

# Water Supply Service Area Plan (Draft)



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*May 20, 2025*

**PREPARED FOR:**  
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## I. INTRODUCTION

In June of 2024, Wisconsin Administrative Code (WAC) NR 854 was released, requiring many public water utilities to create water supply service area plans. This requirement applies to public water systems that withdraw from the waters of the state and that serve a population of 10,000 or more. Water systems are required to have a water supply service area plan prepared before the end of the year 2025. In addition to preparing a plan, if a water system is requesting a new or increased diversion of Great Lakes water, it also is required to submit the plan and obtain department approval.

The Village of Hartland Water Utility meets the above-mentioned criteria and is required to prepare a water supply service area plan but is not required to obtain department approval. The Village of Hartland Water Utility withdraws its water from the waters of the state with its five groundwater wells. Per the Wisconsin Department of Administration (DOA), the estimated population of the Village of Hartland in the year 2023 was 10,084. However, the Village does not divert Great Lakes water nor plans to do so in the future. Therefore, this water supply service area plan is prepared to meet the requirements of NR 854.

### A. Planning Period

This water supply service area plan uses a 20-year planning period and expires in the year 2045. This plan is required to be reviewed at least every 5 years and updated as necessary (NR 854.05). Current and future water needs were evaluated over a 20-year planning period with consideration given to projected future water needs extending to the year 2045.

### B. Scope

This plan uses a systematic approach to introduce and expand basic planning concepts. A review of existing water system facilities is summarized in Chapter II. Population, community growth, and water consumption projections serve as the foundation for evaluating and identifying recommended improvements to the system and are introduced in Chapter III. The assumptions and conclusions presented in Chapter III were used to develop projections of water requirements that are presented in Chapter IV. The developed water requirements are used in Chapter V to summarize the evaluation of the water system supply and storage needs.

Because needs change with time, comprehensive planning is a continuous function; therefore, the longer-term projections and improvements discussed in this report should be periodically reviewed, reevaluated, and modified, as necessary, to ensure the adequacy of future planning efforts. Proper future planning will help ensure that system expansion is coordinated and constructed in the most effective manner.

### C. Service Area

The service area is illustrated in Figure I-1 and consists of the Village of Hartland. The service area for the Village's water system is not planned to expand beyond the Village boundaries. Located along Wisconsin State Trunk Highway 16 and north of Interstate Highway 94, the Village of Hartland is within close proximity to the greater Milwaukee metropolitan area.

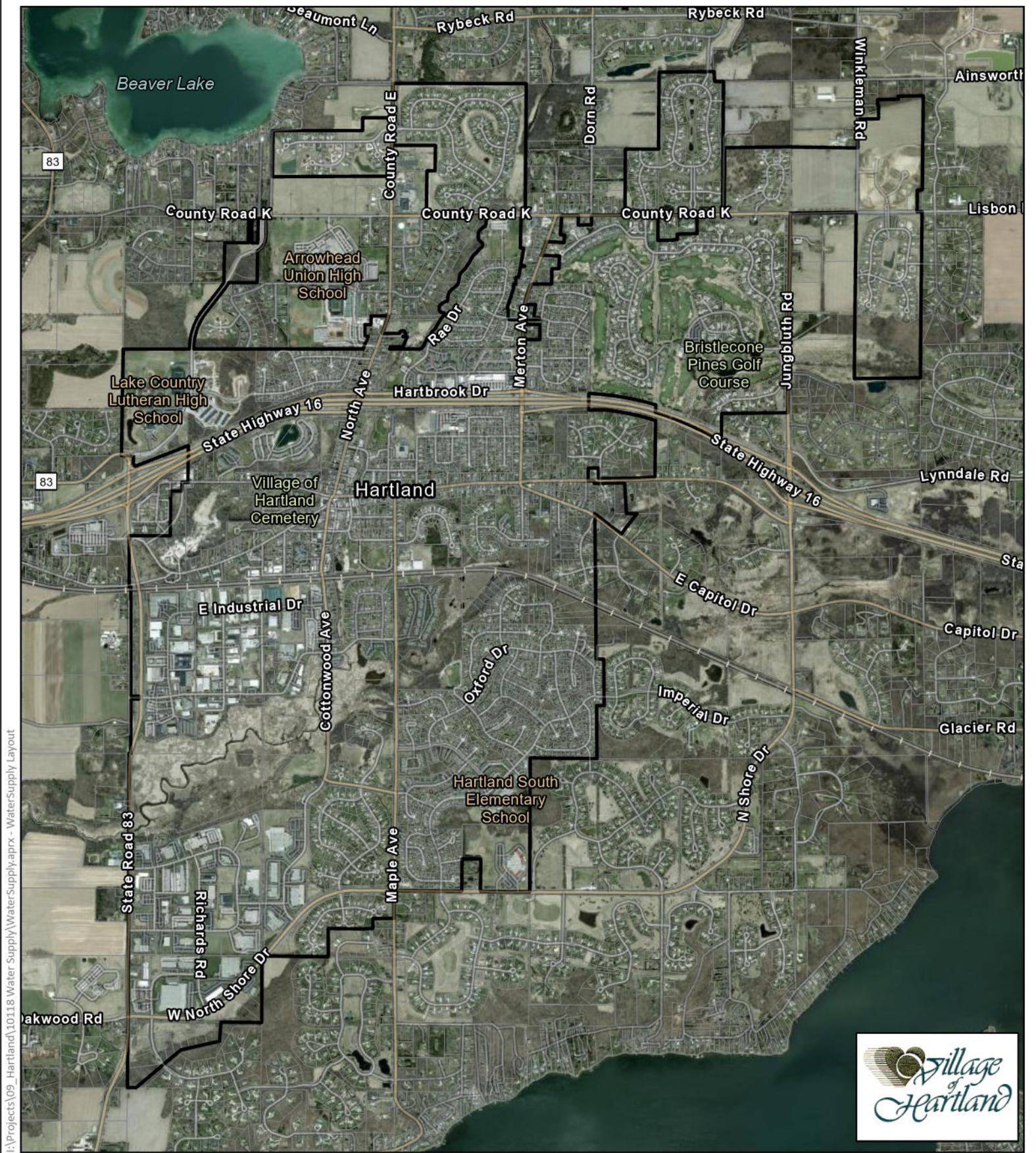
### D. Study Limitations and Assumptions

The following limitations and assumptions underlie the work elements of this plan.

1. The primary purpose of the study is to develop a system plan to guide the extension of adequate water supply services by the Village of Hartland Water Utility to existing and

probable future development within the service area. The plan identifies water system infrastructure needed.

2. The plan produced is to provide a sound basis for future facility planning. To this end, the study reviews the size and capacity of wells, pumping stations, and storage facilities.
3. The plan is to be based upon previously developed land use and population information provided to Ruckert & Mielke, Inc. The plan is to be designed to serve and support anticipated community needs based upon the current land use and population projections assuming complete development of the study area within the planning period.
4. Recommendations resulting from the planning efforts are to be consistent with current federal, state and local regulations regarding facility design.
5. This study includes a cursory investigation of the Village water distribution system. The investigation is limited to a review of existing available water quality data and does not include any sampling, laboratory work, or pilot testing.



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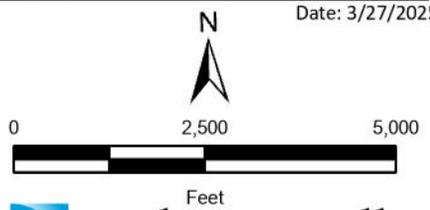


Date: 3/27/2025

Figure I-1

 Village Limits

Village of Hartland  
Waukesha County, Wisconsin



Ruekert • Mielke

## II. EXISTING WATER SYSTEM FACILITIES

This chapter presents a summary of the existing water system components of the Village of Hartland Water Utility water system. The various facilities operated and maintained by the Village of Hartland Water Utility include:

1. Five groundwater wells
2. Three elevated water storage tanks
4. One ground level storage tank
5. One supply pumping station
6. Two booster pumping stations
7. A network of transmission and distribution water mains

The general location and layout of the water system facilities are illustrated in Figure II-1. A schematic of the water system is illustrated in Figure II-2. The distribution system is separated into two pressure zones: the main pressure zone and the Windrush boosted pressure zone. The Windrush boosted pressure zone is at a higher elevation than the rest of the distribution system and requires a separate pressure zone to provide adequate pressure to customers.

### A. Water System Pressure Zones

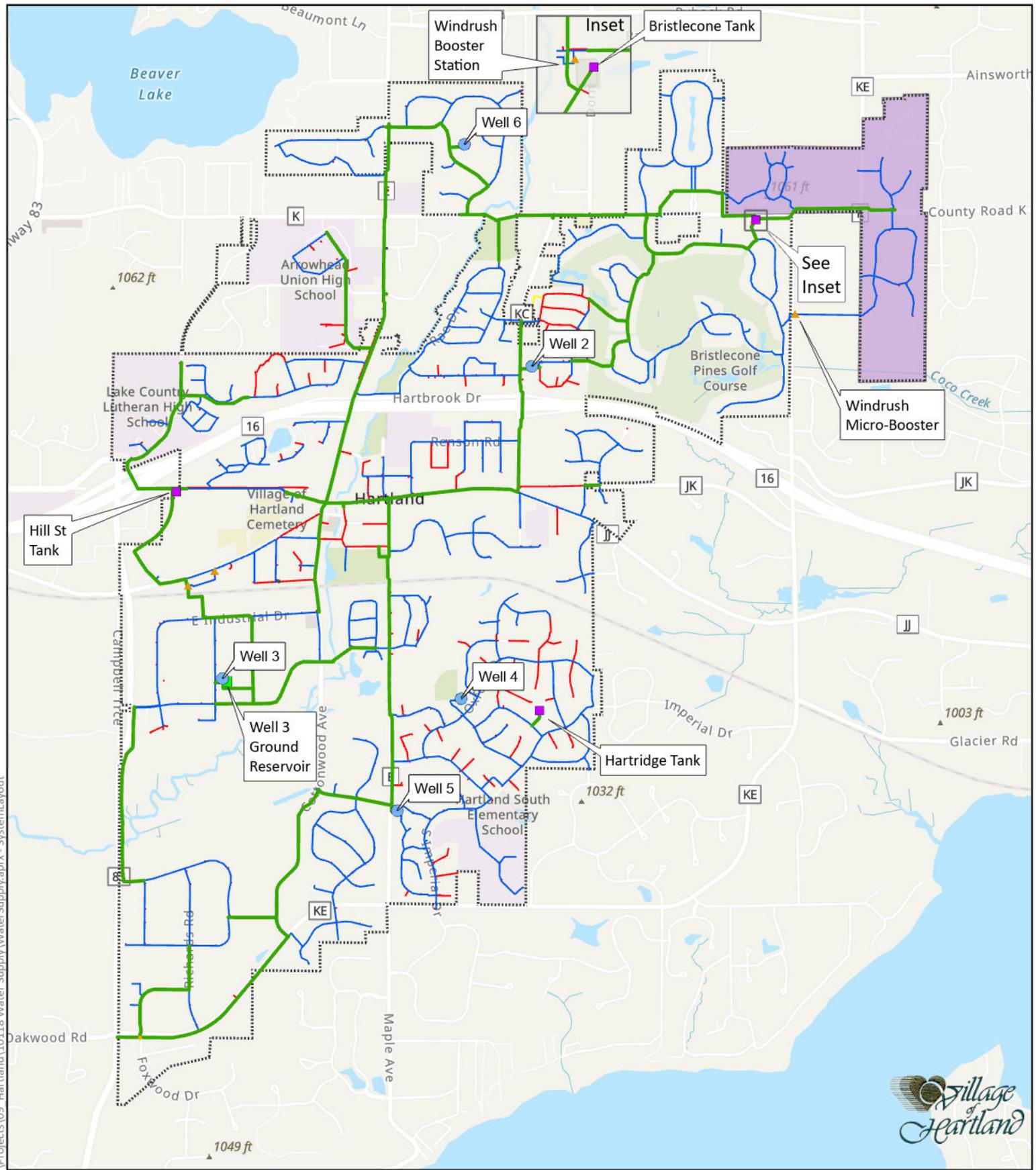
As mentioned above, the Village's water distribution system consists of two pressure zones as illustrated in Figure II-1. Because the Village of Hartland encompasses an area of varied elevations, the pressure zones are necessary to ensure appropriate distribution system pressures for all customers.

#### 1. Main Pressure Zone

The main pressure zone is the largest pressure zone and serves all but a small portion on the northeastern part of the Village. Currently, all of the groundwater wells are located within the Main Pressure Zone. The ground elevations currently served by the Main Pressure Zone are approximately 900 feet to 1,034 feet USGS.

#### 2. Windrush Boosted Pressure Zone

The Windrush Boosted Pressure Zone serves areas of higher elevation north of the Main Pressure Zone and serves the Windrush subdivision. The Windrush Boosted Pressure Zone currently serves elevations from approximately 950 feet to 1,050 feet USGS. The Windrush Boosted Pressure Zone is small in size consisting of approximately 250 acres in total land area.



I:\Projects\09 Hartland\10118 Water Supply\aprx - System\Layout

- ▲ Hydrants
- Well
- Enclosed Storage Facility
- ▲ Booster Station
- ▲ Elevated Tank
- Windrush Boosted Pressure Zone
- 4"
- 6"
- 8"-10"
- 12"
- 16"
- Unknown
- ⋯ Village Limits

Figure II-1

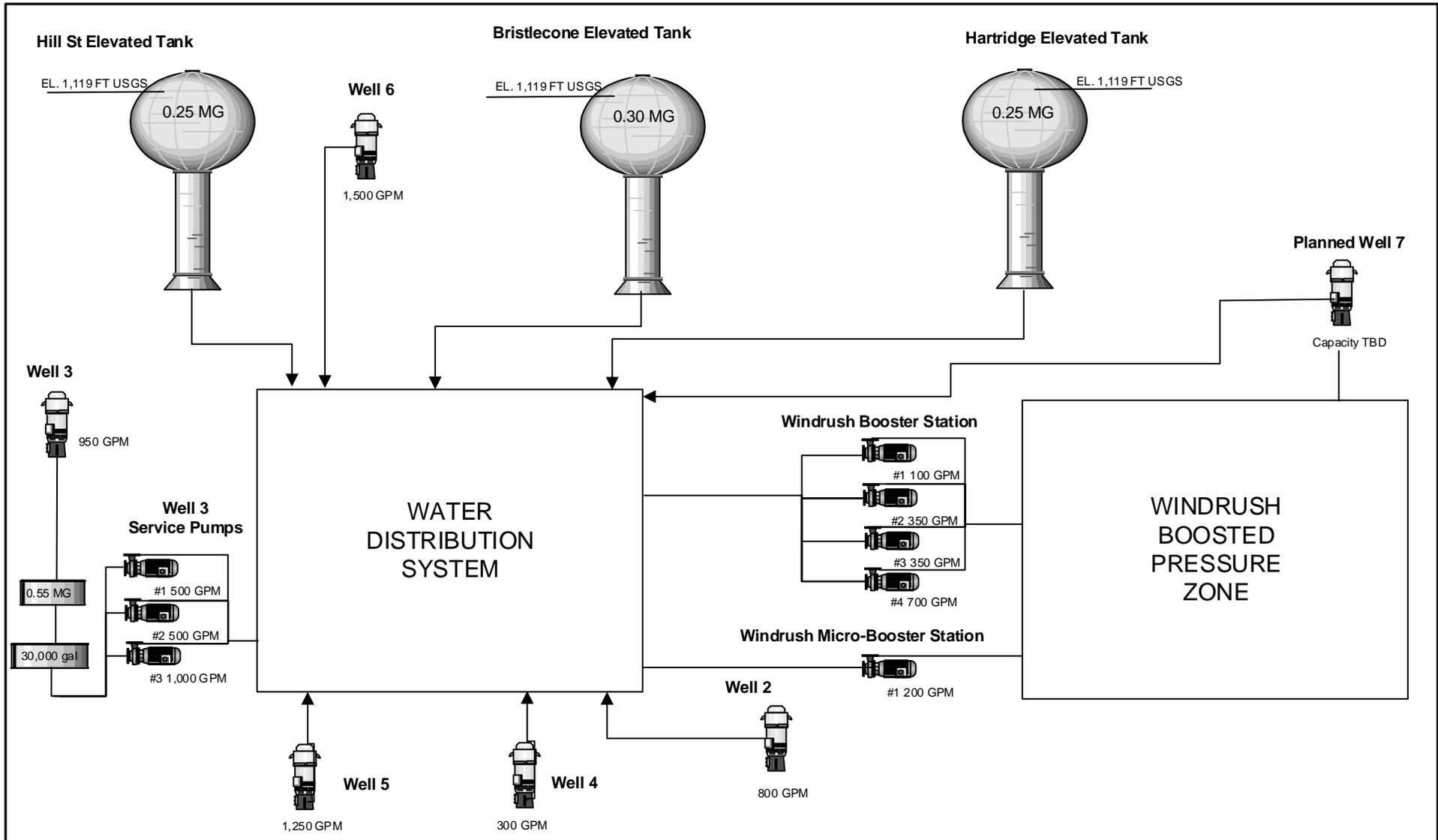
Village of Hartland  
Waukesha County, Wisconsin

