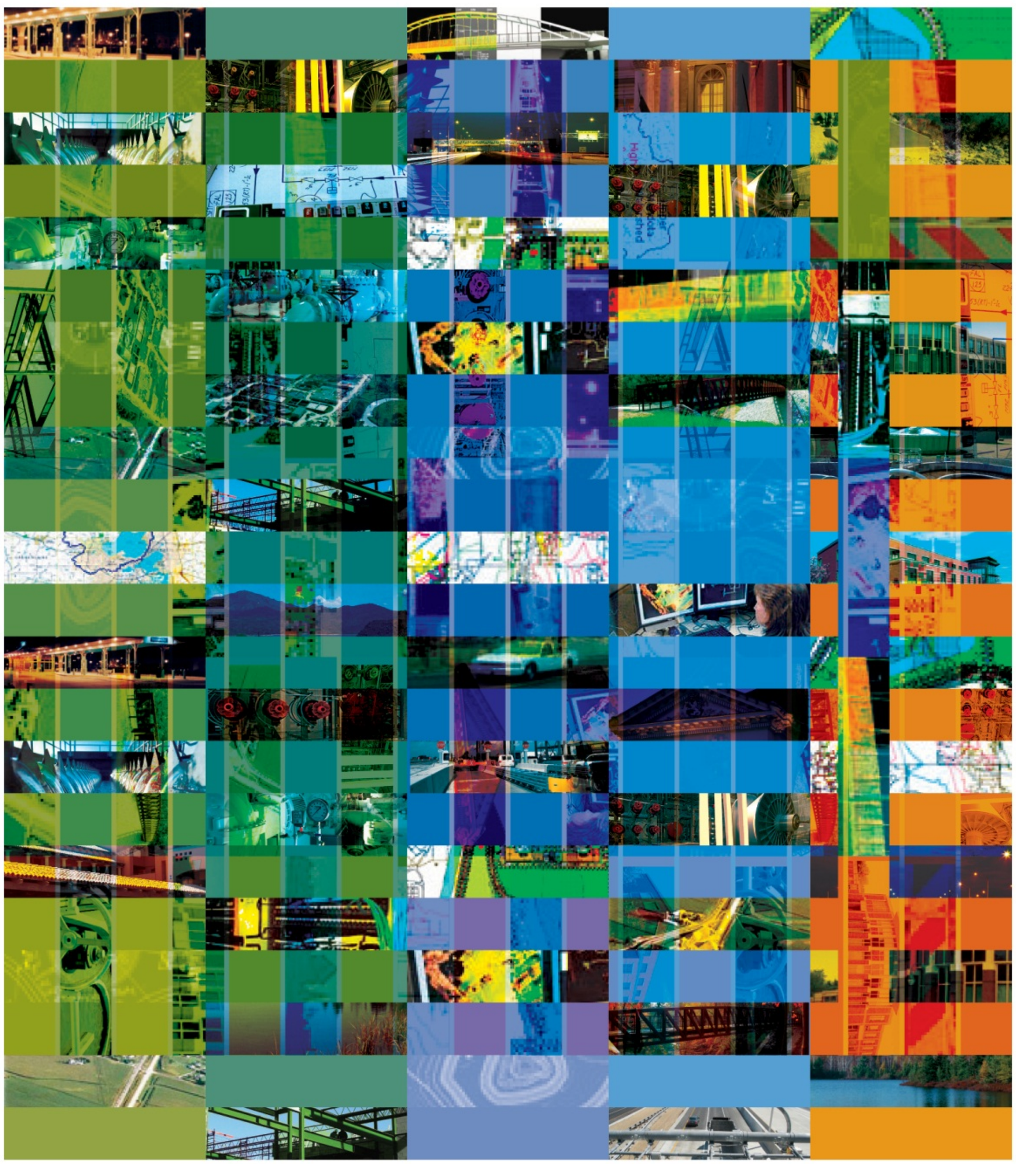
Professional

Engineering

Services

Water Supply Planning Report



Report

Village of

Glencoe, IL

March 2015

STRAND ASSOCIATES®

Strand Associates, Inc.®
910 West Wingra Drive
Madison, WI 53715
(P) 608-251-4843
(F) 608-251-8655

March 18, 2015

Mr. David C. Mau, P.E., Director of Public Works
Village of Glencoe
675 Village Court
Glencoe, IL 60022

Re: Water Supply Planning Report

Dear David,

Enclosed are three copies of the final Water Supply Planning Report. We appreciate the opportunity to assist you with this report and look forward to continuing our services for the Village as this project progresses.

Please call with questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Chris J. Ulm, P.E. Brian L. Hackman, P.E.

Enclosure: Report

CJU:dfe\R:\MAD\Documents\Reports\Archive\2015\Glencoe, IL\WSCP.1410.015.blh.mar\Report_Report Letter.docx\032015

Report for

Village of Glencoe, Illinois

Water Supply Planning Report

BRIAN L. HACKMAN
062-055338
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

3/18/2015
Expires 11/30/2015

CHRIS J. ULM
062-053675
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

MARCH 18, 2015
exp 11/15

Prepared by:

STRAND ASSOCIATES, INC.®
IDFPR No. 184-001273
1170 South Houbolt Road
Joliet, IL 60431
www.strand.com

March 18, 2015

STRAND ASSOCIATES®

TABLE OF CONTENTS

Page No.
or Following

Page No.
or Following

TABLES

Page No.
or Following

FIGURES

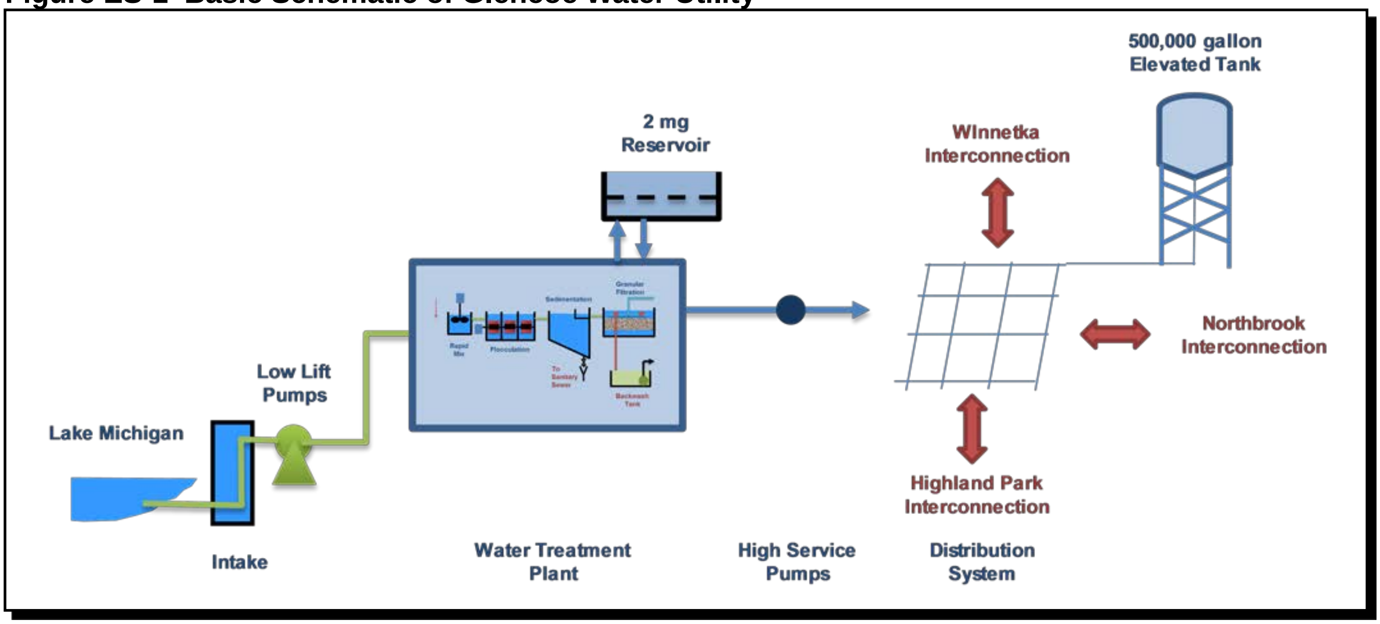
EXECUTIVE SUMMARY

INTRODUCTION

The Village of Glencoe, Illinois, began to supply residents with treated water from Lake Michigan with the construction of the existing intake and portions of the existing water treatment plant (WTP) in 1928. Since then, the Village has expanded its treated water production capacity to 7.3 million gallons per day (mgd) and continued to expand its water supply and distribution system to maintain a reliable and compliant water supply to the residents of the Village.

Figure ES-1 demonstrates the basic elements of the Village's water system that were considered during this study as it relates to the future of the Village's water supply.

Figure ES-1 Basic Schematic of Glencoe Water Utility



While current operations meet regulatory requirements, the age of the existing water treatment plant is not only causing an increase in maintenance costs, but also concerns of major failures because much of the infrastructure is nearing the end of its useful life. This study evaluates a broad range of planning options including rehabilitation of the existing plant, construction of a new WTP, and the ability to purchase water from neighboring water systems. Alternatives presented in this report considered the water supply source, treatment, storage, and distribution improvements necessary to maintain or improve upon the existing level of service to the community.

From the planning stage to operation, water system improvements of this nature can take approximately five to ten years to implement. The Village recognizes its financial and long-term responsibility toward providing an economical drinking water supply to its customers by planning for improvements to its aging water system infrastructure today, and they have commissioned this report to begin this planning process.

SYSTEM SUMMARY AND DEMAND ANALYSIS

The water supply and treatment portion of the existing system includes the existing intake, which extends 3,300 feet into Lake Michigan, and the 8 mgd conventional treatment plant. The Village also currently has water storage in the amount of 2,500,000 gallons, with a 2,000,0000-gallon reservoir near the WTP and a 500,000-gallon elevated storage tank located in the southwest corner of the Village's distribution system. The Village distributes water to the residents through a distribution system consisting of 58 miles of water main ranging in size from 4 to 16 inches in diameter. There are also interconnects with the City of Highland Park, the Village of Northbrook, and the Village of Winnetka, which are intended to assist with water supply in the event of a reduction or loss of supply at the WTP.

Table ES-1 Water Demand Characteristics

Description	Historical Demands	40-Year Projection
Average Day Demand	1.97 mgd	1.97 mgd
Average to Max Ratio	2.75	2.75
Maximum Day Demand	5.42 mgd	5.59 to 6.84 mgd
Population	8,730	9,000 to 11,000

Based on a review of the historic consumption data and future growth projections, it was determined that future water supply should provide 6 mgd of treated water for the residents of Glencoe. Table ES-1 summarizes the historical and projected future water demand characteristics.

MODEL DEVELOPMENT AND SYSTEM PERFORMANCE

To evaluate the ability for the distribution system and storage tanks to distribute the water supply from the future WTP location, which may change from the existing location, a computer water model of the entire existing water system was created and calibrated. It was calibrated by conducting field testing and adjusting the water model parameters until the simulations matched the actual field results.

The model showed that the existing distribution system meets the required maximum day water demands and still provides acceptable flows for firefighting. No areas were observed to have excessively high or low pressures or velocities.

ADDITIONAL REQUIRED CAPACITY ANALYSIS

A capacity analysis reveals that the proposed water supply capacity of 6 mgd from the water treatment plant process, in addition to the 2.5 million gallons of available storage, is adequate to meet the current and anticipated future maximum day demands plus a 1,500 gallons per minute fire flow demand for two hours. This was the fire demand requirement that Village staff desired. Therefore, no additional water storage is necessary if the Village continues to have a water plant with at least a 6 mgd capacity.

FUTURE WATER SUPPLY ALTERNATIVES ANALYSIS

The focus of this report is on providing analysis and developing options for future water supply for the Village. After review of water supply alternatives, this report will focus on four main groups of alternatives for the future water supply, including the following.

1. Purchase of drinking water from a neighboring community.

2. Rehabilitation of the existing WTP.

3. Construction of a new WTP.

    a. At the lakefront:

        (1) On the existing WTP site

        (2) On the beach north of the existing WTP site

        (3) On the beach south of the existing WTP site

    b. At an inland location:

        (1) On acquired school or park property near the intersection of Dundee and Forestway Drive

        (2) On acquired Cook County Forest Preserve property near Forestway Drive and Elder Court

        (3) On Village-owned property at the existing elevated water tank site

        (4) On Village-owned property at the location of the existing public works garage facility

After analysis of the options for constructing a new WTP, it became evident that several inland options were not viable. All the inland options involve pumping raw water through large-diameter transmission mains to new plant locations, and some required distribution system improvements to adequately convey the treated water to all parts of the distribution system. This alone made these options higher in cost than the lakefront options. Ultimately, all the inland options, except for construction at the current public works facility, were found to be not viable for further consideration because of extensive environmental issues or the inability to realistically procure the land.

Table ES-3 provides a brief description of the details of each of the remaining viable alternatives, their advantages and disadvantages, and an opinion of probable project costs. The opinions of probable cost includes the work scope associated with the lake intake, the WTP, distribution improvements necessary, storage and pumping improvements necessary, and demolition. Also included is a 20 percent contingency to account for other costs that may arise as the project moves forward from concept to design, and a 15 percent contingency for professional services that would include geotechnical and design engineering, legal fees, and other related costs.

Table ES-2 Summary of Alternative Water Supply Analysis

		Description	Advantages	Project Challenges	Details	Opinion of Probable Cost Breakdown		Cost
Lake Front Options	Rehab Existing Plant	Rehabilitate and Retrofit existing plant: structural repair/replacement and modification of water treatment process to include current technologies and membrane filtration. Connection to Highland Park to supply water during construction.	Lower cost initially	Higher long-term costs (Operating)	WTP Technology	WTP Probable Cost	$ 13,924,000	$31,874,000
			Plant operational during construction	Requires expansion on existing site	Conventional Plus Membrane	Intake Probable Cost	$ 3,625,000	
			Reduction in overall impact of construction	Space limitations of existing site impact treatment process upgrades		Demolition	$ -	
			Existing Village owned property	Short term temporary connections required (Highland Park/Northbrook/Winnetka)	Intake Sizing	Raw Water Transmission	$ -	
			Minimal change to existing building exterior/appearance	Restricted access to boater beach via west side of WTP	6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				Water Plant access ramp will require modification for construction		2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
				Challenges with perimeter security	Finished Water Storage	Contingency and Professional Services (35%)	$ 8,103,000	
				Many items near the end of their useful life will remain	2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
					Clearwell Storage			
					430,000 gallons			
	New WTP Existing Site	Demolition of existing plant, construct new 6 MGD WTP, modifications/upgrades to existing reservoir, upgrade transmission mains. Connection to Highland Park to supply water during construction.	Smaller footprint for WTP	Long term (2-Years) temporary connections required	WTP Technology	WTP Probable Cost	$ 22,012,000	$51,577,000
			Existing Village owned property	Most costly of lakefront options	Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
			New modern WTP with expected life of 75 years	Restricted access to boater beach (Short/Long-Term)		Demolition	$ 379,000	
			Freedom of architectural design	Impact to current WTP staffing during construction	Intake Sizing	Raw Water Transmission	$ -	
				Water Plant access ramp will require modification for construction	6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
						2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
					FInished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
					2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 2 years)	$ 3,777,000	
					Clearwell Storage			
					500,000 gallons			
	New WTP Adjacent to Existing (Sout	Phased redevelopment - construction of new WTP to the south of existing WTP/Partial demolition of existing plant/construction of final treatment process (membrane/UV). Connection to Highland Park to supply water during construction.	Existing plant operational during construction	Requires property exchange	WTP Technology	WTP Probable Cost	$ 22,012,000	$48,421,000
			Smaller footprint for WTP	Restricted access to boater beach (Short/Long-Term)	Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
			Existing Village owned property	Potentially longer construction time/impact to beach operations		Demolition	$ 379,000	
			New modern WTP with expected life of 75 years	Water Plant access ramp will require modification for construction	Intake Sizing	Raw Water Transmission	$ -	
			Freedom of architectural design		6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
						2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
					Finished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
					2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
					Clearwell Storage			
					430,000 gallons			
	New WTP Adjacent to Existing (Nort	Partial demolition of existing WTP facilities/construction of new fully modernized 6 MGD WTP/Demolition of remaining existing WTP. Connection to Highland Park to supply water during construction.	Existing plant operational during construction	More challenging construction access	WTP Technology	WTP Probable Cost	$ 22,012,000	$48,421,000
			Smaller footprint than existing WTP	Neighboring residential property concerns	Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
			Contiguous beach operations	Loss of separate and distinct boating beach		Demolition	$ 379,000	
			New modern WTP with expected life of 75 years	Requires property exchange	Intake Sizing	Raw Water Transmission	$ -	
			Existing distribution system does not need reinforcement	WTP access ramp will require modification for construction	6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
			Freedom or architectural design			2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
					Finished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
					2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
					Clearwell Storage			
					500,000 gallons			

Inland Plant Options	Current Public Works Garage Site New WTP	Demolition of existing plant, construction of new water plant and storage, 24" raw water transmission main. Connection to Highland Park to supply water during construction.	Lower construction costs compared to other inland options	Requires relocation/construction of new PW garage - $10 million	WTP Technology	WTP Probable Cost	$ 22,012,000	$65,665,000
			WTP off lakefront	Loss of public through street (Temple Ct.)	Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
			Existing Village owned property	Loss of public parking (Temple CT. Lot)		Demolition	$ 569,000	
			Proximity to existing distribution system	Loss of future tax-producing opportunities	Intake Sizing	Raw Water Transmission	$ 1,472,000	
			Existing plant operational during construction	Incompatible with Village's comprehensive plan and update	6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				Long term residential impact (construction/operations) from municipal WTP facility		2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
				Undersized site	Finished Water Storage	Contingency and Professional Services (35%)	$ 12,975,000	
				Access/Delivery issues	2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
					Clearwell Storage	Parking Garage	$ 5,000,000	
					500,000 gallons	New Public Works Facility	$ 10,000,000	
Purchased Water Option	Purchase Water from Highland Park	Demolition of existing plant, new 2 MG reservoir and 2 mgd booster station, new 2 mgd pumping station at existing reservoir, new 6 mgd pumping station in Highland Park, and 16" distribution main improvements.	Existing plant operational during construction	Loss of control of water supply	WTP Technology	WTP Probable Cost	$ -	$11,717,000
			Out of the Water Production Business	Loss of control of water rates	None	Intake Probable Cost	$ -	
			Could reduce staff and save money	Increase in rates to pay for purchase of water plus maintain distribution system		Demolition	$ 379,000	
				Added storage required which add operational difficulty	Intake Sizing	Raw Water Transmission	$ -	
				Responsibility for providing adequate water quality remains	None	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
						2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
					Finished Water Storage	2 MG Reservoir and 2 mgd Booster Station	$ 2,700,000	
					4 MG + 0.5 MG	Contingency and Professional Services (35%)	$ 3,038,000	

RECOMMENDATIONS

If the Village elects to purchase water from a neighboring community, it is recommended that purchasing from the City of Highland Park as the sole source be further investigated. Although the Village of Winnetka has the ability and interest to help with supply, provisions for and operation through one source would simplify the long-term arrangements. The opinion of probable cost to construct this option is the lowest at $11,717,000. However, a long-range analysis of this option appears to cost more after about 30 to 31 years because of the rising purchase price of water over time.

