated in Figure 7-4, the majority of the future service area can be adequately served by the recommended combined pressure zone water system. The same future service area that cannot be adequately served with pressure cannot be adequately served with the minimum recommended fire flows under a Year 2025 maximum day demand condition.

To adequately serve these areas in the future with the minimum recommended fire flows, a higher pressure plane is needed and adequate booster pumping capacity required.

7.2.3 Outlying Future Service Area Recommendations

For the outlying future service area that cannot be adequately served by the recommended combined pressure zone system, it is recommended that this area be served by a small, higher level pressure zone, supplied by a booster pump station. Because of the relatively small size of these needed pressure zone, it is recommended the zone's pressure plane be established by continuously operating variable speed booster pumps, with fire flows provided by a large capacity booster pump(s). Construction of storage facilities to serve this pressure zone is not recommended.

Service to the small area along STH 42 and north of Seaquist Road is not cost effective or recommended at this time.

Figure 7-7 illustrates a schematic of the Sister Bay water system Year 2025 that includes the recommended facilities to meet the needs of the planning area over the 20 year planning period.

7.3 DISTRIBUTION SYSTEM IMPROVEMENTS

Distribution system improvements have been recommended to strengthen the existing system, enhance supply reliability, loop water mains, and improve flow capacity and fire protection to various parts of the existing Village area.

There are several areas where the Sister Bay distribution system cannot supply the higher needed fire flows and where distribution system improvements that loop existing dead end water mains are recommended. Figure 7-8 illustrates recommended improvements to the existing water distribution system. The estimated costs of the water main segments are summarized in Table 7-5.

The existing PRV station on west STH 42 is not operational, and negates the operational benefits of the PRV station in the north Meadow Lane area. As pressures in the far western portion of the existing Village service area are not substandard (similar to the exiting Main Zone areas under a combined pressure zone system), it is recommended that the Village abandon the STH 42 PRV station, and decommission the Meadow Lane PRV station.

7.4 DISTRIBUTION SYSTEM EXPANSION

As the water system begins to expand to serve the Sister Bay future service planning area, it will be necessary to further extend the water transmission main system to adequately accommodate these new service areas.

Figure 7-8 illustrates recommended improvements to serve the future service planning service area. All major transmission mains identified in Figure 7-8 have been sized to meet projected future water system demands, and support system supply sources and storage facilities to serve outlying area land uses. Mains were sized to provide at least 2,000 gpm of flow capacity in commercial and high density residential areas and 1,000 gpm in medium and low density residential development areas at a residual pressure of 20 psi.

The mains shown in Figure 7-8 are only the recommended transmission mains. Smaller local service mains have not been shown. The transmission mains shown follow known or presumed locations for major streets or roads in the future service planning area, and have been located on a conceptual basis to run parallel to recommended trunk sanitary sewers (where feasible). Adjustments in the actual location of these mains can be expected at the time the mains or sanitary sewers are required, or as local needs dictate.

Water mains to serve developing residential land should be sized at a minimum of 8 inches in diameter. These mains should provide a minimum of 1,000 gpm at a 20 psi residual pressure in single-family areas. Fire flows of 2,000 gpm should be used as the criterion for all high density residential and commercial developments. All water mains to serve new developments should be looped; the Village should not allow dead end mains to be constructed.

The recommended improvement plan illustrated in Figure 7-8 to serve the future service area has been developed as a tool to guide the Village of Sister Bay in the siting and sizing of future system improvements. While the plan may represent the current planned expansion of the Sister Bay water system, future changes in land use, water demands, or customer characteristics could substantially alter the implementation of the plan. For this reason, it is recommended that the plan be periodically reviewed

TABLE 7-5

RECOMMENDED DISTRIBUTION SYSTEM IMPROVEMENTS
2006-2010
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Distribution Improvement	**General Location**	**Diameter** (inches)	**Approximate Length** (feet)	**Budget Cost Estimate**
Segment A	Sunny Court	8	400	$ 64,000
Segment B	N. Highland Road	8	250	$ 40,000
Segment C	Sister Bluff Drive	8	550	$ 88,000
Segment D	Country Walk Lane	8	200	$ 32,000
Segment E	STH 57 (near Smith Drive)	8	150	$ 24,000
Segment F	East of Smith Drive (north)	8	450	$ 72,000
Segment G	East of Smith Drive (south)	8	350	$ 56,000
Segment H	Little Sister Rd Loop	8	2,400	$ 384,000
TOTAL			**4,750**	**$ 760,000**

Notes

1. Recommended improvement locations shown in Figure 7-8.
2. Extensive rock excavation assumed.

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and updated using Village planning information to reflect the most current projections of Sister Bay area growth and development.