Date: 3/27/2025

N  
↑

0      2,500      5,000  
Feet





**LEGEND**

 EL. 933 FT USGS  
 ELEVATED TANK VOLUME (MG) AND OVERFLOW ELEVATION (FEET)

 WELL AND PUMP RATED CAPACITY (GPM)

 0.33 MG  
 GROUND RESERVOIR VOLUME (MG)

 500 GPM  
 BOOSTER PUMP RATED CAPACITY (GPM)



**FIGURE II-2**  
 EXISTING WATER SYSTEM SCHEMATIC  
 VILLAGE OF HARTLAND  
 WAUKESHA COUNTY, WISCONSIN

## B. Water Distribution System

The water distribution system provides a means of transporting and distributing water from the water supply and storage facilities to the utility customers and other points of usage. The distribution system must be capable of conveying adequate quantities of water at reasonable water system 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 water demand conditions but must also be capable of delivering adequate water supplies for fire protection purposes.

Using water main data maintained by the Village in a GIS-based database, an inventory of the water distribution system was conducted. The water system is comprised of approximately 59 miles of water mains ranging in size from 4 inches to 16 inches in diameter as illustrated in Figure II-1. The current water main inventory is summarized in Table II-1. Of the approximately 59 miles of water main, approximately 27 percent are 12 inches and larger in diameter. These large diameter water mains represent the system's primary transmission facilities. Most of the distribution system, about 82%, is ductile iron. About 70 percent of the existing water mains were installed between 1981 and 2024.

**Table II-1: Water Main Size, Material, and Installation Date Distribution**

<b>Diameter</b>	<b>Approximate Total Length (ft)</b>	<b>Percentage of Total</b>
4-inch	308	0.1%
6-inch	35,591	11.4%
8-inch	193,199	61.7%
10-inch	69	0.0%
12-inch	84,083	26.8%
16-inch	20	0.0%
<b>Total</b>	<b>313,271</b>	<b>100%</b>

<b>Material</b>	<b>Approximate Total Length (ft)</b>	<b>Percentage of Total</b>
Unknown	1,667	0.5%
Cast Iron	17,442	5.6%
Ductile Iron	255,485	81.6%
HDPE	4,106	1.3%
PVC	34,571	11.0%
<b>Total</b>	<b>313,271</b>	<b>100%</b>

<b>Installation Decade</b>	<b>Approximate Total Length (ft)</b>	<b>Percentage of Total</b>
Unknown	1,486	0.5%
1940-1949	450	0.1%
1950-1959	4,628	1.5%
1960-1969	10,060	3.2%
1970-1979	69,371	22.1%
1980-1989	43,306	13.8%
1990-1999	88,553	28.3%
2000-2009	54,821	17.5%
2010-2019	31,227	10.0%
2020-2024	9,369	3.0%
<b>Total</b>	<b>313,271</b>	<b>100%</b>

C. Water Supply and Treatment

1. Well Facilities

The Village of Hartland Water Utility currently maintains five groundwater wells to supply water for the needs of its customers, as shown in Table II-2. With a combined total design pumping capacity of 7.08 MGD the five wells provide an average of just under 1.0 million gallons of water every day. Wells 2, 4, 5, and 6 discharge directly to the water distribution system, while Well 3 discharges to an adjacent clear well and ground storage reservoir. Table II-3 summarizes the water supply facilities and summarizes the service pumps, reservoir, and clear well at the Well 3 station.

**Table II-2: Wells and Treatment Facilities**

Well Characteristic	Well 2	Well 3	Well 4	Well 5	Well 6
Year Constructed	1956	1973	1971	1983	2005
Depth	82 ft	135 ft	82 ft	89 ft	122 ft
Diameter	20 in	36 in	36 in	20 in	24 in
Static Water Level	51 ft	33 ft	54 ft	18 ft	30 ft
Pump Level	55 ft	78 ft	70 ft	36 ft	35.5 ft
Pump Type	Vertical Turbine				
Capacity	800 gpm	950 gpm	400 gpm	1,200 gpm	1,500 gpm
Motor Size	60 hp	30 hp	30 hp	100 hp	150 hp
<b>Treatment Methods</b>					
Sodium Hypochlorite (disinfection)	X			X	X
Gas Chlorination (disinfection)		X			
Orthophosphate (corrosion control)	X	X	X	X	X
Air Stripper w/ Packed Tower (VOC Removal)		X			

Starting in 2001, the Village constructed several test borings in search of potential sites for new production wells. One of the test borings was later converted into Well 6 in 2005. Another test boring, which is referred to as TB-6 in past reports, is viable enough to be constructed into a production well in the future when the need for more supply capacity arises. TB-6 is located in the Windrush area and will be named Well 7 when it is developed.

Wells 2 through 6 are all used to supply the water system. Annual well pumpage is shown in Table II-4. Pumpage from each well is measure by ...

**Table II-3: Well 3 Reservoir, Clearwell, and Service Pumps**

<b>Well 3 Reservoir/Clearwell</b>	
Clearwell Capacity	50,000 gal
Reservoir Capacity	450,000 gal
HWL Elevation	929.5 ft MSL
<b>Service Pumps</b>	<b>Capacity</b>
Pump #1	500 gpm
Pump #2	500 gpm
Pump #3	1,000 gpm

**Table II-4: Annual Well Pumpage Records**

<b>Year</b>	<b>Annual Pumpage (MGY)</b>					
	<b>Well 2</b>	<b>Well 3</b>	<b>Well 4</b>	<b>Well 5</b>	<b>Well 6</b>	<b>Total</b>
2016	54.2	66.9	19.9	82.5	108.7	332.1
2017	55.2	65.0	21.9	90.2	118.6	351.0
2018	55.5	69.7	21.1	86.5	114.6	347.5
2019	53.5	75.6	22.0	84.8	108.6	344.5
2020	57.3	89.1	25.4	88.8	110.7	371.4
2021	53.0	77.4	22.7	83.3	105.5	341.9
2022	42.6	70.4	20.1	88.0	110.4	331.5
2023	57.0	72.6	25.5	93.6	105.4	354.2
2024	45.3	70.4	19.9	84.2	105.0	324.7

## D. Water Quality and Treatment Methods

The Village's wells have historically produced high quality water with only a few concerns. With the exception of Well 3 and 6 which are discussed in the following sections, most of the Village's wells do not require any treatment except for disinfection and corrosion control. Treatment methods used at each well are shown in Table II-2. All well facilities include chlorine injection for disinfection and orthophosphate injection for corrosion control.

All the Village's wells include disinfection and corrosion control. Most of the wells include injection of liquid sodium hypochlorite for disinfection. Well 3 is disinfected using gaseous chlorine. Orthophosphate is injected at all wells as a corrosion inhibitor. During lead and copper sampling, the Village has in the past experienced concentrations of lead that exceed the Lead and Copper Rule (LCR) action level. In 2022, a study was done to investigate the elevated levels of lead. The study concluded that the lead in the water was most likely a result of pipe corrosion and recommended the use of orthophosphate as a corrosion inhibitor. Orthophosphate injection for corrosion inhibition was implemented in September of 2024.

### 1. Well 3 – Volatile Organic Compounds

Well 3 has regularly tested high on volatile organic compounds (VOCs). Several raw water samples have resulted in VOCs higher than the maximum contaminant levels (MCL). Specifically, raw water samples from Well 3 have tested high in trichloroethane. The VOCs present in Well 3 are removed using aeration in a packed tower. The most recent raw water sample results are included in Appendix A.

### 2. Well 6 – PFAS

PFAS, or Per/Poly-Fluoroalkyls Substances are synthetic compounds that are used in many industrial products and processes and have been found in many water supplies. Exposure to PFAS has been found to be related to various health issues, including high cholesterol, thyroid disease, some cancers, and other health conditions. There have been many efforts in recent years to regulate and eliminate PFAS in industrial processes and in drinking water.

The Village of Hartland performs annual PFAS sampling of each well, the most recent of which took place in February of 2025 and is included in Appendix B. Low levels of PFAS have been found in each of the wells. Until recently, PFAS concentrations were below federal and state regulatory limits and health advisory levels. However, in February 2025, the Wisconsin Department of Health Services (DHS) updated the health advisory levels for PFAS. With these updates, Well 6 slightly exceeds the health advisory level for the compound PFOS. The hazard index calculation, included in Appendix C, is not exceeded. While Well 6 can continue to be used without treatment, public notification to customers may be required in the future for continued use of Well 6.

The PFAS concentrations for all wells are below the state's current MCLs which were adopted in 2022, however, these MCLs are planned to be updated to more stringent standards by 2026. The current and future MCLs are shown in Table II-5 and are compared to the sample results. PFAS concentrations in Well 6 are below current MCLs but are higher than the future MCLs for the compound PFOS. Previous samples have resulted in concentrations of the compound PFOA that exceeded the future MCL. While the future MCLs are planned to be effective by 2026, the Environmental Protection Agency (EPA) will require that solutions need to be implemented by 2029. The Village should start planning treatment solutions for the PFAS concentrations in Well 6.

Table II-5: Summary of PFAS Sample Results

PFAS Chemical Name	Feb. 2025 Sample Results, ppt					Health Advisory, ppt	MCL, ppt	
	Well 2	Well 3	Well 4	Well 5	Well 6		Current	Future
PFOA	0.0	1.7	1.5	0.8	3.5	4	-	4
PFOS	0.7	2.5	1.1	0.6	4.1	4	-	4
PFHxs	0.8	2.3	3.1	0.7	2.3	10	-	10
HFPO-DA (GenX)	0.0	0.0	0.0	0.0	0.0	10	-	10
PFNA	0.0	0.0	0.0	0.0	0.0	10	-	10
PFBS	5.5	7.0	4.7	2.9	2.8	2,000	-	-
Combined PFOA & PFOS	0.7	4.2	2.6	1.4	7.6	-	70	-
Mixture of two or more: PFHxS, PFNA, HFPO-DA and PFBS <sup>1</sup>	0.1	0.2	0.3	0.1	0.2	-	-	1 <sup>1</sup>

1. Hazard index is calculated per EPA requirements, as follows:

$$\text{Hazard Index (1 unitless)} = \left( \frac{[\text{HFPO} - \text{DA}_{\text{ppt}}]}{[10 \text{ ppt}]} \right) + \left( \frac{[\text{PFBS}_{\text{ppt}}]}{[2000 \text{ ppt}]} \right) + \left( \frac{[\text{PFNA}_{\text{ppt}}]}{[10 \text{ ppt}]} \right) + \left( \frac{[\text{PFHxS}_{\text{ppt}}]}{[10 \text{ ppt}]} \right)$$

### E. Water Storage

The Village of Hartland Water Utility operates three water storage facilities which are located throughout the water distribution system. The combined storage capacity of all the facilities is 800,000 gallons. All three facilities are elevated tanks. Two are spheroid type tanks and the third facility is a standpipe. All the elevated storage tanks are in the main pressure zone.

The elevated facilities are identified as follows:

- 300,000-gallon Bristlecone Elevated Storage Tank (see Table II-6)
- 250,000-gallon Hartridge Elevated Storage Tank (see Table II-7)
- 250,000-gallon Hill Street Elevated Storage Tank (see Table II-8)

**Table II-6: Bristlecone Elevated Tank**

**Bristle Cone Elevated Tank**

Capacity	300,000 gallons
Year constructed	1995
Constructed by	
Type	Spheroid
Construction material	Steel
Overflow elevation	1,119 feet
Diameter	Varies
Head range	32'-6"
Height to overflow	85 ft
<b>Comments</b>	



**Table II-7: Hartridge Elevated Tank**

**Hartridge Elevated Tank**

Capacity	250,000 gallons
Year constructed	1975
Constructed by	
Type	Spheroid
Construction material	Steel
Overflow elevation	1,119 feet
Diameter	Varies
Head range	31"-3"
Height to overflow	
<b>Comments</b>	



**Table II-8: Hill St Elevated Tank**

<b>Hill St Elevated Tank</b>	
Capacity	250,000 gallons
Year constructed	1974
Constructed by	
Type	Spheroid
Construction material	Steel
Overflow elevation	1,119 feet
Diameter	Varies
Head range	31'-3"
Height to overflow	93 feet
<b>Comments</b>	



#### F. Booster Pumping Facilities

The Village of Hartland Water Utility operates and maintains two booster pumping facilities that supply water to the Windrush Boosted Pressure Zone. The main booster station has four pumps with the following capacities:

- Pump #1: 100 gpm at 60 ft TDH
- Pump #2: 350 gpm at 60 ft TDH
- Pump #3: 350 gpm at 60 ft TDH
- Pump #4: 700 gpm at 60 ft TDH

The second booster station is a small in-ground station with a single pump. This station has a capacity of 200 gpm and is only used as backup.

#### G. Inventory of Alternative Sources

The Village currently owns and operates 5 groundwater wells. There are currently no plans to abandon any of the wells or seek an alternative supply. However, if the need for an alternative supply arises, there are three potential options that the Village could pursue. One alternative supply option is the test boring TB-6, as discussed in Section II-C.1. This test boring has been shown to be viable enough to be converted into a production well. A second option for alternative supply would be to construct a new well at a new location. This option would require hydrogeologic evaluations and testing to find a viable location for a new well. A third option for an alternative supply could be a wholesale connection to a neighboring water system, such as the Village of Pewaukee, the City of Pewaukee, or the Village Sussex.

A fourth alternative supply option that was considered is to use surface water from Lake Pewaukee. However, this option is not considered feasible. Lake Pewaukee is considered a recreational lake and receives surface runoff from surrounding areas. The lake is not considered a viable source without extensive treatment. Using Lake Pewaukee as a surface water source would require a very large investment in surface water treatment to provide adequate water quality.