It is recommended that the Village construct a new WTP rather than rehabilitating the existing WTP. Rehabilitating the existing WTP has a lower overall opinion of probable cost at $31,874,00, but it has a shorter overall lifespan because of building on the aged foundation and footprint. The resulting rehabilitated plant will have many areas where meeting current codes and accessibility requirements will be very difficult to achieve.

It is not recommended that the Village construct a WTP inland. The only viable option would be at the existing Public Works site, which would present major disruptions to the downtown feel, traffic flow, and parking. In addition, if the cost to replace the lost parking spaces projected in the Temple Court parking lot with a parking deck and the cost to replace the public works facility are included, the probable cost for this option is the highest of all at $65,665,000.

If the Village chooses to construct a new WTP, it is recommended that the plant be built on the lakeshore at whichever of the three options are achievable based on availability of land and the ability to obtain the most acceptance. Construction on the existing plant site has the highest probable cost at $51,577,000, while building to the north or south of the plant has a probable cost of $48,421,000.

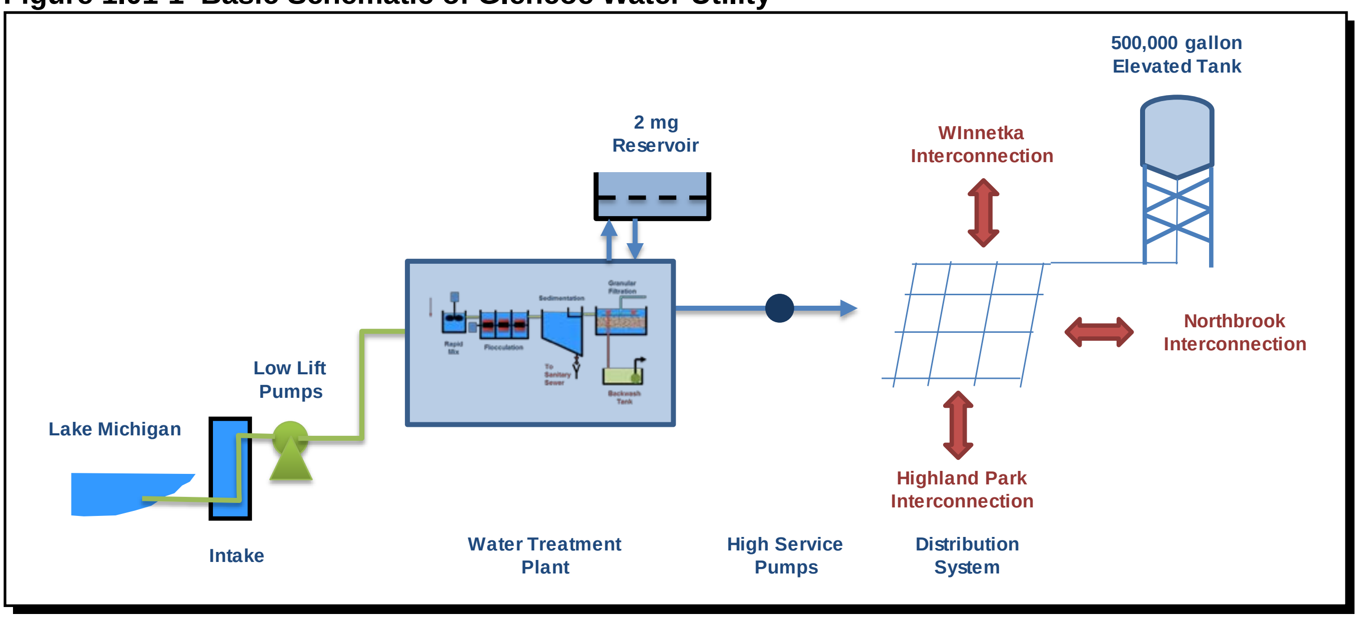
SECTION 1
INTRODUCTION

The Village of Glencoe, Illinois (Village), has authorized preparation of this Water Supply Planning Report to identify improvements required to maintain production of safe drinking water for its customers. This report was commissioned to address the aging water treatment facility, which is nearing the end of its useful life.

The Village began to supply residents with treated water from Lake Michigan with the construction of the existing intake, which extends 3,300 feet into Lake Michigan, and portions of the existing water treatment plant (WTP) in 1928. As additional capacity and treatment processes were required to supply Village residents, the WTP was expanded in 1938 and again in 1951. Since 1951, the Village has undertaken plant maintenance projects, including additional modifications to process equipment and chemical feed facilities, pump and equipment replacement, roofing materials, exterior stucco and tuckpointing improvements, and repairing windows. The Village has also expanded its storage capabilities with a 2 million gallon (MG) reservoir near the WTP, and 500,000-gallon elevated storage tank located in the southwest corner of the Village's distribution system.

Figure 1.01-1 demonstrates the basic elements of the Village's water system that were considered during this study, as it relates to the future of the Village's water supply.

Figure 1.01-1 Basic Schematic of Glencoe Water Utility



The Village also has the ability to obtain water from the neighboring communities of Highland Park, Northbrook, and Winnetka through emergency interconnects between the respective distribution systems. Until this study, the volume and pressure of available water supply from the Village's interconnection points had not yet been quantified or fully understood.

While current operations meet regulatory requirements, the age of the existing WTP is not only causing an increase in maintenance costs, but also concerns about more significant infrastructure nearing the end of its useful life. This study evaluates a broad range of planning options including rehabilitation of the existing WTP, construction of a new WTP, and the ability to purchase water from neighboring water systems. Alternatives presented in this report considered the water supply source, treatment, storage, and distribution improvements necessary to maintain or improve the existing level of service to the community.

From the planning stage to operation, water system improvements of this nature can take from five to ten years to implement. The Village recognizes its financial and long-term responsibility toward providing an economical drinking water supply to its residents by planning for improvements to its aging water system infrastructure today, and has commissioned this report to begin the planning process.

1.01 PURPOSE AND SCOPE

The scope of this report includes the following elements:

1. An inventory and discussion of existing water system supply components including water treatment facilities, storage, pumping and distribution.
2. Projection of future domestic and fire protection demands.
3. Discussion of the computer model creation and calibration.
4. Use of the computer model to evaluate water system hydraulics under existing and future demand conditions.
5. Analysis of existing storage facilities to meet current and projected future demands.
6. Analysis of alternative water supply sources including flow capabilities, pressure requirements, and constraints.
7. A summary of the alternatives including supply, distribution, flow, pressure, and opinions of costs.

7\. Opinions of probable cost for the recommended capital improvements.

1.02 ABBREVIATIONS AND DEFINITIONS

AWWA	American Water Works Association
AwwaRF	American Water Works Association Research Foundation
BOM	biodegradable organic matter
CA	cellulose acetate
Cl_2	chlorine
ClO_2	chlorine dioxide
ClO_{3-}	chlorite
CIP	cleaned-in-place
CPE	Comprehensive Performance Evaluations
CT	contact time

D/DBP	disinfectants/disinfection by-products
D/DBP-Phase I	Disinfectants/Disinfection By-products-Phase I Rule
D/DBP-Phase II	Disinfectants/Disinfection By-products-Phase II Rule
DBP	disinfection by-products
DOC	dissolved organic carbon
EC	enhanced coagulation
EPS	extended period simulation
ESWTR	Enhanced Surface Water Treatment Regulations
FEMA	Federal Emergency Management Agency
fps	feet per second
FRP	fiberglass reinforced plastic
ft	feet
G	constant velocity gradient
GAC	granulated activated carbon
gal	gallons
gcd	gallons per capita day
GIS	geographical information system
gpd	gallons per day
gpd/ft	gallons per day per foot
gpm	gallons per minute
gpm/sf	gallons per minute per square foot
HAA5	the five controlled haloacetic acids
HGL	hydraulic grade line
hp	horsepower
hr	hour
HSPS	high service pumping station
IEPA	Illinois Environmental Protection Agency
IESWTR	Interim Enhanced Surface Water Treatment Rule
in	inches
ISDE	Initial Distribution System Evaluation
ISO	Insurance Service Office
LRAA	local running annual average
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
LRV	log reduction value
MCC	motor control center
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MF/UF	micro/ultrafiltration
mgd	million gallons per day
MG	million gallons
mg/L	milligrams per liter
MIB	methylisoborneol
MRDLs	maximum residual disinfectant levels
msl	mean sea level
MTBE	methyl tertiary-butyl ether
NF/RO	nanofiltration/reserve osmosis

NTU	nepholometric turbidity unit
NSF	National Sanitation Foundation
pCi/L	picocuries per liter
ppb	part per billion or micrograms per liter (μg/L)
ppm	part per million or milligrams per liter (mg/L)
psi	pounds per square inch
PRV	pressure reducing valve
PSV	pressure sustaining valve
PSW	Partnership for Safe Water
PVC	polyvinylchloride
PVDF	Polyvinylideneflouride
RMP	Risk Management Plan
SCADA	supervisory control and data acquisition
SDWA	Safe Water Drinking Act
SOR	surface overflow rate
SSS	system specific study
SUVA	specific ultraviolet absorbance
SWD	side water depth
SWTR	Surface Water Treatment Rule
TDH	total dynamic head
THM	ditrihalomethane
TMH/HAA	trihalomethane/haloacetic acid
TMP	transmembrane pressure
TOC	total organic carbon
TTHM	total trihalomethanes
USACE	United States Army Corps of Engineers
μg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VFD	variable frequency drive
Village	Village of Glencoe
WTP	water treatment plant

SECTION 2
SYSTEM SUMMARY AND DEMAND ANALYSIS

2.01 WATER DISTRIBUTION SYSTEM

The water distribution system within the Village consists of a lakefront WTP, a single elevated tank, and approximately 58 miles of water main ranging from 4 to 16 inches in diameter. A map of the current distribution system is shown in Figure 2.01-1. The Village also has three manual interconnections with neighboring communities. There is an 8-inch connection to the City of Highland Park on Sheridan Road, a 10-inch connection to the Village of Northbrook located near the elevated tank, and a 10-inch connection to the Village of Winnetka near the intersection of Green Bay Road and Scott Avenue. Each interconnect could allow for flow in either direction if the isolation valve is opened.

2.02 WATER STORAGE FACILITIES

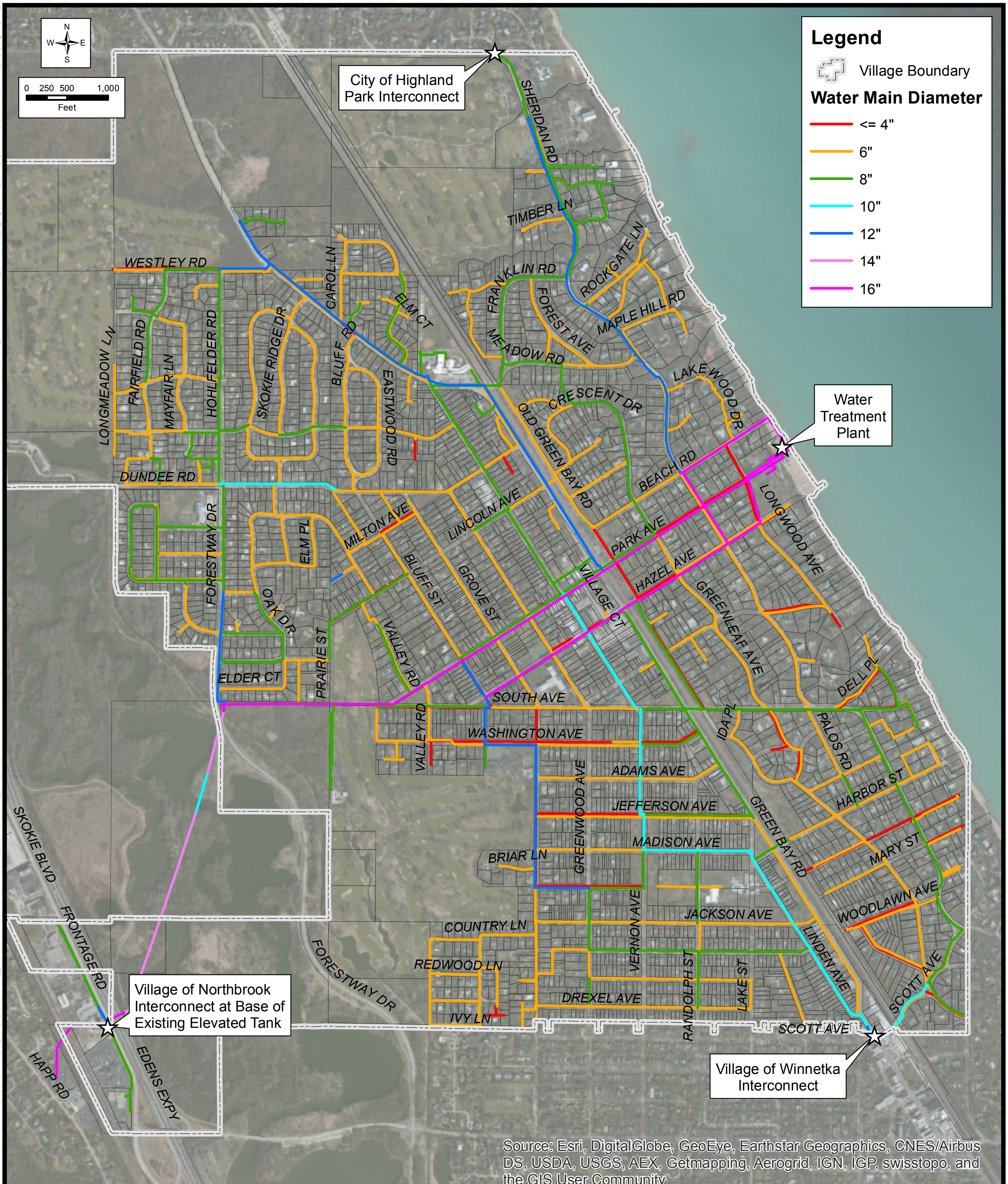
Storage within the Village consists of a 500,000-gallon multileg elevated tank and a 2.0 MG buried reservoir. The elevated tank is located in the southwest part of the distribution system, located west of the Edens Expressway on Skokie Boulevard. The reservoir is located on public land adjacent to the WTP and is able to be pumped to the distribution system through the WTP high lift pumps. According to record drawings supplied by the Village, the overflow elevation of the elevated tank is approximately 155 feet above ground, or 783 feet above mean sea level (amsl).

The WTP has approximately 432,000 gallons of finished water storage that is used for disinfecting the water before distribution. The finished water storage, or clearwell, is necessary to balance water treatment and distribution needs. The amount of available storage in the clearwell varies depending on water temperature and is typically considered part of the treatment process rather than available storage. So, this storage volume will not be included in the water storage calculations or capacity analyses of this report.

2.03 EXISTING WTP

The Village currently draws its source of drinking water from Lake Michigan. Lake water is drawn from a single 24-inch-diameter intake pipe into a collection well for low lift pumping and treatment. The existing WTP has the capability of producing 7.3 million gallons per day (mgd) of potable drinking water based on the firm capacity of the low lift pumps. The existing water treatment process uses conventional treatment techniques including rapid mix, flocculation, sedimentation, granular media filtration, and liquid sodium hypochlorite disinfection. Backwash for the filters is pumped from the 2.0 MG reservoir. Following filtration, water is pumped from the WTP clearwells into the distribution system.