The improvement plan is a guidance document that details existing conditions and recommendations for the future. The plan is based on future conditions as perceived in 2006. As time progresses, additional information will become available and events will shape the development of the Sister Bay area. The plan must be dynamic in response; it should be studied and used but also adjusted to conform to the changes and knowledge that will come with time. Updates should be made on a regular basis. Due to the rapid rate of growth and development expected it the planning area, it is recommended that the water system master plan should be reviewed and updated (as necessary) every five years.

7.5 RECOMMENDED WATER SYSTEM CAPITAL IMPROVEMENTS

7.5.1 Estimated Cost of Water Main Improvements to Address Existing Deficiencies

The improvements to address existing deficiencies are shown in Figure 7-8. These improvements address dead end water mains in low available fire flow areas. The estimated costs to address existing deficiencies were presented in Table 7-5. These are preliminary budget estimates only, and actual costs should be determined through the competitive bidding process. The costs include anticipated contingencies and indirect project costs.

7.5.2 Estimated Cost of Supply and Transmission Main Facilities to Serve Future Growth

Preliminary cost estimates for the proposed supply and transmission main facility improvements to serve expansion areas in 2006 dollars are presented in Table 7-6. These estimates include allowances for surface restoration, construction contingencies, and indirect project costs such as engineering, finance, legal and administrative.

The linear foot costs used for the estimates may vary depending on the year the improvements are constructed. The unit costs used are based on recent projects, and make assumptions for extensive rock excavation and dewatering during construction. Actual costs may vary significantly depending upon actual conditions within the different improvement areas.

Due to the exact location of the transmission mains being unknown at this time, costs are considered preliminary. Extraordinary costs such as subsurface crossings, removal and replacement of other existing utilities, easement costs, etc., are not included in the preliminary estimates.

Table 7-6 lists the costs for the transmission mains that are needed to provide water service within the study planning area. As this study's recommendations are conceptual in nature, detailed feasibility reports and cost estimates should be prepared prior to the design and construction of any improvements.

7.5.3 Schedule of Improvements

The timing of future transmission main improvements will be influenced by a number of parameters. Items such as the location of development pressure in specific areas, aging facilities and/or facilities which are undersized, availability of funds, etc., all play a role in the timing of future transmission main sewer improvements.

TABLE 7-6

RECOMMENDED DISTRIBUTION SYSTEM EXPANSION
2007-2025
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Distribution System Expansion Segment *(as shown in Figure 7-8)*	**General Village Location**	**Diameter** (inches)	**Approximate Length** (feet)	**With Sanitary Sewer** (feet)	**Without Sanitary Sewer** (feet)	**Budget Cost Estimate**
Pipe Segment W100	Southwest	12	1,600	1,600	0	$ 198,400
Pipe Segment W101	Southwest	8	1,600	800	800	$ 239,200
Pipe Segment W102	Southwest	12	1,700	1,700	0	$ 210,800
Pipe Segment W103	Southwest	12	4,200	3,200	1,000	$ 585,800
Pipe Segment W104	South	12	3,600	3,600	0	$ 446,400
Pipe Segment W105	South	8	1,900	1,900	0	$ 222,300
Pipe Segment W106	South	12	2,200	1,000	1,200	$ 350,800
Pipe Segment W107	South	12	3,200	3,200	0	$ 396,800
Pipe Segment W108	Southeast	12	5,400	3,725	1,675	$ 778,500
Pipe Segment W109*	Southeast	12	1,300	0	1,300	$ 245,700
Pipe Segment W110	Southeast	12	1,000	1,000	0	$ 124,000
Pipe Segment W111	East	12	2,500	2,500	0	$ 310,000
Pipe Segment W112	East	12	1,310	1,310	0	$ 162,400
Pipe Segment W113	East	12	2,600	1,300	1,300	$ 406,900
Pipe Segment W114	East	12	1,300	900	400	$ 187,200
Pipe Segment W115	East	12	925	925	0	$ 114,700
Pipe Segment W116	East	12	1,000	1,000	0	$ 124,000
Pipe Segment W117	East	12	1,600	1,100	500	$ 230,900
Pipe Segment W118	East	12	3,600	1,700	1,900	$ 569,900
Pipe Segment W119	East	12	3,000	2,800	200	$ 385,000
Pipe Segment W120*	East	12	4,800	0	4,800	$ 907,200
Pipe Segment W121	Northeast	12	950	200	750	$ 166,600
Pipe Segment W122	Northeast	12	3,800	2,700	1,100	$ 542,700
Pipe Segment W123	North	12	1,450	1,200	250	$ 196,100
Pipe Segment W124	North	12	2,000	1,400	600	$ 287,000
Pipe Segment W125	Northeast	12	3,800	3,700	100	$ 477,700
Pipe Segment W126	North	12	2,760	2,560	200	$ 355,200
Pipe Segment W127	Northeast	12	2,600	1,490	1,110	$ 394,600
Pipe Segment W128	North	12	1,300	1,300	0	$ 161,200
Pipe Segment W129	North	12	5,300	5,030	270	$ 674,800
Pipe Segment W130	North	8	3,190	2,815	375	$ 397,600
Pipe Segment HL100	New HLPZ	12	1,800	500	1,300	$ 307,700
Pipe Segment HL101	New HLPZ	12	3,400	1,400	2,000	$ 551,600
Pipe Segment HL102	New HLPZ	12	2,200	1,425	775	$ 323,200
TOTAL			**84,885**	**60,980**	**23,905**	**$ 12,033,000**