### III. POPULATION AND COMMUNITY GROWTH

This chapter summarizes the planning assumptions made regarding the Village of Hartland Water Utility. The population and community growth discussed here will be used as the basis for the service area water requirement projections presented in Chapter IV.

#### A. Population and Population Density

There is generally a close relationship between a community's population and total water consumption volumes. As a community's population may fluctuate up or down it is anticipated that the water sales will also fluctuate. Therefore, future water sales can be expected to generally reflect future changes in service area population. Similarly, commercial, public, and industrial water consumption will also tend to vary proportionately with the growth of the community.

Table III-2 summarizes historical population data and estimates of future population for the Village of Hartland. According to the DOA, the 2023 population of the Village was approximately 10,084. Comparatively, the 2020 census population was 9,501. The population has therefore grown in recent years having seen an estimated increase of approximately 6.1% percent since the 2020 census.

Table III-2 shows population projections from both the DOA and the Village of Hartland's 2019 Comprehensive Plan for every 5 years for the 20-year planning period until 2045. The DOA projections include population estimates for every 10 years up to 2050. For estimating mid-decade years 2035 and 2045, the population was interpolated. The population estimates in the Village's 2019 Comprehensive Plan end at 10,990 in 2040 and do not reach the end of the planning period of this report.

The average household size throughout the Village, per the comprehensive plan, was 2.55 in 2010 and 2.53 in 2017, suggesting a steady decrease. With a total population of 10,048 in 2023, the total number of residences is about 3,990 residential units, including single- and multi-family. The total single and multi-family residential land use noted in the comprehensive plan is about 1,279 acres, resulting in an average population density of 3.12 units per acre.

The Village's 2019 Comprehensive Plan has several different classifications of residential areas, each with different population densities. The different classes of residential land use and their corresponding population densities are summarized in Table III-1. Land use maps from the comprehensive plan can be found in Appendix D.

**Table III-1: Residential Land Use Categories**

<b>Category</b>	<b>Density</b>	<b>Summary</b>
High Density Residential	8 to 18 units/acre	The High-Density Residential category represents the highest density land use throughout the community. Densities should range from 8 to 18 units per acre and support multifamily development.
Medium Density Residential	5 to 8 units/acre	The Medium Density Residential represents smaller scale residential development, ranging from twin homes to dense single-family home areas.
Low/Medium Density Residential	2.5 to 5 units/acre	The Low/Medium Residential category is new to the 2045 land use plan. This category represents smaller long single-family developments throughout the community.
Low Density Residential	1 to 2.5 units/acre	The Low-Density Residential category represents the standard single-family development that most consider when considering residential uses.
Estate Residential	0 to 1 unit/acre	The Estate Residential land use category is also new for the 2045 land use plan. This land use represents large lot residential development, on lots greater than 1 acre in size.

Source: Village of Hartland 2019 Comprehensive Plan Table 22

**B. Utility Service Area**

The service area of the water system encompasses the municipal boundaries of the Village of Hartland and shown in Figure I-1. There are no water customers outside of Village’s municipal boundary. The Village does not have any plans to expand the water system in serve customers outside of the municipal boundary.

**Table III-2: Population Trends & Projections**

Year	Historical Population	
	Population	Change
1970	2,763	---
1980	5,559	101.2%
1990	6,906	24.2%
2000	7,905	14.5%
2010	9,110	15.24%
2020	9,501	4.3%
2023	10,084	6.1%

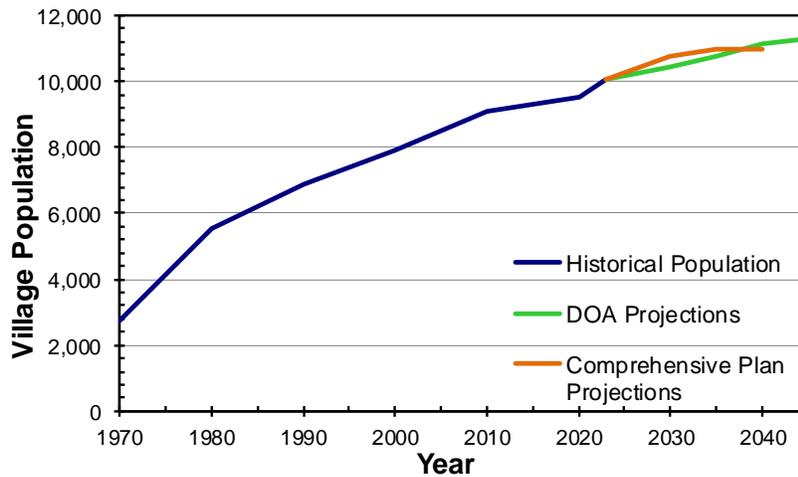
  

Year	WDOA Projections		2019 Comp. Plan Projections	
	Population	Change	Population	Change
<b>2030</b>	<b>10,432</b>	3.5%	<b>10,770</b>	6.8%
<b>2035</b>	<b>10,786</b>	3.4%	<b>10,980</b>	1.9%
<b>2040</b>	<b>11,139</b>	3.3%	<b>10,990</b>	0.1%
<b>2045</b>	<b>11,312</b>	1.6%		

**Notes**

Sources: Wisconsin Department of Administration and U.S. Census Bureau and 2019 Village of Hartland Comprehensive Plan.

**Population Trends & Projections**



**C. Land Use**

For this study, the existing and projected land uses in the Village’s 2019 Comprehensive Plan were reviewed. Table III-3 summarizes existing and projected land use categorized by water service customer type for the Village of Hartland. Appendix D includes existing and projected land use maps extracted from the comprehensive plan.

Table III-3 shows the growth and development that is expected within the Village of Hartland. The 2045 projections from the comprehensive plan show an increase of single-family residential, multi-family residential, and commercial development. Public land use is also expected to increase but only slightly. The overall industrial land use was projected to decrease significantly.

**Table III-3: Summary of Existing and Future Land Use**

Land Use	Current Acres (2019)	From 2019 Comprehensive Plan	
		Future Acres (2045)	Additional Acres Required
Single Family Residential <sup>1</sup>	1,077	1,152	75
Multi-Family Residential <sup>2</sup>	202	251	49
Public Authority	459	471	12
Commercial	89	360	271
Industrial	209	135	-74

Source: Village of Hartland Comprehensive Plan (2019), Tables 2 and 11

**Notes:**

1. Includes Medium Density, Low/Medium Density, Low Density, and Estate Residential land use categories.
2. Includes High Density Residential land use category.

**E. Projected Growth Areas**

There are a few areas in the Village that are anticipated to experience growth during the planning period of this study. Most of the planned developments are multi-family housing developments such as senior living and apartment complexes. Some developments that are planned within the next few years are described below:

- Senior Living: New senior living development near Lake Country Lutheran School.
- Downtown: New apartment complex near Cottonwood Ave and West Park Ave.
- West Rock Development: 264 units of condominiums and apartments near W Capitol Drive and STH 83.

Most of the land throughout the Village’s municipal boundaries is developed. The majority of the undeveloped land throughout the Village, with the exception of a few environmental areas, is located in the northeast section of the Village.

**F. Summary**

This chapter summarizes the primary assumptions regarding future growth within the Village of Hartland Water Utility service area. The needs and characteristics of the service area will have a direct impact on the need for the expansion of water system facilities. Therefore, the conclusions discussed in this chapter are used as a primary basis for projecting future water needs, evaluating the adequacy of existing water system facilities, and determining what water system improvements are needed to maintain an adequate level of service as population increases.

#### IV. WATER REQUIREMENTS

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

##### A. Water Consumption History

To project future water requirements, it is first necessary to determine the water use characteristics of the utility customers. Geographical location as well as socio-economic factors often play a role in shaping how water is used at the local level. For example, communities located in areas of sandy soil may utilize more water for irrigation than communities located in moisture-retaining soils. Communities with agricultural businesses (i.e., canneries) or heavy manufacturing (paper mills, iron and steel production) often use more water than communities with only lighter manufacturing (i.e. fabricating or assembly plants). To determine the water characteristics of the Village, an analysis of past pumpage and water sales records for the period from 2013 to 2023 was conducted. The analysis included a review of both average and maximum day water pumpage along with the amount of water sold in each customer class. The results of this analysis are then utilized to project future water requirements when coupled with estimates of population and community growth discussed in Chapter III.

A summary of historical water sales and pumpage is provided in Table IV-1. Over the 11-year period of data summarized in the table, water sales have fluctuated from a low of 287 million gallons per year (MGY) in 2014 to a high of 348 MGY in 2023. Although water sales have fluctuated both up and down, the overall trend in sales over the past 11 years has increased with 2023 water sales being approximately 15 percent more than sales in the 2013. Over the same period, total pumpage has increased and is currently approximately 11 percent greater than it was in late 2013.

A historical summary of Village of Hartland Water Utility customers served is provided in Table IV-2. Water sales to individual customer classes are summarized in Table IV-3. As shown in the tables, the number of residential and multifamily customers as well as sales has slightly increased over the past 11 years. The number of commercial customers and commercial sales has remained constant. While the number of industrial customers has also remained constant, sales to industrial customers have increased. Also, the number of public customers remained constant, but sales have decreased.

As illustrated in Table IV-2 and Table IV-3, residential customers presently account for 86 percent of the utilities' customers and approximately 63 percent of the total sales. Commercial and multifamily water use in 2023 accounted for approximately 11 percent of the customers and 23 percent of total sales. Metered industrial sales and public uses currently account for approximately 2 percent and 1 percent of the customers respectively, and represent approximately 12 and 2 percent of total sales, respectively.

Table IV-1: Historical Water Pumpage and Sales

Year	Estimated Population	Total Pumpage (MG)	Total Sales (MG)	Pumpage Sold (%)	Non-Revenue Water (%)	Unaccounted for Water (%)	Average Day		Maximum Day		Ratio of Maximum to Average Day Pumpage
							MGD	GPCD	MGD	Date	
2013	9,246	319	303	95%	5%	3%	0.874	94.5	2.163	July 19	2.48
2014	9,287	308	287	93%	7%	5%	0.845	91.0	1.787	July 24	2.12
2015	9,416	317	302	95%	5%	3%	0.869	92.3	2.664	Oct 25	3.07
2016	9,441	330	299	91%	9%	8%	0.905	95.8	1.824	Aug 10	2.02
2017	9,535	351	311	88%	12%	10%	0.962	100.8	1.830	Sep 25	1.90
2018	9,620	347	309	89%	11%	9%	0.952	98.9	1.787	July 18	1.88
2019	9,683	344	294	85%	15%	12%	0.944	97.5	1.835	July 26	1.94
2020	9,770	371	321	86%	14%	11%	1.017	104.1	2.182	July 6	2.14
2021	9,875	342	340	99%	1%	0%	0.937	94.8	2.243	June 14	2.39
2022	9,998	332	308	93%	7%	5%	0.908	90.8	1.855	July 1	2.04
2023	10,084	354	336	95%	5%	0%	0.970	96.2	2.004	July 29	2.07

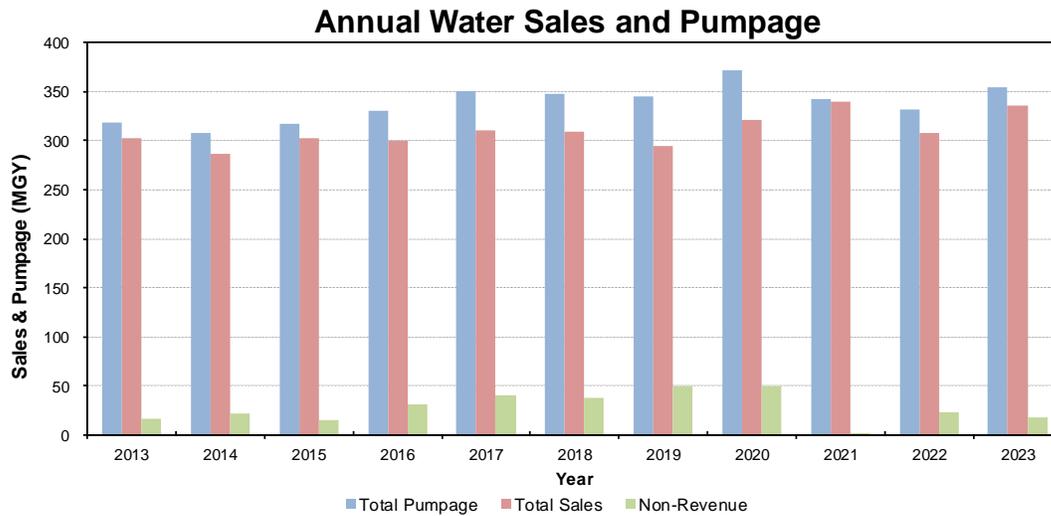


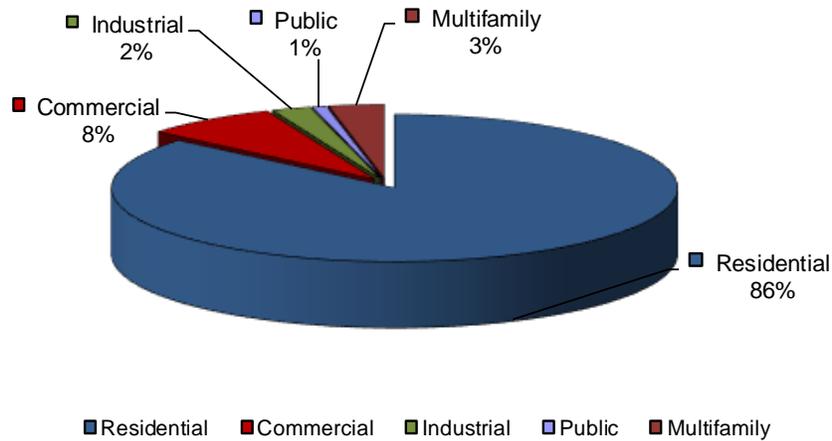
Table IV-2: Historical Customer Summary

Year	Number of Customers					Total
	Residential	Commercial	Industrial	Public	Multifamily <sup>1</sup>	
2013	2,502	339	73	23		2,937
2014	2,516	338	73	23		2,950
2015	2,558	336	74	23		2,991
2016	2,570	239	76	24	90	2,999
2017	2,595	244	75	24	91	3,029
2018	2,622	242	75	25	92	3,056
2019	2,640	243	76	25	92	3,076
2020	2,655	242	74	26	92	3,089
2021	2,696	244	74	26	97	3,137
2022	2,743	239	70	24	100	3,176
2023	2,761	245	72	26	101	3,205

**Notes:**

1. Multifamily was previously considered commercial until 2016.

**2023 Customer Summary**



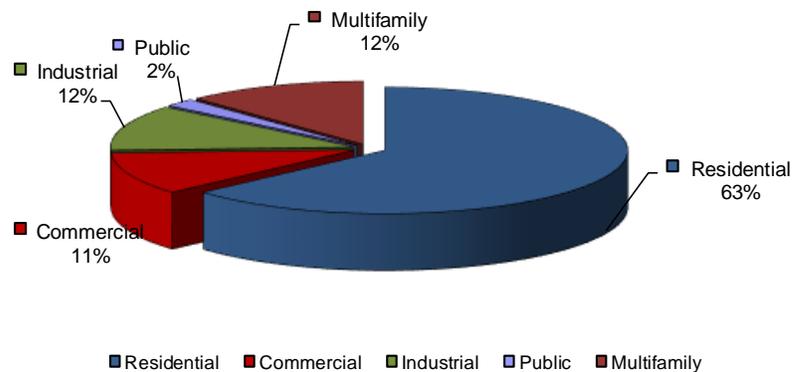
**Table IV-3: Water Consumption History**

Year	Annual Water Sales (MGY)					Total Sales (MGY)	Total Pumpage (MGY)	% of Pumpage Sold
	Residential	Commercial	Industrial	Public	Multifamily <sup>1</sup>			
2013	194.21	73.71	20.33	11.21		299.44	318.97	94%
2014	183.05	73.98	15.59	11.72		284.34	308.32	92%
2015	186.70	75.41	20.34	11.45		293.90	317.21	93%
2016	187.38	36.30	26.15	10.52	35.90	296.24	330.20	90%
2017	185.75	37.08	39.10	10.67	34.63	307.22	350.98	88%
2018	176.49	37.18	48.79	11.87	34.48	308.80	347.37	89%
2019	169.74	35.31	44.16	11.05	33.87	294.14	344.47	85%
2020	197.66	34.91	43.12	9.49	35.93	321.12	371.34	86%
2021	204.44	37.01	47.34	11.87	39.19	339.85	341.87	99%
2022	187.35	36.52	39.17	7.29	37.66	307.99	331.52	93%
2023	213.18	36.31	39.24	6.86	40.56	336.15	354.17	95%

**Notes:**

1. Multifamily was previously considered commercial until 2016

**2023 Water Consumption**



**B. Unit Consumption Water Usage**

Residential, commercial, and public water usage can often be correlated to a community’s population. Sales to these customer classes will generally rise and fall in proportion to changes in population and thus make it useful for projecting future water sales. Nearly all the residents within the Village’s boundaries are served by the Village’s water system.