From a residuals handling perspective, the Village currently discharges sludge waste once per year to the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). The existing sanitary connection is rated to handle approximately 75 to 100 gallons per minute (gpm). The average volume of waste generated per year during a one-day maintenance washdown from the backwash recycling basin is approximately 120,000 gallons.



Path: S:\MAD\1400--1499\1410\015\Data\GIS\Figures\Figure 2.01-1 Distribution 8x11.mxd

User: mikea

Date: 3/13/2015

Time: 1:37:37 PM

WATER DISTRIBUTION SYSTEM

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 2.01-1
1410.015

2.04 HISTORICAL AND PROJECTED WATER DEMANDS

A water system capacity analysis includes a review of historical population and water pumpage data to help identify and size future improvements to meet the Village's needs. Historical population data and projections will be used to identify the potential for increased water use based on growth of the Village. Historical water pumpage data and projections will be used to identify the potential for increased water use based on consumptive use within the Village. Both data sets will be used in evaluating water system improvements for the Village.

Water demand rate terminology used in this report is defined as follows:

Average Day Demand: The total volume of water produced in a year divided by the number of days in the year.

Maximum Day Demand: The volume of water on which the maximum amount of water is pumped in a single day.

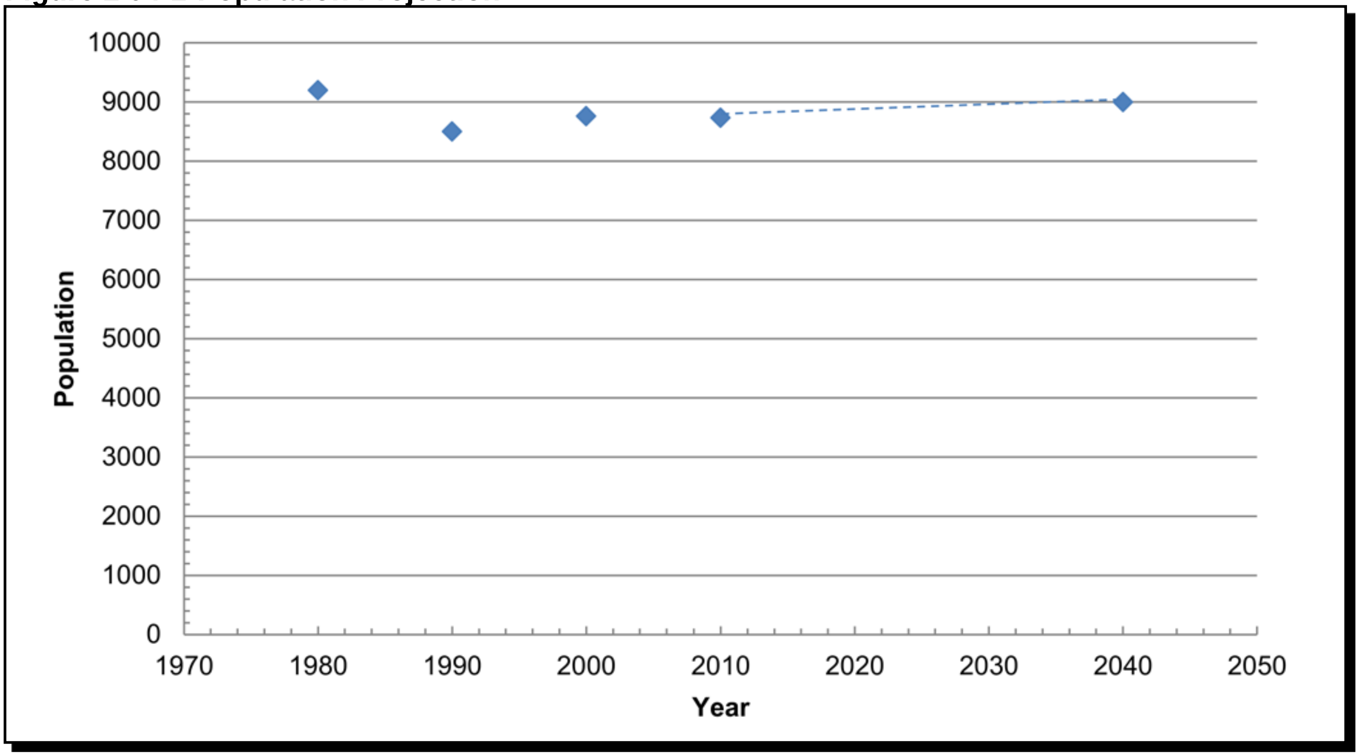
Fire Demand: The estimated amount of water required in a community to fight a fire. This demand is generally specified as a rate of flow, in gpm, for a given period of time, in hours. The calculated fire demand is added to the domestic demand during the maximum day to obtain the demand on a day that a major fire occurs. Fire demand generally increases the volume of storage that must be available on a maximum day.

The estimation of future water demands is not precise. The best forecast of future water demand is obtained by projecting average day demand based on population or customer growth and water use within the service area. Future maximum day demands are then estimated by analyzing past ratios of maximum to average day demand and applying the resulting factor to average day water use projections.

A. Population Trends

Figure 2.04-1 presents United States Census Bureau population data for the Village from 1980, 1990, 2000, and 2010.

Figure 2.04-1 Population Projection

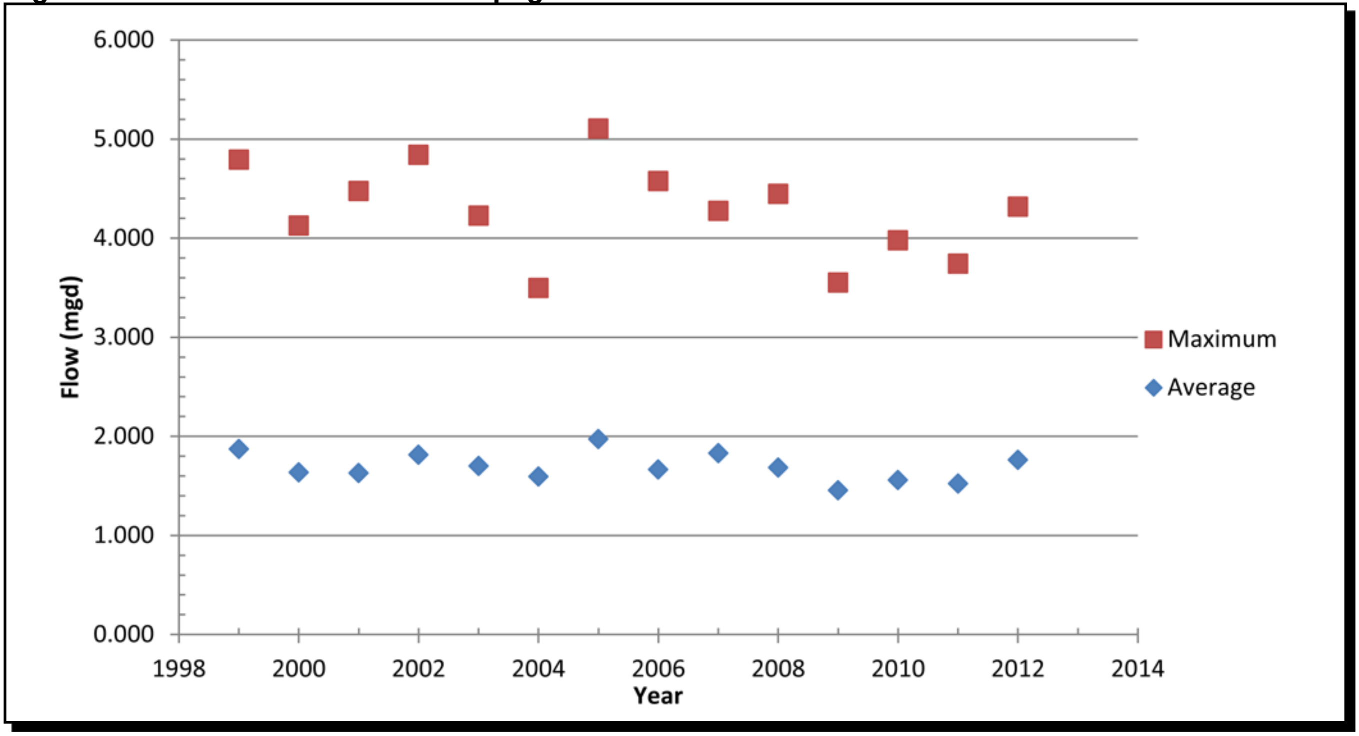


The Village serves approximately 8,723 people, based on 2010 Census data. The Village's population has remained relatively stable over the past 30 years. Recent population projection studies by the Chicago Metropolitan Area Planning (CMAP) Agency have reported a potential Village population of about 11,000 residents by 2040. However, for water system design purposes, the Village has projected a population increase from 8,723 to approximately 9,000 people by the year 2040 based on the 30-year population history and community development plan. The Village's population projection outlook supports a neutral to slightly positive growth for the community and water system.

B. Historical Water Use Records

Historical water demand data for the WTP high lift pumps was compiled from monthly operating reports supplied by the Village from January 1999 to March 2013 and is presented in Figure 2.04-2. Demand over the past 14 years has remained consistently level with little or no growth in the average day. The highest value of the past 14 years of average day demand is equal to 1.97 mgd. The highest maximum to average day ratio of the past 14 years was 2.75. Multiplying the historical average day demand by the historical maximum to average day ratio resulted in a maximum day design demand of 5.42 mgd. While this value is larger than any historical maximum days over the past 14 years, it will be used as a conservative effort for the purpose of determining future improvements.

Figure 2.04-2 Historical Water Pumpage Data



C. Projected Demands

To project the future system demands, both the Village's population growth estimates over the next 40 years of up to about 9,000 people, and the CMAP population projections of 11,000 people were investigated. Assuming that usage trends remain the same at about 226 gallons per person per day on average, and the maximum to average day ratio remains the same at 2.75, the projected 40-year maximum day demands are between 5.59 mgd and 6.84 mgd. Table 2.04-1 summarizes these projections.

Table 2.04-1 WTP Demand Summary

Description	Historical Demands	40 Year Projection
Average Day Demand	1.97 mgd	1.97 mgd
Average to Max Ratio	2.75	2.75
Maximum Day Demand	5.42 mgd	5.59 to 6.84 mgd
Population	8,723	9,000 to 11,000

After discussion with Village staff, it was determined that using 6 mgd as the projected maximum day water demands would result in a WTP that will likely be adequate to meet the ultimate population of the Village. If growth continues to climb beyond the 9,000 person projection towards the 11,000 person projection, it is likely that only a few of the processes at a new WTP would need to be expanded and it would be a relatively minor effort to increase the capacity to meet the demands.

SECTION 3
MODEL DEVELOPMENT AND SYSTEM PERFORMANCE

3.01 MODEL CREATION

The computer model of the Village's water distribution system was created using WaterGEMS V8i as part of this report. The physical characteristics of the Village's distribution system were imported into the computer modeling software using geographic information system (GIS) shapefiles. High lift pump and storage facility information was added separately to the model from information provided by the Village. Each element was assigned an elevation from digital elevation models using the WaterGEMS TRex Terrain Extractor program.

Water demands were allocated evenly throughout the model. Adjustments to demands were used to model estimated average and maximum day demands.

The model was used to evaluate the existing performance of the existing distribution system's ability to supply the previously defined design year water demands throughout the Village by analyzing available fire flows and system pressures.

3.02 MODEL CALIBRATION

To simulate "real world" conditions, results of the model are confirmed against actual observed conditions in the distribution system. This was completed by performing field testing of hydrant flows in various parts of the distribution system. Eleven flow tests were completed on April 9, 2014. Test locations were chosen to provide data that was thought to be representative of the entire distribution system.

The flow test typically used one monitoring hydrant and one flowing hydrant. The monitoring hydrant was used to observe the static pressure when no hydrants were flowing and observe residual pressure when the flowing hydrant was opened. A pressure gauge was attached to the monitoring hydrant and air was purged from the hydrant and gauge manifold before taking a static pressure reading.

When the flowing hydrant was fully opened, the residual pressure reading was taken at the monitoring hydrant. If a pressure drop of less than 10 pounds per square inch (psi) was observed, the flowing hydrant was slowly closed and a second cap on the hydrant was removed to yield additional flow. The residual pressure was recorded at the monitoring hydrant and the pressure of the flow in each open outlet of the flowing hydrant was recorded using a pitot gauge. After obtaining all the readings, the hydrants were closed and the caps were replaced.

The flow from the hydrants was calculated after the field tests were completed. The flow from each outlet was determined based on the pitot gauge reading observed and the diameter of the hydrant outlet. Discharge rates were obtained using the following equation:

$Q = 29.83 * C * d^2 * P^{0.5}$ = flow in gpm
C = discharge coefficient for the outlet*
D = diameter of outlet in inches
P = pitot pressure in psi

*A coefficient "C" of 0.90 for the 2.5-inch outlet and 0.75 for a 4.5-inch outlet, which assumes a full and relatively smooth flow from the hydrant outlet, is typical for most standard utility hydrants.

The model was calibrated by modifying the roughness coefficients of pipes, or C-factors, within the distribution system based on size, location, and age. As a starting point, C-factors from the previously calibrated water model were used and then modified based on the age of the water main and the results of these flow tests.

Real-time operating data taken from the Village's supervisory control and data acquisition (SCADA) system were obtained during each field flow test and were used to set high lift pumping rates and the elevated tank level in the model. The model was then used to simulate the flow tests under the observed conditions. Table 3.02-1 shows the flows and pressures measured in the field compared to the model-simulated pressures at the testing locations in the distribution system under both static and residual flow conditions. The data indicates the model is calibrated.

Table 3.02-1 Model Calibration Results

Test Number	Flowing Hydrant Location	Field Static Pressure (psi)	Modeled Static Pressure (psi)	Field Residual Pressure (psi)	Modeled Residual Pressure (psi)	Field Measured Fire Flow (gpm)
1	Skokie Boulevard	65	63.3	51	49.8	1,138
2	Beach Road	51	49.8	43	44.5	937
3	Longwood Avenue	56	55.8	27	29.0	653
4	Old Green Bay Road	47	46.7	39	40.4	1,130
5	Sheridan Road	53	52.9	33	40.9	816
6	Drexel Avenue	62	63.3	40	48.9	832
7	Washington Avenue	54	50.0	42	27.2	1,345
8	Lincoln Avenue	64	59.4	50	51.4	908
9	Forestway Drive	62	61.1	53	55.8	979
10	Orchard Lane	61	59.2	52	51.6	878
11	Forest Avenue	52	49.9	34	32.2	730

Extensive efforts were made to bring all differences between the model-simulated and field-collected pressures to within 5 psi. All simulated tests met this standard with the exception of the residual pressure results for Test Numbers 5, 6, and 7. The discrepancies in these tests may be attributed to the following potential factors.

1. The information on the system map may not be accurate, leading to inaccurate pipe diameter, age, or connectivity data in the model.

2. Valves known to be closed at the time of flow testing were incorporated into the model. No additional valves encountered during the field testing were found to be closed. Many water systems contain a few "left-handed" valves that open and close in the opposite direction as is now standard. Therefore, other valves may be unknowingly closed within the distribution system.

However, examination of the magnitude and location of the calibration anomalies indicated that additional calibration effort was not warranted. Because these tests were located along small-diameter mains, within residential neighborhoods and away from transmission mains, the benefit of additional calibration is thought to be minimal.

3.03 MODEL ANALYSIS

A. Model Conditions

The model was analyzed under various demand and flow conditions. Two general types of steady-state simulations were performed with the model, domestic (nonfire) and fire flow.

A steady-state simulation evaluates the operating behavior of the system at a specific point in time under steady-state (unchanging) conditions. Using this type of analysis, the behavior of pump, tank, and supply/storage relationships can be determined. It can be useful for determining pressures and flow rates within the distribution main supporting fire hydrants under various demand conditions. The contour mapping represents available flow to the hydrants, which is controlled by the number and size of nozzle connections.

