ENGINEERING REPORT
SANITARY SYSTEM

Village of Random Lake

Prepared for:

Village of Random Lake
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February 1, 2019

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EXECUTIVE SUMMARY

The Village of Random Lake has retained Kapur & Associates, Inc. (Kapur) to evaluate the sanitary sewer system and plan for upgrades based upon projected future development. This study incorporates the planned expansion as detailed in the 20-Year Comprehensive Plan Addendum 2019.

This sanitary report presents the feasibility of the Village to provide sanitary sewer service to several undeveloped areas inside and outside of the official Village corporate limits. The areas located within the existing sanitary sewer network are divided into 7 areas and are numbered 101 to 107. Areas of anticipated expansion outside of the existing sanitary sewer network are divided into 8 areas and are numbered 1 through 8.

Wastewater flow projections were calculated for the entire study area. Flow projections were based upon land use and associated wastewater flow contribution flow rates. Contribution rates included a peaking factor of 4, which is a ratio of peak flow to average flow. A total design flow projection, with peaking factor, of 725 GPM was calculated based on future expansion.

The 2039 Comprehensive Plan details a potential future development expansion of 1,140-acres. These areas have been designated for planning and zoning land use. For planning purposes of the sanitary sewer system, 219 acres have been analyzed as part of this study.

Recommended Improvements are found on Page 10 of this report. Initial improvements include implementing a regular sanitary sewer televising program and coordinate future road work with improving the sanitary sewer system. An upgrade to the Lift Station on E. Shore Drive is recommended within the next 5-years. Additional improvements for years 6 through 20 can be found on Pages 10 and 11.

1.0 INTRODUCTION

This study evaluates anticipated expansion and analyzes the condition of the current sanitary sewer system. It provides the Village of Random Lake with recommendations for upgrades to the current sewerage system based upon modeling of proposed future village expansion.

1.1 Purpose and Scope

This report presents the feasibility of the Village to provide sanitary sewer service to several undeveloped areas inside and outside of the official Village corporate limits. The areas located within the existing sanitary sewer network are divided into 7 areas, numbered 101 to 107 (Figure 3), the areas outside of the existing sanitary sewer network are divided into eight (8) areas based upon contour lines and where the proposed network extension could use gravity flow (Figure 3). Directly below is a list of maps and data used to develop this study and possible alternatives:

- Existing Random Lake Sanitary Sewer and Official Village maps
- Survey mapping with 2' contour intervals
- GIS terrain information maps
- Wisconsin Administration Code

1.2 Project Background

The previous study was completed by Kapur in June of 2004 and was entitled *Southeastern Sanitary Sewer Improvements Study*. The previous study was specifically related to a small area within and adjacent to the southeastern village limits.

2.0 SERVICE AREA AND EXISTING SANITARY SEWER SYSTEM

2.1 Geographic Location

The Village of Random Lake is located in Sections 26, 27, 34, and 35 of Township 13 North, Range 21 East. The Village is situated in southern Sheboygan County near the border with Ozaukee county, in southeastern Wisconsin. Random Lake (the lake) is situated within the Village boundaries. The lake drains to Silver Creek, a tributary of the Milwaukee River, which flows west along the north side of the Village. Wastewater effluent is discharged into a storm sewer that discharges into Silver Creek.

The Random Lake Wastewater Treatment Facility (WWTF) is located in the Northwest 1/4 of the Northeast 1/4 of Section 34, Township 13 North, Range 21 East, near the northwestern edge of the Village of Random Lake, south of State Trunk Highway (STH) 144. The address of the WWTF is 690 Wolf Road, Random Lake, Wisconsin.

2.2 Description of Study Area

The area included in this study consists of the Planned Land Use, as approved by the Village of Random Lake, in the 20-Year Comprehensive Plan Addendum 2019. The study area is relatively flat with rolling terrain around all sides of the village. The highest elevations in the study area are at the north and east sides of the village and approximately 960 feet above mean sea level (MSL). The lowest elevation is approximately 846 feet MSL and is located at the southeast corner of the study area.

The Village of Random Lake has a population of approximately 1,573 (2017 US Census Bureau) and encompasses an area of approximately 1,120 acres. The 2039 map was analyzed identify areas that were likely to be developed, focusing on land inside the current Village boundary, and land within the expansion area that would be easy to connect to the existing networks (Figure 1). Our analysis identified approximately 219 acres of likely future areas of expansion, of which 201 acres is inside the current Village boundaries, and 18 acres is outside. Approximately 11 acres is already developed, but not connected to the utility networks.

2.3 Existing Sanitary Sewer System

The existing sanitary sewer system has over 12 miles of sanitary sewer pipe as shown in Table 1. The system has a treatment plant located on Wolf Road and three lift stations around the village. The largest lift station is located on the east side of Random Lake and pumps sewage under the lake. See Figure 2 for the existing sanitary sewer system.

Table 1: Existing Sanitary Sewer System

Pipe Size	Linear Feet
6" Sanitary Pipe	2,507
8" Sanitary Pipe	43,814
10" Sanitary Pipe	8,409
12" Sanitary Pipe	3,292
15" Sanitary Pipe	547
18" Sanitary Pipe	1,500
2" Forcemain	486
4" Forcemain	526
6" Forcemain	3,297
Total	**65,473**

Areas within the existing sanitary sewer network:
Area 101 is located on the eastern side of Random Lake and includes a portion of East Shore Drive north of Deppiesee Road and the area between Maires Way on the north and Orth Drive on the south. The eastern boundary is STH 57 and the western boundary is Random Lake to East Shore Drive then south to the west side of the intersection of Evergreen Drive and Deppiesee Road then south to the extension of Hickory Drive and then east to Woodland Drive and south to Orth Drive. Area 101 also includes a parcel to the southwest of the intersection of Orth Drive and STH 57. The area includes residential, industrial, and commercial properties. The sewer network in this area drains to the lift station east of the lake. Area 101 consists of 97 acres.

Area 102 is located southeast of Random Lake and includes the residential area along East Shore Drive, Mueller Lane, Wind Sail Court, and Hickory Drive. The sewer network in this area drains to the lift station on the east of the lake. Area 102 consists of 43 acres.

Area 103 is located west of Random Lake and includes residential area along the west side of the lake, including properties along West Lake Drive, Franzen Street, and Russel Drive. The sewer network in this area drains to the north and connects to area 106 near Wolf Road. Area 103 consists of 54 acres.

Area 104 is located in downtown Random Lake and includes the properties along Butler Street, Spring Street, Western Avenue, 1st St / CTH II, and all area in-between. The area includes residential, industrial, and commercial properties. The sewer network in this area drains to the north and connects to area 106 at North Street. Area 104 consists of 118 acres.

Area 105 is located on the northwest side of the Village of Random Lake. The area includes parcels located along Random Lake Road, between Western Avenue and Wolf Street. This area includes residential, governmental/institutional, and commercial properties. The sewer network in this area drains to the east and connects to area 106 along Wolf Street. Area 105 consists of 30 acres.

Area 106 is located on the north side of the Village of Random Lake. The area includes industrial, residential, and commercial parcels along Wolf Road between Spring Street and Allen Street, and a several properties on the north end of North Street. The sewer network in this area receives flow from areas 103-107 and connects to the waste water treatment plant on Wolf Road. Area 106 consists of 32 acres.

Area 107 is located on the north side of Random Lake and includes the residential parcels along Jessie Lane and Stark Road. The sewer network in this area drains to the southwest and connects to area 106 near Wolf Road. Area 107 consists of 21 acres.

Areas of future expansion:

The areas of future expansion included in this study are 219 acres from the 20-Year Comprehensive Plan Addendum 2019 that are likely to be developed.

Area 1 is located west of STH 57 and south of STH 144. Existing land use in the area is undeveloped farmland. Future land use in the area is residential. Area 1 consists of 13 acres.

Area 2 is located on the east side of Random Lake and includes the northern portion of East Shore Drive and extends to STH 57 on the east and Maries Way to the south. Existing land use in the area is agriculture/open space and natural area. Future land use in the area is residential and commercial. Area 2 consists of 54 acres.

Area 3 is located east of STH 57 near CTH RR. Existing land use in the area is commercial and agricultural/open space. Future land use in the area is commercial. Area 3 consists of 40 acres.

Area 4 is located west of STH 57, between Orth Dr and CTH K. Existing land use is commercial, agricultural/open space, and natural areas. Future land use in the area is commercial and industrial. Area 4 consists of 32 acres.

Area 5 is located along Orth Drive and Hickory Drive near Lake Breeze Lane. Existing land use is agricultural/open space, residential, and natural areas. Future land use in the area is residential, commercial, and industrial. Area 5 consists of 28 acres.

Area 6 is located at the west end of Hickory Drive near the intersection with CTH K. Existing land use is commercial, residential, and natural area. Future land use in the area is commercial/industrial mix. Area 6 consists of 10 acres.

Area 7 is located along CTH II and includes the farmland between CTH II and the high school. The existing land use is agricultural/open space and residential. Future land use is residential. Area 7 consists of 42 acres.

Area 8 is the Lakeside Foods / Krier Foods property. Their flows were calculated based on estimated production instead of standard flow rates and acreage.

3.0 FLOWS

3.1 Land Use

The 20-Year Comprehensive Plan Addendum 2019 land use map indicates the 219 acres of future development included within the sanitary sewer study area will be a mix of residential, commercial, and industrial. The Future Growth Drainage Basins, including land use, are provided in Figure 3.

Table 2: Land Area of Existing and Proposed Sanitary Sewer Service Area

Area (Acres)	Current	Future	Total
Commercial	73	71	144
Industrial	79	24	103
Residential	244	124	368
Total	**396**	**219**	**615**

3.2 Wastewater Flow Projections

Wastewater flow projections were completed for the entire study area. Flow projections are based upon the land use and typical wastewater flow contribution flow rates associated with each land use. Contribution rates utilized include a peaking factor of 4.0, which is a ratio of peak flow to average flow.

The flow projections for this study are based on the acreage of each land use. The flow rates were computed as part of the water system study, based upon the Village's water usage during 2017. Average values were calculated and used to calibrate the model.

Table 3: Wastewater Flow Projections

DESIGN DEMAND			GPAM	PEAK
COMMERCIAL	400	GPAD	0.28	1.11
INDUSTRIAL	650	GPAD	0.45	1.81
RESIDENTIAL	50	GPCD	0.21	0.83

* GPAD Gallons Per Acre Per Day
* GPCD Gallons Per Capita Per Day
* GPAM Gallons Per Acre Per Minute

Table 4: Estimated Existing Wastewater Flows

EXISTING	ESTIMATED DESIGN FLOW (GPM)				CONTRIBUTIONS FROM OTHER AREAS		TOTAL (GPM)	DISCHARGES TO:
DB	COMM	INDUS	RES	TOTAL	PROP	EXIST		
101	19	81	29	129	145	0	275	103
102	0	0	36	36	23	0	59	103
103	3	0	43	46	11	334	391	106
104	28	9	68	105	35	0	140	106
105	23	0	8	31	0	0	31	106
106	3	52	0	56	79	590	725	TREATMENT PLANT
107	0	0	18	18	11	0	28	106
TOTAL	77	143	201	420	305	0	725	

The flows from each drainage basin flows into other drainage basins, so the totals may not align per column.

Table 5: Wastewater Flows for Future Areas of Expansion

PROPOSED	ESTIMATED DESIGN FLOW (GPM)				DISCHARGES TO:
DB	COMM	INDUS	RES	TOTAL	
1	0.0	0.0	10.8	10.8	107
2	14.4	0.0	34.2	48.6	101
3	44.4	0.0	0.0	44.4	101
4	8.9	43.3	0.0	52.2	101
5	0.0	0.0	23.3	23.3	102
6	11.1	0.0	0.0	11.1	103
7	0.0	0.0	35.0	35.0	104
8	0.0	79.2	0.0	79.2	106
TOTAL	79	123	103	305	

4.0 STUDY APPROACH

4.1 Step I

Drainage boundaries of the proposed expansion area were delineated using the USGS quadrangle maps with contour intervals of 2 feet, with the intent to connect each area to the existing sewer network. The low point of each area was identified where the sewer could easily transport the sewage via gravity. Some of the areas have low points that are too low to reasonably connect to the existing network, so a lift station would be needed.

4.2 Step II

Drainage boundaries of the existing network were delineated using the existing network map. The study focused on the larger trunk lines, particularly lines that would receive large flows from the future areas of expansion as identified in Step 1.

4.3 Step III

The 20-Year Comprehensive Plan Addendum 2019 land use was imported into AutoCAD and the area of each land use within each drainage area was computed. These areas should be considered approximate since they are drawn based on a PDF map and include roads, empty lots, and the occasional lot of a different land use (i.e. the boundaries were not drawn exactly based on the use of each individual property and may have included a few properties of a different category).