An analysis of per capita water consumption for the Village of Hartland Utility for each of the customer classifications was made from the available sales records summarized in Table IV-3. Tabular results of the analysis are illustrated in Table IV-4. As can be seen from the table, per customer sales to residential and multi-family residential have followed generally consistent trends over the previous 10 years. The per customer industrial consumption has nearly

doubled since 2013. The consumption per public customer has decreased by nearly half since 2013 and the consumption per commercial customer has decreased by about 32%.

Table IV-5 shows that the per capita water consumption has remained fairly constant since 2013 with some variation, averaging at about 54 gpcd (gallon per capacity per day). The commercial water usage included multi-family residential usage until 2015. After that, commercial water consumption remained constant at about 10 gpcd. Public and multifamily residential water consumption also remained stable around 3 and 10 gpcd, respectively. Industrial water usage per capita has nearly doubled since 2013.

An analysis of the per acre water consumption was also made for the Village of Hartland for each of the customer classifications. Table IV-6 summarizes the results of the analysis. Similar to the residential per service consumption trend, the Utility's residential per acre consumption has remained fairly constant over the previous 11 years, averaging at approximately 480 gallons per acre per day (gpac). Since 2016, commercial consumption has been stable around 314 gpac. Industrial consumption per acre has had a significant increase since 2013 of almost double. Public per acre consumption increased steadily until 2018 and then decreased significantly after 2021. Multifamily per acre consumption has shown a gradual increase since 2016.

**Table IV-4: Historical Usage per Service**

Year	Gallons per Service per Day					Total
	Residential	Commercial	Industrial	Public	Multifamily <sup>1</sup>	
2013	213	596	763	1,335		279
2014	199	600	585	1,396		264
2015	200	615	753	1,364		269
2016	200	416	943	1,201	1,093	271
2017	196	416	1,428	1,218	1,043	278
2018	184	421	1,782	1,301	1,027	277
2019	176	398	1,592	1,211	1,009	262
2020	204	395	1,596	1,000	1,070	285
2021	208	416	1,753	1,250	1,107	297
2022	187	419	1,533	833	1,032	266
2023	212	406	1,493	723	1,100	287
<b>Average</b>	<b>198</b>	<b>463</b>	<b>1,293</b>	<b>1,166</b>	<b>1,060</b>	<b>276</b>

**Table IV-5: Historical Per Capita Usage**

Year	Estimated Total Retail Population	Gallons per Capita per Day						Total Metered	Total Pumpage
		Residential	Commercial <sup>1</sup>	Industrial	Public	Multifamily <sup>1</sup>			
2013	9,246	57.5	21.8	6.0	3.3		88.7	94.5	
2014	9,287	54.0	21.8	4.6	3.5		83.9	91.0	
2015	9,416	54.3	21.9	5.9	3.3		85.5	92.3	
2016	9,441	54.4	10.5	7.6	3.1	10.4	86.0	95.8	
2017	9,535	53.4	10.7	11.2	3.1	9.9	88.3	100.8	
2018	9,620	50.3	10.6	13.9	3.4	9.8	87.9	98.9	
2019	9,683	48.0	10.0	12.5	3.1	9.6	83.2	97.5	
2020	9,770	55.4	9.8	12.1	2.7	10.1	90.0	104.1	
2021	9,875	56.7	10.3	13.1	3.3	10.9	94.3	94.8	
2022	9,998	51.3	10.0	10.7	2.0	10.3	84.4	90.8	
2023	10,084	57.9	9.9	10.7	1.9	11.0	91.3	96.2	
<b>Average</b>		<b>53.9</b>	<b>10.2</b>	<b>9.9</b>	<b>3.0</b>	<b>10.3</b>	<b>87.6</b>	<b>96.1</b>	

**Notes**

1. Multifamily water consumption was included with commercial consumption until 2016. Therefore, the average usage for commercial water consumption does not include the years 2013-2015.

Table IV-6: Historical Per Acre Usage

Land Use	Residential	Commercial <sup>1</sup>	Industrial	Public	Multifamily <sup>1</sup>
Land Use Area (acres):	1,077	317	209	459	202
Year	Gallons per Acre per Day (gpad)				
2013	494.0	637.0	266.4	66.9	
2014	465.6	639.4	204.4	69.9	
2015	474.9	651.8	266.6	68.3	
2016	476.7	313.7	342.8	62.8	487.0
2017	472.5	320.5	512.5	63.7	469.7
2018	449.0	321.3	639.6	70.9	467.7
2019	431.8	305.2	578.9	66.0	459.3
2020	502.8	301.7	565.2	56.7	487.4
2021	520.1	319.9	620.6	70.8	531.5
2022	476.6	315.6	513.4	43.5	510.8
2023	542.3	313.8	514.3	41.0	550.1
<b>Average</b>	<b>482.4</b>	<b>314.0</b>	<b>456.8</b>	<b>61.9</b>	<b>495.4</b>

**Adjustment to Industrial Water Usage to Account for Medline Industries<sup>2</sup>**

2023 Total Industrial Water Usage:	39.2 MGY
2023 Medline Industries Water Usage:	28.4 MGY
2023 Industrial Water Usage (Not Including Medline)	10.8 MGY
Acreage of Medline Industries:	16.3 acres
Industrial Acreage (Not including Medline)	192.7 acres

**Adjusted per Acre Consumption: 154.1 GPAD**

Land Use	Residential	Commercial	Industrial	Public	Multifamily
<b>Projected Usage (gpad)<sup>3</sup></b>	<b>500</b>	<b>325</b>	<b>160</b>	<b>60</b>	<b>550</b>

**Notes**

1. Multifamily water consumption was included with commercial consumption until 2016. Therefore, the average usage for commercial water consumption does not include the years 2013-2015.
2. Medline Industries is the Village's largest water customer and accounts for about 70% of all sales to industrial customers. For projecting future industrial water usage, the per acre water use for industrial customers was adjusted to separate it from Medline Industries.
3. Used for projecting water consumption.

### C. Industrial Water Usage

Table IV-3 and Table IV-5 summarize the annual industrial water sales and resulting per capita usage from 2013 to 2023. As seen in Table IV-5, per capita industrial sales increased over the years and peaked in 2018 and then decreased. However, unlike other water sales components, sales to industrial customers do not necessarily correlate well with population but are more a function of business needs and activities. As such, it is often necessary to implement other means of estimating future water sales.

To understand why industrial water sales do not correlate well with population, one should consider what is most likely to impact a business's need for water. While the size of the workforce can influence a company's water use, variations in water use are not generally population dependent but rather depend on the types of industries served and the level of production activity. Much more than population, fluctuations in water consumption for a particular industrial firm can be attributed to other factors including:

1. Changes in production schedules or operational capacity.
2. Changes in manufacturing processes.
3. Changes in the number of people employed.
4. Addition or deletion of product lines.
5. Seasonal variation in cooling requirements.
6. Seasonal changes in business activity.
7. Implementation of conservation measures.

While industrial customers often represent a small percentage of the total number of customers (Table IV-2), these customers can represent a significant portion of the total water sales (Table IV-3). The average industrial customer used more water than any other customer class, as shown in Table IV-4. Consequently, changes in water consumption characteristics by these potential high volume water users could have an impact on total future water requirements. Estimates for future industrial water sales are discussed in specific detail later in this Chapter.

Additionally, the average industrial water use from 2023 was about 39.2 MG which equates to about 514 gpad for industrial customers. However, about 70% of the industrial water consumption is the result of a single customer, Medline Industries. Therefore, for purposes of projecting industrial water consumption, water usage from Medline Industries was separated from the overall average. When water consumption from Medline Industries is not included in the total industrial water usage, the average industrial water consumption drops to about 160 gpad. This value is used for purposes of projecting industrial water usage, as shown in Table IV-6.

### D. Non-revenue Water and 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. The total metered water sales are most often less than the amount of pumpage due to several factors including:

1. Unmetered water usage for firefighting.
2. Inaccuracies in water metering devices.
3. Unmetered public water usage.
4. Leakage within the distribution system.
5. Unmetered water usage for treatment processes and maintenance purposes, such as filter cleaning, hydrant flushing and water main repairs.

The difference between total pumpage and total water sales is termed "non-revenue water" and is usually expressed as a percentage. That portion of non-revenue water attributed to

leakage, meter inaccuracies, and other unknown losses is often termed “unaccounted-for water” and can be an indicator of the condition of the water system. When a distribution system is very old or poorly maintained, the amount of unaccounted-for water often increases dramatically.

Over the last 11 years, the percentage of the total pumpage volume that is sold (metered) has been reported to be as low as 85 percent in 2019 and as high as 99 percent in 2021. A summary of historical non-revenue water and unaccounted-for water (Water Losses) volumes is provided in Table IV-1. The degree of fluctuation experienced in metered pumpage is common for 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 very general rule, the percentage of non-revenue water should ideally be less than 15 percent. For water pumpage projections, this study assumes that the percentage of non-revenue water in future years will be maintained at 10 percent.

Historically, the unaccounted-for water, or water losses, for the Village of Hartland has varied. Reported water losses for some years have been between 8 and 12 percent, while most years have been at 5 percent or lower.

It is important to note that quantifying non-revenue water simply as a percent of pumped water to billed water, while widely used and accepted, is limited in its ability to accurately indicate an appropriate or acceptable level of water loss. For example, if water conservation measures are implemented causing total consumption to decrease, and yet leakage and other unaccounted for water uses remain that same (as volume) then the percent of unaccounted-for water actually increases as a percent. This would mistakenly indicate that the level of water loss has gotten worse, while in actuality it has remained the same.

#### E. Variations in Customer Demands and Pumpage

Water consumption is not constant throughout the calendar year and varies day to day and even hour to hour. It is important that the Village of Hartland Water Utility be able to meet the needs of its customers even during periods of increased water demand. To ensure that the needs of customers can be met at all times, it is important to understand the variations that occur in water consumption and then quantify the variations in demand.

Maximum daily water demands usually occur during the summer months on hot days when additional water is used for watering lawns, gardening, washing, and industrial cooling. Understanding and quantifying the maximum day pumpage is of particular importance to water system planning, because water supply facilities must be sized to meet this demand. The maximum day demand is defined as the amount of water pumped during a single day of the year with the highest water usage. Maximum day demand is often expressed as a ratio (or factor) of the annual average day pumpage.

Table IV-7 presents the average and maximum day pumpage for each year from 2013 to 2023. With the exception of maximum day pumpage resulting from artificial demands caused by water main breaks, tank overflows, or hydrant flushing, the maximum day pumpage typically occurs during the meteorological summer months of June, July, August, or September.

Over the last 11 years, the maximum day pumpage ratio (ratio of maximum day to average day pumpage) has varied from a low of approximately 1.88 in 2018 to a high of 3.07 in 2015. The values shown in Table IV-7 are typical for similar communities, where design ratios of 2 to even 3 percent are common. This is due to the larger percentage of the total water usage being

consumed to meet the variable demands of residential and commercial customers as opposed to the more continuous water needs of industrial customers.

To gain a better understanding of expected fluctuations in customer demands for the Village of Hartland, a statistical analysis was performed of historical maximum day to average day pumpage ratios. The results of this analysis are also summarized in Table IV-7. For the years 2013 to 2023, the average maximum day demand ratio was about 2.19.

For planning purposes, it is good practice to project future pumpage using a maximum day ratio greater than the average. For this reason, Table IV-7 also includes a statistical analysis of maximum day pumpage ratios for various confidence levels. For example, there is a 90 percent chance in any given year that the actual maximum day pumpage ratio will be less than or equal to 2.48. Conversely, there is a 10 percent chance that the actual ratio will exceed 2.48. To evaluate future water supply and storage needs, a maximum day pumpage ratio of 2.48 was used for this study. This ratio provides a confidence level of approximately 90 percent.

#### F. Hourly Demand Fluctuations

The hour-to-hour variation of customer demands is also an important characteristic used to evaluate water supply and storage requirements. Peak hour demand is important because storage facilities are usually designed to provide water to meet the peak hour demand requirement in excess of the demand equal to the maximum day pumpage. As with maximum day demands, peak hour demand is often expressed as a ratio of peak hour to average day demand for the year. Peak hour demand is defined as the hour of maximum demand that occurs on the maximum day.

According to AWWA Manual M32, typical ranges for peak hour factors in distribution systems of various sizes are 1.3 to 2.0 for peak hour to maximum day and 0.2 to 0.6 for minimum hour to maximum day. In this study, a peak hour demand factor of 1.6 times the maximum day demand is used which is typical for municipalities the size of Hartland.