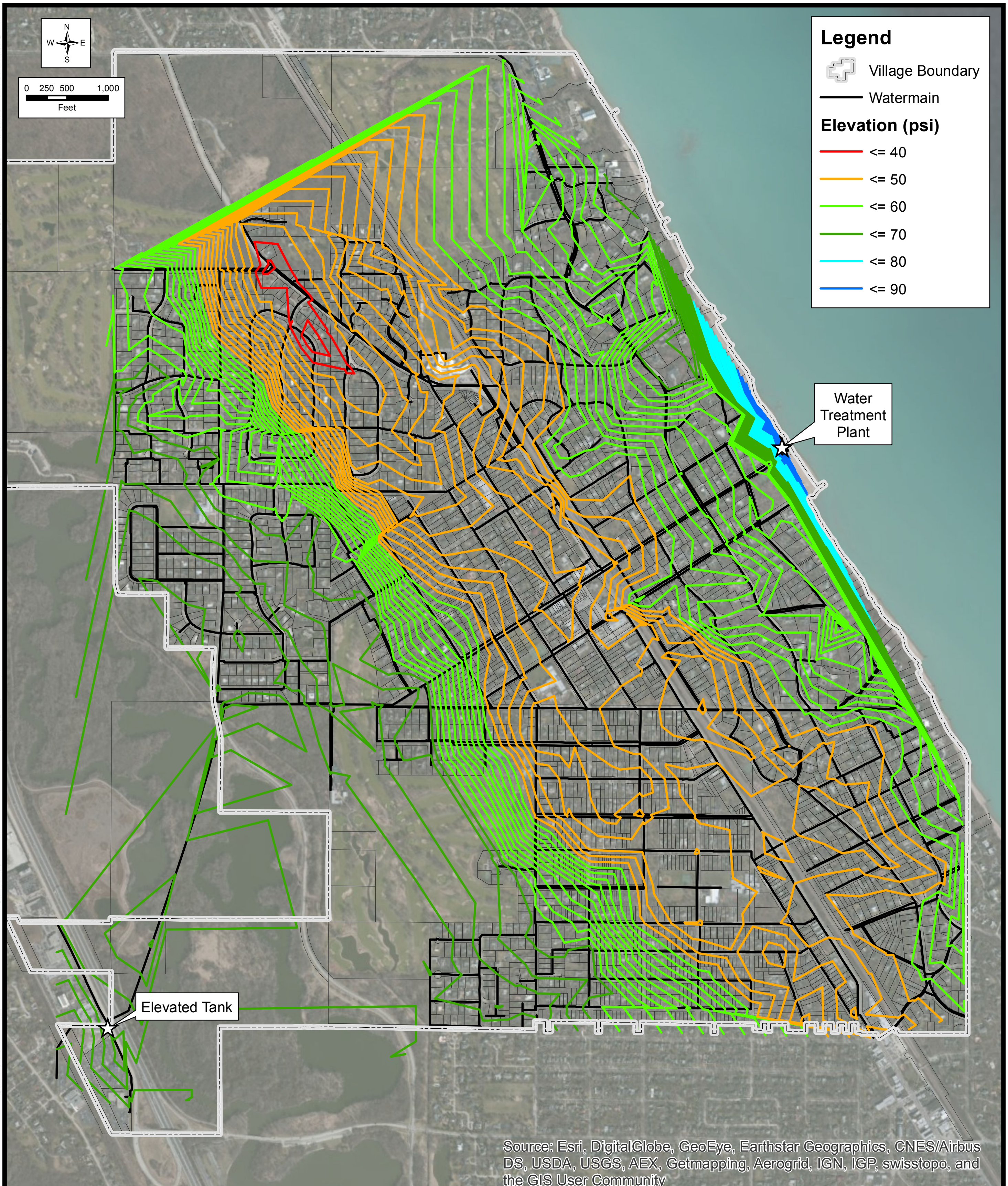
A fire flow simulation provides an instantaneous snapshot of the amount of water available at points within the system while still maintaining a minimum 20 psi residual pressure. The model simulates a separate fire event at each junction in the system and increases the flow until either the node itself or any point in the system reaches the 20 psi residual pressure threshold. Very high available fire flows (over 5,000 gpm) are not considered realistic but indicate areas of very strong hydraulic connectivity. Available fire flow will be limited by location of the hydrant relative to the model junction, diameter of the hydrant outlet, and type of firefighting equipment used.

B. Maximum Day–Domestic Only (Nonfire)

The maximum day domestic demand condition, equaling 5.42 mgd, was modeled using a steady-state analysis with the WTP supply matching the demand and the elevated tank set to 5 feet below overflow. The average day demand scenario was not modeled because the maximum day demand would provide more conservative results. System operating pressure was modeled to be between approximately 38 and 89 psi, as shown by the pressure contours generated by the model in Figure 3.03-1. This range is above the minimum 35 psi pressure value suggested by Ten States Standards–Recommended Standards for Water Works. The area of lowest pressure, in the northwest part of the Village, appears to be a result of high elevation. The area of highest pressure, although not excessive, occurred adjacent to the WTP along the lakefront and appears to be the result of low elevations.

C. Maximum Day–Domestic and Fire Flow

The model was operated similarly when determining system operating pressures to simulate available fire flows throughout the distribution system. The modeled available fire flow, which was based on a minimum 20 psi residual pressure threshold, ranged from approximately 160 gpm to greater than 5,000 gpm, as shown by the available fire flow contours generated by the model in Figure 3.03-2.

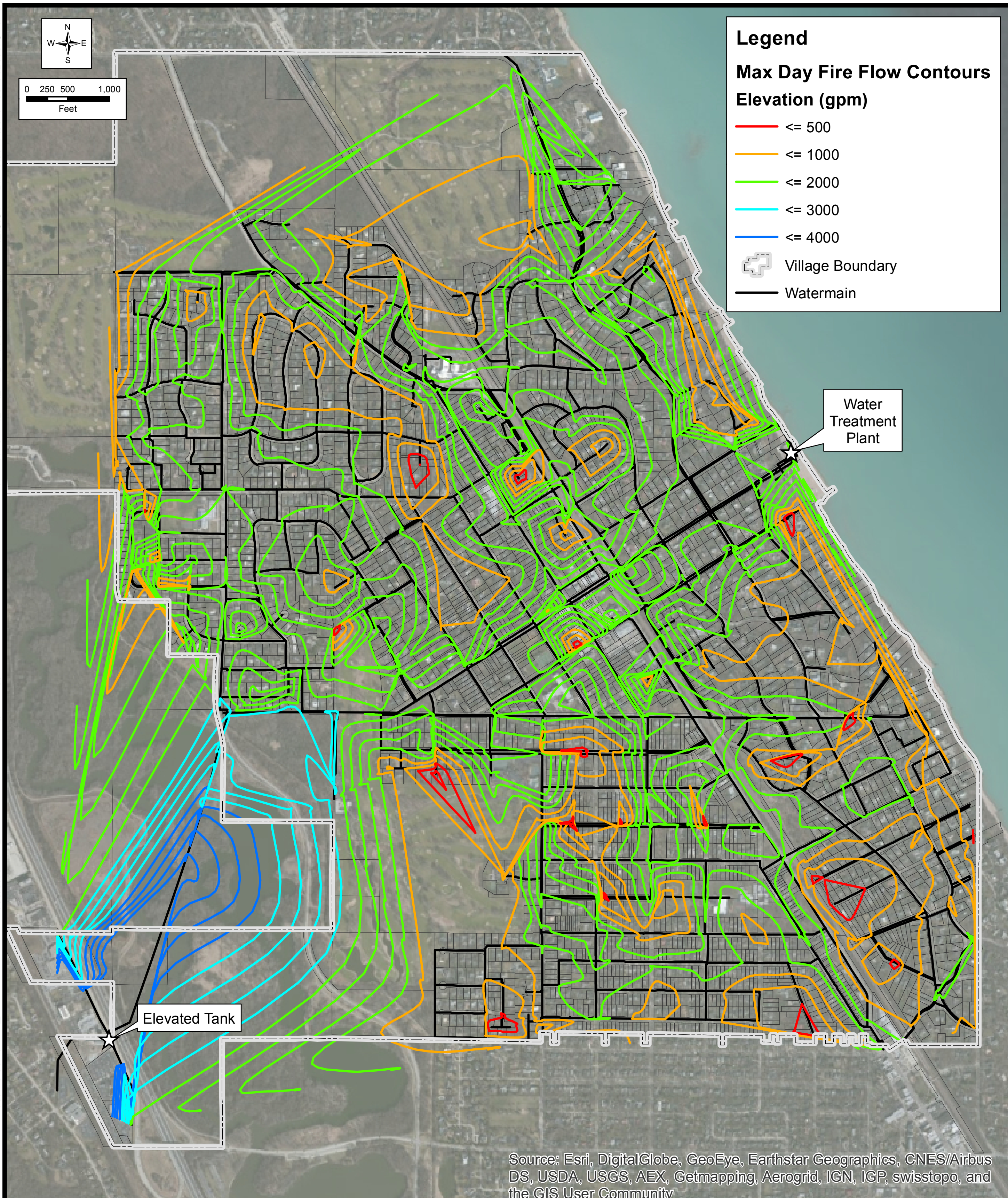


MAXIMUM DAY PRESSURE CONTOURS

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 3.03-1
1410.015



MAXIMUM DAY AVAILABLE FIRE FLOW CONTOURS

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 3.03-2
1410.015

Typically, the available fire flow will be highest near elevated storage, booster stations, and transmission main and in areas of low elevations.

While fire flows below 500 gpm (red areas) are below recommended minimums, they regularly occur at dead-end portions of the distribution system similar to locations shown in Figure 3.03-2. It appears most of the deficient areas are located on dead-end 4- and 6-inch water mains. Lower fire flows in these areas suggest a need to provide additional water main looping in the distribution system, larger replacement distribution mains (minimum 8-inch-diameter pipe), or a need to have fire response teams connect to multiple hydrants during an emergency. The Village's Department of Public Safety has an understanding of the available fire flows at most hydrant locations as a result of its own field-testing. It has a color coding system on the hydrant caps that is associated with the available flows from its testing. This should assist them in making informed decisions on which hydrants need to be operated to obtain the desired flows.

SECTION 4
ADDITIONAL REQUIRED CAPACITY

4.01 GENERAL

Days of maximum demand can and do occur on several days in succession, especially during the warm summer months. As a result, water withdrawn from storage during any one maximum day must be replaced before the following day to ensure an adequate supply of water for the next day. Therefore, total demand on the maximum day determines the minimum amount of water that must be available each day. It is recommended the system be designed to meet maximum day domestic demands with the most critical high lift pump out of service. The total amount of water that can be pumped with the largest high lift pump out of service is referred to as the firm high lift capacity. If the firm high lift capacity is less than the maximum day demand, system storage will be depleted and an inadequate amount of water may exist for the following day. Alternatively, if the firm capacity meets or exceeds the total demands, all storage facilities may be refilled during any 24-hour period and water will be available to meet the following potential maximum day demand.

If the system's firm capacity just equals the maximum day domestic demand, the amount of storage required would be equal to fire requirements plus peak domestic storage demands and operational buffer. Water withdrawn from storage facilities to meet fire demand need not be replaced the same day or the day following the fire. However, it is advisable to replenish the fire storage as soon as possible.

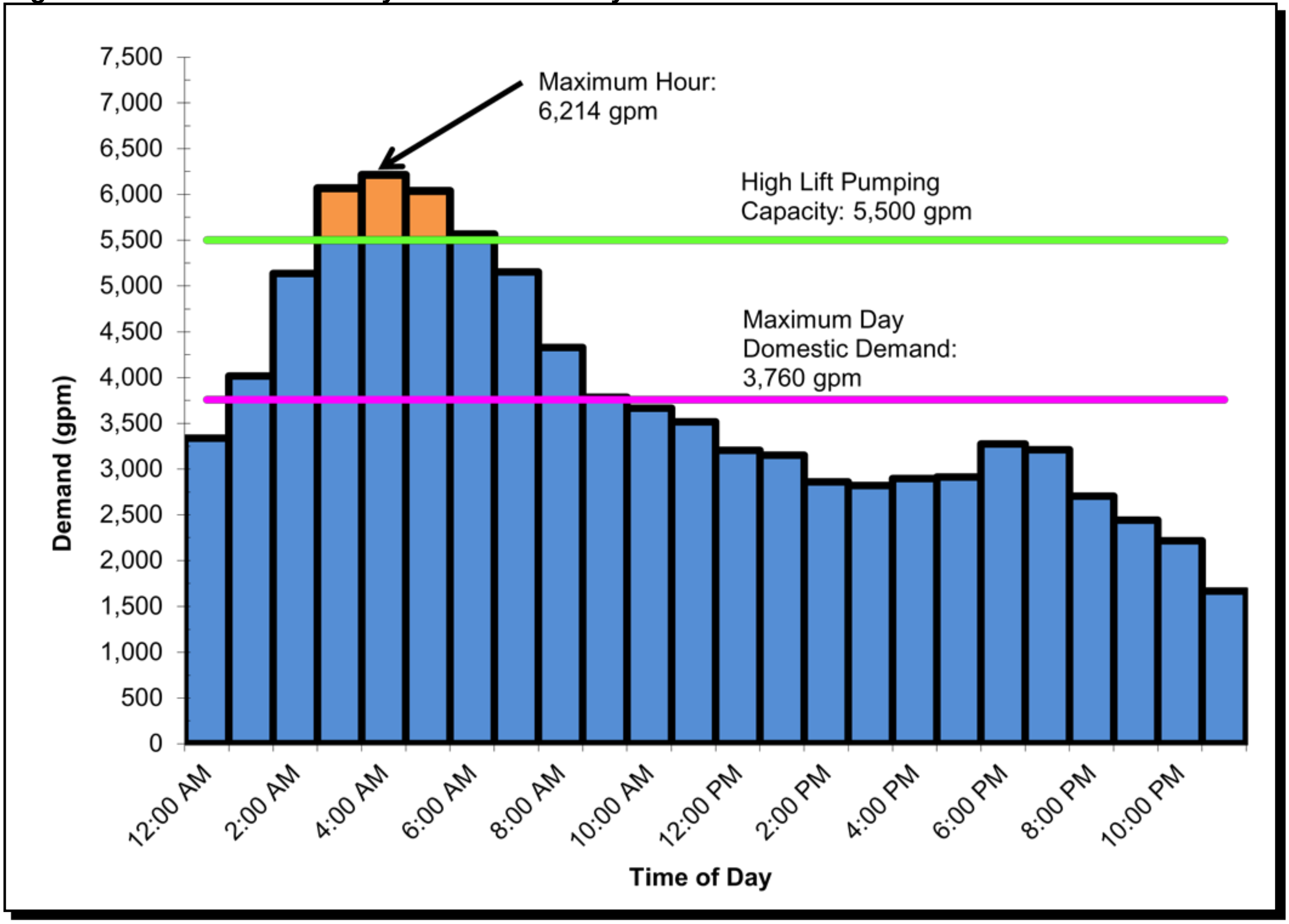
A. Capacity Evaluation

1. Maximum Day–Domestic Only (Nonfire)

The total domestic demand for the current maximum day is estimated to be 5.42 mgd or 3,760 gpm. The existing firm high lift pumping capacity, with High Lift Pump No. 4 out of service, is approximately 7.92 mgd or 5,500 gpm. The Village has a surplus pumping capacity of 1,740 gpm, so no additional high lift pumping capacity is required at this time.

Figure 4.01-1 presents a graph of the projected hourly demands for the current design year maximum day. Hourly peaking factors were obtained from tank level and high lift pump flow data obtained from the Village's SCADA system. For this analysis, it was assumed the high lift pumping capacity equaled the current maximum day domestic demand of 3,760 gpm to evaluate the Village's storage capacity. The maximum hourly demand is projected to be 6,214 gpm, which correlates with the start times (3 A.M. to 5 A.M.) for residential irrigation systems within the Village.

Figure 4.01-1 Maximum Day Domestic Hourly Demand



Because there are periods of time when the projected hourly demand is greater than the supply, as indicated in the areas above the WTP high lift pumping capacity line, storage must be used to satisfy water demands. Based on hour-by-hour calculations of usage, beyond approximately 113,000 gallons of water are required from elevated storage to meet projected peak domestic hourly demands. Typically, 10 percent of the elevated storage, or 50,000 gallons, is needed for operational fluctuations. Therefore, the total required elevated storage to meet current maximum day domestic demands plus other operational needs is 163,000 gallons. The 0.50 MG elevated tank has sufficient capacity to meet the total distribution storage needs.

2. Maximum Day–Domestic and Fire Flow

The total amount of water available to satisfy the maximum day domestic plus fire flow demand is equal to the WTP firm high lift pumping capacity plus the water available from usable system storage.

The Insurance Services Office (ISO) typically recommends basic fire flow requirements based on the amount of water a municipality should be able to supply. The required fire flow for individual buildings can range from a minimum of 500 gpm for 2 hours for residential districts to a maximum of 12,000 gpm for 4 hours for large industrial complexes. The maximum basic fire flow requirement for a community is 3,500 gpm for a duration of 3 hours. After discussions with the Village and its Public Safety Department, a fire flow of 1,500 gpm for 2 hours was selected by the Village as the target minimum requirement. This is a relatively low system-wide fire flow requirement, however, it is reasonable given the residential and commercial development within the Village.

The flow available from storage is equal to the volume remaining after accounting for peak hourly demands and normal water level fluctuations. The volume needed for these daily water level fluctuations is estimated to be 163,000 gallons. It is assumed this storage is removed from elevated storage, leaving 337,000 gallons.

Although the firm high lift pumping capacity is 5,500 gpm, the proposed treatment capacity of the WTP is only 7.3 mgd, or 5,069 gpm. The difference in flow of 431 gpm must be taken from the existing 2.0 MG reservoir. The flow difference over 2 hours is equal to a volume of approximately 52,000 gallons. Therefore, water can be withdrawn from the reservoir without it being drained during a 2-hour fire demand on a maximum day.

A demand rate of 5,260 gpm (3,760 gpm domestic demand plus 1,500 gpm fire demand) for 2 hours must be satisfied to provide the targeted minimum fire protection. Because a fire can start at any time during the day, domestic use must be taken into account when calculating available capacity.