4.4 Step IV

Sewer flow rates were calculated utilizing averages from the MMSD 2020 Conveyance Report, with a peaking factor of 4.0. Due to the complexity of the network, and the fact that most of the branch pipes receive very little flow, the study focused on the trunk lines particularly where they created a bottleneck in the network. The branch pipes were not evaluated as part of this study.

4.5 Step V

The total flow for each trunk line was calculated by combining the flows from the existing sanitary sewer network and the future areas of expansion. The theoretical flow for each pipe size was calculated, assuming minimum slope. This identified where the network would need to be upgraded to accommodate future flows.

4.6 Step VI

A rough cost estimate was completed for the proposed upgrades to the existing system to handle proposed flows. The cost estimates include the trunkline pipes that would connect each drainage area to the existing sewer system, and lift stations if needed, but does not include the smaller branch pipes that would be installed as part of a development. Unit prices in the cost estimate were derived from recent projects in Random Lake but should be seen as approximate as unit prices will likely change significantly over the next 20 years.

5.0 RECOMMENDED IMPROVEMENTS

Developing and maintaining a sanitary sewer system is critical to a community. General recommendations are:

- Implement a regular sanitary sewer televising program to inspect the entire Village every 5-years.

- Identify road projects and repair/replace sanitary sewer and manholes accordingly.

- Add backup generators to the lift stations on STH 144 and E. Shore Drive when improvements are necessary at those lift stations.

Based on our analysis of future areas of expansion, the sanitary sewer deficiencies have been identified and the following conclusions, including necessary recommended improvements (Figure 4) to provide an adequate dependable system are provided below:

UPGRADES IN THE NEXT 5 YEARS:

1. **Upgrade Lift Station on E Shore Drive**
   The current lift station is adequate for existing peak flows, but as the Village grows the pumps will need to be upsized to keep up with future expansion. The lift station will need upgrading with the addition of approximately 20 new homes. This depends heavily on other development that may occur over that time. Therefore, the recommendation to upgrade is within the next 5-years. The force main pipes under Random Lake have adequate capacity for the estimated future growth. The existing backup generator should be replaced when the lift station is upgraded. Approximate cost is $80,000.

UPGRADES IN THE YEARS 6 TO 20:

2. **Lake Drive Sanitary Sewer**
   It is recommended to inspect and perform necessary maintenance to the existing sanitary sewer from Butler Road to Point Road (approx. 3,000'). This work shall be in conjunction with water main and road work. Estimated cost for lining is $150,000 and cost for replacement is $590,000.

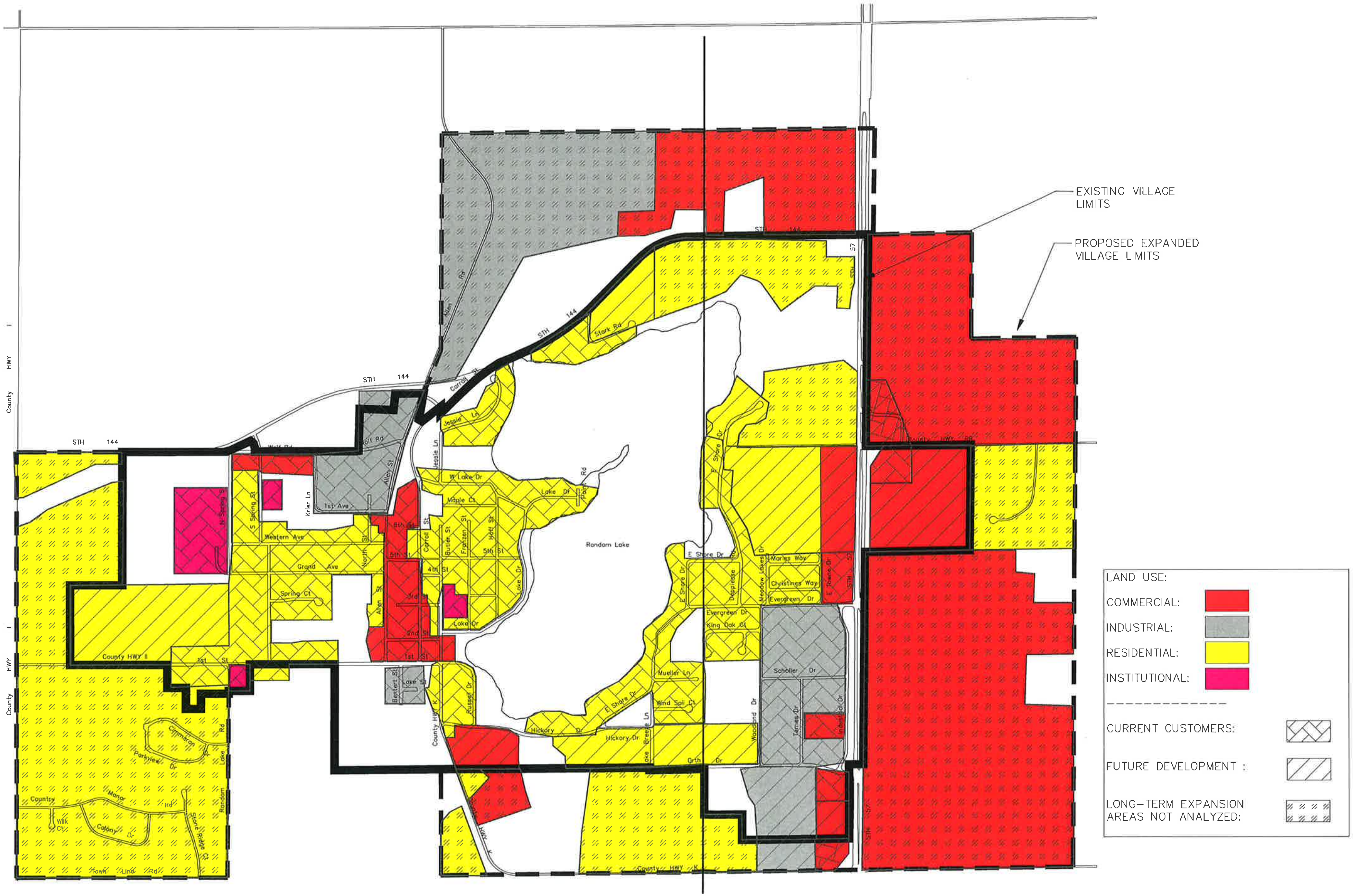
3. **Grand Avenue Sanitary Sewer**
   It is recommended to inspect and perform necessary maintenance to the existing sanitary sewer from Allen Street to Spring Street (approx. 1,900'). This work shall be in conjunction with water main and road work. Estimated cost for lining is $110,000 and cost for replacement is $330,000.

4. **West 1st Street Sanitary Sewer and DB 7 Expansion**
   It is recommended to inspect and perform necessary maintenance to the existing sanitary sewer from from Allen Street to the current sanitary sewer dead end (approx. 2,700'). Also, to feed any future development south of the High School, extend 8-inch sanitary sewer (approx. 1,000'). This work should be in conjunction with water main and coordinated with planned Sheboygan County road work on CTH II. Approximate cost to extend the sanitary sewer is $170,000. Estimated cost for lining the existing sanitary is $310,000 and cost for replacement of the existing sanitary sewer is $565,000.

5. **DB 4: Expansion area near STH 57 and CTH K**
   The low point in the middle of the basin will prevent a gravity sewer from reaching the existing network to the north. The existing vault at Orth Drive and Lake Breeze Lane will require lowering with the addition of a lift station and approximately 3,200 LF of 8-inch sewer pipe to connect to the existing network at Ternes Drive. Approximate cost is $550,000.

6. **DB 1: Expansion area near Stark Road and STH 144**
   This area has low areas on the far side of a hill which will prevent a gravity sewer from reaching the existing network at Stark Road. A lift station will be required on the northeast side of the area, and approximately 1,000 LF of 8-inch sewer pipe to connect to the existing network. Approximate cost is $275,000.

7. **DB 2: Expansion area between E. Shore Dr and STH 57**
   A new 8-inch sewer line (approx. 1,500 LF) is recommended along the existing dirt road on the north side of the area (extension of CTH RR). Sanitary sewer service will make the area more desirable to developers. A water main extension is also recommended for the same road, so cost savings may be realized by combining construction tasks. Approximate cost is $210,000.



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PROJECT:
SANITARY SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

SCALE: N.T.S.

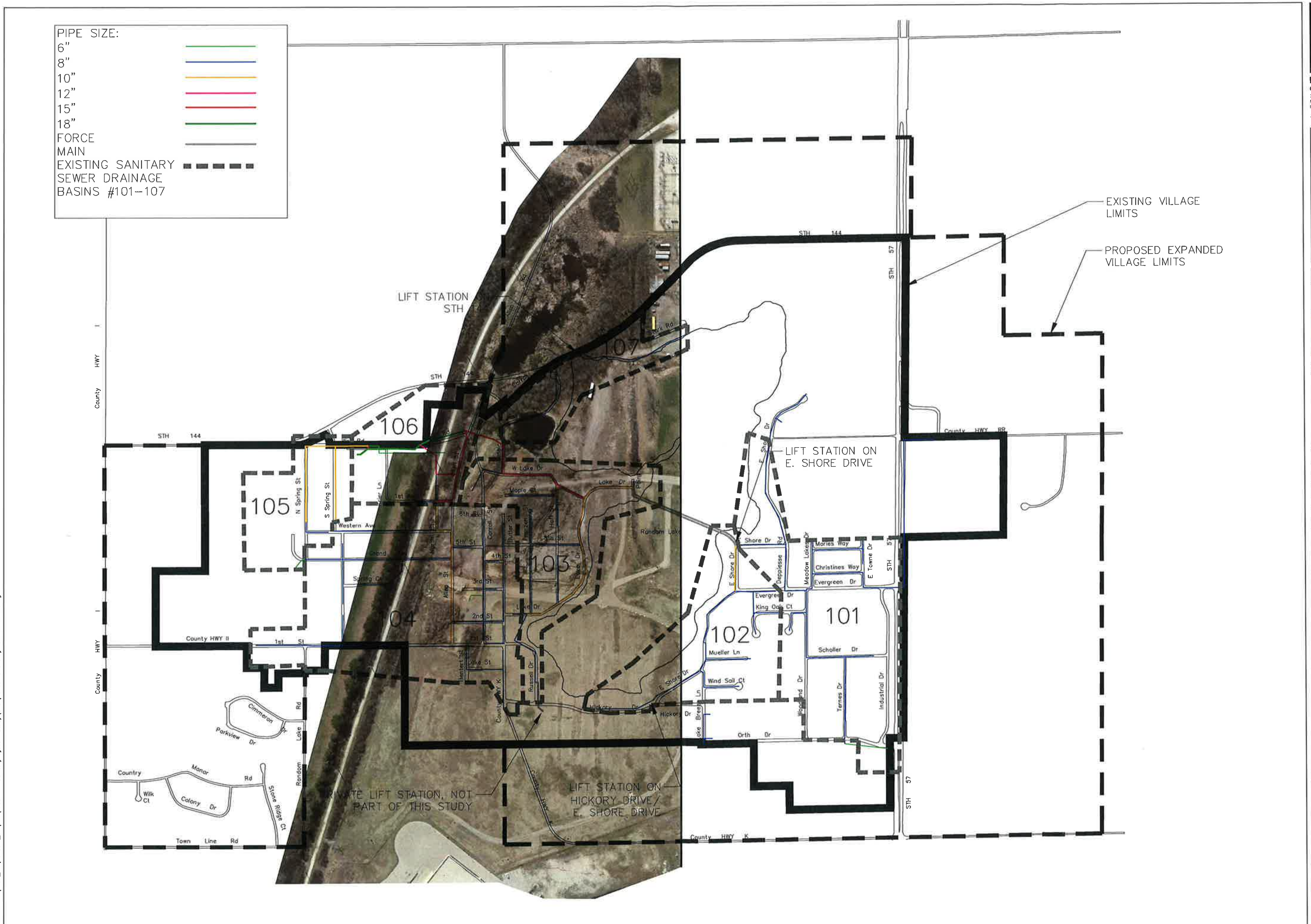
SEAL:

we listen. we innovate. we turn your vision into reality.