**Table IV-7: Daily Pumpage Variations**

Year	Avg. Day Pumpage (MGD)	Max. Day Pumpage (MGD)	Date of Maximum Day	Ratio of Max. to Ave Day
2013	0.87	2.163	July 19	2.48
2014	0.84	1.787	July 24	2.12
2015	0.87	2.664	Oct 25	3.07
2016	0.90	1.824	Aug 10	2.02
2017	0.96	1.830	Sep 25	1.90
2018	0.95	1.787	July 18	1.88
2019	0.94	1.835	July 26	1.94
2020	1.02	2.182	July 6	2.14
2021	0.94	2.243	June 14	2.39
2022	0.91	1.855	July 1	2.04
2023	0.97	2.004	July 29	2.07

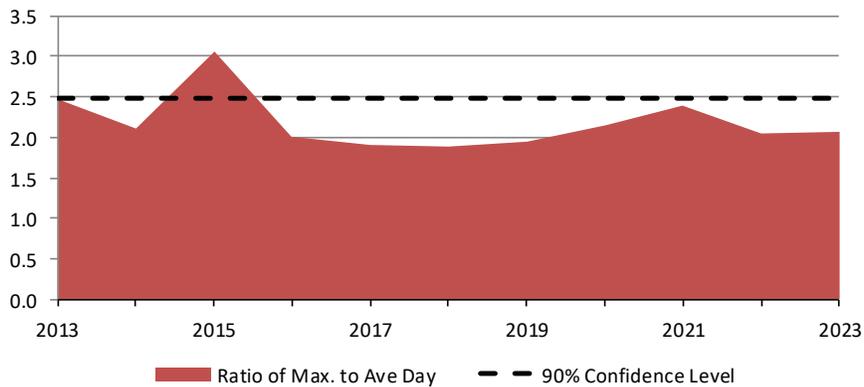
  

Statistical Analysis	Result
Number of years of Data	11
Maximum Ratio - Max. to Avg. Day Pumpage	3.07
Minimum Ratio - Max. to Avg. Day Pumpage	1.88
Average Ratio Max. to Avg. Day Pumpage	2.19

Confidence Level (%)	Ratio of Max. to Avg. Day Pumpage
80%	2.39
85%	2.43
90%	2.48
95%	2.77
98%	2.95
100%	3.07

**Historical Maximum Day Ratios**



## G. 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 presented in Chapter III. A detailed summary of the individual components of projected water sales and pumpage requirements is provided in Table IV-8.

### 1. Residential Sales

Residential sales were projected based on current trends and assumptions regarding future development and per acre water consumption. For the planning period, it is assumed that the residential consumption rate will remain approximately 500 gpad, resulting in total residential sales of about 229 MGY by 2045. Residential water sales are anticipated to account for approximately 63 percent of total water sales by 2045.

### 2. Commercial Sales

Future per acre consumption by commercial customers was projected to be approximately 325 gpad over the planning period. Total annual sales to commercial customers are expected to reach 43 MGY by 2040, or approximately 12 percent of total annual sales.

### 3. Industrial Sales to Existing Customers

Sales to existing industrial customers have generally increased since 2013 but have decreased somewhat in recent years. To project future industrial sales, it is assumed that the per acre sales to industrial customers will remain around 160 gpad and that sales to Medline Industries, the Village's largest water consumer, will remain constant. Given that the industrial land use area is projected to decrease from 209 acres to 135 acres, the overall water sales to industrial customers is estimated to drop to 35 MGY.

### 4. Public Sales

Future per acre sales to public customers were projected to be approximately 60 gpad throughout the planning period. By the year 2045, it is estimated that public sales will be approximately 10 MGY, or roughly 3 percent of total annual sales.

### 5. Multi-family Sales

Future per acre sales to multi-family customers are projected to be approximately 550 gpad over the planning period. Total annual sales to multi-family customers are expected to reach 50 MGY by 2045, or approximately 14 percent of total annual sales.

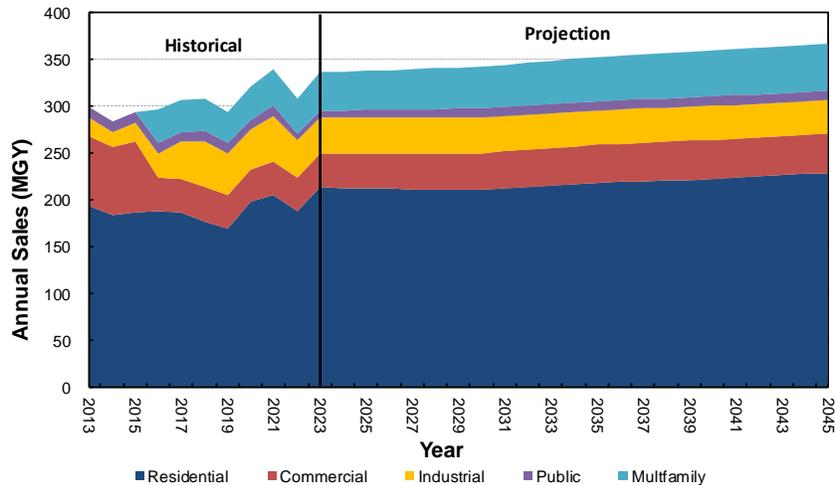
**Table IV-8: Water Sales and Pumpage Projections**

Customer Classification	Actual 2023	Projected			
		2030	2035	2040	2045
<i>Population (Total)</i>	10,084	10,432	10,786	11,139	11,312
<b>Per Acre Sales (gpad)</b>					
Residential Sales	542	500	500	500	500
Commercial Sales	314	325	325	325	325
Industrial Sales	514	160	160	160	160
<i>Medline Industries</i>	4,774	4,774	4,774	4,774	4,774
Public Sales	41	60	60	60	60
Multi-Family Sales	550	550	550	550	550
<b>Land Use Area (2019 Comp. Plan)</b>					
Residential	1,077	1,151	1,194	1,218	1,252
Commercial	317	335	346	352	360
Industrial (not including Medline)	193	161	143	133	119
<i>Medline Industries</i>	16	16	16	16	16
Public	459	464	467	469	471
Multi-family	202	223	235	242	251
<b>Annual Sales (MGY)</b>					
Residential Sales	213.2	210.1	217.9	222.4	228.5
Commercial	36.3	39.8	41.0	41.7	42.7
Industrial Sales (not including Medline)	10.8	9.4	8.4	7.8	6.9
<i>Medline Industries</i>	28.4	28.4	28.4	28.4	28.4
Public Sales	6.9	10.2	10.2	10.3	10.3
Multi-family	40.6	44.7	47.1	48.5	50.4
<b>Total Metered Sales</b>	<b>336.1</b>	<b>342.5</b>	<b>353.0</b>	<b>359.0</b>	<b>367.2</b>
<b>Total Pumpage (MGY)</b>					
Non-revenue Water <sup>1</sup>	18.0	38.1	39.2	39.9	40.8
<b>Total Pumpage</b>	<b>354.2</b>	<b>380.6</b>	<b>392.2</b>	<b>398.9</b>	<b>408.0</b>

**Note**

1. Non-revenue water was projected at 10% of total pumpage for future years.

**Annual Water Sales Projections**



H. Largest Retail Customers

**Table IV-9: Top 10 Largest Water Customers**

2023 Rank	Major Customer Consumption			
	Customer Name	Billing Classification	2023 Water Purchased (MG)	Daily Water Use (GPD)
1	Medline Industries	Industrial	28.4	77,892
2	Wright, Thomas	Multi-Family	6.1	16,632
3	Entrata-Hopper	Multi-Family	4.3	11,833
4	Arrowhead High School	Public	4.3	11,770
5	Paradise Trails Condo Assoc	Multi-Family	2.6	7,229
6	Wisconsin Athletic Club	Commercial	2.3	6,429
7	Hartland Service	Commercial	2.3	6,346
8	Breezewood II	Multi-Family	2.0	5,364
9	Hartland Riverwalk	Multi-Family	1.7	4,653
10	Waukesha County Housing	Multi-Family	1.2	3,213

The ten largest individual water users within the Village are shown in Table IV-9. According to billing data, the largest water users throughout the Village include one industrial customer, one public customer, two commercial customers, and six multi-family residential customers.

Medline Industries is by a large margin the largest water customer. Medline is a manufacturer of medical products and accounts for nearly 10% of all water sales. The total industrial water usage in 2023 was 39 MG. Of that amount, 28 MG are attributed to Medline Industries.

Multi-family housing complexes account for six of the large water users in Table IV-9. Cumulatively, the six multi-family customers in Table IV-9 used about 18 MG in 2023.

The public and commercial customers in Table IV-9 include Arrowhead High School, the Wisconsin Athletic Club, and Hartland Service. Arrowhead High School facilities include pool, showers, cafeteria, and multiple playfields. The Wisconsin Athletic Club is a fitness center with an indoor pool and shower facilities. Hartland Service is an auto repair shop with a large car automatic car wash.

I. Summary of Total Demands and Pumpage Requirements

The total annual sales and pumpage projections previously summarized in Table IV-8 were based on a summation of water sales projections for each major customer classification. An allowance was also made for unmetered miscellaneous water usage and losses (non-revenue water) to arrive at total pumpage projections.

Table IV-10 summarizes projections of future water needs for average day, maximum day, and peak hour demands. Total annual pumpage is projected to increase from approximately 336 MGY (0.92 MGD) to approximately 370 MGY (1.01 MGD) by the year 2045. Table IV-10 also illustrates the projected water sales and pumpage through the planning period.

**Table IV-10: Future Pumpage Projections**

Description	Actual 2023	Projected			
		<u>2030</u>	<u>2035</u>	<u>2040</u>	<u>2045</u>
Total Annual Retail Sales (MGY)	336	345	355	361	370
Total Annual Pumpage (MGY)	354	383	395	401	411
Average Day Pumpage (MGD)	0.970	1.05	1.08	1.10	1.12
Design Maximum Day Pumpage (MGD)	2.40	2.60	2.68	2.72	2.78
Design Peak Hour Demand (gpm)	2,670	2,890	2,970	3,020	3,090

**Notes**

1. Design maximum day pumpage projections were estimated using a ratio of maximum to average day pumpage of 2.48.
2. Design peak hour demand projections were estimated using a ratio of peak hour demand to maximum day pumpage of 1.60.

## V. SUPPLY AND STORAGE ANALYSIS

A critical step in the water system evaluation for the Village of Hartland Water Utility is 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 day and peak hour demands, operational characteristics, and fire protection needs.

### A. Water Supply Analysis

As it is frequently necessary to take a well and/or booster pump out of service for periods of days to even weeks for maintenance or repair, it is necessary to properly plan to ensure that demand requirements can be met even when a pumping unit may be out of service. It is then necessary to determine a reliable capacity that accounts for the uncertainty that all pumping units will be available. By excluding one pumping unit (for planning purposes, the largest capacity unit is typically used) the reliable capacity is then determined. Therefore, reliable capacity is defined as the total available delivery rate with the largest pumping unit out of service.

For evaluating a municipal water system, the 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.

In this Water Supply Service Area Plan for the Village of Hartland, the reliable supply capacity is evaluated. The reliable capacity for the booster station is calculated but the water needs in the Windrush Boosted Pressure Zone are not analyzed in detail.

Reliable water supply capacity is the capacity of the existing supply sources (well facilities and service pumps) to reliably supply maximum day demands from the aquifer to the water system. Table V-1 summarizes the well pump, service pump, and booster pump capacities used for the reliable water supply capacity evaluation. The existing Village reliable supply capacity is calculated without the largest supply unit out of service. This is calculated for wells with Well No. 6 out of service, for Well No. 3 Service Pumps with Service Pump 3 out of service, and for the Windrush Booster Station with Booster Pump 4 out of service. The following sections discuss reliable water supply and system capacity in further detail for the existing water system.

Table V-1: Existing Reliable Supply Capacity

<u>SUPPLY SOURCE</u>	<b>Supply Capacity</b>		<b>Service Pump Capacity</b>		<b>Windrush Booster Pump</b>	
	<u>(gpm)</u>	<u>(MGD)</u>	<u>(gpm)</u>	<u>(MGD)</u>	<u>(gpm)</u>	<u>(MGD)</u>
<b>Wells</b>						
Well #2 - Well Pump	800	1.15				
Well #3 - Well Pump	950	1.37				
Well #4 - Well Pump	300	0.43				
Well #5 - Well Pump	1,200	1.73				
Well #6 - Well Pump <sup>1</sup>	1,500	2.16				
<b>Well 3 Service Pumps</b>						
Well #3 - Service Pump #1			500	0.72		
Well #3 - Service Pump #2			500	0.72		
Well #3 - Service Pump #3			1,000	1.44		
<b>Windrush Booster Stations</b>						
Booster Pump #1					100	0.14
Booster Pump #2					350	0.50
Booster Pump #3					350	0.50
Booster Pump #4					700	1.01
Micro-Station (Backup)					200	0.29
Total Pumping Supply Capacity	4,750	6.84	2,000	2.88	1,700	2.45
Less: Largest Supply Unit	<u>1,500</u>	<u>2.16</u>	<u>1,000</u>	<u>1.44</u>	<u>700</u>	<u>1.01</u>
<b>Reliable Supply<sup>2</sup></b>	<b>3,250</b>	<b>4.68</b>	<b>1,000</b>	<b>1.44</b>	<b>1,000</b>	<b>1.44</b>

<b>Notes</b>
1. Well #6 has a design capacity of 2,000 gpm, but the well pump is rated for 1,500 gpm.
2. Reliable Supply Capacity is the total supply capacity assuming that the largest supply unit is out of service.

1. Existing Reliable Supply Capacity

Based on the reliable water supply capacities of the existing wells (summarized in Table V-2), reliable supply capacity evaluations were performed on the existing water system. As mentioned in Chapter II, supply sources are located only in the Main Pressure Zone. The Windrush Boosted Pressure Zone relies upon booster pumping capacity to transfer water from the Main Pressure Zone. The Main Pressure Zone must therefore have adequate reliable water supply capacity to meet the needs of not only the Main Pressure Zone, but also the Windrush Boosted Pressure Zone as well.

The reliable supply capacity evaluation for the current design maximum day is summarized in Table V-2. The table summarizes the maximum day demand requirement and the available reliable water supply capacity for the entire system. As shown in Table V-2, the total reliable supply capacity from the existing wells and service pumps is currently adequate to meet maximum day demands.

2. Existing Reliable System Capacity

As stated above, to meet the demand requirements of the Windrush Boosted Pressure Zone, it is necessary to transfer water from the Main Pressure Zone. To ensure that there is adequate capacity to transfer water between pressure zones, a system capacity analysis was conducted that looks at meeting the needs of each individual pressure zone.

a. Main Pressure Zone

As mentioned above, with all the supply sources being located in the Main Pressure Zone there is currently adequate reliable supply capacity to meet the needs of the Main pressures zone and Windrush pressure zone.

**Table V-2: Existing Recommended Reliable Supply Capacity**

<b><u>SUPPLY REQUIREMENTS</u></b>	<b>Water System 2023</b>	
	<b><u>gpm</u></b>	<b><u>MGD</u></b>
Average Day Demand	674	0.97
Maximum to Average Day Ratio <sup>1</sup>	2.48	
Maximum Day Demand	1,672	2.41
Peak Hour Demand <sup>2</sup>	2,674	3.85
Present Reliable Supply Capacity (gpm)	3,250	4.68
<b>Reliable Supply Capacity Excess or (Deficiency)</b>	<b>1,578</b>	<b>2.27</b>
<b>Notes</b>		
1. See Table IV-10		
2. Assuming an hourly peaking factor of 1.6		

b. Boosted Pressure Zone

The Windrush Boosted Pressure Zone has no supply sources and relies upon the transfer of water from the Main Pressure Zone via booster pumps located at the Windrush Booster Pump Station. The existing reliable booster pumping capacity is summarized in Table V-1. The total amount of recommended reliable pumping capacity is determined in the same way as the reliable supply capacity described above.

The recommended reliable booster pumping capacity for the Windrush Boosted Pressure Zone is based on the number of homes in the service area and the requirements established in NR 811.29 when no storage is provided. The pumping equipment was sized to provide the peak hour flow. The booster station was designed to provide enough capacity for the entire pressure zone at full build-out condition which is about 324 residential units with a peak flow of 590 gpm.

B. Water Storage Analysis

1. 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 include average and peak hour 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 community grows and improvements are implemented.