Note: Extensive rock excavation assumed.
*Water main not installed in a common trench with sanitary sewer

Because of the factors involved, it is difficult to accurately predict the timing of future improvements, especially those which may occur far into the future. However, some areas of the Village are more likely to experience rapid development than others.

Based on input from Village staff, a recommended Capital Improvement Plan (CIP) for water system improvements has been developed. The CIP is broken down into short-term and long-term improvements. Short term improvements generally include improvements that are needed to address existing deficiencies. Short term improvements can also include improvements to accommodate future development in areas where development is relatively cost effective, such as areas that do not need to be served by a new high level pressure zone. Long term improvements typically include providing service to future expansion areas that are located farther from the existing system and are more expensive to construct. The CIP for short term improvements and long term improvements is presented in Table 7-7.

7.5.4 Financing of Water System Improvements

Expanding the existing water system to accommodate future development can include construction of transmission mains, and implementing new pressure zone booster stations in areas where adequate service cannot be provided by the recommended combined pressure zone system.

It is anticipated that these improvements will either be financed by a developer, assessed to benefiting properties, paid for by the Utility, or a combination thereof. Typically, construction of future transmission main improvements will be constructed and paid for in conjunction with a development project. In some communities, the costs of transmission main extensions are the sole responsibility of the developer. In other communities, the developer has the option of allowing the transmission improvements to be constructed by the Utility with all associated costs being assessed back to the benefiting properties.

Construction of future booster stations and implementation of new pressure zones can also be treated in a similar way to transmission main extensions. If the pressure zone and booster pump station are necessary only to serve new development, the entire cost of these facilities can be passed back to the identified new development. If development is staged, it may be possible to stage the improvements to track with the development. When staging improvements is not possible, over-sizing costs can be recovered through special assessments, transmission area charges, or other means. As a last resort, over-sizing costs may need to be carried by the Utility until future development occurs within the larger service area, at which time the costs can be recovered from the development through one of the methods described above.

7.5.5 Short-Term System Improvement Impacts on Utility Revenue Requirements

Table 7-8 summarizes the results of a preliminary analysis of the probable impact on Water Utility revenue requirements (rates) of implementing the recommended short-term capital improvements. The effect of the short-term improvements with respect to each revenue requirement category has been estimated.

Table 7-9 summarizes projected increases in the Water Utility's cost of service with the implementation of the proposed short-term improvements. It is projected that the improvements will cause the Utility's revenue requirements to increase by $206,100 to approximately $578,500. This represents a 143 percent increase from the Utility's 2005 operating revenues. The actual impact on water rates would need to be determined based on the Utility's revenues in the year the improvements were constructed. Water sales are projected to increase approximately 2 percent per year during the planning period.

TABLE 7-7

WATER SYSTEM CAPITAL IMPROVEMENT PLAN
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

SHORT TERM IMPROVEMENTS

Type of Improvement	System Location	Recommended Improvement	Planning Level Costs
Water Storage	Village Wastewater Treatment Plant	Construct New Water Tower	$840,000
Distribution System	South Central	Eliminate Dead End Water Mains in Low Fire Flow Areas	$760,000
Combine Pressure Zones	All	Modify Well 1 Pump to operate in Combine Zone System	$55,000
		Total	**$1,655,000**

LONG TERM IMPROVEMENTS

Type of Improvement	System Location	Recommended Improvement	Planning Level Costs
Water Supply or Storage	West Village area (supply) or adjacent to Standpipe (storage)	Construct water supply Well 4 or a new 100,000 gallon ground reservoir	$800,000
Distribution System Expansion	Planning Area	Construct Transmission Main Improvements to Support Growth and Development within Planning Area	$12,033,000
Implement New Southwest High Level Pressure Zone	Southwest	Construct Booster Pumping Station to Serve New Pressure Zone	$450,000
		Total	**$13,283,000**

TABLE 7-8

CAPITAL IMPROVEMENTS IMPACT ON UTILITY REVENUE REQUIREMENTS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

		Estimated Increase in Utility Revenue Requirements				
Recommended Water System Capital Improvement	**Budget Cost Estimate**	Operation & Maintenance Expenses	Depreciation Expense	Tax Equivalent	Return on Rate Base*	**Total**
New Water Tower	$895,000	$22,400	$17,900	$7,000	$76,000	**$123,300**
Water Main Improvements	$760,000	$3,800	$8,000	$6,000	$65,000	**$82,800**
Total	**$1,655,000**	**$26,200**	**$25,900**	**$13,000**	**$141,000**	**$206,100**