SHEET:
20-YR COMP PLAN ADDENDUM 2019 LAND USE

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0311
DATE: 2/1/19

FIGURE:
1



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PROJECT:
SANITARY SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

SCALE: N.T.S

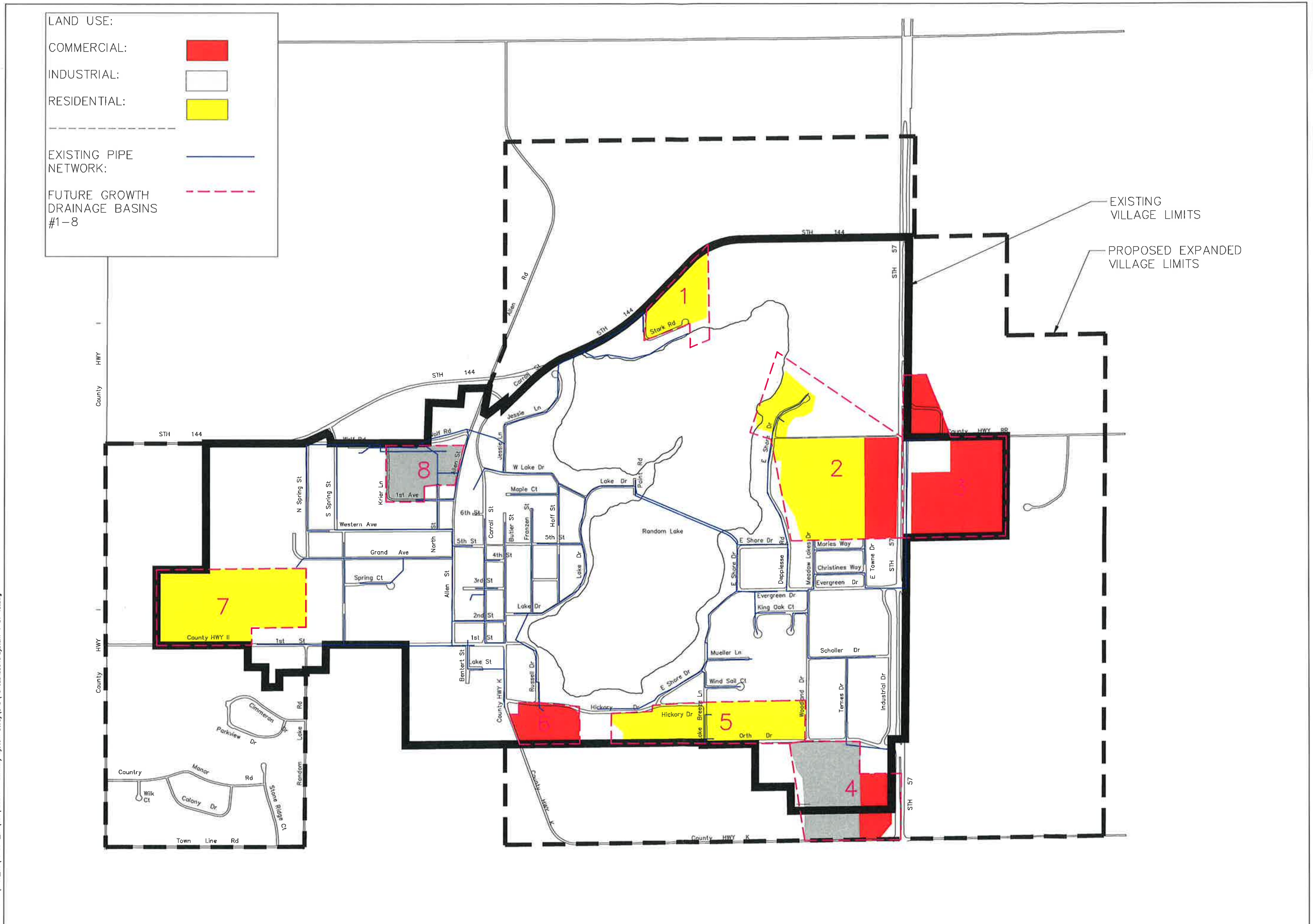
SEAL:

we listen, we innovate, we turn your vision into reality.

SHEET:
EXISTING SANITARY SEWER SYSTEM

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0311
DATE: 2/1/19

FIGURE:
2



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PROJECT:
SANITARY SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

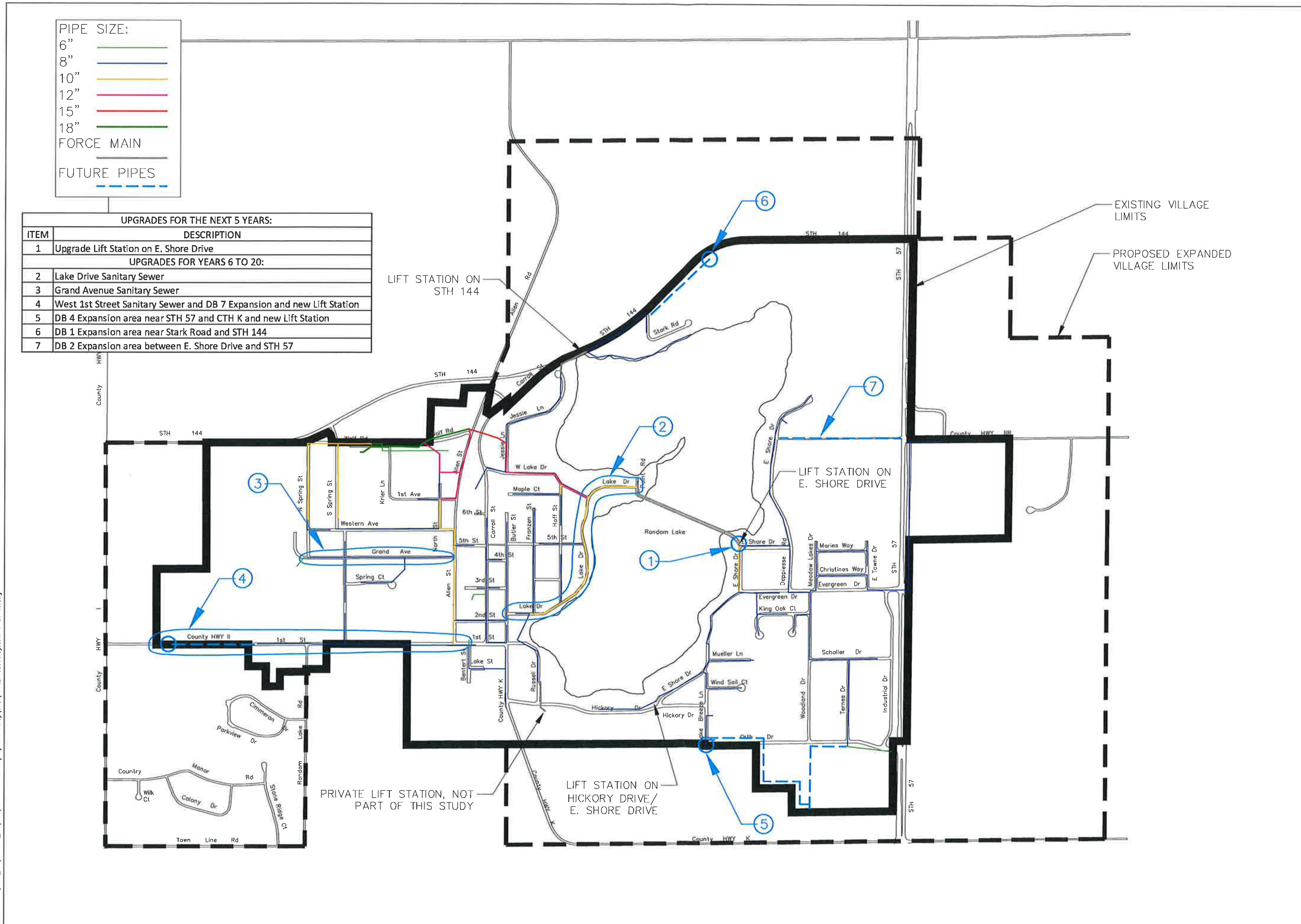
SCALE: N.T.S.

SEAL:

SHEET:
FUTURE GROWTH DRAINAGE BASINS

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0311
DATE: 2/1/19

FIGURE:
3



ITEM	DESCRIPTION
	UPGRADES FOR THE NEXT 5 YEARS:
1	Upgrade Lift Station on E. Shore Drive
	UPGRADES FOR YEARS 6 TO 20:
2	Lake Drive Sanitary Sewer
3	Grand Avenue Sanitary Sewer
4	West 1st Street Sanitary Sewer and DB 7 Expansion and new Lift Station
5	DB 4 Expansion area near STH 57 and CTH K and new Lift Station
6	DB 1 Expansion area near Stark Road and STH 144
7	DB 2 Expansion area between E. Shore Drive and STH 57

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PROJECT: SANITARY SYSTEM STUDY

LOCATION: VILLAGE OF RANDOM LAKE

CLIENT: RANDOM LAKE WISCONSIN

RELEASE: FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

SCALE: N.T.S.

SEAL:

SHEET: RECOMENDED IMPROVEMENTS

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0311
DATE: 2/1/19

FIGURE: 4

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ENGINEERING REPORT
WATER SYSTEM

Village of Random Lake

Prepared for:

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February 1, 2019

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FIGURES

EXECUTIVE SUMMARY

This report evaluates the current and future condition for the Village of Random Lake's water system, as well as preparing the Village for future growth and expansion through the year 2039, coordinating with the Village's 20-Year Comprehensive Plan Addendum 2019 Update. With possible growth in the Village, it is critical to maintain a safe dependable supply of water. Along with being able to supply safe drinking water, the supply and storage must also be adequate for existing and future projected demands. This report will illustrate the existing water system, predict future demands, identify deficiencies, and conclude with recommendations for improvement.

The existing two wells and elevated water storage tank must be capable of supplying treated water, at a peak demand rate, to the Village through their 12 miles of water main. More specifically, the water system must be able to meet the source capacity, peak hour storage, fire flow, and the emergency supply. Based on existing and future water use data, existing capacity and the *WaterGems* model for Random Lake, an additional well and elevated storage system is recommended to meet deficiencies and future water demands. Along with an additional well and storage tank, additional pipe installations are recommended to create loops in the system. Loops increase flow and provide multiple directions for water supply. Various other improvements to the existing water system are provided to ensure adequate water supply for future demands. Details of the recommended improvements can be found on Pages 25 and 26.

1.0 INTRODUCTION

The Village of Random Lake has retained Kapur & Associates, Inc. (Kapur) to evaluate their water system and identify improvements to meet future demands. The previous Water Study was completed by Kapur in June of 2009. With new growth trends, development, and infrastructure changes, an up-to-date report will assist the Village of Random Lake with current needs to build a comprehensive water system.

1.1 Purpose and Scope

The purpose of this study is to determine the capacity of the existing water system and to make recommendations for future improvements. This study acknowledges the *Random Lake 20-Year Comprehensive Plan Addendum 2019* existing and future service areas.

This study evaluates the adequacy of the present distribution system consisting of water supply wells, storage tanks, controls, and the water distribution system. This study will recommend upgrades of specific size and location such that strategic future service areas (2039) will be provided with sufficient municipal water service.

Estimated total costs of all recommended improvements will also be presented. Finally, the conclusions and recommendations of this study will be integrated with those from the previous water system study prepared in June 2009.

The goal of this study is to assess the existing water system and to plan for the future system, which is outlined below:

- Review the previous water study
- Review the *Random Lake 20-Year Comprehensive Plan Addendum 2019*
- Review current water demands
- Review current pumpage capability
- Predict future demands
- Prepare a summary of "unaccounted for" water usage
- Generate a calibrated hydraulic computer model for the entire system
- Summarize water demands
- Determine surplus/deficiency analysis for current and future demands
- Prepare a future water plan identifying water main sizes and locations
- Make recommendations on facility improvements and expansions
- Prioritize recommendations
- Determine cost estimates for recommendations

1.2 Project Background

The previous study was completed in June of 2009 by Kapur and was entitled *Engineering Report – Water Study*.

2.0 EXISTING WATER SYSTEM

2.1 Geographic Location

The Village of Random Lake is located in Sections 26, 27, 34, and 35 of Township 13 North Range 21 East. The Village is situated in southern Sheboygan County near the Ozaukee and Sheboygan county boundary in southeastern Wisconsin. A lake, named Random Lake, is situated within the Village boundaries. The lake drains to Silver Creek, a tributary of the Milwaukee River, which flows west along the north side of the Village.

The Random Lake water system consists of two wells and one elevated storage tank. Well No. 1 is located at 701 North Street, Well No. 2 is located at 100 Lake Drive, and the elevated storage tank is located at 600 Butler Street.