Figure V-1 illustrates general components of system storage. As customer demands exceed supply capacities during peak hour conditions, the 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 ensure a reliable supply for fire protection, this portion of storage should be reserved for emergency use only and should not be utilized to meet peak hour or operational requirements. Based upon the existing and anticipated future land uses within each pressure zone it is assumed that the maximum fire flow requirement for the Village Main Pressure Zone is 3,500 gpm for a duration of 3 hours, or the equivalent of 630,000 gallons.

In most instances, it is desirable to provide additional storage for the purposes of operational needs. Operational storage allows for the control of pumps prior to the depletion of needed peak hour equalizing storage. Operational storage may be needed as a safety factor in emergencies or where customer demands are unpredictable and fluctuate widely. Operational storage may also be desired to take advantage of off-peak electrical rates for pumping. An additional storage volume of 30% of the equalizing storage volume is included for an operational cushion.

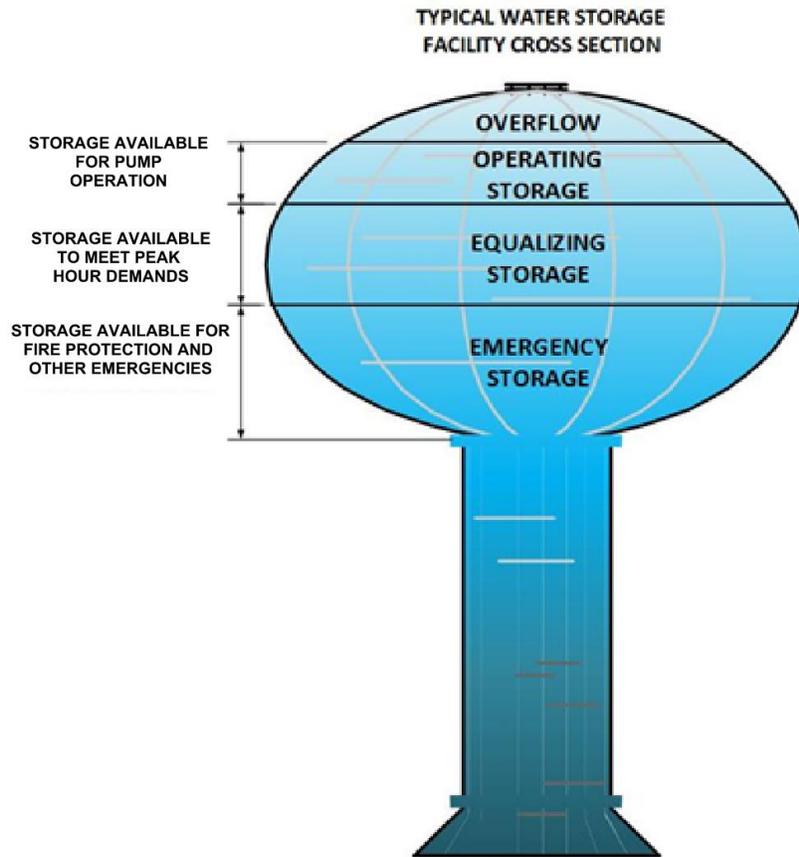


Figure V-1: Storage Components

## 2. Effective Storage Volumes

The effective storage volume of a water storage facility is the amount of available water that can be utilized while meeting regulatory requirements for system pressure. The Wisconsin Department of Natural Resources (WDNR) requires that water system pressures under normal operating conditions are above 35 psi and under emergency conditions, such as during a fire, system pressures must be maintained at a minimum pressure of 20 psi. To meet these requirements the water surface in the storage facility must be approximately 81 feet above the highest elevation area in the service area to maintain 35 psi and at least 46 feet to maintain 20 psi. These water column heights are based upon static conditions (assuming no head losses due to friction) so actual water column heights would be higher as friction losses are included.

Based upon this evaluation, the effective volume of each existing storage facility is summarized in Table V-3. As can be seen in the table, all of the Village's 800,000 gallons of total storage is effective for fire protection. However, only about 666,000 gallons is effective for meeting peak hour equalizing requirements.

## 3. Recommended Existing Water Storage Volumes

The following relationships between supply capacities and storage volumes are the primary criteria used to determine optimum storage volumes:

1. Reliable supply capacity should at least equal projected maximum day supply requirements.
2. Total available storage should be capable of meeting demands in excess of the maximum day demand as well as fire protection needs, assuming reliable supply capacity is adequate to meet maximum day requirements.
3. Based upon the above criteria, Table V-4 summarizes the existing supply and storage requirements for the Village of Hartland Water Utility based on 18 hours of continuous pumping per day. The Wisconsin Public Service Commission (PSC) uses 18 hours per day of pumping to estimate excess reliable capacity in wells under maximum day conditions. This helps to maximize pump reliability and to ensure proper well recharge. The table includes calculations for the water system as a whole. Since the supply and storage for the Windrush Booster Zone is supplied by the Main pressure zone, a global review of available supply and storage capacity provides an adequate evaluation of available and recommended supply and storage capacities.

The existing optimum water storage requirement for the Village is 1.020 MG (million gallons). The existing storage facilities provide 0.800 MG of available storage. However, due to excess pumping capacity, the recommended storage volume can be reduced because the excess pumping capacity can be used to reduce the equalizing storage needed. When this is done, the recommended total storage capacity can be reduced by 0.223 MG to 0.797 MG. The Village's combined storage capacity of 0.800 MG in elevated storage is sufficient for existing demands.

**Table V-3: Effective Storage Volumes**

	Hill Street Elevated Storage Tank	Hartridge Elevated Storage Tank	Bristlecone Elevated Storage Tank
Pressure Zone	Main	Main	Main
Design Volume (gallons)	250,000	250,000	300,000
Diameter (feet)	Varies	Varies	Varies
Head Range (feet)	31.25	31.25	32.50
Storage Volume per foot (gallons)	Varies	Varies	Varies
Overflow elevation (feet USGS)	1,119	1,119	1,119
Approximate Highest Elevation Served in Pressure Zone (feet USGS)	1,034	1,034	1,034
Approximate Hydraulic Grade Elevation needed to provide minimum 35 psi to all areas	1,115	1,115	1,115
Maximum Effective Peak Hour Storage Volume (gallons) <sup>1</sup>	222,500	222,500	221,000
Approximate Hydraulic Grade Elevation needed to provide minimum 20 psi to all areas	1,080	1,080	1,080
Additional Effective Fire Protection and Emergency Storage Volume (gallons) <sup>2</sup>	27,500	27,500	79,000
<b>Total Effective Storage Volume (gallons)</b>	<b>250,000</b>	<b>250,000</b>	<b>300,000</b>

Notes
1. Effective peak hour storage is considered the volume available which will continue to maintain adequate pressures in the distribution system at a minimum of 35 psi (under static conditions). Volumes derived from storage tank gauging tables.
2. Effective fire protection and emergency storage is considered the volume available which will continue to maintain pressures in the distribution system at a minimum of 20 psi (under static conditions). Volumes derived from storage tank gauging tables.

**Table V-4: Existing Supply and Storage Requirements**

<u>SUPPLY RECOMMENDATIONS</u>		Water System 2023	
		<u>gpm</u>	<u>MGD</u>
Average Day Demand		674	0.97
Maximum Day Demand		1,672	2.41
Peak Hour Demand		2,674	3.85
Total Reliable Supply Capacity		3,250	4.68
<b>Recommended Supply Based on 18 hours/day of Pumping</b>			
Design Pumping hours per day		18 hours/day	
Design Reliable Supply Capacity (MGD) <sup>1</sup>		3.51 MGD	
<b>Reliable Supply Capacity Excess or (Deficiency)</b>		<b>766</b>	<b>1.10</b>
<u>STORAGE RECOMMENDATIONS</u>		Water System 2023	
Peak Hour Equalizing Need (gallons) <sup>2</sup>		237,000	
Optimum Fire Protection Needs (gallons) <sup>3</sup>		630,000	
Reserve Storage (gallons; 15% of Total) <sup>4</sup>		<u>153,000</u>	
<b>Total Optimum Recommended Storage (gallons)</b>		<b>1,020,000</b>	
<u>Available Effective Storage Capacity (gallons):</u>			
Hill Street Elevated Storage Tank		250,000	
Hartridge Elevated Storage Tank		250,000	
Bristlecone Elevated Storage Tank		300,000	
<b>Total Effective Storage Capacity (gallons)<sup>5</sup></b>		<b>800,000</b>	
<b>Subtotal Additional Capacity Recommended (gallons)</b>		<b>220,000</b>	
Less: Excess Available Reliable System Supply Capacity for Peak Hour (gallons) <sup>6</sup>		223,000	
<b>Total Additional Capacity Recommended (gallons)</b>		<b>None</b>	

Notes
1. Reliable Supply Capacity is with largest source out of service. Based on 18 hours of pumping per day.
2. Peak hour storage is storage utilized to meet demands which exceed the maximum day demand rate assuming the reliable supply capacity is equal to the maximum day demand rate.
3. Optimum fire protection based on 3,500 gpm for 180 minutes.
4. Reserve storage is storage utilized to provide a start/stop range for pump operation and an emergency reserve storage supply.
5. Total Effective Storage Capacity is limited to a total of the Optimum Fire Protection Needs plus peak hour available storage to maintain regulatory system pressures.
6. The reliable supply capacity exceeds peak hour demand. Therefore, no peak hour equalizing storage is required.

## C. Supply and Storage Results

The following sections evaluate the supply and storage requirements for each pressure zone. Table V-5 summarizes the projected optimum supply and storage needs for the water system.

### 1. Main Pressure Zone

Currently all the wells are located within the Main Pressure Zone. The supply system is adequate to meet the existing design maximum day demand. The total volume of storage provided is adequate for the aggregate of peak hour equalizing, fire protection, and reserve storage for existing conditions.

The existing reliable supply capacity is sufficient to meet the Village's projected water usage throughout the planning period of this study which is the year 2045. Assuming 18 hours of pumping per day as shown in Table V-5, the Village's existing reliable supply capacity of 3.51 MGD is about 0.72 MGD greater than the projected maximum day pumpage in 2045.

When only accounting for elevated storage, the Village's storage capacity is projected to be about 29,000 gallons deficient by the end of the planning period in 2045. However, this does not include ground storage capacity at Well 3 which has a total capacity of 0.45 MG. The service pumps at Well 3 have a reliable capacity that is about 50 gpm greater than the well capacity. Over the course of 18 hours, this excess pumping rate can supply an additional 54,000 gallons. This excess pumping volume is used in Table V-5 to satisfy storage needs. When accounting for this excess pumping volume from the Well 3 reservoir, the Village's existing storage facilities are sufficient for the projected demands through the planning period of this study.

If the water demands throughout the planning period exceed the water demands projected, the supply and storage recommendations may need to be revisited and updated as necessary. If additional storage is required, the Village may be able to satisfy additional storage requirements by increasing the service pump capacity at Well 3 to further utilize the existing 0.45-MG ground storage reservoir. Using this approach may eliminate the need to provide additional elevated storage volume.

### 2. Windrush Boosted Pressure Zone

With a total reliable pumping capacity of 1,000 gpm, the Windrush Boosted Pressure Zone has adequate reliable pumping capacity to meet the existing and projected requirements of the existing boosted pressure zone through the planning period.

The reliable capacity of the booster pump station is designed to accommodate peak demands with no storage in the boosted pressure zone. Storage for the Windrush Boosted Pressure Zone is provided by the Main Pressure Zone.

## D. Summary

This section summarizes the findings from the supply and storage evaluation of the Village of Hartland Water Utility water system. Major findings from this evaluation include the following:

1. The existing reliable supply capacity is adequate to meet current and projected water demands until the end of the planning period of 2045.

- When accounting for excess service pump capacity from Well 3 reservoir , the existing storage capacity is sufficient for the project water demands until the end of the planning period.

**Table V-5: 2045 Supply and Storage Requirements (24 Hours of Pumping per Day)**

<u>SUPPLY RECOMMENDATIONS</u>	Projected 2030		Projected 2035		Projected 2040		Projected 2045	
	gpm	MGD	gpm	MGD	gpm	MGD	gpm	MGD
Average Day Demand	724	1.04	746	1.07	759	1.09	776	1.12
Maximum Day Demand	1,796	2.59	1,850	2.66	1,882	2.71	1,925	2.77
Peak Hour Demand	2,873	4.14	2,961	4.26	3,011	4.34	3,080	4.44
Present Total Reliable Supply Capacity	3,250	4.68	3,250	4.68	3,250	4.68	3,250	4.68
<b>Recommended Supply Based on 18 hours/day of Pumping</b>								
Design Pumping hours per day	18 hours/day		18 hours/day		18 hours/day		18 hours/day	
Design Reliable Supply Capacity (MGD) <sup>1</sup>	3.51 MGD		3.51 MGD		3.51 MGD		3.51 MGD	
<b>Reliable Supply Capacity Excess or (Deficiency) (gpm)</b>	<b>642</b>	<b>0.92</b>	<b>587</b>	<b>0.85</b>	<b>555</b>	<b>0.80</b>	<b>512</b>	<b>0.74</b>
<u>STORAGE RECOMMENDATIONS</u>								
Peak Hour Equalizing Need (gallons) <sup>2</sup>	255,000	262,000	267,000	273,000				
Optimum Fire Protection Needs (gallons) <sup>3</sup>	630,000	630,000	630,000	630,000				
Reserve Storage (gallons; 15% of Total) <sup>4</sup>	<u>157,000</u>	<u>158,000</u>	<u>159,000</u>	<u>160,000</u>				
<b>Total Optimum Recommended Storage (gallons)</b>	<b>1,042,000</b>	<b>1,050,000</b>	<b>1,056,000</b>	<b>1,063,000</b>				
<u>Available Effective Storage Capacity (gallons):</u>								
Hill Street Elevated Storage Tank	250,000	250,000	250,000	250,000				
Hartridge Elevated Storage Tank	250,000	250,000	250,000	250,000				
Bristlecone Elevated Storage Tank	300,000	300,000	300,000	300,000				
<b>Total Effective Storage Capacity (gallons)<sup>5</sup></b>	<b>800,000</b>	<b>800,000</b>	<b>800,000</b>	<b>800,000</b>				
<b>Subtotal Additional Capacity Recommended (gallons)</b>	<b>242,000</b>	<b>250,000</b>	<b>256,000</b>	<b>263,000</b>				
Less: Excess Available Reliable System Supply Capacity for Peak Hour (gallons) <sup>6</sup>	229,000	231,000	233,000	234,000				
Less: Repump Volume Capacity at Well 3 (gallons) <sup>7</sup>	54,000	54,000	54,000	54,000				
<b>Total Additional Capacity Recommended (gallons)</b>	<b>None</b>	<b>None</b>	<b>None</b>	<b>None</b>				

Notes
1. Recommended reliable Supply Capacity based on 18 hours of pumping per day.
2. Peak hour storage is storage utilized to meet demands which exceed the maximum day demand rate assuming the reliable supply capacity is equal to the maximum day demand rate.
3. Optimum fire protection based on 3,500 gpm for 180 minutes.
4. Reserve storage is storage utilized to provide a start/stop range for pump operation and an emergency reserve storage supply.
5. Total Effective Storage Capacity is limited to a total of the Optimum Fire Protection Needs plus peak hour available storage to maintain regulatory system pressures.
6. Supply Capacity Credit cannot exceed Peak Hour Equalization and is calculated utilizing the time of day demand curve and current supply capacity.