Maximum Day Demand	- 3,760 gpm
Fire Demand	- 1,500 gpm
WTP Production Rate (6.0 mgd)	+ 5,069 gpm
2.0 MG Reservoir Contribution	+ 431 gpm
0.5 MG Elevated Tank Contribution*	+ 2,808 gpm
Total (Reserve)	+ 3,048 gpm

*Storage capacity = 337,000 gallons/120 minutes

During a 120-minute fire event, the system is projected to have a storage capacity reserve of approximately 365,000 gallons (3,048 gpm x 120 minutes = 365,000 gallons).

4.02 SUMMARY

The Village maintains reserve storage capacity using its existing storage facilities and WTP high lift pumps to meet maximum day demands and fire flow conditions.

SECTION 5
FUTURE WATER SUPPLY ALTERNATIVES ANALYSIS

5.01 INTRODUCTION

The Village commissioned this report to evaluate conceptual options toward the future supply of drinking water to its customers. The conceptual ideas provided in the report are based on visual observation of the existing water system components, meetings with neighboring community water supply leaders, including those from Northbrook, Winnetka, and Highland Park, and input from the Village staff.

As result of water supply alternatives, this report will focus on four main groups of alternatives based on:

1. Purchase of drinking water from a neighboring community in Section 5.02.
2. Rehabilitation of the existing WTP in Section 5.03.
3. Construction of a New WTP at the lakefront in Section 5.04.B.
4. Construction of a New WTP at an inland location in Section 5.04.C.

As part of each water supply alternative, a total opinion of probable construction cost (OPCC) was developed. The OPCC is based on 2nd quarter 2015 pricing. Included with the probable cost for treatment equipment, materials, and facility construction are general conditions, contingency, and technical services. The general conditions include contractor bonding, insurance, mobilization/demobilization, and general project requirements. The technical services include engineering services, legal services, project financing and administration fees, and related professional services associated with the project. OPCCs for improvements that are broken out individually do not include general conditions or contingencies, unless otherwise noted. As design and construction progresses, the Village should seek to update OPCCs as conditions fluctuate.

Where the purchase of neighboring water supply is contemplated, the purchase cost of water is estimated to be $2.15 per 100 cubic feet, or $2.87 per 1,000 gallons at a yearly average flow of 1.97 mgd. Although this is slightly higher than the rate of $1.827, which some Highland Park wholesale customers pay, this is the nonresident rate from the City’s ordinance, which will be used in case similar arrangements could not be made. Each alternative presented in this report is based on water system needs and regulatory requirements for water supply. For all WTP facility locations, additional geotechnical engineer exploration and design based on the acquired property to confirm layout and structural foundation designs are needed. As a result, a more detailed preliminary engineering report should be completed before proceeding with the final design of the selected alternative.

5.02 PURCHASE OF WATER FROM NEIGHBORING COMMUNITY

The Village is bounded by three communities, the City of Highland Park to the north, the Village of Northbrook to the west, and the Village of Winnetka to the south. As part of the supply alternative selection process, purchase of water from these communities was analyzed.

When purchasing water from outside communities, it is generally understood that the relatively long supply lines (as compared to producing with water in the Village) and lack of local control of supply may result in reduced supply reliability. As a result, many communities that purchase water choose to construct additional storage to improve local supply in case a problem occurs along the lengthened line of supply. This is often obtained by maintaining approximately two average days of local water storage. The Village's average day domestic demand has been reported to be approximately 1.97 MG. Therefore, the total needed storage volume under purchased supply conditions should be approximately 4.0 MG.

Currently, the Village has a 0.5 MG elevated tank and a 2.0 MG ground storage facility, for a total of 2.5 MG available storage, which is inadequate to meet the two average day recommendation. To provide adequate reserve storage and operationally match the existing 2.0 MG ground storage facility, this report will utilize an additional 2.0 MG ground storage facility and associated 2 mgd pumping station for all purchased water alternatives.

A. Northbrook

Northbrook is not a viable alternative as a source of purchased water for the Village.

Although the Village currently maintains an interconnection with Northbrook near the existing elevated tank, there are significant environmental issues and long-term reliability issues associated with the area between the tank and the distribution system and water main hydraulic capacity issues associated with purchasing water at this site. Because of these difficulties, purchasing significant volumes of water long term from Northbrook at the point of the existing interconnect would be impractical compared to other options.

A second possible location for consideration of purchased water from Northbrook is near the Village boundary on Dundee Road. The OPCC for Glencoe's portion to construct the necessary interconnection and transmission main improvements to supply 6 mgd was approximately $8,010,000. After discussions with Northbrook, it was determined that it could not provide the maximum day domestic demand without significant treatment plant expansion and its own significant water main infrastructure upgrades to their system.

B. Winnetka

It does not appear that Winnetka has the treatment or hydraulic capacity to permanently supply the Village with water as a single source; however, options exist for Winnetka to supply some of the Village's water needs.

C. Highland Park

Highland Park may be a viable alternative as the source of purchased water for the Village. Highland Park has excess production capacity and maintains a higher hydraulic grade line compared to Glencoe's system under normal operating conditions. Their water tower overflows are about 30 feet higher than the water tower overflow in the Village. The potential ability to supply the Village's additional capacity by gravity into the Village's water system was seen as an advantage to this particular interconnection.

1. Use of the Existing Interconnect

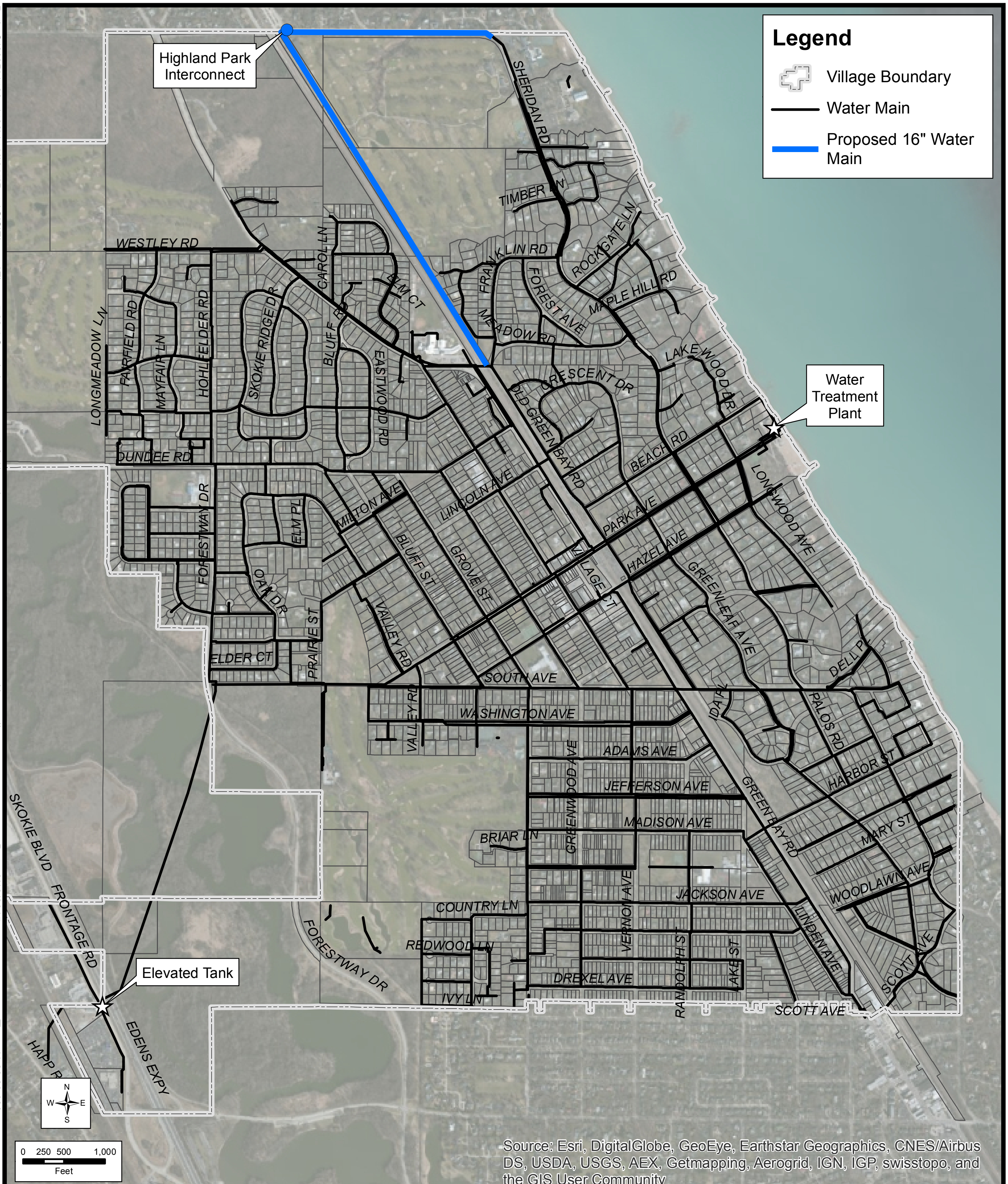
The Village's water distribution system is presently connected to Highland Park's water system at the north end of Sheridan Road. Modeling shows that the hydraulic capacity through this interconnection and area of the Village's distribution system, even with the aid of a pumping station, is relatively low and would not be sufficient to meet the Village's current maximum day demands. Therefore, a new interconnection with transmission main improvements would be necessary to provide a reliable supply of water to the Village.

2. Construction of a New Interconnect

A hydraulic computer model of the Highland Park water system was used to determine how much water it can provide to the Village if connected at the appropriate location with sufficient sized mains. The closest significant transmission main in Highland Park to the Village is a 16-inch main located at the intersection of Lake Cook Road and St. Johns Avenue. To obtain adequate volumes of water it would be necessary to install two connecting mains. The first is a 16-inch transmission main extended 3,250 feet east from this intersection to the Village's existing 12-inch main on Sheridan Road. The second is a separate 16-inch transmission main extended 5,250 feet west and then south along the Green Bay Trail to an existing Village 12-inch main on Green Bay Road. These transmission main upgrades are shown in Figure 5.02-1. Even with these improvements, it was determined that Highland Park was only able to provide 3,000 gpm by gravity while supplying its own maximum day domestic demand. This is not sufficient to meet the Village's current maximum day demands. The modeling effort did show that the Village would be able to operate off Highland Park's water system during a maximum demand day with the help of a booster pump station at the point of connection with Highland Park, which is further discussed after the investigation of other possible gravity fed connections.

3. Highland Park/Winnetka

To supplement the flow that Highland Park is able to provide during a maximum day, the existing interconnect to Winnetka was evaluated to estimate whether enough flow at sufficient pressure could be obtained if both the improved Highland Park connection, previously described, used in conjunction with whatever flow could simultaneously be obtained from Winnetka, is adequate to meet the Village's needs. The model showed that the existing Village distribution system north of the interconnection does not have sufficient hydraulic capacity to convey 1,200 gpm under reasonable operating conditions. To alleviate this local pressure increase, a 12-inch transmission main was simulated 6,200 feet north along the Green Bay Trail to the existing 16-inch transmission main on Hazel Avenue. The same 16-inch main upgrades required for the Highland Park-only supply option are also needed. The modeling effort, with the recommended transmission main improvements, predicted that Winnetka would have to supply water at approximately 47 psi at a flow of 1,200 gpm to meet the Village's needs. The proposed transmission main upgrades are shown in Figure 5.02-2. For this option to work, further testing would need to be completed to verify whether Winnetka can provide the necessary flow and pressure at the interconnect point.



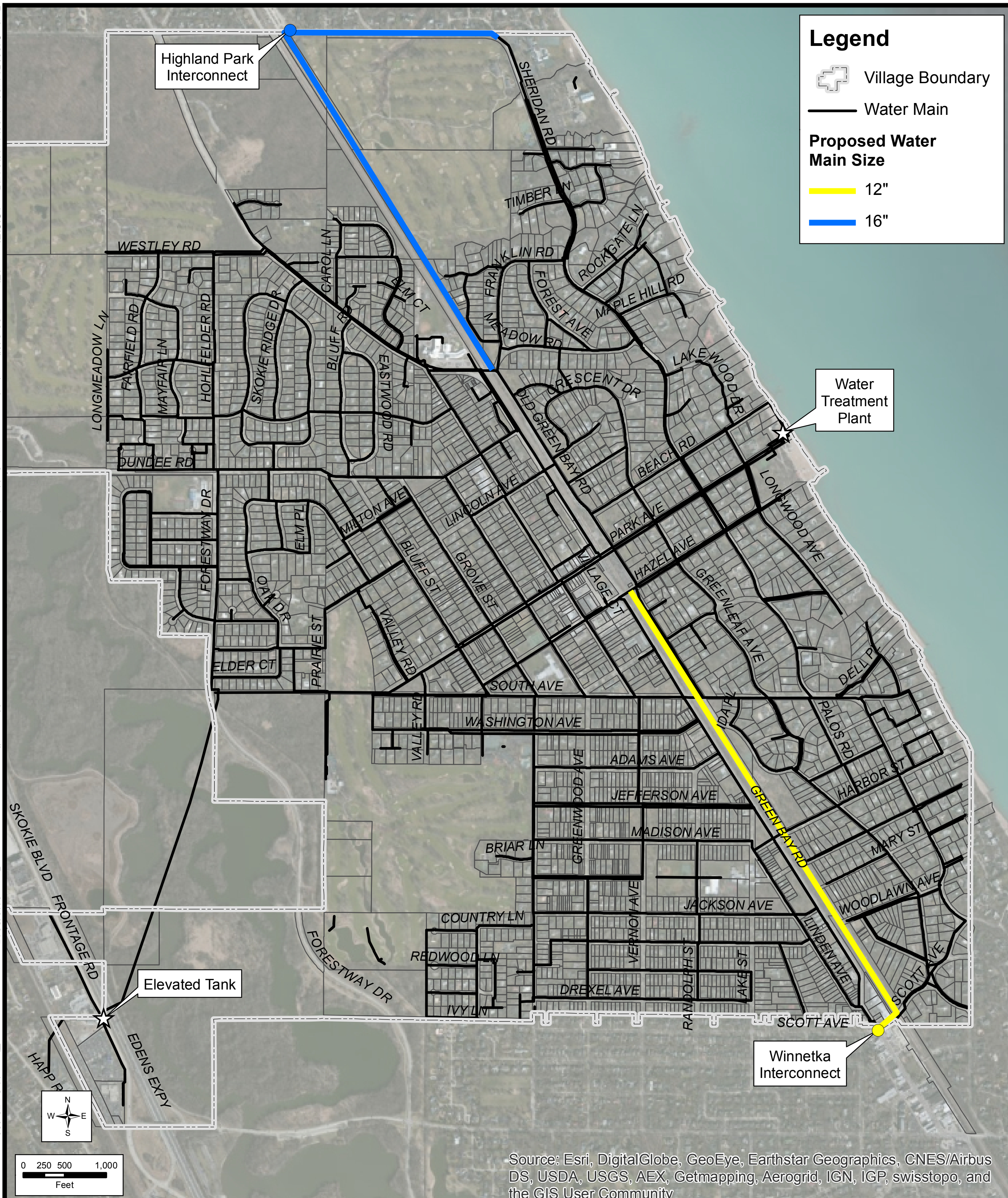
HIGHLAND PARK SUPPLY IMPROVEMENTS

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 5.02-1
1410.015

Path: S:\MAD\1400--1499\1410\015\Data\GIS\Figures\Figure 5.02-1 Supply Improvements 8x11.mxd User: mikea Date: 3/13/2015 Time: 11:20:23 AM



Path: S:\MAD\1400--1499\1410\015\Data\GIS\Figures\Figure 5.02-2 Winnetka Improvements 8x11.mxd
User: mikea
Date: 3/13/2015
Time: 11:24:50 AM

HIGHLAND PARK/WINNETKA SUPPLY IMPROVEMENTS

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 5.02-2
1410.015

4. Pumped Supply from Highland Park

Although Highland Park was not able to provide the Village sufficient water during the maximum day without the addition of a booster pump station, computer modeling indicates that Highland Park would be able to adequately supply the Village if a new booster station and reservoir are constructed near the interconnect point. A specific booster pump location was not evaluated for the purposes of this study, but it would likely need to be located somewhere along the Lake-Cook Road Corridor. The new booster station would be sized to meet the maximum day domestic demand, or approximately 6.0 mgd. The same 16-inch transmission main upgrades would be required for this option as described in the Highland Park-only gravity supply option above.

Assuming the existing 2.0 MG reservoir near the WTP were to have a new 2.0 mgd booster station add to that facility and assuming the Village should have two average days' worth of storage capacity, a new reservoir should be sized for 2.0 MG with an associated pumping station capable of 2.0 mgd. This new reservoir and booster station could be located at many different locations throughout the Village, which could be determined during a preliminary design phase.

The upgrades for the pumped supply from Highland Park option are shown in Figure 5.02-3.