* 8.5% return on rate base assumed

TABLE 7-9

PRELIMINARY COST OF SERVICE ANALYSIS

SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

2005 Utility Revenue Requirements:

Operation & Maintenance Expenses	$197,919	
Depreciation Expense	$51,586	
Tax Equivalent	$28,358	
Authorized Return on Rate Base	$94,498	
Total		**$372,361**
Plus: Increased Revenue Requirements due to Proposed Improvements		**$206,100**
Total Projected Revenue Requirements		**$578,461**
2005 Utility Operating Revenue		$238,362
Net Service Cost Increase		$340,099
Net Service Cost Increase as a Percentage of 2005 Utility Revenue		***143%***

7.5.6 Water System Ordinance Review

As part of the analysis of future improvements, a review of the Village's existing water system regulations and ordinances was conducted. The purpose of this review was to identify any changes that could be made to the ordinances that would allow the Village to better implement the water system recommendations contained in this report.

Several documents were reviewed, including the Municipal Code of the Village of Sister Bay, and the Engineering Design Manual.

7.5.6.1 Municipal Code

The Municipal Code contains the essential rules and regulations pertaining to governance of the Village. The water system is discussed primarily in Chapter 54 (Land Division and Platting Code) and Chapter 62 (Utilities).

Chapter 54 of the Municipal Code contains Section 54.106, Water Supply Facilities. This section covers the design, installation and cost recovery aspects of constructing water distribution system facilities in conjunction with development. Section 54.106 addresses these areas quite thoroughly, and only a few suggested additions are recommended:

1. Reference this Comprehensive Utilities Plan and its role in the development review process in Section 54.106. Although this plan is conceptual and schematic in nature, this plan should be an important tool for the Village in the development review process. The plan is intended to be used as a guide, for both developers and the Village, of an efficient and economic way to construct the future distribution system. Concept plans submitted by developers should be consistent with the "spirit" of the plan, whenever possible. This may not be possible in some cases, due to unique conditions and constraints that are not known at this time. However, where it is not possible to follow the concepts identified in the plan, the developer should document why the proposed deviation would be in the best interests of the Village. Similar to the Engineering Design Manual, this plan should be kept on file at the Village Hall, and should be open to inspection by the public during normal office hours.

2. Section 54.105 (k) (3) states that the Village will pay the oversizing costs for water main pipes that need to be oversized to accommodate future development. It is not clear how the Village recovers the cost for this payment. Paying for and carrying this oversizing cost will be one of the major challenges that the Village will face in the future.

Chapter 62 of the Municipal Code is entitled "Utilities", and it provides rules for the Village water and sewer system, abandonment of private wells and cross connection control. Chapter 62 is quite comprehensive and thorough; no changes are needed. Section 62-7 (e) (2) identifies accommodating property owners in routing of water mains, and suggests looping of water mains "whenever possible". The Village should only approve dead-end water mains in very special circumstances – dead end water mains compromise public fire protection and distribution system water quality, and should not be allowed to be constructed unless there is a specific plan to loop the water main in the near-term future.

7.5.6.2 Engineering Design Manual

The Engineering Design Manual contains Chapter 7 that deals with water distribution system issues. The purpose of this chapter is to provide guidance to the designer regarding the Village's requirements for design of water system facilities. Comments on this document are listed below:

1. The required fire flow listed in Section C.5 is less than the flows used in this planning study. It is recommended that the required flows used in the Village be consistent with this report (1,000 gpm in low density residential areas, 2,000 gpm in higher density residential, commercial, industrial or public areas).

2. Required easement widths for water mains are listed in Section C.12 as 25 feet, whereas required easement widths in Village Ordinance Sections 54.105 and 62-7 are listed as 30 feet. The 30 foot dimension is recommended.