## VI. CONCLUSION AND RECOMMENDATIONS

### A. Key Findings and Recommendations

#### 1. Population Projections:

The WDOA projections predict a population increase from 10,084 in 2023 to 11,312 by 2045 which is the end of the planning period of this study. Most of the development throughout the Village is anticipated to be commercial but will also include well as single- and multi-family residential development.

#### 2. Water Quality: PFAS

The Village's wells do not currently have any outstanding water quality issues that need immediate correction. However, samples from Well 6 have consistently resulted in PFAS concentrations above the current health advisory levels and above future MCLs. The Village will need to notify water customers of the PFAS concentrations. Additionally, the Village will likely need to provide treatment to remove PFAS from Well 6 in the future. The DNR is planning to adopt more stringent MCLs for PFAS by the year 2026 and the EPA will require solutions to be implemented by the year 2029.

There are several treatment options that are commonly used to remove PFAS from drinking water, the three most common and effective of which are listed below:

- Activated Carbon (very common)
- Anion Exchange (very common)
- Reverse Osmosis (less common)

Unless PFAS concentrations in Well 6 reduce over time, the Village will need to implement treatment by 2029 or stop usage of the well. The PFAS concentrations are low and only slightly exceed the proposed MCLs, therefore, treatment will likely be a feasible option. Studies and pilot testing will be required to select a treatment method.

Other wells have tested positive for PFAS chemicals as well, but at concentrations lower than the proposed MCLs. It is unlikely that treatment will be needed at the other well, but the Village will need to continue monitoring to verify that the PFAS levels are stable and not increasing over time.

#### 3. Water Demands

The existing average day and maximum day water demands from 2023 pumpage are 0.97 MGD and 2.40 MGD, respectively. The total average and maximum day water demands are projected to increase to 1.12 MGD and 2.77 MGD by 2045. These projections are based on the per acre sales of water by customer type.

Medline Industries, the Village's largest water consumer, is assumed in this study to have constant usage into the future. If this customer's water usage increases significantly, the water projections may need to be revised.

#### 4. Supply

The Village has 5 wells with a total reliable supply capacity of 3,250 gpm or 4.68 MGD. When planning for 18 hours of pumping per day for each source, the total daily reliable capacity is about 3.51 MGD, which is sufficient to meet projected demands through the year 2045.

The Village has previously constructed a test boring that has the potential to be further developed into a production well. If any of the Village's existing wells are abandoned or decommissioned, then more supply capacity will need to be added to the system and the findings in this study will need to be updated.

#### 5. Storage

The Village currently has 0.8 MG of elevated water storage and 0.45 MG of ground storage, which is sufficient for projected demands to the year 2045. However, the storage capacity is only sufficient because there is excess pumping capacity from the Well 3 reservoir. If the water demands exceed the projections in this report as development progresses throughout the planning period, the service pumping capacity at Well 3 may need to be increased to allow for more utilization of the 0.45-MG ground storage reservoir.

#### B. Consistency With Other Plans and Agreements

This Water Supply Service Area Plan is consistent with the Village's 2019 Comprehensive Plan. However, this study uses population projections from the WDOA which predicts more population growth than is predicted in the comprehensive plan.

#### C. Plan Implementation

This plan will be reviewed by the public via a public hearing, providing an opportunity for the public to give written comments.

APPENDIX A: WELL 3 VOC SAMPLING



<https://dnr.wisconsin.gov>

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Drinking Water System Portal (/dwsportalpub/)

HARTLAND WATERWORKS (26802050)

**Sample Group** Volatile Organics  
**Source ID** 3  
**Sample Date** 5/9/2024  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WC02708-04  
**Well #** BH398  
**Sample Time** 1015  
**Sample Description**  
**Reported Date** 5/22/2024  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

Sampling Results

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2990	BENZENE	0	UG/L	Non-detect	5	UG/L	1
2943	BROMODICHLOROMETHANE	0.82	UG/L		80	UG/L	2
2942	BROMOFORM	1.6	UG/L		80	UG/L	3
2982	CARBON TETRACHLORIDE	0	UG/L	Non-detect	5	UG/L	4
2944	DIBROMOCHLOROMETHANE	1.8	UG/L		80	UG/L	5
2968	O-DICHLOROBENZENE	0	UG/L	Non-detect	600	UG/L	6
2969	P-DICHLOROBENZENE	0	UG/L	Non-detect	75	UG/L	7
2980	1,2-DICHLOROETHANE	0	UG/L	Non-detect	5	UG/L	8
2977	1,1-DICHLOROETHYLENE	0	UG/L	Non-detect	7	UG/L	9
2380	CIS-1,2-DICHLOROETHYLENE	0	UG/L	Non-detect	70	UG/L	10
2979	TRANS-1,2-DICHLOROETHYLENE	0	UG/L	Non-detect	100	UG/L	11
2964	DICHLOROMETHANE	0	UG/L	Non-detect	5	UG/L	12
2983	1,2-DICHLOROPROPANE	0	UG/L	Non-detect	5	UG/L	13
2992	ETHYLBENZENE	0	UG/L	Non-detect	700	UG/L	14
2989	MONOCHLOROBENZENE (CHLOROBE..)	0	UG/L	Non-detect	100	UG/L	15
2996	STYRENE	0	UG/L	Non-detect	100	UG/L	16
2987	TETRACHLOROETHYLENE	0	UG/L	Non-detect	5	UG/L	17
2991	TOLUENE	0	UG/L	Non-detect	1000	UG/L	18
2378	1,2,4-TRICHLOROBENZENE	0	UG/L	Non-detect	70	UG/L	19
2981	1,1,1-TRICHLOROETHANE	0	UG/L	Non-detect	200	UG/L	20
2985	1,1,2-TRICHLOROETHANE	0	UG/L	Non-detect	5	UG/L	21
2984	TRICHLOROETHYLENE	0	UG/L	Non-detect	5	UG/L	22
2976	VINYL CHLORIDE	0	UG/L	Non-detect	0.2	UG/L	23
2955	XYLENES, TOTAL	0	UG/L	Non-detect	10000	UG/L	24

Showing 1 to 24 of 24 entries

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APPENDIX B: 2025 PFAS SAMPLING



<https://dnr.wisconsin.gov>

rm) Sample 2/25/2025

HARTLAND WATERWORKS (26802050)

**Drinking Water System Portal (/dwsportalpub/)**

**Sample Group** Per/Poly-Fluoroalkyls (PFAS Form)  
**Source ID** 2  
**Sample Date** 2/25/2025  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WD01149-02  
**Well #** BH397  
**Sample Time** 900  
**Sample Description**  
**Reported Date** 3/5/2025  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

**Sampling Results**

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2813	11CL-PF3OUDS	0	NG/L	Non-detect		NG/L	1
2814	9CL-PF3ONS	0	NG/L	Non-detect		NG/L	2
2815	ADONA	0	NG/L	Non-detect		NG/L	3
2816	HFPO-DA	0	NG/L	Non-detect		NG/L	4
2817	NETFOSAA	0	NG/L	Non-detect		NG/L	5
2818	NMEFOSAA	0	NG/L	Non-detect		NG/L	6
2801	PFBS	5.5	NG/L			NG/L	7
2807	PFDA	0	NG/L	Non-detect		NG/L	8
2808	PFDOA	0	NG/L	Non-detect		NG/L	9
2802	PFHPA	0.54	NG/L	Between LOD and LOQ		NG/L	10
2809	PFHXA	1.7	NG/L	Between LOD and LOQ		NG/L	11
2803	PFHXS	0.81	NG/L	Between LOD and LOQ		NG/L	12
2804	PFNA	0	NG/L	Non-detect		NG/L	13
2806	PFOA	0	NG/L	Non-detect		NG/L	14
2805	PFOS	0.68	NG/L	Between LOD and LOQ		NG/L	15
2830	PFOA AND PFOS TOTAL	0.68	NG/L		70	NG/L	16
2810	PFTA	0	NG/L	Non-detect		NG/L	17
2811	PFTTrDA	0	NG/L	Non-detect		NG/L	18
2812	PFUNA	0	NG/L	Non-detect		NG/L	19

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rm) Sample 2/25/2025

HARTLAND WATERWORKS (26802050)

**Drinking Water System Portal (/dwsportalpub/)**

**Sample Group** Per/Poly-Fluoroalkyls (PFAS Form)  
**Source ID** 3  
**Sample Date** 2/25/2025  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WD01149-06  
**Well #** BH398  
**Sample Time** 1100  
**Sample Description**  
**Reported Date** 3/5/2025  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

**Sampling Results**

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2813	11CL-PF3OUDS	0	NG/L	Non-detect		NG/L	1
2814	9CL-PF3ONS	0	NG/L	Non-detect		NG/L	2
2815	ADONA	0	NG/L	Non-detect		NG/L	3
2816	HFPO-DA	0	NG/L	Non-detect		NG/L	4
2817	NETFOSAA	0	NG/L	Non-detect		NG/L	5
2818	NMEFOSAA	0	NG/L	Non-detect		NG/L	6
2801	PFBS	7	NG/L			NG/L	7
2807	PFDA	0	NG/L	Non-detect		NG/L	8
2808	PFDOA	0	NG/L	Non-detect		NG/L	9
2802	PFHPA	1	NG/L	Between LOD and LOQ		NG/L	10
2809	PFHXA	2.7	NG/L			NG/L	11
2803	PFHXS	2.3	NG/L			NG/L	12
2804	PFNA	0	NG/L	Non-detect		NG/L	13
2806	PFOA	1.7	NG/L			NG/L	14
2805	PFOS	2.5	NG/L			NG/L	15
2830	PFOA AND PFOS TOTAL	4.2	NG/L		70	NG/L	16
2810	PFTA	0	NG/L	Non-detect		NG/L	17
2811	PFTTrDA	0	NG/L	Non-detect		NG/L	18
2812	PFUNA	0	NG/L	Non-detect		NG/L	19

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rm) Sample 2/25/2025

HARTLAND WATERWORKS (26802050)

**Drinking Water System Portal (/dwsportalpub/)**

**Sample Group** Per/Poly-Fluoroalkyls (PFAS Form)  
**Source ID** 4  
**Sample Date** 2/25/2025  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WD01149-10  
**Well #** BH399  
**Sample Time** 930  
**Sample Description**  
**Reported Date** 3/5/2025  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

**Sampling Results**

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2813	11CL-PF3OUDS	0	NG/L	Non-detect		NG/L	1
2814	9CL-PF3ONS	0	NG/L	Non-detect		NG/L	2
2815	ADONA	0	NG/L	Non-detect		NG/L	3
2816	HFPO-DA	0	NG/L	Non-detect		NG/L	4
2817	NETFOSAA	0	NG/L	Non-detect		NG/L	5
2818	NMEFOSAA	0	NG/L	Non-detect		NG/L	6
2801	PFBS	4.7	NG/L			NG/L	7
2807	PFDA	0	NG/L	Non-detect		NG/L	8
2808	PFDOA	0	NG/L	Non-detect		NG/L	9
2802	PFHPA	1.1	NG/L	Between LOD and LOQ		NG/L	10
2809	PFHXA	2.6	NG/L			NG/L	11
2803	PFHXS	3.1	NG/L			NG/L	12
2804	PFNA	0	NG/L	Non-detect		NG/L	13
2806	PFOA	1.5	NG/L			NG/L	14
2805	PFOS	1.1	NG/L	Between LOD and LOQ		NG/L	15
2830	PFOA AND PFOS TOTAL	2.6	NG/L		70	NG/L	16
2810	PFTA	0	NG/L	Non-detect		NG/L	17
2811	PFTTrDA	0	NG/L	Non-detect		NG/L	18
2812	PFUNA	0	NG/L	Non-detect		NG/L	19

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rm) Sample 2/25/2025

HARTLAND WATERWORKS (26802050)

**Drinking Water System Portal (/dwsportalpub/)**

**Sample Group** Per/Poly-Fluoroalkyls (PFAS Form)  
**Source ID** 5  
**Sample Date** 2/25/2025  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WD01149-13  
**Well #** BH400  
**Sample Time** 1000  
**Sample Description**  
**Reported Date** 3/5/2025  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

**Sampling Results**

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2813	11CL-PF3OUDS	0	NG/L	Non-detect		NG/L	1
2814	9CL-PF3ONS	0	NG/L	Non-detect		NG/L	2
2815	ADONA	0	NG/L	Non-detect		NG/L	3
2816	HFPO-DA	0	NG/L	Non-detect		NG/L	4
2817	NETFOSAA	0	NG/L	Non-detect		NG/L	5
2818	NMEFOSAA	0	NG/L	Non-detect		NG/L	6
2801	PFBS	2.9	NG/L			NG/L	7
2807	PFDA	0	NG/L	Non-detect		NG/L	8
2808	PFDOA	0	NG/L	Non-detect		NG/L	9
2802	PFHPA	0.56	NG/L	Between LOD and LOQ		NG/L	10
2809	PFHXA	1.1	NG/L	Between LOD and LOQ		NG/L	11
2803	PFHXS	0.72	NG/L	Between LOD and LOQ		NG/L	12
2804	PFNA	0	NG/L	Non-detect		NG/L	13
2806	PFOA	0.79	NG/L	Between LOD and LOQ		NG/L	14
2805	PFOS	0.57	NG/L	Between LOD and LOQ		NG/L	15
2830	PFOA AND PFOS TOTAL	1.36	NG/L		70	NG/L	16
2810	PFTA	0	NG/L	Non-detect		NG/L	17
2811	PFTTrDA	0	NG/L	Non-detect		NG/L	18
2812	PFUNA	0	NG/L	Non-detect		NG/L	19

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rm) Sample 2/25/2025

HARTLAND WATERWORKS (26802050)

**Drinking Water System Portal (/dwsportalpub/)**

**Sample Group** Per/Poly-Fluoroalkyls (PFAS Form)  
**Source ID** 6  
**Sample Date** 2/25/2025  
**Site ID**  
**Sample Type** Compliance  
**Sample Source** Entry Point  
**Sample Collector** J SCHLAFER  
**Lab ID** 721026460  
**Reason for No Results**

**Sample ID** WD01149-16  
**Well #** RG658  
**Sample Time** 1300  
**Sample Description**  
**Reported Date** 3/5/2025  
**# Taken** 1  
**Lab Name** Northern Lake Service Inc. (Crandon)  
**Lab Comment**

**Sampling Results**

Show  entries

Filter:

Storet Code	Description	Result	Units	Qualifier	MCL	MCL Units	Labslip Order
2813	11CL-PF3OUDS	0	NG/L	Non-detect		NG/L	1
2814	9CL-PF3ONS	0	NG/L	Non-detect		NG/L	2
2815	ADONA	0	NG/L	Non-detect		NG/L	3
2816	HFPO-DA	0	NG/L	Non-detect		NG/L	4
2817	NETFOSAA	0	NG/L	Non-detect		NG/L	5
2818	NMEFOSAA	0	NG/L	Non-detect		NG/L	6
2801	PFBS	2.8	NG/L			NG/L	7
2807	PFDA	0	NG/L	Non-detect		NG/L	8
2808	PFDOA	0	NG/L	Non-detect		NG/L	9
2802	PFHPA	1.7	NG/L	Between LOD and LOQ		NG/L	10
2809	PFHXA	3.5	NG/L			NG/L	11
2803	PFHXS	2.3	NG/L			NG/L	12
2804	PFNA	0	NG/L	Non-detect		NG/L	13
2806	PFOA	3.5	NG/L			NG/L	14
2805	PFOS	4.1	NG/L			NG/L	15
2830	PFOA AND PFOS TOTAL	7.6	NG/L		70	NG/L	16
2810	PFTA	0	NG/L	Non-detect		NG/L	17
2811	PFTTrDA	0	NG/L	Non-detect		NG/L	18
2812	PFUNA	0	NG/L	Non-detect		NG/L	19