2.2 Study Area

The area included in this study consists of the Planned Land Use as shown in the Random Lake 20-Year Comprehensive Plan Addendum 2019. The study area is relatively flat with rolling terrain west of the lake. The northwestern portion of the study area has the highest surface elevation of approximately 960 feet above mean sea level (MSL) and the lowest elevation is approximately 846 feet MSL and is located at the southeast corner of the study area.

Currently, the Village of Random Lake has a population of approximately 1,573 (2017 US Census Bureau) and encompasses an area of approximately 1,120 acres. The projected maximum buildup *Random Lake 20-Year Comprehensive Plan Addendum 2019* expanded area for the Village encompasses approximately 2,120 acres (Figure 1). Expansion of this magnitude is not expected in the next 20 years. A more strategic value, discussed in Section 4.2 of this report, was used for analysis.

2.3 Supply

The existing water system consists of two deep wells and an elevated storage tank. Well and pumphouse No. 1, were constructed in 1936 and includes a 550 gpm deep well pump. The construction details of Well No. 1 are provided in Table 1. The well was acidized in 1971 to increase the well yield. The standby engine drive for the auxiliary booster pump was removed and all the pumping equipment and the well pump was replaced in 2010 (Photo 1), a new natural gas backup generator was also installed as part of this upgrade.

Photo 1: Well #1, 2010 upgrade

Well and pumphouse No. 2 were constructed in 1954 with an iron removal filter added in 1966. The well pump currently pumps 550 gpm, with the capability to pump 700 gpm, through the pressure filter directly to the distribution system. The construction details for Well No. 2 are included in Table 1. All the pumping equipment, iron filter and the well pump were replaced in 2017 (Photo 2 & 3), a new natural gas backup generator was also installed as part of this upgrade.

Photo 2: Well # 2, 2017 upgrade

Each well runs approximately 10-12 hours per day.

Photo 3: New iron filter in Well #2, part of 2017 upgrade

Table 1: 2017 Well Information

Well Name	DNR ID	Depth (feet)	Casing Diameter (inches)	Yield Per Day (gallons)
Well #1	BH37	534	12	792,000
Well #2	BH38	550	21	720,000
				1,512,000

2.4 Storage

One of the most important elements of the water distribution system is storage capacity. Storage is a means of providing pressure head for a complex water distribution system. In general, the functions of storage are to meet peak demand rates in order to supply fire fighting requirements, to provide flexibility in the operation of wells and service pumps, to provide the equalization of pressure and flows, to provide system reliability, and to reduce the size of the distribution mains. During periods of low demands, the water is pumped to the storage tank.

The existing storage facility in Random Lake consists of one 300,000 gallon elevated storage tank constructed in 1986 (Photo 4). The *total operating capacity* of the reservoir is approximately 285,000 gallons (Table 2).

Photo 4: Elevated storage tank in Random Lake

Table 2: Reservoir Information

	Elevated Storage
Year Built	1986
Material	Steel
Capacity	300,000 Gallons
Operating Capacity	285,000 Gallons

2.5 Distribution System

The function of a distribution system is to transport water, under pressure, from the supply sources to the customers and fire hydrants. The force of gravity pushes the water through the pipes to various locations within the Village limits. Accumulating water in the storage tank at a higher ground elevation provides the water pressure. Smaller pipes, called service laterals, are attached to the main water lines to bring water from the distribution system to homes and businesses. An inventory of the laterals installed for the Village of Random Lake is located in Table 3. The existing water system is shown on Figure 2.

Table 3: 2017 Water Lateral Inventory

Pipe Material	Pipe Diameter (inches)	Number of Laterals	Percentage of System
Metal	1.0	510	78.2
Plastic	1.0	121	18.6
Plastic	1.5	2	0.3
Metal	2.0	7	1.1
Plastic	2.0	2	0.3
Metal	3.0	1	0.2
Metal	4.0	2	0.3
Metal	6.0	1	0.2
Plastic	6.0	6	0.9
Utility Total		**652**	**100%**

With exception to a few cases, Random Lake currently uses polyvinylchloride (PVC) pipe for new construction. PVC is understood to be the best choice for municipalities, because of its resistance to corrosion and the ability to deliver clean water. There is also little, if any, maintenance costs associated with PVC, making it the most economical and safe solution.

As shown in Table 4, Random Lake currently has approximately 69,638 ft of water main.

Table 4: 2017 Water Main Inventory

Pipe Material	Main Function	Diameter (inches)	Feet of Main	Percentage of System
Cast Iron	Distribution	6	15,591	22.4
Cast Iron	Distribution	8	420	0.6
Ductile Iron	Distribution	6	5,459	7.8
Ductile Iron	Distribution	8	3,279	4.7
Ductile Iron	Distribution	10	662	1.0
Ductile Iron	Distribution	12	11,481	16.5
PVC	Distribution	6	4,818	6.9
PVC	Distribution	8	6,632	9.5
PVC	Distribution	12	17,549	25.2
Unknown	Distribution	8	2,265	3.3
Unknown	Distribution	12	1,482	2.1
Total Utility			**69,638**	**100%**

SOURCE: RANDOM LAKE GIS WATER SYSTEM MAP

The Village of Random Lake currently uses Waterous Pacer, Model WB-67 hydrants for their system. This is a breakaway type that is red in color and has two 2½ inch outlets and one 4½ inch outlet. If needed, the fire department pumper trucks can use the larger outlet as a suction supply. There are 122 hydrants in the water system.

Valves are included in a distribution system to control the magnitude or direction of water flow. If a system has a sufficient number of valves and no long dead ends, a water main break can be isolated in order to reduce the number of customers from being out of service. There are 303 valves in the water system.

2.6 Pressure

Water flow can be attributed to the result of pressure on volume. The volume is the amount of water available for the customer, and the pressure is the amount of force exerted on it. Pressure forces water through pipes to customers.

Low pressure reduces the volume of water available to the customer. High pressure can damage appliances and other equipment. An adequate water system has pressure in the range of 35 psi to 80 psi.

If there is low pressure in the system, or if the water main to that area is undersized, pressure may not be increased without adding a mechanical device. Pressure can always be reduced, but it cannot be increased, unless there is adequate volume to maintain it.

The majority of the customers in the Village of Random Lake have adequate pressure. Currently, the distribution system has static pressures ranging from 45 psi near the tank, to 80 psi near the northwest corner of the Village.

2.7 Controls

A System Control and Data Acquisition (SCADA) is used to monitor and control the entire water system. SCADA consists of a computer placed at a central location, communications equipment, programmable logic controllers, sensors, and other devices that, when put together, will monitor and control a water system. SCADA requires only a single qualified operator and automates the wells, pumps, and monitors the reservoir levels.

Currently, the two wells and one elevated tank are controlled entirely by SCADA. When the elevation in the elevated tank drops 1.5 ft the pumps start. After the water level reaches 29.0 ft in the elevated tank, the pumps shut off. While the pumps are running, a controlled amount of chemicals are injected into the water. An alarm sounds if the water level in the reservoir or the chemical levels in the containers reaches a low level, alerting the operator to inspect the system.

2.8 Treatment

Water is treated to protect public health by removing microorganisms and natural or man-made chemicals that may cause illness to consumers. Water treatment is also used to improve the water's color, taste, and odor as required. The Village of Random Lake currently treats its water with the following chemical:

- Sodium Hypochlorite (Chlorine), which is used as a disinfection method by killing disease-causing microorganisms.

2.9 Quality

The quality of the water from the Village of Random Lake meets all established Wisconsin Department of Natural Resources standards. The Village provides a *Consumer Confidence Report* annually. The report is an important public relations/outreach tool that shows customers the efforts made by the water utility to provide safe potable water. It is designed to inform the consumers of the quality of the water they are drinking.

2.10 Risk Assessment

The supply, treatment, and distribution infrastructures are important elements of communities, and may face various threats. This *infrastructure* is essential to the nation's security, economic health, and social well-being. Recent threats and isolated attacks on the water distribution system suggest a trend that has put our water infrastructure at high risk.

In response to this, President Bush signed the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 due to the tragic events of September 11, 2001. This law requires community water systems to complete Vulnerability Assessments and update their Emergency Response Plan (ERP) based on the recommendations from the report.

Vulnerability assessments evaluate susceptibility to potential threats to community water systems and identify corrective actions that can reduce or mitigate the risk of serious consequences from adversarial actions. It also considers risks posed to the surrounding community related to attacks on the water system. The vulnerability assessment provides a framework for developing risk reduction options and associated costs.

The ERP incorporates the recommendations from the vulnerability assessment study and will assist the Village of Random Lake in responding in the event of a crisis. The ERP is meant to provide basic information, contacts and procedures that a water utility and the authorities should follow. This document should be updated frequently to keep the plan current with the changing conditions related to the security of the water utility. These security measures will ensure that the Village of Random Lake continues to provide a safe and economical water supply for current and future generations.

3.0 WATER DESIGN CRITERIA

Demand for water fluctuates throughout the day. Most water utilities are familiar with short periods during which the demand surpasses the supply. Some examples include, water used to fight fires, water main breaks, and lawn watering. During events when the rate of demand for water temporarily exceeds the rate of supply, depleting storage makes up the shortfall. Design criteria must be in place in order to prevent depletion of the water supply. The WDNR has set forth criteria that needs to be met, and are described below.

3.1 Supply

Utilities experience their peak demands during the summer time, usually between May and September. This is due to excess lawn watering and various other outdoor activities.

A water utility must have a large enough supply to meet the peak day demand. Customer demand on a peak day typically is 1.5 to 3.5 times the annual average daily demand. Because of this peak demand, it is recommended that the *source capacity* of all the wells exceed the expected peak day demand. If this can be accomplished, it will guarantee the utility can meet all consumer demands.

3.2 Storage

Storage is one of the most integral parts of any water distribution system. It is essential that enough storage volume be available to meet varying and peak flow demands as well as enough capacity for fire protection. Elevated storage provides pressure for a water distribution system. While actual existing total storage volume may meet or exceed that required by any chosen design criteria, the effective volumes available at the required pressures may not. In other words, having enough storage is not effective if the water cannot be accessed due to lower than normal water pressure.

There are two general design parameters, which are used to evaluate storage facilities for any water distribution system.

1. Does the effective storage required meet the peak hour demand rate?
2. Is the required supply needed for fire flows available using the source capacity?

To be sufficient, storage should be capable of supplying an effective volume equal to the peak hour demand rate less the available source capacity over a minimum duration of four hours. This volume should be available to all parts of the system at a minimum residual pressure of 35 psi.

Each of these storage criteria will be considered in determining the condition of the existing Random Lake Water Utility distribution system.

3.3 Distribution

The purpose of a distribution system is to convey water from supply and storage sources, to the area of demand. The WDNR describes a distribution system as "a part of a water system consisting of the water mains, water services, valves, hydrants, meters, and treatment equipment; used to supply water to the customers". A system can be looped or branched. A looped system has pipes that are interconnected throughout the entire system such that water can travel back and forth, depending on the demands and their locations. A branched system has only one path flow to a customer. The looped system is preferred because of the following advantages:

- The *velocities* are lower, because the demand can be fed from at least two different directions.
- If a water main break occurs, the customer can usually still be fed from another direction.
- Fire protection flows are greater because the fire hydrants feed from two or more sources.

A disadvantage to the looped system is the added cost of having additional pipe in the ground.

Water main diameters must be large enough to convey water, which meets or exceeds the required flow. Pipe carrying capacity depends on pipe size, pressure, flow velocity, and head loss resulting from friction. Friction factors include roughness of pipe, flow velocity, and pipe diameter. Velocities should normally be 5 fps or less, due to high friction losses that occur at greater velocities. This may be difficult to obtain under normal operating conditions, and velocities can significantly exceed these guidelines under fire-flow conditions.

All urban distribution water mains should be sized large enough to provide existing and future domestic, irrigation, commercial, industrial, and fire protection flows to the area requesting service. The minimum water main size should be eight (8) inches in diameter, unless otherwise approved by the Village. *Transmission mains* are used to carry a large volume of water usually a long distance, and these should be strategically placed in a grid like pattern to supply the current customer demands, as well as the future development.

The Insurance Services Office (ISO) establishes flow rates needed for fire protection. One of the insurance industry's most important assets is the Public Protection Classification (PPC) program. The PPC program provides important information regarding municipal fire-protection services. Insurance companies use the PPC information to help establish premiums for the public fire insurance. The better the protection, the lower the premiums will be. Rated in 2013, the Village of Random Lake has a Public Protection Class rating of 3 which is based on the percentage credit score of 72.25 % out of 100 %. The PPC was re-evaluated in November 2018 by the ISO and should have results published in mid-2019.