TABLE 4-1

WATER CONSUMPTION HISTORY
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Annual Water Sales (MGY)					System Uses	Total Usage (MGY)	Total Pumpage (MGY)	% Pumpage Metered
	Resi-dential	Com-mercial	Multi-Family	Indust-rial	Public*				
1988	13.471	25.044	0.000	0.000	5.438	-	43.953	73.070	60.2%
1989	15.290	25.236	-	0.000	6.090	-	46.615	52.277	89.2%
1990	15.517	23.588	-	0.000	5.876	-	44.981	51.538	87.3%
1991	17.929	25.520	-	0.000	6.431	-	49.879	54.872	90.9%
1992	17.330	24.778	-	0.000	6.391	-	48.500	62.343	77.8%
1993	17.649	26.527	-	0.000	7.605	-	51.781	66.984	77.3%
1994	19.888	29.570	-	0.000	8.537	-	57.996	71.106	81.6%
1995	19.514	32.460	-	0.000	9.170	-	61.144	78.726	77.7%
1996	19.586	30.065	-	0.000	8.630	-	58.281	75.491	77.2%
1997	21.109	32.461	-	0.000	9.122	0.904	63.596	68.630	92.7%
1998	24.392	36.721	-	0.000	9.994	1.264	72.371	87.293	82.9%
1999	22.778	34.257	-	0.000	8.228	1.982	67.245	83.516	80.5%
2000	21.017	28.877	-	0.000	7.870	1.042	58.806	85.448	68.8%
2001	23.745	31.862	-	0.000	8.182	1.792	65.581	73.906	88.7%
2002	22.529	32.258	-	0.000	8.502	1.802	65.091	70.207	92.7%
2003	24.454	32.109	-	0.000	8.767	0.587	65.917	79.459	83.0%
2004	21.910	30.849	-	0.000	9.239	1.217	63.215	83.764	75.5%
2005	26.856	32.259	-	0.000	12.163	2.761	74.039	88.653	83.5%
2006	21.758	30.655	-	0.000	10.239	0.754	63.406	77.563	81.7%
2007	26.990	31.741	-	0.000	11.018	2.149	71.898	82.979	86.6%
2008	23.674	27.537	-	0.000	8.151	1.304	60.666	73.039	83.1%
2009	22.296	34.348	-	0.000	11.002	1.859	69.505	77.938	89.2%
2010	21.125	27.374	-	0.000	10.053	2.096	60.648	72.041	84.2%
2011	23.300	29.370	-	0.000	11.329	1.109	65.108	79.727	81.7%
2012	21.590	26.707	3.045	0.000	11.077	1.337	63.756	77.195	82.6%
2013	20.211	25.200	3.145	0.000	9.006	2.779	60.341	68.452	88.2%
2014	20.690	28.175	4.204	0.000	9.795	2.012	64.876	74.534	87.0%

Maximum Value =

* Public sales include water sales to LGUD#1

TABLE 4-1

WATER CONSUMPTION HISTORY
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

YEAR	Number of Customers				
	Residential	Commercial	MultiFamily	Public Authority	Total
1997	606	166	0	9	781
1998	632	173	0	9	814
1999	655	174	0	12	841
2000	688	175	0	12	875
2001	696	175	0	12	883
2002	703	177	0	13	893
2003	707	179	0	13	899
2004	738	180	0	13	931
2005	750	180	0	15	945
2006	761	188	0	15	964
2007	776	185	0	15	976
2008	781	184	0	16	981
2009	779	186	0	15	980
2010	776	192	0	15	983
2011	808	192	0	15	1015
2012	837	195	0	15	1047
2013	843	191	20	15	1049
2014	849	188	23	15	1052

Maximum Value =

TABLE 4-1

WATER CONSUMPTION HISTORY
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Customers		Water Sales (MGY)		System Uses	Total Usage (MGY)
	Resi-dential	Com-mercial	Resi-dential	Com-mercial		
1997	88	23	0	4.246	0.066	4.312
1998	89	23	3.560	4.968	0.086	8.614
1999	91	23	3.444	3.807	0.064	7.315
2000	94	23	3.461	3.450	0.123	7.034
2001	96	25	3.987	3.323	0.056	7.366
2002	95	25	3.656	3.686	0.036	7.378
2003	100	25	4.111	3.425	0.049	7.585
2004	109	26	4.091	3.794	0.043	7.928
2005	113	26	5.496	4.250	0.139	9.885
2006	123	25	4.761	3.714	0.031	8.506
2007	134	20	6.597	2.075	0.430	9.102
2008	143	18	4.800	1.912	0.097	6.809
2009	147	18	4.658	1.830	0.061	6.549
2010	148	18	4.429	1.929	0.064	6.422
2011	150	19	4.399	1.792	0.033	6.224
2012	153	19	4.874	1.869	0.091	6.834
2013	153	19	4.105	1.937	0.080	6.122
2014	154	19	4.326	1.594	0.080	6.000