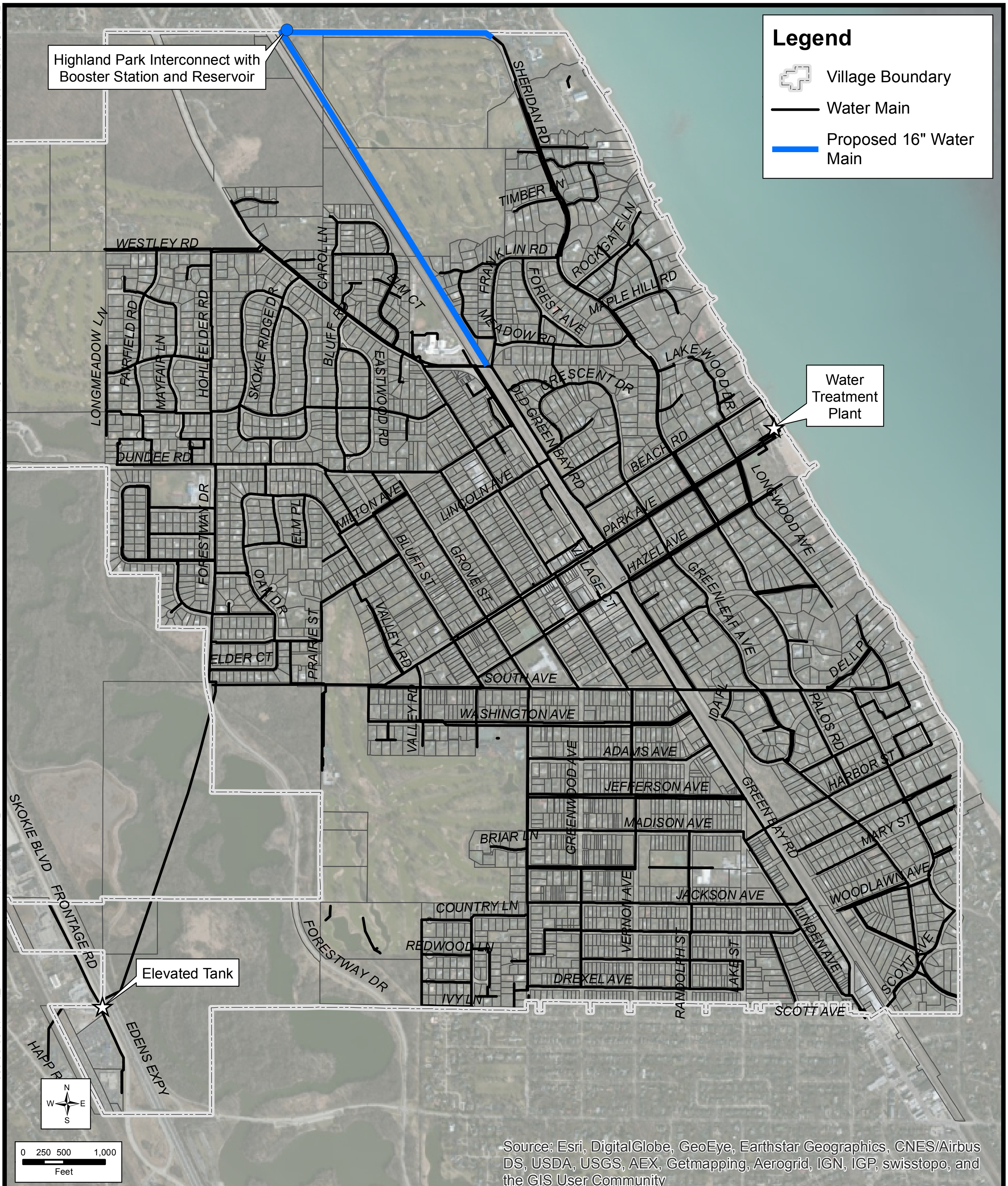
D. Summary of Interconnection Options

For the purposes of this study, the Highland Park Pumped Supply option and probable costs will be presented. In evaluating the Highland Park-Winnetka interconnect option, the OPCC for this combination of transmission main improvements was directly comparable to the Highland Park Pumped Supply Option OPCC. As mentioned earlier in this section, the sole Northbrook and Winnetka interconnect options were not evaluated further.

The OPCC for the 16-inch transmission main upgrades and a new 6.0 mgd booster station at the Highland Park interconnect is $5,535,000. The OPCC for a new 2.0 mgd booster station over the existing reservoir is $2,025,000. The OPCC for a new 2.0 mgd booster station and new 2.0 MG reservoir is $3,645,000. These OPCCs, which include general conditions (8 percent) and contingency and professional services, are summarized in Table 5.02-1. The OPCC will be adjusted within the summary of probable costs presented in Section 5.05 to include the cost of purchase water depending on proposed needs within the distribution system.

Table 5.02-2 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Path: S:\MAD\1400--1499\1410\015\Data\GIS\Figures\Figure 5.02-3 Booster Station 8x11.mxd User: mikea Date: 3/13/2015 Time: 11:29:06 AM



BOOSTED HIGHLAND PARK SUPPLY IMPROVEMENTS

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 5.02-3
1410.015

Table 5.02-1 Highland Park Pumped Supply Option OPCC

Description	OPCC
6 mgd Booster Station and 16-inch Transmission Main	$4,100,000
2 mgd Booster Station at Existing Reservoir	$1,500,000
2 MG Reservoir and 2 mgd Booster Station	$2,700,000
Subtotal	**$8,300,000**
WTP Demolition	$351,000
General Conditions (8 percent)	$28,000
Construction Probable Cost	**$379,000**
Construction Probable Cost Subtotal	$8,679,000
Professional Services and Contingency (35 percent)	**$3,038,000**
Total Construction Probable Cost *	**$11,717,000**

* Does not include land acquisition costs

Table 5.02-2 Advantages and Project Challenges Associated with Highland Park Pumped Supply

Advantages	Project Challenges
Existing plant operational during construction.	Loss of control of water supply.
Out of the water production business.	Loss of control of water rate.
Could reduce water production staff and associated costs.	Increase in rates to pay for purchase of water plus maintain distribution system.
	Added storage required which add operational difficulty.
	Responsibility for providing adequate water quality remains.

5.03 REHABILITATION OF THE EXISTING WATER TREATMENT PLANT

The rehabilitation of the existing WTP to extend its service life was considered through a detailed site visit, review of facility plans and related documents, and discussions with Staff. As the WTP has aged and expanded over the years, this study recognizes that the existing treatment process had some value based on a successful operational history and continued need to produce water for the Village. However, as the various components in the WTP have aged or been updated, rehabilitated, or repaired, the efforts to review and evaluate the existing WTP focused on establishing the scope of improvements necessary to support operations.

The typical useful life of concrete WTP structures is 75 to 100 years, depending on the quality of original construction and site conditions. Glencoe has had portions of its existing WTP constructed in 1928, 1937, 1951, and the early 1990s, each adding onto the original 1928 construction. Rehabilitation of the existing equipment and facility may prolong the operation of the WTP for an additional 15 to 20 years. However, implementation of improvements may prove difficult in portions of the infrastructure that is nearing, or has reached, the end of its useful life.

To provide an additional barrier for *Giardia* and *Cryptosporidium* protection, this rehabilitation alternative project considers the installation of the membrane filtration process following granular filtration. The use of membrane filtration may help the Village meet future regulatory requirements and is considered an “or equal” approach to the direct membrane filtration system.

The following is a discussion of needs discovered during the site visit and recommended for rehabilitation of the existing WTP.

A. Intake

The existing intake structure is in operating condition and has been in service since its design in 1928. The exposed upper portion of the intake structure at the shoreline has experienced significant freeze-thaw damage and is in need of replacement. The interior of the intake structure was not observed as part of this planning effort. The OPCC to repair the existing intake structure opening and cover is $30,000.

Based on recent discussion, a manual screen will be incorporated into the existing intake structure to protect the low lift pumps from sea grass and prevent fish entering the low lift pump suction.

In June 2004, the Village’s vulnerability assessment included a recommendation for a redundant intake pipe to supplement the existing 24-inch pipe. A new intake pipe includes chemical feed piping to inject permanganate for zebra mussel control at the intake crib. The OPCC for a redundant 24-inch intake extended 3,300 feet out into Lake Michigan is $3,326,000.

The total OPCC to rehabilitate the intake facilities is $3,356,000.

B. Rapid Mix

The existing WTP uses an induction-based rapid mix system with the use of aluminum chlorohydrate coagulant. The existing induction-based rapid mix unit has reached the end of its service life. The existing induction mixer would be replaced with a similar-type mixer. In addition, for reliability and system redundancy, there is a need to have a secondary in-line rapid mix unit available for maintenance to the primary mixer. The redundant mixer would be installed in the location of the existing. The OPCC for installation of two new in-line rapid mix units and related appurtenances is $110,000.

C. Flocculation

The existing flocculation basins are sized to treat up to 12 mgd at a minimum retention time of approximately 30 minutes (111,000 gallons each train, two trains total) based on Ten States Standards. An on-site observation was made of the basin with staff present.

The existing flocculation train design is based on a three-stage tapered-energy horizontal paddle system, installed in 1989, that has reached the end of its useful life. In addition, the wood baffling used to form each of the reaction areas is failing and is not designed to efficiently distribute water flow along the length of the flocculation trains.

Within the basin, it was noted that minor concrete repairs are necessary to maintain the existing infrastructure.

The OPCC to replace the flocculation basin equipment and install internal baffling is approximately $185,000.

D. Sedimentation-Clarification

The existing sedimentation basins are sized to treat up to 8 mgd at a minimum retention time of approximately 120 minutes (344,500 gallons each train, two trains total). The sedimentation basins are limiting the production capacity of the WTP based on a minimum two-hour retention time as permitted by the Illinois Environmental Protection Agency (IEPA). Operators are able to regularly inspect the basins and indicated no concerns regarding the existing structure.

The basins were not observed as a part of this planning effort. The basins are maintained at least once a year and washed out. For safety and efficient operation, each basin can be retrofitted with automatic sludge withdrawal equipment. The OPCC for incorporating automated sludge removal equipment into the existing WTP is $245,000.

E. Granular Media Filtration

The existing granular media filtration basins are sized to treat up to 9 mgd at a maximum rate of 4 gallons per minute per square foot (gpm/sf) with one of the largest filters out of service (1,562-square-foot operating area). The filtration process was designed in two steps. Filters 1 through 4 were originally designed in 1928 and Filters 5 and 6 were designed in 1951. Filtration performance, based on historical water quality data, does not indicate a need for the existing filter media to be replaced.

1. Filter Basin Equipment

Filters 1 through 4 were upgraded in 1996 using a concrete false floor and nozzle underdrain system designed for water backwash only. Each filter is equipped with dynamic surface wash arms and equipment, allowing high-rate filtration. The existing filler media is performing with an effluent meter quality of about 0.05 NTU. Media replacement in Filters 1 through 4 is not recommended at this time.

To reduce the amount of backwash water produced by the existing filters, it is possible to incorporate air scour as part of the filtration process. Information for the existing filter underdrain system indicates that the false floor and nozzle system would have to be replaced to incorporate an air scour system. Replacement of the existing underdrain, with air scour capabilities, cannot be accomplished within the existing filtration basins and is not recommended at this time. In light of this, the filtration underdrain manufacturer has recommended the installation of a polyvinyl chloride (PVC) air grid-based system installed above the existing underdrain system in Filters 1 through 4 for incorporating air scour. The OPCC for installation of the PVC air grid scour system is $265,000.

Filters 5 and 6 were upgraded (approximately 1974) using a Leopold ceramic tile underdrain system designed for water backwash only. Each filter is equipped with static surface wash arms and equipment that allow for high-rate filtration. New dynamic surface wash arms are recommended to improve filter backwash performance. The OPCC for incorporating new dynamic surface wash arms is $30,000.

Filters 5 and 6 should be upgraded to replace the existing Leopold underdrain system and incorporate an air scour feature similar to Filters 1 through 4. To perform this upgrade, the existing filter media would need to be removed and replaced with new media. The OPCC for replacing the existing ceramic tile underdrain with a low profile fiberglass reinforced plastic underdrain with media cap, new media, and PVC lateral air scour system is $665,000.

2. Filtration System Valves and Controls

Staff have been in the process of replacing the existing hydraulic-actuated filtration valves with new electric actuators and valves on the 16-inch wash water connection to Filters 1 through 6. The remaining valves and actuators should be replaced with the rehabilitation of the WTP. Table 5.03-1 indicates the OPCC for upgrading the remaining valves is $165,000.

Table 5.03-1 Valves Scheduled for Replacement

Valve Description	Valve Size (inches)	Valve Quantity	Probable Replacement Cost
Filter Nos. 1 through 4			
Influent Valve	10	4	$23,000
Rewash	6	4	$16,000
Waste	16	4	$32.000
Filter Effluent	8	4	$18,000
Surface Wash Valve	4	4	$11,000
Filter Nos. 5 and 6			
Influent Valve	16	2	$16.000
Surface Wash Valve	6	2	$8,000
Drain Valve	20	2	$20.000
Filter Effluent	12	2	$12,000
Rewash	8	2	$9,000
		Total Probable Cost	**$165,000**

In addition to upgrading the filter valves, both sets of filter control panels (installed in 1988) would need to be replaced to work with the new valves. The OPCC for replacement of the existing filter control panels is $110,000.

The total OPCC to rehabilitate the filtration facilities is $1,235,000 (see Table 5.03-2).

Table 5.03-2 Filtration Equipment Rehabilitation Probable Costs

Equipment To Be Rehabilitated	Filter System Rehabilitation Probable Costs
Filter Basin Equipment	
Filter Nos. 1 through 4-Air Scour Equipment	$265,000
Filter Nos. 5 and 6-Surface Wash Equipment	$30,000
Filter Nos. 5 and 6-Underdrains and Air Scour	$665,000
Filter System Valves and Controls	
Valves	$165,000
Control Panels	$110,000
Total Probable Cost	**$1,235,000**

F. Finished Water Basins

The internal portion of the existing clearwells could not be observed during this planning effort.

Isolation of the clearwells using the junction well, located in the 1951 improvements, has been difficult. Sluice gates controlling each half of the filtration system need to be replaced and motorized. The OPCC for replacing the existing sluice gates and incorporating electric actuators is $45,000.

G. Membrane Filtration

Membrane filtration has been previously considered by the Village and this report includes updated information based on improvements made to the technology along with an updated OPCC. The Village identified three areas, referred to as Proposed Area Nos. 1, 2, and 3, to implement membrane filtration within the existing WTP facility.

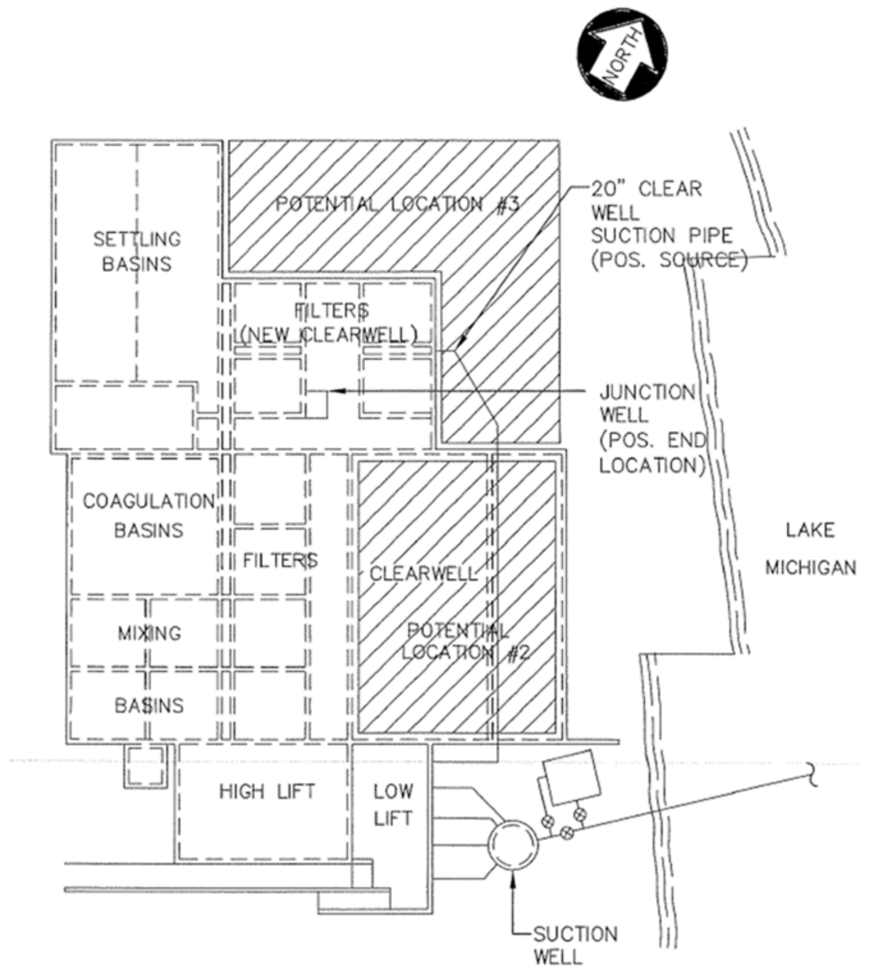
Proposed Area No. 1 represented a membrane system installed in place of the Filter Nos. 5 and 6, which would have required more costly improvements and elimination of the granular filters that could serve as an effective pretreatment step ahead of membrane filtration. Membrane system expansion into this area was not considered further due to the difficulties associated with this option.