The *ISO* recommends fire flow rates depending on the types of buildings in a particular community along with other factors. Using ISO guidelines, recommended fire flows range from 2,500 gpm for 2-hours in residential areas, to 3,500 gpm for 4-hours in commercial and industrial areas, with a residual pressure of 20 psi. The WDNR requires a minimum of 500 gpm at 20 psi. The NFPA recommends 1,500 gpm at 20 psi. For the purposes of the Village of Random Lake, a fire flow of 1,500 gpm for 4-hours was used for fire flow calculations.

The most efficient and ideal distribution system has:

- Elevated tanks near areas needing high flow rates.
- No dead-end water main (Looped system)
- Transmission mains between elevated tanks and high fire flow rate areas.
- Transmission mains connecting elevated tanks or reservoirs to pumping stations.
- Minimum pressure of 35 psi
- Maximum pressure of 80 psi
- Adequate valve placement to isolate the system for maintenance or emergency

3.4 Pressure

Household appliances have a minimum *pressure* requirement in order to function properly. Pressure losses occur whenever water flows through a pipe. The faster the water flows (velocity), the greater the pressure losses are. If the pressure drops too low, the remaining flow rate and pressure will be insufficient to serve the needed demand. Increasing pipe diameters will reduce the pressure losses. Pressure criteria are established by three different Wisconsin regulatory agencies.

- The Wisconsin Department of Natural Resources (NR-811) states, "The minimum and peak pressure in service areas shall be 35 and 100 psi respectively at ground level".

- The Department of Commerce, states, "If the water pressure available from a water main or private water supply exceeds 80 psi, a pressure reducing valve and strainer, if a strainer is not a component of the valve, it shall be installed in the water distribution system.

- The Public Service Commission (PSC) states, "This standard shall ordinarily require that the distribution main pressure at the corporation stop connection be at least 35 psi. The peak pressure at the meter shall not exceed 100 psi for new systems and, to the extent practical, major additions to existing systems."

The municipalities are required to comply with the WDNR, as well as the PSC. Plumbers, on the other hand, who are installing new laterals, must comply with the Department of Commerce.

Based on the above various criteria, an appropriate operating range of pressure would be between 35 psi to 80 psi, with a maximum pressure of 100 psi.

4.0 WATER DEMANDS

In general, water supply requirements are measured by per capita consumption in terms of annual rate in millions of gallons per day (mgd). Specific design parameters are defined by the average daily demand, maximum or peak daily demand, peak hour demand, and daily per capita consumption.

Historical records were gathered from the Village of Random Lake to determine current demands. Pumping and consumption data from 2012 through 2017 were analyzed to determine historical totals. From this data, future demands can be estimated based on projection design parameters.

4.1 Current Demand

Water consumption history for the Village of Random Lake, from 2012 through 2017 are shown in Tables 5a-c. Average and peak day water consumption during this period, together with the amount of water sales for each customer category is analyzed. Table 6 summarizes the average water sales for year 2017.

Tables 5a-c also indicate that the total annual water sales vary during this period. The lowest sale was about 111 million gallons, occurring in 2017, while the highest sale was about 166 million gallons in 2013.

Table 5a: Water Consumption History – Customers

Year	Number of Customers				
	Residential	Commercial	Industrial	Public Authorities	Multifamily Residential
2012	575	65	14	11	
2013	579	65	14	10	
2014	575	49	14	11	14
2015	621	52	14	13	14
2016	618	51	13	12	17
2017	619	55	14	14	17

Table 5b: Water Consumption History – Water Sales

Year	Water Sales (Thousands of Gallons)						
	Residential	Commercial	Industrial	Public Authorities	Multifamily Residential	Total Sales	Total Pumpage
2012	29,034	7,861	93,811	10,498		141,204	196,549
2013	24,721	7,740	123,381	10,183		166,025	181,657
2014	22,799	4,248	78,635	8,386	2,712	116,780	169,814
2015	24,287	5,176	118,543	7,035	2,532	157,573	190,326
2016	23,410	4,699	99,897	6,178	3,144	137,328	180,071
2017	23,014	4,068	75,155	5,855	2,962	111,054	185,743

Table 5c: Water Consumption History – Demand Fluctuations

Year	Demand Fluctuations				
	% Ratio of Total Sales / Pumpage	Average Day Pumpage (Thousands of Gallons)	Peak Day (Thousands of Gallons)	Pumpage Date	Ratio of Max to Average Day Pumpage
2012	72%	538.490	1,437	8/1/2012	2.669
2013	91%	497.690	1,341	7/9/2013	2.694
2014	69%	465.244	1,075	9/25/2014	2.311
2015	83%	521.441	1,229	7/14/2015	2.357
2016	76%	493.345	1,157	8/1/2016	2.345
2017	60%	508.885	1,034	10/20/2017	2.032

Table 6: Metered Water Sales 2017

Account Type	Average Customers	Thousands of Gallons of Water Sold	Revenues
Residential	619	23,014	$101,274
Commercial	55	4,068	$14,371
Industrial	14	75,155	$123,890
Public Authority	14	5,855	$15,293
Multifamily Residential	17	2,962	$9,361
Public Fire Protection Service	1		$91,218
Total			**$355,407**

SOURCE: PUBLIC SERVICE COMMISSION OF WISCONSIN

Residential water demand is the second largest usage component, at about 15% of the total pumpage. Normal typical household water consumption includes:

- Drinking and cooking
- Bathing
- Toilet flushing
- Washing clothes and dishes
- Watering lawns and gardens
- Maintaining swimming pools
- Washing cars

When divided into indoor consumption, the amount of water consumed is fairly constant throughout the year. The typical breakdown of interior water use in a house is: the bathroom (74%), cleaning/laundry (21%), and the kitchen (5%). (USEPA, 1992).

4.1.1 Daily Demand Fluctuations

An important factor in the design and sizing of water supply and storage facilities is the ratio of *peak day demand* to average day demand for the entire Village. The ratio for the last 6 years ranged from 2.0-2.7, with an average of 2.4.

4.1.2 Peak Hour Demand

Another important factor in the design and sizing of water supply and storage facilities is the *peak hour demand.* Typical design ratios for the peak hour demand to the average day demand range from 2.0 to 3.5, depending on the types of customers served by a water utility. The peak hour is taken as 1.5 times the maximum peak ratio. For the purposes of this study, the peak hour demand will be 3.5 times the average day demand.

4.1.3 Water Supply Efficiency

The water supply efficiency is the difference between the total pumpage and the total water sales. The total water sales are always less than the total pumpage. This is due to various factors such as:

- Water used for fire fighting
- Unmetered public water usage
- Water used for hydrant flushing
- Water main leaks, breaks, and repairs

Generally, the ratio of total water sales to total pumpage is an indication of the condition of the water distribution system. The lower the ratio the poorer the condition of the system. As shown in Tables 5a-c, the percent of total pumpage to total sales, or the "unaccounted for" water, for the Village of Random Lake has ranged from a low of 60 to a high of 91 percent. Each year the Village must review the water consumption records, determine reasons for the unaccounted water, and take corrective measures to reduce the amount of lost water. Based on existing data, and for the purposes of this study, the percent of the total sales to the total pumpage is assumed to be 75 percent for the last six years. The year 2017 had a larger difference between total water sales and total pumpage, with a percentage of 60 percent. This was partly due to the backwashing of a new iron filter that was constructed that year. Table 5c show the Average and Peak Day pumpage from 2012 through 2017.

4.2 Future Demand

Projections of future water supply requirements are based on population growths, trends, and an estimated per capita consumption. The future demand for the Village of Random Lake was be based on the acreage of future residential, commercial, and industrial land use. The UW-Extension created a map for the Village showing their estimate of potential expansion and land uses in 2039, and the potential expanded Village boundary. Using this map, we identified approximately a maximum buildout of 1,140 acres of possible future expansion, including areas of new development and areas that are already developed but not within the Village or connected to the utility networks. This future expansion was determined to be unlikely and a more strategic estimate was developed after while analyzing the 2039 potential expansion map.

The 2039 map (Figure 1) was analyzed to find areas that were likely to be developed, focusing on land inside the current Village boundary, and land within the expansion area that would be easy to connect to the existing networks. Our analysis identified approximately 219 acres, of which 201 acres are inside the current Village boundaries, and 18 acres is outside. Approximately 11 acres is already developed, but not connected to the utility networks. A more detailed breakdown of expansion by drainage area can be found in the *2019 Sewer Report*.

4.2.1 Population and Growth

One of the factors contributing to the future water consumption of a community is the residential water demand. The residential water demand is directly proportional to the population. For additional details on population trends and growth, please refer to the 20 -Year Comprehensive Plan Addendum 2019.

4.2.2 Residential

For the purposes of projecting future residential water demand for the Village of Random Lake, the per capita water usage rate of 50 Gallons per Capita per Day (GPCD) was used based off historical customer monthly meter reports.

Our analysis has projected the Village could gain approximately 124 acres of residential properties, a growth of about 51%. This represents an added population of about 300-500 depending on lot size and population density. This corresponds with an annual population growth of 0.9-1.4% over 20 years.

4.2.3 Commercial and Public

Commercial and Public Demand is often related to a community's residential demand. The water consumption records indicate that the commercial customers have a reliable and consistent base consumption, relating to the residential population. This land use category also includes governmental and institutional properties, for example Village properties, churches, schools, etc. because we estimate the water usage will be similar to general commercial properties like offices, stores, etc.

Our analysis has projected the Village could gain approximately 71 acres of commercial land, a growth of about 96%. Recent water bills were analyzed to find the average flow for current commercial properties on a per-acre basis, and used to calculate future flows. The average 2017 commercial water demand per acre is 400 Gallons per Acre per Day (GPAD).

4.2.4 Industrial

The high volume water users, or the industrial sector, can vary their water consumption depending on the type of industry and the level of production activity.

Our analysis has projected the Village could gain approximately 24 acres of industrial properties, a growth of about 30%. Recent water bills were analyzed to find the average flow for current industrial properties on a per-acre basis, and used to calculate future flows. The average 2017 industrial water demand per acre is 650 GPAD.

The two largest industrial water consumers, Krier and Lakeside, were analyzed separately due to their high consumption and more variable water usage. Discussions with Krier foods about future growth were conducted. They estimate a 20-year increase in water consumption from 50,000 GPD to 115,000 GPD. The flow values were calculated based on the expected annual number of bottled cases that will be produced by the plant in 20 years. A more conservative value of 10% growth in water consumption was used for Lakeside's expansion.

4.2.5 Fire Protection

The total amount of water used in a year for extinguishing fires is usually a negligible part of water used for all purposes. However, in many cases, the rate of demand and volume of water used may be great enough to be a deciding factor in modifying the capacities of storage facilities and distribution pipes.

Total required fire flow may be considered a function of population, but it is more directly a function of the size of the configuration of the water system. The Village of Random Lake Fire Department currently has two pumping trucks with a combined pumping capacity of 4,000 gpm. As discussed earlier, the maximum four-hour fire flow recommendation for the Village of Random Lake is estimated at 1,500 gallons per minute (gpm) at a minimum pressure of 20 psi.

4.2.6 Water Consumption Projections

A map of the Future Growth Water Study Areas are shown on Figure 3. Water consumption for the proposed future growth in 2039 is presented in Table 7. The existing information is based on 2017 area, water sale, and water pumpage data. The future annual consumption and pumpage values are based on the assumptions previously discussed. From this analysis, the average day pumpage is estimated to increase to about 0.57 million gallons. The peak day pumpage for the year 2039 is projected to increase to about 1.37 million gallons.

Table 7: Water Consumption Projections

	AREA (ACRES)			ESTIMATED DESIGN FLOW (GPM)					
STUDY AREA / DRAINAGE AREA (SEE FIG. 3)	COMM	INDUS	RES	COMM	INDUS	RES	TOTAL WATER SALE	TOTAL PUMPAGE*	PEAK DAY
EXISTING	69	79	241	18.8	143.0	49.5	211.3	281.7	
1	0	0	13	0.0	0.0	2.7	2.7	3.6	
2	13	0	41	3.6	0.0	8.5	12.2	16.2	
3	40	0	0	11.1	0.0	0.0	11.1	14.8	
4	8	24	0	2.2	10.8	0.0	13.1	17.4	
5	0	0	28	0.0	0.0	5.8	5.8	7.8	
6	10	0	0	2.8	0.0	0.0	2.8	3.7	
7	0	0	42	0.0	0.0	8.8	8.8	11.7	
8 (Krier)	0	N/A	0	0.0	28.9	0.0	28.9	38.5	
TOTAL (GPM)				38.5	182.7	75.3	296.6	395.5	949
TOTAL (MGD)				0.055	0.263	0.108	0.427	0.569	1.366

* Total pumpage equals water sales plus water losses in the system. Based on the last 6 years, water sales accounts for an average 75% of total pumpage.