Maximum Value =

TABLE 4-1

WATER CONSUMPTION HISTORY
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Estimated Population	GALLONS PER CAPITA PER DAY					
		Residential	Commercial	MultiFamily	Public*	Total Metered	Total Pumpage
1988	653	56.4	104.8	-	22.8	183.9	305.7
1989	664	63.1	104.1	-	25.1	192.3	215.7
1990	675	63.0	95.7	-	23.9	182.6	209.2
1991	696	70.6	100.5	-	25.3	196.3	216.0
1992	717	66.0	94.4	-	24.4	184.8	237.6
1993	738	65.5	98.5	-	28.2	192.2	248.7
1994	759	71.8	106.7	-	30.8	209.3	256.7
1995	780	68.5	114.0	-	32.2	214.8	276.5
1996	801	66.8	102.6	-	29.5	198.9	257.5
1997	822	70.4	108.2	-	4.8	183.3	228.7
1998	843	79.3	119.3	-	4.5	203.1	283.7
1999	864	72.2	108.6	-	2.9	183.8	264.8
2000	886	65.0	89.3	-	2.6	156.9	264.2
2001	902	72.1	96.8	-	2.5	171.4	224.5
2002	918	67.2	96.3	-	3.4	166.9	209.5
2003	934	71.7	94.2	-	3.5	169.4	233.1
2004	950	63.0	88.7	-	3.8	155.5	240.9
2005	967	76.1	91.4	-	6.8	174.3	251.2
2006	981	60.8	85.6	-	4.9	151.3	216.6
2007	985	75.1	88.3	-	6.5	169.9	230.8
2008	990	65.5	76.2	-	4.0	145.7	202.1
2009	989	61.8	95.2	-	12.5	169.4	215.9
2010	983	58.9	76.3	-	10.3	145.5	200.8
2011	879	72.6	91.5	-	16.0	180.2	248.5
2012	892	66.3	82.0	-	24.2	172.5	237.1
2013	903	61.3	76.5	9.5	20.7	168.0	207.7
2014	897	63.2	86.1	12.8	22.8	184.9	227.7

* Includes water sales to LGUD#1 (1988-1996)

TABLE 4-6

SEASONAL PUMPAGE VARIATIONS
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Month	2014 Monthly Pumpage (MG)	Percentage of Total Pumpage	Percentage of Average Pumpage
January	4.950	6.64%	0.0%
February	3.951	5.30%	63.6%
March	4.498	6.03%	72.4%
April	3.962	**5.32%**	63.8%
May	5.769	7.74%	92.9%
June	7.700	10.33%	124.0%
July	12.199	16.37%	196.4%
August	10.831	14.53%	174.4%
September	6.371	8.55%	102.6%
October	5.704	7.65%	91.8%
November	5.092	6.83%	82.0%
December	3.507	4.71%	56.5%
	74.534	100.00%	

TABLE 4-7

DAILY PUMPAGE VARIATIONS
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Year	Avg. Day Pumpage (MGD)	Max. Day Pumpage (MGD)	Ration of Max. to Avg. Day
1988	0.000	0.471	2.36
1989	0.143	0.402	2.81
1990	0.141	0.358	2.54
1991	0.150	0.397	2.64
1992	0.170	0.482	2.83
1993	0.184	0.363	1.98
1994	0.194	0.466	2.40
1995	0.216	0.560	2.60
1996	0.206	0.466	2.26
1997	0.188	0.516	2.74
1998	0.239	0.698	2.92
1999	0.229	0.498	2.18
2000	0.234	0.467	1.99
2001	0.202	0.614	3.03
2002	0.192	0.524	2.72
2003	0.218	0.595	2.73
2004	0.229	0.590	2.58
2005	0.243	0.779	3.21
2006	0.213	0.582	2.74
2007	0.227	0.669	2.94
2008	0.200	0.531	2.65
2009	0.214	0.568	2.66
2010	0.197	0.429	2.17
2011	0.218	0.532	2.44
2012	0.211	0.532	2.52
2013	0.188	0.532	2.84
2014	0.204	0.532	2.61

Maximum Value =

TABLE 4-10

WATER SALES PUMPAGE PROJECTIONS
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Customer Classification	Actual 2005	Actual 2014	Projected 2015
Population Served	967	897	1163
Residential Sales			
Per Capita Sales (gpcd)	76.1	63.2	70
Annual Sales (MGY)	26.86	20.69	29.70
Public Sales			
Per Capita Sales (gpcd)	6.8	22.8	4
Annual Sales (MGY)	2.42	3.88	1.70
Commercial Sales			
Per Capita Sales (gpcd)	91.4	86.1	93
Annual Sales (MGY)	32.26	28.18	39.00
MultiFamil Sales			
Per Capia Sales (gpcd)	-	12.8	-
Annual Sales (MGY)	-	4.20	-
LGSD #1 Sales			
Annual Sales (MGY)	9.89	5.92	9.50
Sytem Uses			
Annual Sales (MGY)	2.76	2.01	3.30
TOTAL METERED SALES (MGY)	74.18	64.88	83.20
Unaccounted-For Water (MGY)	14.48	11.50	14.70
TOTAL PUMPAGE (MGY)	*88.65*	*76.37*	*97.90*

Village of Sister Bay
Water & Sewer Utilities
2005- Present Water Tower Impact Fee Detail