It was ultimately determined that a combination of Proposed Area Nos. 2 (3,375 square feet) and 3 (5,660 square feet), shown in Figure 5.03-3, would be necessary to implement a postgranular filtration membrane facility. Instead of installing new membrane technology within the existing infrastructure, it is recommended that membrane filtration be added after the granular filtration process is upgraded to help maintain WTP operations during construction of the proposed improvement. Table 5.03-3 summarizes the OPCC for the Membrane Filtration Facility addition.

Table 5.03-3 Membrane Filtration Facility Addition

Valve Description	Facility Footprint (sq ft)	Total Probable Cost
Membrane Treatment Facility	3,000	$5,255,000
Clean-In-Place Support Facility	580	$145,000
Air Compressor and Blower Facility	580	$145,000
Membrane Backwash Treatment	1,350	$1,475,000
Intermediate Pump Facility	1,200	$750,000
Electrical Room	610	$290,000
Totals	**7,320**	**$8,060,000**

Figure 5.03-3 Membrane Facility Expansion Locations



Source: *Feasibility Study for the Installation of Membranes or UV Disinfection*, CTE-AECOM, November 2006

Membrane filtration, when properly maintained and operated, has been demonstrated by the United States Environmental Protection Agency (USEPA) to provide a higher level of protection from *Giardia* and *Cryptosporidium* compared to conventional granular filters like those used at the WTP. The implementation of membrane technology into the existing WTP would provide similar water quality compared to a new direct membrane filtration WTP, as described later in this report. By installing membrane filtration after the existing granular filtration process, the Village would likely see the benefit of the existing pretreatment processes through reduced operation and maintenance cost compared to a direct membrane filtration facility constructed to treat Lake Michigan. However, overall operation and maintenance cost for the combination of conventional and membrane facility would be higher, on the order of $215,000 per year in addition to the cost to continue to operate a conventional WTP.

H. Pumping Equipment

There are several groups of pumping systems within the WTP including the low lift service pumps, high lift service pumps, backwash supply pump, and sanitary and residuals handling pumps.

The low lift and high service pump sets are each supported by a vacuum priming system. The vacuum priming systems are in good working condition and do not require rehabilitation.

For the low lift service pumps, the existing pumps were rehabilitated around 1990. The low lift pumps are in good working condition and do not require additional rehabilitation.

The large valves, next to the low lift pumps, should be motorized. The OPCC to install electric actuators on the large system valves is $30,000.

For the high service pumps, the 3,150 gpm emergency service high lift pump (1928), with diesel engine drive (1962), needs to be replaced with in-kind equipment. The OPCC for replacement of the pump with diesel engine drive is $80,000.

For the backwash supply pump, the existing pump needs to be replaced. The OPCC for replacing this pump and motor is $37,000.

For the sanitary and residuals handling pump stations with the facility, the existing sludge pump (2002), connected to the sedimentation basin sump, needs to be replaced. The OPCC for replacing this pump system is $37,000.

The total OPCC to rehabilitate the pumping facilities is $184,000 (see Table 5.03-4).

Table 5.03-4 Pumping Equipment Rehabilitation Probable Costs

Equipment To Be Rehabilitated	Pumping System Rehabilitation Probable Costs
Electric Valve Actuators	$30,000
Design Engine Drive	$80,000
Backwash Supply Pump	$37,000
Residuals and Sanitary Pumps	$37,000
Total Probable Cost	**$184,000**

I. Chemical Feed Systems

The existing WTP incorporates the following chemical storage and feed systems:

1. Potassium permanganate
2. Polyaluminum hydroxychloride coagulant
3. Caustic soda
4. Sodium hypochlorite
5. Hydrofluorosilicic acid
6. Phosphate corrosion inhibitor

The chemical feed storage and feed systems, except for the caustic soda storage and feed system, have been in service for at least 20 years and are reaching the end of their useful service life. Consideration was given to replacing the existing chemical storage and feed systems with in-kind systems. For sodium hypochlorite, the future bulk storage tank should be designed to accept a full 4,400-gallon tanker load to reduce the overall cost of the chemical solution.

Table 5.03-5 summarizes the OPCC of $265,000 associated with the recommended rehabilitation of the existing chemical feed systems.

Table 5.03-5 Chemical System Rehabilitation Probable Costs

Chemicals	Equipment To Be Rehabilitated	Chemical System Rehabilitation Probable Costs
Potassium Permanganate	Chemical scale, feed pumps (2), and appurtenances.	$30,000
Polyaluminum Hydroxychloride Coagulant	Bulk tank, transfer pump, day tank, scale, feed pumps (2), and appurtenances.	$105,000
Caustic Soda	No modifications.	$0
Sodium Hypochlorite	Bulk tank and appurtenances.	$50,000
Hydrofluorosilicic Acid	Day tank, scale, feed pumps (2), and appurtenances.	$40,000
Phosphate Corrosion Inhibitor	Day tank, scale, feed pumps (2), and appurtenances.	$40,000
	Total Probable Cost	**$265,000**

J. Building Infrastructure

Both the interior and exterior elements of the WTP were observed. The following are general observations of those elements.

1. Interior

Flocculation Basin: The concrete walls and roof appear to be in good condition with minor spalls and exposed aggregate resulting from the original poor concrete consolidation during placement.

Basement Coagulant Pump Room: Leakage is evident in the framing around the skylight and around the heating, ventilation, and air-conditioning (HVAC) opening in the buried concrete roof slab. Leakage is also evident at wall/roof slab joint between mixing tanks and basement coagulant pump room.

Basement Low Lift Pump Room: Staining on exterior walls and floor slab indicates water infiltration through exterior walls. Electrical boxes are corroding because of water infiltration through the structure and conduit.

Filter Room Walls: The tile walls and concrete floor in the filter room addition are stained from water infiltration through the walls, presumably through the deteriorated stucco and cut stone coping on the exterior wall face.

2. Exterior

Suction Well: The I-beams supporting the 1/2-inch checkered plate cover are severely corroded. The top exposed edges of the suction well concrete walls are spalled. The concrete and cover I-beam support system should be replaced.

Stone Wall Façade: The basement portion of the original 1928 building was constructed with concrete walls and a cut-limestone façade. The low lift pump room walls extend above the roof and provide a parapet wall around a flagstone patio. Numerous cracks were observed in the parapet wall allowing water to infiltrate the mortar joints and concrete wall. Moss is growing in mortar joints, and weeping is evident on the interior low lift pump room walls and floor. The stone walls should be cleaned, tuckpointed, sealed, and capped with stone or precast coping.

Stucco Façade: The upper portion of the original structure and subsequent additions were constructed with an exterior stucco façade over masonry block walls. Numerous cracks and spalled sections are evident in the stucco. Interior walls and floors in the filter addition are stained from water infiltration through the walls. The stucco should be cleaned, repaired, and sealed.

Roofing: The tile roof on the original 1928 building has recently been replaced and is in good condition. The ballasted membrane roof on the 1951 filter addition is in poor condition, including cracked and deteriorated cut stone coping joint caulking and flashing. The adhered membrane roof of the 1951 addition is 20 to 25 years old and is reaching its replacement age. Numerous sections have been patched. The 1951 roof portion is recommended to be replaced.

Flagstone Walking Surface: A flagstone walking surface covers the concrete elevated roof slab of the basement low lift pump room. The flagstone surface is uneven and poorly pitched to the floor drains located along the east parapet wall. The flagstone's numerous joints allow water to infiltrate to the concrete roof slab below. The roof slab is not visible; however, the low lift pump room interior surfaces, conduits, and electrical boxes show evidence of water stains and water infiltration, indicating some degree of cracking exists. Compounding the drainage problem is a roof downspout dumping directly onto the flagstone surface. The flagstone should be removed and replaced with a plaza deck surface.

Doors and Windows: Door frames are corroded or rotting and windows are reported to leak at panes. Moisture condensation on inside panes is causing deterioration of the frames. Doors and windows should be replaced.

Driveway: The asphalt driveway shows signs of rutting and cracking with several patched areas. The driveway should be replaced.

Exterior Stairs: Exterior concrete stairs on the west side of the building are spalled at the edges. Steel railing embedments are corroding causing spalling of the concrete. The stairs and railings should be replaced.
Access Roadway Modification: For construction of improvements, the existing roadway would need to widened to accept deliveries from flat-bed and container style trucks. The probable cost to install retaining walls and additional pavement is approximately $500,000 when included in the work scope of this discussion.

3. Summary

The condition of reinforced concrete elements appears to be good with minor spalled areas. The condition of the original stone walls and areas of the stucco façade are in poor condition, which allows moisture to infiltrate the interior of the building. Left unaddressed, conditions will continue to deteriorate increasing both exterior and interior maintenance costs. The oldest parts of the treatment plant are nearing 90 years old and are reaching their life expectancy. The building has been well-cared for but the age of the structure is evident. Portions of the building additions such as roofing are also approaching their expected life span. Costs for rehabilitation of the existing WTP building are shown in Table 5.03-6. The age of the structure leaves many unknowns that may appear when renovating an old building. Table 5.03-4 itemizes those items that were readily apparent from site observations.

Table 5.03-6 Building Structure Rehabilitation OPCC

Description	OPCC
Interior	
Demolition	$15,000
Concrete Walls	$16,000
Elevated Roof Slabs	$15,000
Exterior	
Concrete repairs	$10,000
Stone Walls Cleaning	$15,000
Stone Walls Tuckpointing	$65,000
Stone Walls Sealing	$20,000
Stone Walls Precast Coping	$15,000
Stucco Cleaning	$15,000
Stucco Repairs	$10,000
Stucco Sealing	$22,000
Roofing	$75,000
Plaza Decking	$25,000
Door Replacement	$15,000
Window Replacement	$60,000
Asphaltic Driveway	$27,000
Concrete Sidewalk	$5,000
Seeding/Sod	$5,000
WTP Access Improvements	$500,000
Total Construction Probable Cost	**$930,000**

K. Ancillary Facilities

The ancillary facilities associated with the WTP include the electrical system and controls, building HVAC, and miscellaneous items such as painting, building and facility access, and lighting.

1. Electrical System and Controls

During our site visit, staff pointed out areas of the electrical system where deterioration of the facility has led to water leaking into the existing conduit and electrical boxes within the WTP. The WTP is fed by a single 480 VAC, three-phase, 600 Amp feed from the Com Ed’s distribution system. While most of the WTP is operational through the existing manual and SCADA controls, these electrical systems and controls have been in service for at least 20 years, well beyond their useful service life, and are in need of replacement.

The facility does have standby power generation and operators regularly operate the existing generator under load conditions. No issues were noted with the existing generator.

The OPCC to renovate the existing motor control center and install miscellaneous electrical items (conduits, wires, and junction boxes) and a new SCADA system is $720,000.

2. HVAC

The existing HVAC system within the WTP consists of a central dehumidification system within the process areas, gas unit heaters in the lower levels, electric unit heaters in the upper levels, and unit air conditioning within office spaces of the WTP. There are no ventilation systems associated with the chemical feed equipment.

Staff indicated that the HVAC systems within the facility are in need of replacement. The OPCC to replace all HVAC-related systems and install additional ventilation systems for the existing chemical feed systems to meet current code requirements is $510,000.

3. Miscellaneous

Ladders within the WTP including those within treatment basins, clearwells, and tanks are in need of replacement to meet Occupational and Safety Health Administration requirements. There are also areas within the WTP where guardrails are necessary to meet current safety requirements. The OPCC to replace existing ladders and install guardrail is $90,000.

The existing air compressor is in need of replacement. The OPCC to replace the air compressor with a new system is $20,000.

Painting of the existing piping is proposed in areas where the existing coatings have been worn or would be affected by rehabilitation. The OPCC to provide coatings within the WTP is $43,000.

The total OPCC to install ancillary facility improvements is $1,383,000 (see Table 5.03-7).

Table 5.03-7 Ancillary Facilities Rehabilitation Probable Costs

Equipment To Be Rehabilitated	Ancillary Facilities Rehabilitation Probable Costs
Electrical System and Controls	$720,000
HVAC	$510,000
Miscellaneous	
Ladders	$90,000
Air Compressors	$20,000
Painting	$43,000
Total Probable Cost	**$1,383,000**

L. Security Upgrades

The Vulnerability Assessment for the Village, prepared in 2002, established several recommended security upgrades to the site. These improvements are intended to "harden" the facility and reduce its vulnerability to malicious attacks. Several of the measures were implemented, but the technology used is now outdated and in need of replacement. Other measures have yet to be implemented and should be if the plant is rehabilitated. The OPCC for the security upgrades is $250,000.

M. Interconnection Supply

Given the potential for water outages during construction, the construction of the Highland Park interconnection improvements discussed in Section 5.02 ($4,100,000) and a 2-MG booster station on the existing reservoir ($1,500,000) will be necessary to support the distribution system. The probable cost for the interconnection, booster pumps, and transmission main is approximately $5,600,000. The Highland Park interconnection would be necessary for at least 4 months, and may be required for longer periods of time depending on the complexity of construction and shut downs required during construction.

N. WTP Rehabilitation Project OPCC Summary

Table 5.03-8 details an OPCC for rehabilitation of the Village's existing WTP based on an overview of the existing facilities.

Table 5.03-8 Rehabilitated WTP OPCC

Description	OPCC
6 mgd Intake Facility	
Repair Existing Intake	$30,000
Intake Piping (24-inch)	$3,326,000
Subtotal	$3,356,000
General Conditions (8 percent)	$269,000
Construction Probable Cost	**$3,625,000**
Rehabilitate WTP	
Rapid Mix	$110,000
Flocculation	$185,000
Sedimentation-Clarification	$245,000
Granular Media Filtration	$1,235,000
Finished Water Basins	$45,000
Membrane Filtration	$8,060,000
Pumping Equipment	$184,000
Chemical Feed Systems	$265,000
Building Infrastructure	$930,000
Ancillary Facilities	$1,383,000
Security Upgrades	$250,000
Subtotal	$12,892,000
General Conditions (8 percent)	$1,032,000
Construction Probable Cost	**$13,924,000**
Highland Park Water Supply and Booster Stations	
6 mgd Booster Station and 16-inch Transmission Main	$3,797,000
2 mgd Booster Station	$1,389,000
Subtotal	$5,186,000
General Conditions (8 percent)	$414,000
Construction Probable Cost	**$5,600,000**
Construction Probable Cost Subtotal	$23,150,000
Professional Services and Contingency (35 percent)	**$8,103,000**
Total Construction Probable Cost	**$31,253,000**

Note: Does not include cost to purchase water during construction, as this amount will vary based on plant location.

Table 5.03-9 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Table 5.03-9 Advantages and Project Challenges Associated with WTP Rehabilitation

Advantages	Project Challenges
Lower initial cost of construction.	Higher long-term operating and maintenance costs.
Existing WTP remains in operation.	Requires expansion on existing site.
Construction impact minimized.	Space limitations of existing site impact treatment process upgrades.
Village owns property.	Short-term temporary connections with neighboring communities required.
Minimal change to existing building exterior/appearance.	Restricted access to boater beach via west side of WTP due to the need for enhanced security.
	Water Plant access ramp would require modification for construction.
	Challenges with perimeter security.
	Many items near the end of their useful life would remain in service.

5.04 CONSTRUCTION OF A NEW WTP

Based on the anticipated future demands discussed in Section 2, a new 6 mgd WTP was evaluated as a replacement to the existing WTP. There are two major facets of a new WTP that were evaluated as part of this study; the treatment process to be used, and the location for the new WTP. This section will first discuss two of the most common Lake Michigan water treatment processes and develop OPCCs. Then one of the processes will be selected to analyze new lakefront WTP options and new inland WTP options.

A. Treatment Process Analysis

From a treatment perspective, both conventional water treatment and direct membrane filtration were considered for the purpose of this report when evaluating construction of a new WTP. This part of the report will develop the details and OPCCs for conventional treatment and direct membrane filtration.

1. Conventional Filtration Facility

For a comparison with direct membrane filtration, a conventional WTP option was developed based on treatment similar to the existing WTP and applicable design standards. A conventional WTP, using Ten States Standards for design guidelines, would maintain the current level of water quality and quantity for the Village.

There are several key unit processes that are included with the conceptual conventional treatment plan compared to the rehabilitation option that help describe the conventional WTP design:

a. The use of a new 6-mgd intake wetwell.

b. The use of a flow splitting and rapid mix chambers for accurate metering of coagulant ahead of flocculation and clarification.

c. The use of a minimum 20-minute retention time basin for flocculation purposes.