5.0 ANALYSIS OF FUTURE REQUIREMENTS

Using future water estimates, we can estimate the adequacy of the existing system and determine which future upgrades will be needed in order to supply the demands projected in this report. The current system will be analyzed with the projected future demands through 2039.

5.1 Supply

The capability of the existing water system and the determination of future requirements, based on projected averages and peaks, will be based on three parameters. These parameters are used to determine whether or not a system has sufficient service. The three parameters are listed below.

1. Source Capacity: A water system should be able to supply the peak day pumpage from water sources (wells) with the largest capacity source out of service.

2. Fire Flow: A water system should be able to supply the required *fire flow demand* in addition to a concurrent peak day pumpage from existing storage facilities and with the pump stations largest source out of service.

3. Emergency Supply: A water system should be able to supply an average day pumpage using only elevated storage and auxiliary power pumping.

5.1.1 Source Capacity

Well capacity for the Village of Random Lake is identified in Table 8. With the largest well out of service, Well Number 2, the source capacity is 550 gpm (.792 MGD).

Table 8: Average Operating Capacity

Pumping Capacity	Well No. 1	Well No. 2
Rated	550 gpm	700 gpm
Current	550 gpm	550 gpm

Using this source capacity, the minimum water supply requirements are shown in Table 9. Peak day demand for the year 2017 was taken from historical data provided by the Village. Peak day demand for 2039 was calculated by multiplying the average day demand, from the analysis above, by a peaking factor of 2.4, based on historical water pumpage data.

Table 9: Minimum Water Supply Requirements

Year	Peak Day Demand (MGD)	Existing Source Capacity (MGD)	Minimum Additional Supply Capacity Required (MGD)	(gpm)
2017	0.974	0.792	0.182	127
2039	1.366	0.792	0.574	398

Based on the peak day demand and the source capacity, there is an existing supply deficiency when one well is offline.

5.1.2 Fire Flow Analysis

In addition to being able to store and supply water to meet peak hour operational demands, a water system should have an additional effective storage volume equal to the required fire flow over the fire flow duration. This volume should be available throughout the system at a minimum pressure of 20 psi. The available storage used in this analysis is the volume required to maintain 20 psi throughout the system under fire flow conditions, less the volume, which is available for peak hour demands at a minimum pressure of 35 psi. The recommended NFPA fire flow for the Village of Random Lake is 1,500 gpm for duration of four (4) hours.

Based on required fire flows, there is a fire flow deficiency when one well is offline.

5.1.3 Emergency Supply

The emergency supply should equal the average day demand, which for Random Lake is 0.569 MGD in year 2039. For calculations, use the elevated storage plus one well with a means of backup power, so the entire water system would not be affected.

Emergency Supply = 0.285 + 0.792 = 1.077 - 0.569 = 0.508 MG Surplus

There is sufficient emergency supply.

5.2 Storage

Water storage system provides storage for fire and fire protection needs, balances out wide fluctuations in water demands, provides consistent water system pressures, and improves system reliability by providing water storage for use under emergency conditions.

The minimum recommended volume of storage within a water system is largely dependent on the source of supply and the maximum day demand. In general, the functions of system storage are to meet peak demand rates, to supply fire fighting requirements, to provide flexibility in the operation of well and service pumps, to provide pressure and flow equalization, to provide system reliability, and to reduce the size of the distribution mains. The only quantitative functions are those relating to maximum day and *fire demands*. Quantity of storage is one of the major factors in providing adequate fire protection. The other functions are equally important, but are more characteristic of the management and operation of the system.

For water systems supplied by distributed wells, it is recommended that total elevated storage volume be approximately 15% to 20% of the maximum day pumpage. This volume is normally sufficient to provide the desired system reliability and stability. Also, about one third to one half the *total storage* capacity should be available to meet fire demands. There is no stipulation on the maximum amount of storage volume, provided that the water is not stored too long that the quality degrades.

It is important to note that all elevated storage volume is not necessarily usable in supplying normal system demands. The actual effective elevated storage volume available in supplying demands other than fire flows is that which is contained in a maximum head range without lowering system pressures below the allowable minimum of 35 psi. The minimum water level allowed in elevated storage structures is based on the highest ground surface elevation, which is served by the system. The storage system also reduces the dependency of the system demand on the supply wells alone. Frequent starting and stopping of electric pumps can result in preventable wear on the pumps and can shorten their life.

As shown in Table 10, the minimum supply storage required for year 2039 is 0.456 MG. Since the current system can supply 0.285 MG, this indicates that new storage of 0.171 MG will be required to satisfy fire storage requirements.

Table 10: Minimum Supply Storage

Year	Fire Storage Requirement (MG)	Operational Requirements (MG)	Total Required Storage	Existing Storage Available (MG)	Recommended New Storage (MG)
2017	0.360	0.030*	0.390	0.285	0.105
2039	0.360	0.096*	0.456	0.285	0.171

* (Peak Day – Reliable Storage) x 4 hours

5.3 Distribution

As stated previously, the function of a distribution system is to transport water from the supply sources to the customers. If the mains are large enough and looped in a grid pattern, the pressure loss will not be excessive. The mains must be sized so that the pressure loss will be acceptable at the maximum anticipated flow rate. This rate would normally be equal to the projected peak day demand plus a concurrent fire demand.

Computer modeling, using *WaterGEMS*, assists in the analysis of the water distribution system. The computer model was calibrated using results from actual hydrant flow tests that were conducted throughout the Village. Therefore, the model simulates existing field conditions as closely as possible. Computer modeling allows the selection of the most economical methods of providing the needed flows and pressures throughout the distribution system.

The recommended size and locations of water mains and storage tanks were entered into the existing model along with proposed demand rates and fire flows. Water mains were upsized until the required flows and pressures were met.

5.4 Pressure

As stated previously, normal water system pressure requirements are established by different Wisconsin regulatory agencies. Based on these agencies, a suitable range of static pressures is 35 psi to 80 psi. The Village of Random Lake maintains their pressure with an elevated reservoir.

The pressure loss in the system must be limited such that a minimum of 35 psi is available throughout the system during maximum day flows excluding fire demand, and a minimum of 20 psi is available throughout the system during fire flow situations.

The current system supplies the suitable range of pressure to all of its customers.

All future water main installations will need to meet the regulatory agency guidelines.

5.5 Fire

The total volume of storage and supply with the largest well out of service is required for a duration of 240 minutes at a flow rate of 1,500 gpm plus a concurrent peak day pumpage. The difference in these volumes must be available from system storage. See Table 10 for Minimum Supply Storage. As described previously, there is an existing deficit of 0.105 MG, and a future deficit of 0.171 MG. Additional future storage will be recommended in the next Chapter.

6.0 RECOMMENDED IMPROVEMENTS

Based on the analysis for future requirements, both existing and future deficiencies have been identified.

The Village has made several upgrades to the water system. These include, but are not limited to:

1. Well #1 Upgrades (new backup generator, new deep well pump)
2. Well #2 Upgrades (new backup generator, new iron filter system)
3. Allen Street Water Main Replacement
4. Hoff Street Water Main Replacement
5. 5th Street Water Main Replacement

Using future water estimates, we can estimate the deficiencies of the existing system and determine which future upgrades will be required in order to supply the demands projected in this report. The existing system will be analyzed with the projected future demands through the year 2039.

All fire hydrants within the Village should have their tops painted a color corresponding to the maximum flow the hydrants can provide. Marked hydrants will inform firefighters on what hydrants will provide required flow during an emergency. Based on National Fire Protection Association guidelines, red topped hydrants correspond to 500 gpm or less, orange topped hydrants correspond to 500-999 gpm, green topped hydrants correspond to 1000-1499 gpm and blue topped hydrants correspond to more than 1500 gpm.

6.1 Recommended Source Improvements

Water systems must have multiple reliable sources of water to supply the community and provide redundancy within the system. With one well out of service, there is an existing deficiency of 0.182 MGD and a future deficiency of 0.574 MGD. A third well, well #3, with a minimum 550 gpm pump would eliminate these deficiencies.

A new well should be located in an area that has a sufficient groundwater supply. Ideally, Well #3 would be located on the east side of the Village, close to future development areas. The well should be located close to a water tower. A backup generator should be installed to power the pump in case of a power outage.

6.2 Recommended Storage Improvements

Water systems must be reliable in maintaining water pressure and equalizing the demand on supply sources. There is an existing Fire Flow Storage deficiency of 0.105 MG, and a future deficiency of 0.171 MG. One way to reduce these deficiencies is to add storage to the system. The capacity of a storage tank must always be sized to meet the daily consumption of the Village. The system must be balanced, allowing for constant pumping during the day while providing a constant pressure head.

Additional storage should be developed to reduce the existing deficiencies. In planning for future projected demands, it is recommended that a 200,000-gallon tank be developed in the next five years.

There are primarily two alternative structures that could be used to provide additional storage, elevated storage or ground storage. Both of these storage considerations need to provide the required hydraulic grade line for the minimum main pressure of 35 psi. Ground storage would require booster pumps and a much larger foot print, while an elevated tank can be constructed anywhere to help stabilize the flows and pressures.

A major consideration for the placement of a storage tank is the location. The existing elevated storage tank is located just east of Butler Street. Having additional storage on the East side of the Village will help stabilize the flow and pressure.

From the standpoint of water distribution characteristics and fire protection needs, the best alternative for an elevated storage tank would be on the east side of the Village.

An elevated tank should be located away from buildings, heavy traveled public areas and parking lots, to prevent damages to a third party or the tank. To help moderate pressure fluctuation, the tank should be located near a well. The tank site should be free from all obstructions, such as power lines. The site should be large enough to provide maintenance to the tank and site.

The existing elevated water tower and additional future elevated water towers should include mixers. Mixers prevent freezing of the water in the water tower during winter months.

6.3 Recommended Flow Distribution Improvements

The Village of Random Lake has over 21,000 feet of older 6-inch water mains. These mains restrict the fire flow to hydrants. General maintenance and up keep of a system is also critical to the integrity. The following should be reviewed for improvements now and as the community grows:

- All mains connecting to hydrants should be replaced with a minimum 8-inch water main pipe. It is recommended that this work should be coordinated with future street projects.

As described previously, a looped system increases the integrity of the entire system. There are some noteworthy sections in the current system that should be looped to improve the system. The following water main should be installed to complete loops in the system:

- Install 12-inch main from the existing 12-inch water main on the south end of Lake Breeze Lane running east in Orth Drive and connecting to the 12-inch water main in the south end of Temes Drive.
- Install 12-inch main, along the north east corner of the lake, to connect Stark Road and East Shore Drive.
- Install 8-inch main, along Lake Drive.
- Install 8-inch main, along Grand Avenue.
- Install 12-inch main, along 1st Street.
- Install 12-inch main, along Jessie Lane.
- Install 8-inch water main from Maple Court to Carroll Street.
- Install 12-inch water main along STH 57 and CTH K
- Install 12-inch water main along CTH RR from STH 57 to East Shore Drive.

6.4 Conclusions

Developing and maintaining a water supply system is important to any community. General recommendations are:

- Mark fire hydrants by painting the top of the hydrant a color that corresponds with the maximum flow the hydrant can provide.
- Identify road projects and upsize/replace water main accordingly.

Based on the following conclusions and course of action, in order of importance, recommended improvements (Figure 4) to provide an adequate dependable system are as follows:

UPGRADES IN THE NEXT 5 YEARS:

1. **New Well No. 3**
   The existing well capacities are insufficient at this time. To insure that the Village continues to maintain an adequate supply, the development of Well No.3 should move forward as soon as possible. With the completion the new well No. 3, with backup power, it can then be considered as part of the reliable supply and will significantly reduce the requirement for future storage. Approximate cost is $650,000.

2. **New Elevated Tank**
   The existing system currently does not provide enough effective storage volume to provide reliability and flexibility to satisfy fire flow demands. The construction of a 200,000 gallon elevated storage tank should be initiated soon after the completion of the new well No. 3 on the east side of the lake to accommodate current residential and future industrial demands. A mixer should be installed in the water tower as well as in the existing water tower to prevent freezing in winter. Approximate cost is $750,000.

3. **Orth Drive Water Main Extension**
   It is recommended that a new 12-inch water main should be installed from the existing 12-inch water main on the south end of Lake Breeze Lane running east in Orth Drive and connecting to the 12-inch water main at the south end of Temes Drive (approx. 1,900'). This will create a loop and increase flow. Approximate cost is $325,000

4. **Water Main Loop around Northeast side of the Lake**
   It is recommended that a new 12-inch water main (transmission line) should be installed in a future utility easement along the north east corner of the lake, connecting the water main at the end of Stark Road and continuing east and connecting to the water main at the north end of East Shore Drive. (approx. 2,800') this will create a loop and increase flow. This will also provide added protection in case of a water main break or required maintenance of the existing 12-inch water main located in Hickory Drive on the south side of the lake. Note that a water transmission line would not require hydrants which would lower the cost of this project. Approximate cost is $450,000.