Ordinance enacted 10/25/2005

date collected	parcel #		Impact Fee Paid	total interest collected	Expended (Engineering)	Individual Total	Yearly Total
11/16/2005	181-35-0101 & 181-35-0102		$ 2,956.00	$ 378.01	$ (3,334.01)	$ 0.00	
11/16/2005	181-35-0901 & 181-35-0902		$ 2,956.00	$ 378.01	$ (3,334.01)	$ 0.00	
12/31/2005	181-41-5701 + ↓		$ 13,302.00	$ 1,849.76	$ (13,318.48)	$ 1,833.28	
		$ 19,214.00					
1/16/2006	181-00-05312841B2		$ 1,478.00	$ 278.98		$ 1,756.98	
1/16/2006	181-32-07002 & 181-32-07001		$ 1,478.00	$ 278.98		$ 1,756.98	
1/16/2006	181-00-05312811A5		$ 1,478.00	$ 278.98		$ 1,756.98	
							$ 7,104.22
							use or refund before 10/20/15
5/10/2006	181-00-05312811Z		$ 1,478.00	$ 257.46		$ 1,735.46	
5/23/2006	Pheasant Park		$ -				
5/26/2006	Pheasant Park		$ 1,478.00	$ 257.46		$ 1,735.46	
5/26/2006	181-35-0501		$ 1,478.00	$ 257.46		$ 1,735.46	
5/26/2006	181-35-0502		$ 1,478.00	$ 257.46		$ 1,735.46	
5/26/2006	Pheasant Park		$ 1,478.00	$ 257.46		$ 1,735.46	
8/9/2006	Pheasant Park		$ 1,478.00	$ 240.09		$ 1,718.09	
10/6/2006	181-46-0003		$ 1,478.00	$ 228.31		$ 1,706.31	
10/6/2006	181-46-0004		$ 1,478.00	$ 228.31		$ 1,706.31	
10/24/2006	181-06-0004		$ 631.00	$ 97.47		$ 728.47	
10/24/2006	181-06-0004		$ 847.00	$ 130.84		$ 977.84	
12/12/2006	181-48-0901 & 181-48-0902		$ 2,956.00	$ 433.48		$ 3,389.48	
12/12/2006	181-48-1101 & 181-48-1102		$ 2,956.00	$ 433.48		$ 3,389.48	
12/12/2006	181-48-0801 → 181-48-0804		$ 5,912.00	$ 866.97		$ 6,778.97	
		$ 29,560.00					**$ 34,343.21**
							use or refund by 2019
1/15/2007	181-49-0001 & 181-49-0002		$ 2,956.00	$ 422.05		$ 3,378.05	
6/11/2007	181-12-0000 (7)		$ 1,478.00	$ 182.82		$ 1,660.82	
6/15/2007	181-00-08312811D		$ 1,478.00	$ 182.82		$ 1,660.82	
6/15/2007	181-48-1001 & 181-48-1002		$ 2,956.00	$ 365.64		$ 3,321.64	
10/17/2007	181-48-0601 → 181-48-0604		$ 5,912.00	$ 643.17		$ 6,555.17	
10/31/2007	181-00-07312811G1		$ 1,478.00	$ 160.79		$ 1,638.79	
12/12/2007	181-00-05312832L		$ 653.00	$ 66.24		$ 719.24	