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APPENDIX C: WELL 6 PFAS HAZARD INDEX CALCULATION

## Village of Hartland, Well 6 PFAS Hazard Index

PFAS Name	Short Name	DHS Hazard Index Standard, ng/L <sup>1</sup>	Sample: 2/25/2025		Sample: 6/5/2024		Sample: 5/15/2023	
			Measured, ng/L <sup>2</sup>	Index	Measured, ng/L <sup>2</sup>	Index	Measured, ng/L <sup>2</sup>	Index
N-ethyl perfluorooctane sulfonamido ethanol <sup>3</sup>	NeTFOSE	4		-		-		-
N-ethyl perfluorooctanesulfonamidoacetic acid <sup>3</sup>	NETFOSAA	4	0	-	0	-	0	-
N-Ethylperfluorooctanesulfonamide <sup>3</sup>	NETFOSA	4		-		-		-
Perfluorooctane sulfonamide <sup>3</sup>	FOSA or PFOSA	4		-		-		-
perfluorooctanesulfonic acid <sup>3</sup>	PFOS	4	4.1	-	2.3	-	4.5	-
perfluorooctanoic acid <sup>3</sup>	PFOA	4	3.5	-	1.9	-	4.1	-
perfluorononanoic acid	PFNA	10	0	0.00	0	0.00	0	0.00
perfluorohexanesulfonic acid	PFHxS	10	2.3	0.23	2.2	0.22	3.6	0.36
hexafluoropropylene oxide dimer acid	HFPO DA or GenX	10	0	0.00	0	0.00	0	0.00
perfluorodecanoic acid	PFDA	300	0	0.00	0	0.00	0	0.00
perfluorododecanoic acid	PFDoA	500	0	0.00	0	0.00	0	0.00
4,8-dioxa-3H-perfluorononanoic acid	ADONA or DONA	3,000	0	0.00	0	0.00	0	0.00
perfluoroundecanoic acid	PFUnA	3,000	0	0.00	0	0.00	0	0.00
Perfluorobutanoic Acid	PFBA	10,000		0.00		0.00		0.00
perfluorotetradecanoic acid	PFTA or PFTeA	10,000	0	0.00	0	0.00	0	0.00
perfluorohexanoic acid	PFHxA	150,000	3.5	0.00	1.9	0.00	3.9	0.00
Perfluorooctadecanoic acid	PFODA	400,000		0.00		0.00		0.00
perfluorobutanesulfonic acid	PFBS	2,000	2.8	0.00	4.3	0.00	3.8	0.00
<b>Resulting PFAS Hazard Index<sup>4</sup>:</b>			<b>0.23</b>		<b>0.22</b>		<b>0.36</b>	

1. Advisory levels as of February 2025. " - " Indicates that no health advisory level is given for a particular compound.
2. Blank cells indicate not tested. Measured concentration of 0 indicates not detected.
3. Compounds not included in hazard index calculation.
4. Standard Hazard Index for Wisconsin Department Health Services (WI DHS) is 1.

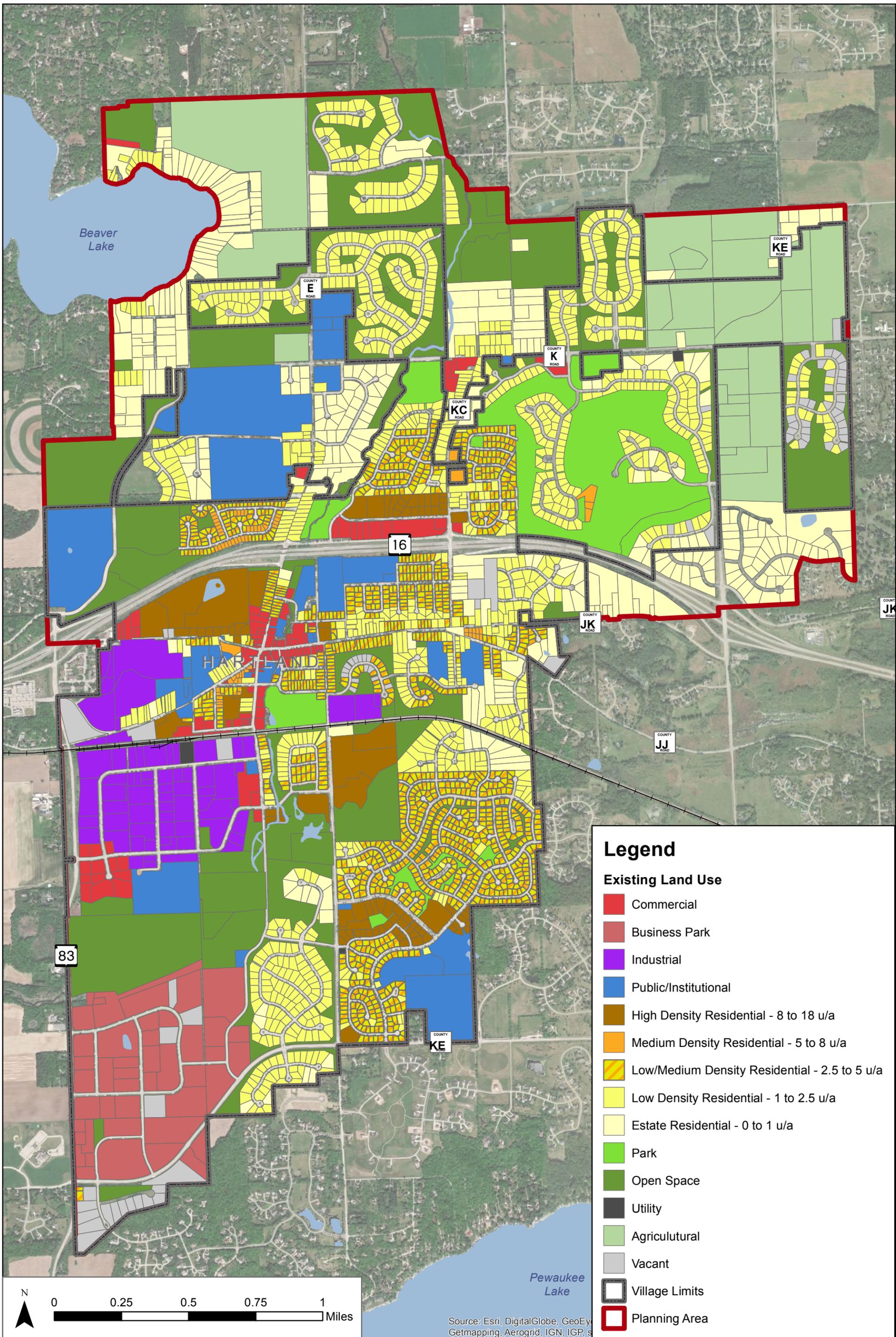
### DHS' 2025 PFAS Hazard Index Equation

$$\text{Hazard Index} = \text{HQ}_{\text{HFPO-DA}} + \text{HQ}_{\text{PFBS}} + \text{HQ}_{\text{PFHxS}} + \text{HQ}_{\text{PFNA}} + \text{HQ}_{\text{DONA}} + \text{HQ}_{\text{PFBA}} + \text{HQ}_{\text{PFDA}} + \text{HQ}_{\text{PFDoA}} + \text{HQ}_{\text{PFHxA}} + \text{HQ}_{\text{PFODA}} + \text{HQ}_{\text{PFTeA}} + \text{HQ}_{\text{PFUnA}}$$

Where:

$$\text{HQ} = \frac{\text{PFAS}_x \text{ Concentration}}{\text{PFAS}_x \text{ Health Guideline}}$$

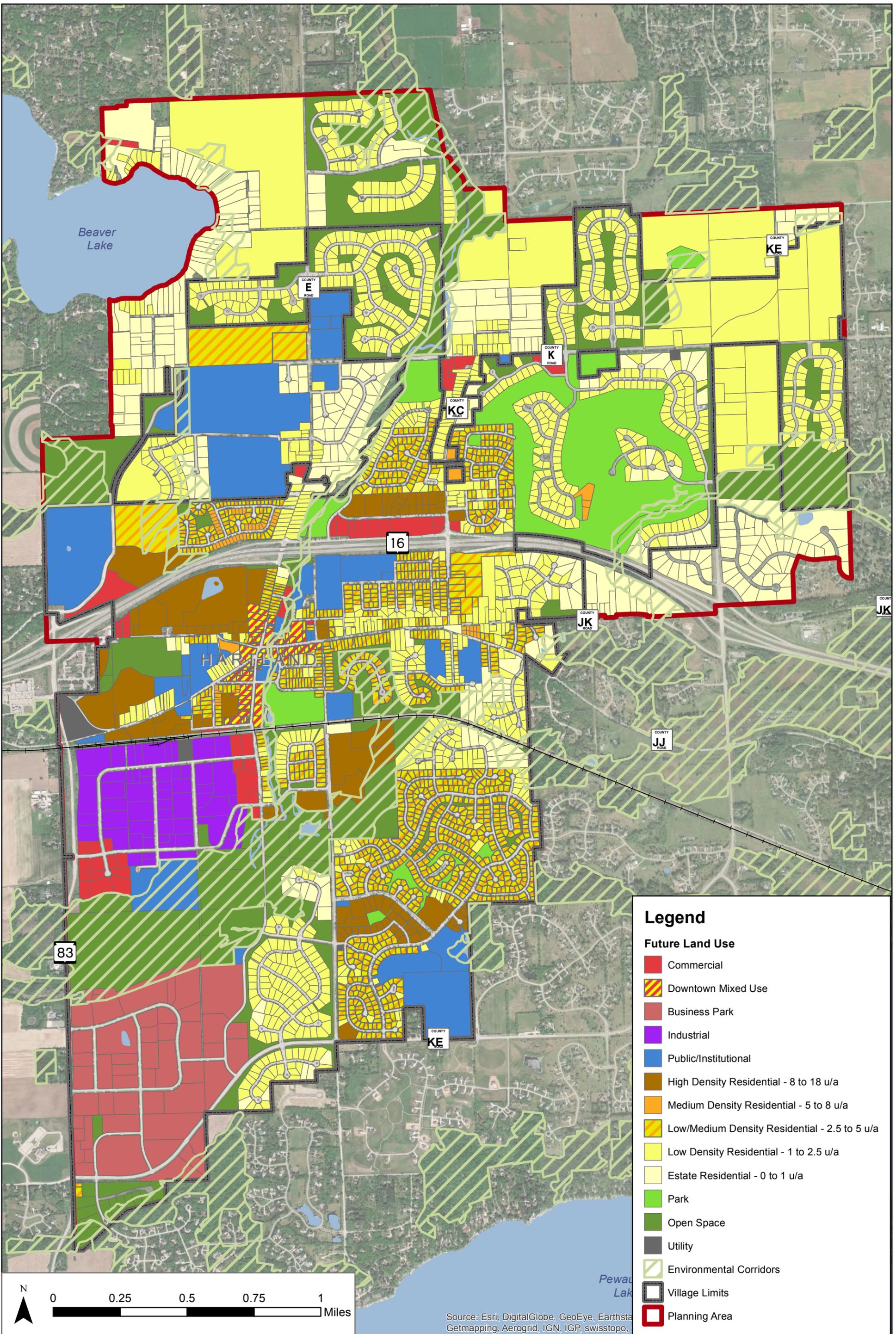
APPENDIX D: LAND USE FROM 2019 COMPREHENSIVE PLAN



### Legend

**Existing Land Use**

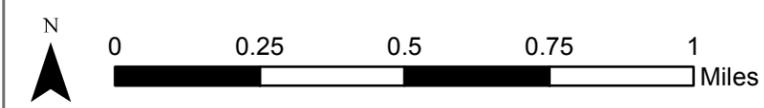
- Commercial
- Business Park
- Industrial
- Public/Institutional
- High Density Residential - 8 to 18 u/a
- Medium Density Residential - 5 to 8 u/a
- Low/Medium Density Residential - 2.5 to 5 u/a
- Low Density Residential - 1 to 2.5 u/a
- Estate Residential - 0 to 1 u/a
- Park
- Open Space
- Utility
- Agricultural
- Vacant
- Village Limits
- Planning Area



**Legend**

**Future Land Use**

- Commercial
- Downtown Mixed Use
- Business Park
- Industrial
- Public/Institutional
- High Density Residential - 8 to 18 u/a
- Medium Density Residential - 5 to 8 u/a
- Low/Medium Density Residential - 2.5 to 5 u/a
- Low Density Residential - 1 to 2.5 u/a
- Estate Residential - 0 to 1 u/a
- Park
- Open Space
- Utility
- Environmental Corridors
- Village Limits
- Planning Area



Source: Esri, DigitalGlobe, GeoEye, Earthstar, Getmapping, Aerogrid, IGN, IGP, swisstopo,

## Land Uses Categories

A total of 13 land use categories were used to identify a future land use plan for the Village of Hartland. These categories represent all uses, from large lot residential to public utilities. Table 22 provides a summary of each of the future land use categories

**Table 22: Land Use Categories**

Category	Density	Summary
Commercial	N/A	Represents commercial retail sales, services, and office buildings throughout the community. This land use is a primary location for employees and the diversity of the development provides goods and services for residents
Downtown Mixed Use	12 to 18 units/acre	The Downtown Mixed-Use Category is a new category for the 2045 land use plan. This land use represents a mixture of commercial, public and residential uses throughout the core of the Village. Both vertical and horizontal mixed uses are encouraged throughout this area.
Business Park	N/A	The Business Park land use represents a variety of uses within the Village's industrial park. These locations are centers for employment but are not dependent on drive by traffic.
Industrial	N/A	The Industrial land use category represents manufacturing and warehouse uses throughout the Village. These uses typically have higher commercial truck volumes and are not dependent on drive by traffic.
Public/Institutional	N/A	The Public/Institutional category represents the government owned facilities throughout the community. These uses range from the Village Hall to schools and churches. Typically, new areas of Public/Institution are not identified unless future government sites have been purchased.
High Density Residential	8 to 18 units/acre	The High Density Residential category represent the highest density land use throughout the community. Densities should range from 8 to 18 units per acre and support multifamily development.
Medium Density Residential	5 to 8 units/acre	The Medium Density Residential represents smaller scale residential development, ranging from twin homes to dense single-family home areas.
Low/Medium Density Residential	2.5 to 5 units/acre	The Low/Medium Residential category is new to the 2045 land use plan. This category represents smaller long single-family developments throughout the community.
Low Density Residential	1 to 2.5 units/acre	The Low Density Residential category represents the standard single-family development that most consider when considering residential uses.
Estate Residential	0 to 1 units/acre	The Estate Residential land use category is also new for the 2045 land use plan. This land use represents large lot residential development, on lots greater than 1 acre in size.
Park	N/A	The Parks land use category represents dedicated Village, County or Regional Parks throughout the Village
Open Space	N/A	The Open Space category is used to identify public open spaces or environmental preservation areas.
Utility	N/A	The Utility category is used to represent properties service a public utility function. Cell towers are an example of this use.