UPGRADES IN THE YEARS 6 TO 20:

5. **Lake Drive Water Main Replacement**
   It is recommended to replace the existing water main from Butler Road to Point Road with 8-inch water main (approx. 3,000'). This replaces 6-inch cast iron water main. Approximate cost is $470,000.

6. **Grand Avenue Water Main Replacement**
   It is recommended to replace the existing water main from Allen Street to Spring Street with 8-inch water main (approx. 1,900'). This replaces 6-inch cast iron water main. Approximate cost is $310,000.

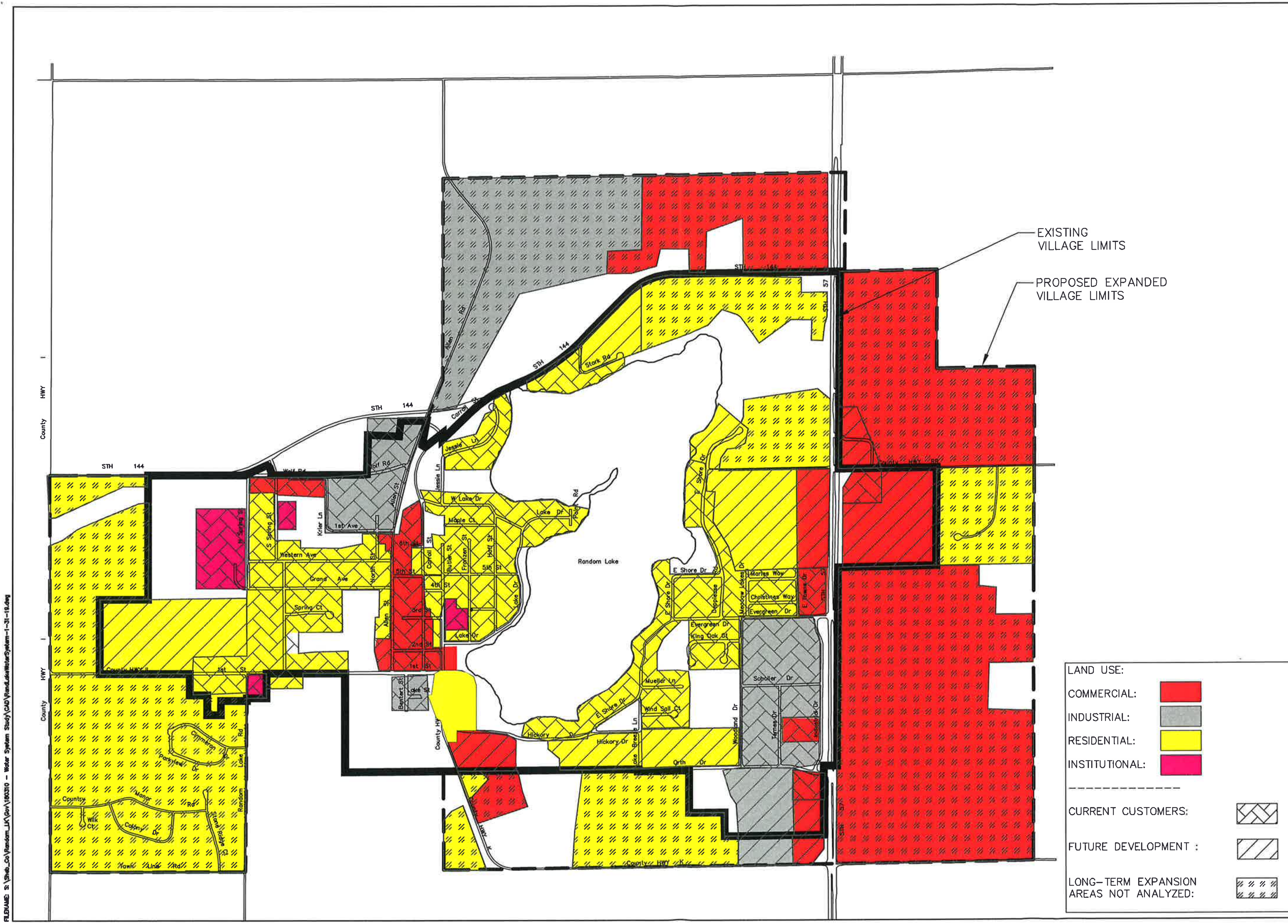
7. **West 1st Street Water Main Extension and Replacement**
   It is recommended to replace the existing water main from Allen Street to the current water main dead end with 12-inch water main (approx. 2,700'). Also, to feed any future development south of the High School, extend 12-inch new water main (approx. 550'). This work should be coordinated with planned Sheboygan County road work on CTH II. Approximate cost is $570,000.

8. **Jessie Lane Water Main Replacement**
   The cause of the low flow on Stark Road appears to be the 6-inch connecting pipe in Jessie Lane that feeds the 12-inch water main. It is recommended that the existing pipe in Jessie Lane be upsized to 12-inch (approx. 1,900'). This will increase flow and deliver required fire flows to the hydrants on Stark Road. Approximate cost is $300,000.

9. **Maple Court Water Main Extension**
   An 8-inch water main should be installed from the west end of Maple Court running west in the existing road right of way and connect to the 12-inch water main in Carroll Street (approx. 300'). This will create a loop and increase flow. Approximate cost is $50,000.

10. **STH 57 & CTH K Water Main Extension**
    For future expansion on the east side of STH 57 a new 12-inch water main should be extended east on Orth Drive to STH 57, and then south to CTH K, and west to feed future expansion (approx. 3,550'). This will facilitate future expansion to the south and east of the Village. Approximate cost is $600,000.

11. **CTH RR Water Main Extension**
    It is recommended that a new 12-inch water main should be installed between East Shore Drive and up to the terminus of CTH RR (approx. 1,750'). This will create a loop and supply new developments on the east side of the Village. Approximate cost is $250,000.



KAPUR & ASSOCIATES, INC.
CONSULTING ENGINEERS
7711 N. PORT WASHINGTON ROAD
MILWAUKEE, WISCONSIN 53217
Phone: 414.351.6668 Fax: 414.351.4117
www.kapurengineers.com

PROJECT:
WATER SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

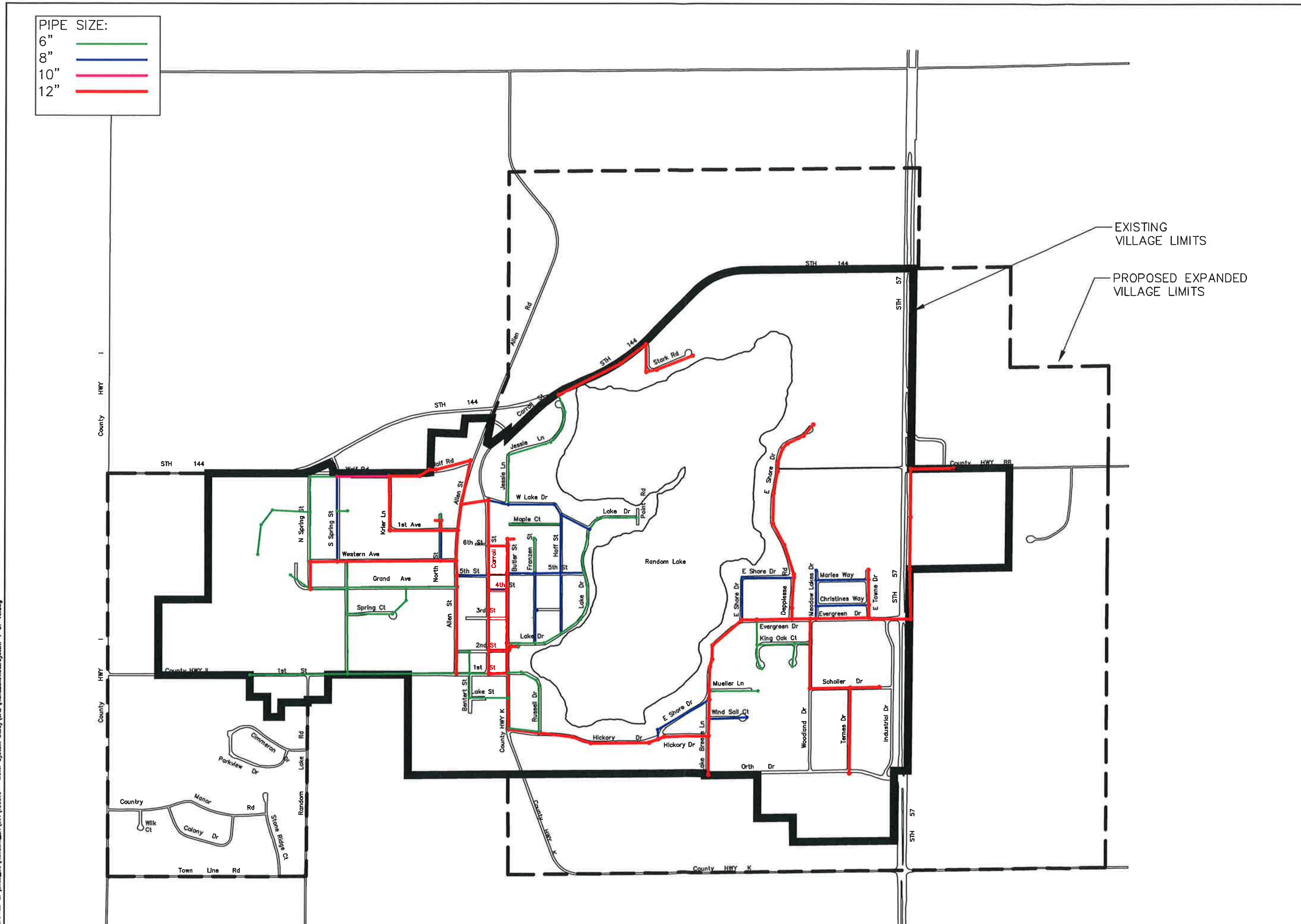
SCALE: N.T.S.

SEAL:

SHEET:
20-YR COMP PLAN ADDENDUM 2019 LAND USE

PROJECT MANAGER:	ARG
PROJECT NUMBER:	18.0310
DATE:	2/1/19

FIGURE:
1



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PROJECT:
WATER SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

SCALE: N.T.S.

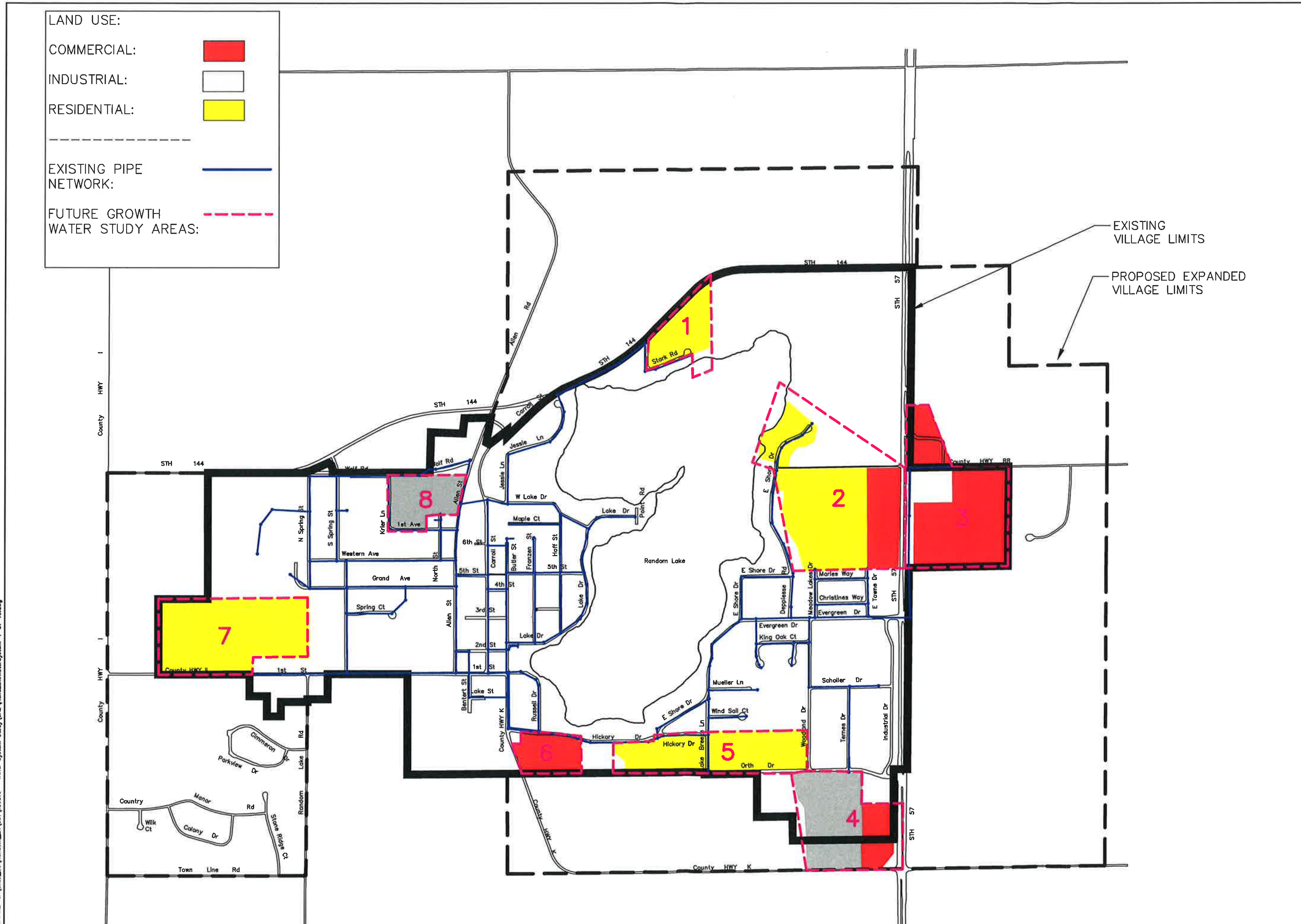
SEAL:

SHEET:
EXISTING WATER SYSTEM

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0310
DATE: 2/1/19

FIGURE:
2

FILENAME: S:\Sheb_Co\Random_LK\Gov\180310 - Water System Study\CAD\RandLakeWaterSystem-1-31-19.dwg



FILENAME: S:\Sheb_Co\Random_LK\Gov\180310 - Water System Study\CAD\RandLakeWaterSystem-1-31-19.dwg

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PROJECT:
WATER SYSTEM STUDY

LOCATION:
VILLAGE OF RANDOM LAKE

CLIENT:
RANDOM LAKE WISCONSIN

RELEASE:
FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

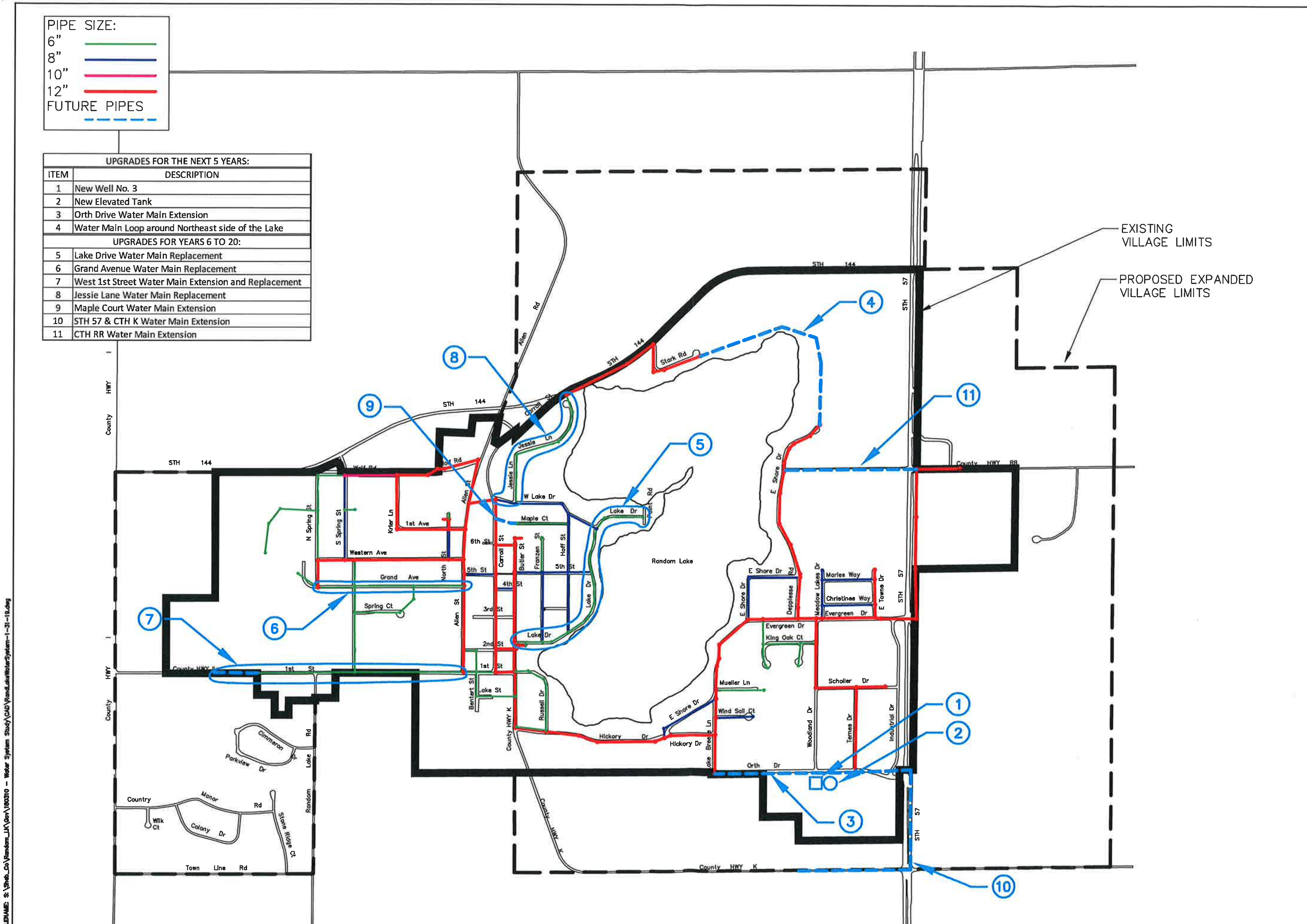
SCALE: N.T.S.

SEAL:

SHEET:
FUTURE GROWTH WATER STUDY AREAS

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0310
DATE: 2/1/19

FIGURE:
3



UPGRADES FOR THE NEXT 5 YEARS:	
ITEM	DESCRIPTION
1	New Well No. 3
2	New Elevated Tank
3	Orth Drive Water Main Extension
4	Water Main Loop around Northeast side of the Lake
UPGRADES FOR YEARS 6 TO 20:	
5	Lake Drive Water Main Replacement
6	Grand Avenue Water Main Replacement
7	West 1st Street Water Main Extension and Replacement
8	Jessie Lane Water Main Replacement
9	Maple Court Water Main Extension
10	STH 57 & CTH K Water Main Extension
11	CTH RR Water Main Extension

FILENAME: S:\Sheb_Co\Random_LK\Gov\180310 – Water System Study\CAD\RandLakeWaterSystem-1-31-19.dwg

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PROJECT: WATER SYSTEM STUDY

LOCATION: VILLAGE OF RANDOM LAKE

CLIENT: RANDOM LAKE WISCONSIN

RELEASE: FINAL

REVISIONS:

#	DATE	DESCRIPTION
1	2/1/19	FINAL

NORTH ARROW:

SCALE: N.T.S.

SEAL:

SHEET: RECOMENDED IMPROVEMENTS

PROJECT MANAGER: ARG
PROJECT NUMBER: 18.0310
DATE: 2/1/19

FIGURE: 4

WISCONSIN

MELODY LORGE
CLERK OF CIRCUIT COURTS

615 N SIXTH STREET, SHEBOYGAN, WISCONSIN 53081 920.459.3068 FAX 920.459.3921

January 25, 2019

Treasurer
Village of Random Lake

To Whom It May Concern:

Enclosed is our check in the amount of $14.08 for fines and officer fees collected in the month of December 2018. Listed also is the number of cases disposed of during the same period for which we have deducted a $5.00 per case municipality fee (excluding seatbelt violations).

Circuit Court Fines	$ 24.08
Officer Fees	
2 Cases Disposed @ $5.00	10.00
TOTAL	$ 14.08

Best,

Melody Lorge
Clerk of Circuit Courts

SHEBOYGAN COUNTY
Agency: **Village of Random Lake**

MUNICIPAL FORFEITURE REPORT
Period Ending 12-31-2018
Final

01-04-2019
04:00 pm

Receipts this period:

Case Number	Citation Number	Defendant Name	Receipt Date	Receipt Number	Amount
2017FO000358	G880BMQKRN	Wenske, Andrew James	12-19-2018	18R 029442	5.08
2017FO000430	G881C0TWRF	Case, Roger D	12-27-2018	18R 029908	19.00
				Total Receipts:	**$24.08**

Voids This Period:

Case Number	Citation Number	Defendant Name	Receipt Date	Receipt Number	Amount
				Total Voids:	**$0.00**

Dispositions This Period:

Case Number	Citation Number	Disposition Date	Caption	Amount
2018TR005304	BB4913506	12-04-2018	Random Lake, Village of vs. Micaela Rose Caples	-5.00
2018TR005637	BC9223281	12-14-2018	Random Lake, Village of vs. Elizabeth L Brandt	-5.00
			Total Dispositions:	**$-10.00**

Other Adjustments This Period:

Case Number	Citation Number	Defendant Name	Adjust. Number	Adjust. Date	Amount
				Total Adjustments:	**$0.00**

TOTAL MUNICIPAL FORFEITURE **$14.08**

Lynn Videkovich Coenen

From: mbrockmeier@randomlakewi.com
Sent: Monday, January 28, 2019 4:55 PM
To: lcoenen@randomlakewi.com; clerk@randomlakewi.com
Subject: Fw: Fwd: Question

Please share with the board under correspondence for next Monday's meeting.

Matthew

Matthew Brockmeier

President
Village of Random Lake

On Mon, 28 Jan, 2019 at 4:24 PM, Pat Depies <randomlakechief@gmail.com> wrote:

To: Matthew Brockmeier

Matthew, this was the response that we had gotten from our Medical Director Dr Zils back in December. Not sure if you ever seen this or not but maybe should be shared with the board that any left over monies could be used on equipment for the AEMT position.

Thanks

Pat Depies, Chief
Random Lake Fire Department
N7045 Kay-K Road
Belgium, WI 53004
(920) 994-4188 station
(920) 946-1848 cell
(920) 994-4188 fax
randomlakechief@gmail.com
www.randomlakefiredept.org

---------- Forwarded message ---------
From: **Zils, Steven** <steven.zils@aurora.org>
Date: Thu, Dec 6, 2018 at 10:22 PM
Subject: RE: Question
To: Pat Depies <randomlakechief@gmail.com>

Hi Pat,

Thank you for your email. Please see my responses below in red.

Let me know if you have any other questions or if I can provide any further information.

Take care,

Dr. Zils

Steven Zils, MD, FAEMS, FACEP, NRP
Out of Hospital Medical Director, Aurora Regional EMS

Greater Milwaukee North/Sheboygan
Aurora Medical Center - Grafton
975 Port Washington Rd.
Grafton, WI 53024
O: 262.329.1911
M: 708.426.3929

From: Pat Depies <randomlakechief@gmail.com>
Sent: Tuesday, December 4, 2018 11:54 AM
To: Zils, Steven <steven.zils@aurora.org>
Subject: Question

Dr Zils, as our medical director I have a couple of questions for you;

What is your opinion is on a chase type vehicle for our full time AEMT person to use?

I think if your full time AEMT is going to be away from the station during the day, a chase type vehicle would make sense. That way, if a call goes out, they could respond directly to the scene. This would shorten response times to getting a medical provider and treatment to a patient.

Would it have a beneficial purpose?

Yes, please see above.

What type of equipment should be on board this vehicle?

This depends. At the very minimum, it should be staffed at the EMR level with basic equipment and an AED. Ideally, it would be stocked so the AEMT could utilize all their skills and training while waiting for the rest of the crew to bring the ambulance to the scene. Being able to provide interventions such as 12-lead acquisition and medication administration would enhance patient care. This would require a vehicle that is equipped with a temperature control cabinet, as medications and IV fluids would need to be temperature controlled, if the vehicle is left outside. We have our EMS support vehicles set up this way and would be happy to show you how we accomplished this, as we've been very happy with our setup.

Thanks for your time

Pat Depies, Chief

Random Lake Fire Department

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Belgium, WI 53004

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