		$	16,911.00						$ 18,934.55
									use or refund by 2020
11/7/2008	181-00-05312841B4			$	2,069.20	$	154.88	$ 2,224.08	
		$	2,069.20						$ 2,224.08
									refund due by 2021
3/31/2010	181-26-01004			$	1,773.60	$	104.83	$ 1,878.43	
7/16/2010	181-00-05312811H2			$	1,773.60	$	98.33	$ 1,871.93	
7/21/2010	181-00-05312811A3R			$	1,478.00	$	81.94	$ 1,559.94	
		$	5,025.20						$ 5,310.29
									use or refund by 2023
1/14/2011	181-50-0001 → 181-50-0008			$	6,784.02	$	338.98	$ 7,123.00	
3/18/2011	181-26-02004			$	2,364.80	$	113.33	$ 2,478.13	
5/13/2011	181-07-0501 & 181-07-0502			$	2,024.86	$	92.45	$ 2,117.31	
7/8/2011	181-50-0009 → 181-50-0016			$	6,651.00	$	288.62	$ 6,939.62	
7/8/2011	181-50-0009 → 181-50-0016			$	1,359.76	$	59.01	$ 1,418.77	
7/29/2011	181-26-01018			$	1,906.62	$	80.58	$ 1,987.20	
8/12/2011	181-29-0015			$	324.44	$	13.71	$ 338.15	
9/30/2011	181-26-01002			$	1,448.44	$	57.95	$ 1,506.39	
10/29/2011	181-00-06312844J			$	1,256.30	$	48.85	$ 1,305.15	
10/29/2011	181-00-06312844D			$	1,005.04	$	39.08	$ 1,044.12	
11/11/2011	181-50-0017 → 181-50-0024			$	7,936.86	$	308.63	$ 8,245.49	
		$	33,062.14						$ 34,503.34
									use or refund by 2024
1/10/2012	181-50-0025 → 181-50-0032			$	8,188.12	$	300.00	$ 8,488.12	
2/3/2012	181-42-40003			$	1,005.04	$	35.70	$ 1,040.74	
4/27/2012	181-00-08312824E2			$	5,039.98	$	162.08	$ 5,202.06	
5/18/2012	181-50-0057 → 181-50-0060			$	3,754.12	$	120.73	$ 3,874.85	
7/6/2012	181-50-0041 → 181-50-0048			$	7,936.86	$	237.52	$ 8,174.38	
10/12/2012	181-26-01006			$	1,803.16	$	47.94	$ 1,851.10	
10/12/2012	181-21-0302			$	1,300.64	$	34.58	$ 1,335.22	
									$ 29,966.45
									use or refund by 2025
11/9/2012	181-00-05312841Y			$	1,478.00	$	37.65	$ 1,515.65	
11/9/2012	Stony Ridge			$	7,064.84	$	179.97	$ 7,244.81	
12/7/2012	181-07-0519 & 181-07-0520			$	2,734.30	$	66.62	$ 2,800.92	
12/14/2012	181-00-05312811P2			$	-				$ 11,561.39
		$	40,305.06						within reason

2/19/2013	181-00-08312824F1			$	4,537.46	$	100.50		$	4,637.96		
2/19/2013	181-00-08312824F1			$	7,966.42	$	176.45		$	8,142.87		
2/19/2013	181-00-08312824F1			$	6,591.88	$	146.00		$	6,737.88		
6/3/2013	181-29-0015			$	295.60	$	5.47		$	301.07		
6/3/2013	181-05-0029			$	472.96	$	8.75		$	481.71		
6/7/2013	181-27-0028			$	650.32	$	12.03		$	662.35		
7/2/2013	Stony Ridge			$	3,754.12	$	7.23		$	3,761.35		
7/11/2013	181-35-CE			$	295.60	$	0.57		$	296.17		
7/11/2013	181-35-CE			$	295.60	$	0.57		$	296.17		
8/1/2013	181-42-10008A			$	295.60	$	0.54		$	296.14		
8/5/2013	Stony Ridge			$	7,936.86	$	14.56		$	7,951.42		
8/13/2013	Stony Ridge			$	6,311.06	$	11.58		$	6,322.64		
9/9/2013	181-00-07312812D1			$	1,448.44	$	2.52		$	1,450.96		
10/14/2013	181-00-05312833F			$	1,049.38	$	1.73		$	1,051.11		
11/13/2013	181-29-0004			$	1,300.64	$	2.03		$	1,302.67		
		$	43,201.94								$	**43,692.47**
												within reason
2/21/2014	181-00-05312841W			$	2,128.32	$	2.73		$	2,131.05		
4/21/2014	181-48-0701 & 181-48-0702			$	3,961.04	$	4.36		$	3,965.40		
4/21/2014	181-42-30021A			$	2,128.32	$	2.34		$	2,130.66		
6/23/2014	181-00-08312822L1			$	141.64	$	0.13		$	141.77		
7/18/2014	181-00-08312822L1			$	141.64	$	0.12		$	141.76		
8/7/2014	181-00-08312822L1			$	141.64	$	0.10		$	141.74		
9/8/2014	181-00-08312822L1			$	141.64	$	0.09		$	141.73		
10/12/2014	181-00-08312822L1			$	141.64	$	0.08		$	141.72		
10/31/2014	181-00-08312812M			$	35,117.28	$	16.10		$	35,133.38		
11/10/2014	181-00-08312822L1			$	141.64	$	0.06		$	141.70		
11/10/2014	181-48-0402			$	1,401.10	$	0.64		$	1,401.74		
12/8/2014	181-00-08312822L1			$	141.64	$	0.05		$	141.69		
		$	45,727.54								$	**45,754.34**
												within reason
1/16/2015	181-00-08312822L1			$	141.64	$	0.04		$	141.68		
2/15/2015	181-00-08312822L1			$	141.64	$	0.03		$	141.67		
3/9/2015	181-00-08312822L1			$	141.61	$	0.01		$	141.62		
3/12/2015	181-00-05312814E4			$	2,231.78	$	0.20		$	2,231.98		
4/16/2015	181-00-08312822L1			$	141.61				$	141.61		
		$	2,798.31								$	**2,798.56**
												within reason
				$	71,213.12	**$**	**13,034.11**	**$**	**(19,986.51)**		$	**206,226.46**