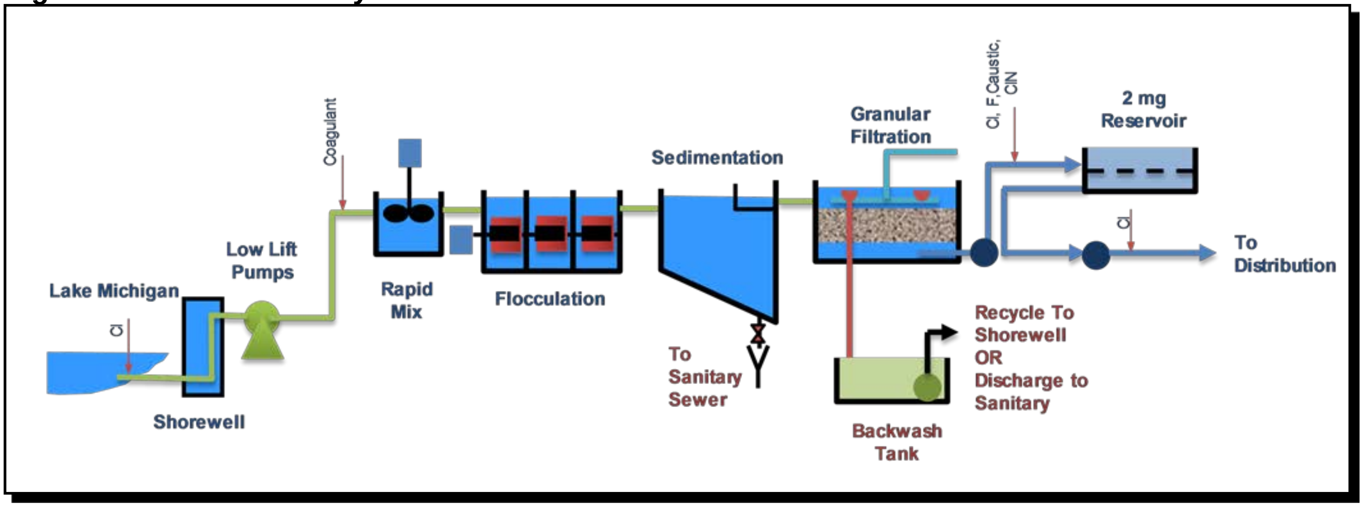
d. The use of a 2-hour retention time clarification basin with tube settlers to effectively minimize the volume of clarification required ahead of filtration

e. The use of rapid rate sand filters with a N-1 basin design to allow for 6-mgd production when backwashing one filter.

f. The ability to include membrane filtration or UV disinfection as a postfiltration treatment method should regulations change in the future.

Figure 5.04-1 graphically displays the overall process schematic considered.

Figure 5.04-1 Preliminary New WTP Process Schematic–Conventional Filtration



The proposed conventional WTP relies on phased construction of a new intake and shorewell, transmission main, and new WTP, allowing construction to occur over a two- to three-year time frame.

Chemical treatment of the source water would be necessary within the overall conventional water treatment process. The process schematic shows the injection location of coagulant (aluminum- or ferric-based), sodium hypochlorite (NaClO) for zebra mussel control and disinfection, fluoride (F) for dental health, corrosion inhibitor (CIN) for corrosion control, and caustic (Caustic) for pH adjustment.

Similar to the direct membrane filtration option, a new 3,300-foot-long 24-inch intake pipe would be constructed out into Lake Michigan to replace the existing intake. Minor piping modifications on shore would allow an interconnection with the existing 24-inch intake pipe to maintain redundancy.

At the new intake wet well, a traveling screen would be used to keep fish and large debris from entering the low lift pump suction. A 500-micron prescreen is not necessary for the conventional WTP process as it would be for direct membrane filtration.

Following the low lift pump station, a flow splitter box would allow operators to balance flow into two independent rapid mix, flocculation, and sedimentation treatment trains for effective treatment and to allow for biannual maintenance of the basins. The sedimentation basins are sized to allow over-under flow to take advantage of the limited site.

After clarification, four rapid rate filter basins (4 gpm/sf rating) permit a maximum production capacity of 8-mgd, allowing one basin to be out of service or in backwash to produce a firm capacity of 6-mgd. The filters are planned with surface wash arms and air scour to obtain the highest surface loading rate and maintain long-term filter operations. The multimedia filters are designed to incorporate approximately 30 inches of filter media using a combination of sand and anthracite materials. Under the granular media filters, a clearwell has been planned to provide disinfection time and allow adequate pump suction for the backwash and high service pumps to work with the 2 MG reservoir.

A backwash collection system is included within the proposed schematic. The anticipated backwash volume from the proposed filtration system would be approximately 180,000 to 300,000 gpd at capacity. On a scheduled basis, it would be possible to remove sludge solids, to be tested by operators prior to discharge, from the bottom of the backwash collection reservoir for discharge to MWRDGC. It is anticipated the backwash sludge waste would be in the range of approximately 36,000 to 72,000 gpd, within the capacity of the existing sanitary system (120,000 gpd). As part of the USEPA's Filter Backwash Recycling Rule, the Village has the option to recycle treated remaining decanted backwash water waste back to the headworks of the facility at a rate of 10 percent or less of the forward flow.

The transfer of water from the granular filters would be accomplished using intermediate pumps. The pumps can be dual purposed to allow backwash of the proposed granular media filters. The piping and valve arrangement to the 2 MG reservoir can incorporate features to allow filter backwash by gravity.

To pump from the 2 MG reservoir into the distribution system, a high service pump station is included with modifications to the existing 2 MG reservoir. Temporary water supply from neighboring communities would still be a consideration during construction and could be limited to times when modifications are being made to the 2 MG reservoir.

Ancillary to the WTP, provisions to the conventional treatment process can be planned during the final design stage for the incorporation of membrane filters or ultraviolet (UV) disinfection treatment technologies.

Table 5.04-1 details the OPCC of a new conventional WTP and the demolition of the existing WTP.

Table 5.04-1 New Conventional WTP OPCC

Description	OPCC
6 mgd Intake Facility	
Intake Piping (24-inch)	$3,326,000
Shoreline Stabilization	$320,000
Intake Equipment and Structure	$3,220,000
Subtotal	$6,866,000
General Conditions (8 percent)	$550,000
Construction Probable Cost	**$7,416,000**
6 mgd Conventional Treatment Facility	
Administration and Offices	$438,000
Chemical Storage and Feed	$742,000
Rapid Mix/Flocculation/Sedimentation	$1,650,000
Tube Settlers	$1,367,000
Granular Filtration	$2,465,000
HVAC	$1,956,000
Electrical and Generators	$2,446,000
Intermediate and Backwash Pumps	$500,000
Piping	$1,367,000
Coatings	$474,000
Reservoir and High Lift Yard Piping (24-inch)	$266,000
2-Million-Gallon Reservoir Rehabilitation	$531,000
Residuals Handling	$880,000
Civil and Site Work	$965,000
WTP Access Improvements	$500,000
Site Security	$250,000
Distribution Garage	$393,000
Subtotal	$17,190,000
General Conditions (8 percent)	$1,376,000
Construction Probable Cost	**$18,566,000**
Existing WTP Demolition	$351,000
General Conditions (8 percent)	$28,000
Construction Probable Cost	**$379,000**
Professional Services and Contingency (35 Percent)	$9,227,000
Total Construction Probable Cost	**$35,588,000**

2. Direct Membrane Filtration

Direct membrane filtration is seen as an advantage compared to a conventional WTP design because:

a. it has the benefit of slightly reducing the overall WTP footprint while providing a higher quality finished water for the Village customers.

b. the finished water quality from membrane filtration, based on suspended solids removal, is not impacted by changes in Lake Michigan water quality.

c. the membrane filtration process is an noninvasive barrier to pathogens, requiring less chemical addition compared to a conventional WTP for disinfection, fluoridation, and pre-treatment purposes.

d. membranes can be operated as a start/stop process with consistent effluent quality, compared to a conventional treatment facility which may require 1 to 2 hours of operational time after restart to establish consistent finished water quality.

e. while higher in initial capital and operational costs, the ability to expand a membrane system may represent a lower total cost of ownership compared to a conventional WTP with expansion.

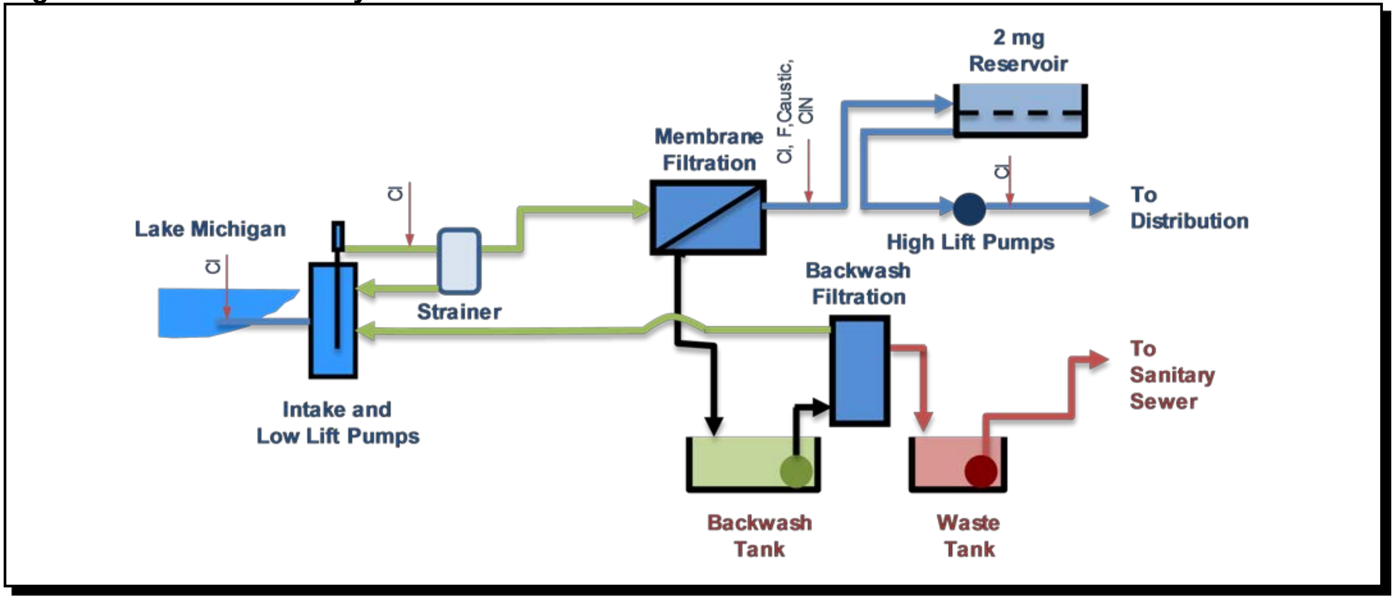
f. the cost of membrane filtration technology has standardized, rising at the rate of inflation instead of paying for the cost of research and development.

g. membrane filtration is capable of meeting the requirements of the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and has the potential to meet more stringent future treatment regulations.

Given the long term benefits of membrane filtration compared to a conventional WTP, this treatment process option was included in subsequent discussions regarding the construction of a new WTP on the lakefront or at an inland location.

In Figure 5.04-2, a WTP process schematic generally describes the new proposed WTP process using membrane filtration similar to that used at other Great Lakes communities including 11 other facilities along the Lake Michigan shoreline. Pilot testing of membrane filtration would be required by the IEPA to demonstrate the technology and process being designed for the Village.

Figure 5.04-2 Preliminary New WTP Process Schematic Direct Membrane Filtration



Based on our review, the existing 10-foot-diameter intake facility, constructed in 1928, is not sufficient to meet the future needs with construction of a new WTP for the Village. While it currently provides service to the existing WTP, the existing intake structure has been susceptible to freezing during cold water conditions on Lake Michigan, forcing the existing WTP out of service for periods up to 12 hours. The proposed WTP includes a new 24-inch intake pipe and wet well. As an option to provide a redundant 24-inch intake alongside a new 24-inch intake pipe, a connection and piping to the existing 24-inch intake pipe could be considered.

Chemical treatment of the source water would be necessary within the overall water treatment process. The process schematic shows the injection location of sodium hypochlorite (NaClO) for zebra mussel control and disinfection, fluoride (F) for dental health, corrosion inhibitor (CIN) for corrosion control, and caustic (Caustic) for pH adjustment.

Ahead of membrane filtration, screening would be used to protect both the intake pumps and membrane filtration system. At the intake wet well, a traveling screen would be used to keep fish and large debris from entering the low lift pump suction. Following the low lift pumps, an additional 500 micron strainer would be used to protect the membrane system from debris such as leaves and sand.

To remove filterable suspended solids throughout the water treatment process, a backwash treatment system is included within the proposed schematic. The anticipated backwash volume from the proposed membrane filtration system would be approximately 300,000 to 400,000 gallons per day (gpd) at capacity. The proposed backwash water volume is more than the 120,000 gpd discharge capacity currently established by Metropolitan Water Reclamation District of Greater Chicago (MWRDGC).

As part of the USEPA's Filter Backwash Recycling Rule, the Village has the option to recycle treated backwash water waste back to the headworks of the facility at a rate of 10 percent or less of the forward flow. However, solids removal treatment is recommended to prevent concentrating solids within the water treatment process. The proposed backwash tank and filtration system allows membrane backwash water to be collected, pumped, and treated for the removal of suspended solids before recycling the treated water back to the headworks of the proposed facility.

On a periodic basis, the backwash filtration system is itself backwashed, and the solids are collected in a waste tank for pumping to the sanitary system. It is anticipated the backwash filtration system would waste approximately 36,000 to 72,000 gpd, which is within the reported capacity of the existing sanitary system. Bench scale testing of the backwash filtration system during membrane pilot testing is recommended to confirm the rate and level of filtration possible for the full-scale system. As part of future discussions with MWRDGC, it would likely benefit the Village to consider options that improve waste discharge flow capacity from the WTP site.

Following membrane filtration, disinfection would be required. While it would be possible to construct a bifurcated clearwell within the new WTP, the existing 2 MG reservoir has sufficient storage capacity and would allow the low lift pumps to pump through the membrane filters to the reservoir efficiently. The 2 MG reservoir would require rehabilitation, tank sectioning, and internal baffling to convert the reservoir from a single fill/draw pipe system to a dual fill and draw piping arrangement with isolatable sections. Tank sectioning would allow for one-half of the basin to be taken out of service for normal maintenance. Internal baffling (baffling factor of 0.3 to 0.5) would allow for the required contact time disinfection for more than 0.5-log inactivation of *Giardia* and 2-log inactivation of viruses. The use of neighboring water supplies should be considered as an option to support the Village’s distribution system operations during construction of the 2 MG reservoir improvements.

A new high lift pump station is required to pump water from the 2 MG reservoir into the distribution system. Piping from the discharge of the high lift pumping station would be connected to the existing distribution system near the discharge of the existing WTP. From a facility perspective, the Village may want to consider construction of a high lift service pump station adjacent to the 2 MG reservoir to help minimize site piping to and from the facility.

Depending on the results of a membrane pilot study, the preliminary site plan demonstrates one potential membrane system layout combined with intake facility, low lift pumps, membrane filtration, chemical storage and feed systems, administrative offices, distribution garage, and supporting HVAC and electrical facilities.

Table 5.04-2 details the OPCC of a new direct membrane filtration WTP and the demolition of the existing WTP.

Table 5.04-2 New Direct Membrane Filtration WTP OPCC

Description	OPCC
6 mgd Intake Facility	
Intake Piping (24-inch)	$3,326,000
Shoreline Stabilization	$320,000
Intake Equipment and Structure	$3,220,000
Subtotal	$6,866,000
General Conditions (8 percent)	$550,000
Construction Probable Cost	**$7,416,000**
6 mgd Direct Membrane Filtration	
Administration and Offices	$438,000
Chemical Storage and Feed	$778,000
Membrane Treatment	$5,541,000
Backwash Treatment	$1,475,000
HVAC	$2,065,000
Electrical and Generators	$3,789,000
Piping	$2,401,000
Coatings	$753,000
Reservoir and High Lift Yard Piping (24-inch)	$266,000
2-MG Reservoir Rehabilitation	$531,000
Civil and Site Work	$1,201,000
Distribution Garage	$393,000
WTP Access Improvements	$500,000
Site Security	$250,000
Subtotal	$20,381,000
General Conditions (8 percent)	$1,631,000
Construction Probable Cost	**$22,012,000**
WTP Demolition	$351,000
General Conditions (8 percent)	$28,000
Construction Probable Cost	**$379,000**
Construction Probable Cost Subtotal	$29,807,000
Professional Services and Contingency (35 percent)	**$10,433,000**
Total Construction Probable Cost	**$40,240,000**

B. Construction of a New WTP at the Lakefront

Three basic alternatives were evaluated for location of a WTP on the Lake Michigan shoreline, including:

1. A new direct membrane filtration facility located north of the existing WTP, allowing construction of a new WTP while the existing facility remained online.

2. A new direct membrane filtration facility WTP located to the south of the existing WTP, allowing construction while the existing WTP remained online.

3. A new direct membrane filtration facility WTP located within the footprint of the existing WTP, requiring a water supply interconnection with a neighboring community.

Each of these options are very similar from an engineering standpoint. Location and construction of the WTP at the lakefront will require an interconnection with Highland Park. The location of the new WTP will help define the amount of purchased water needed during construction of the water plant. If the existing plant can remain in service during construction of the new plant, costs associated with water purchased from the City of Highland Park could be significantly less than construction in place of the existing WTP. From a distribution system point of view, a lakefront WTP location requires little or no distribution system improvements as compared to construction of a new WTP at the inland locations described later in this report.

1. <u>Construction of a New WTP north of the Existing WTP site</u>

Construction of a new direct membrane filtration WTP north of the site, as shown in Figure 5.04-3, would allow the consolidation of the beachfront area to the south of the new WTP. The proposed WTP process would take advantage of the existing WTP facilities. In particular, the construction of the new WTP alongside the existing WTP would be based on using the existing 2 MG reservoir for clearwell disinfection. The rehabilitation of the 2 MG reservoir would occur at the start of the WTP construction to allow construction, over a four-month period, and tie-in of the new WTP before demolition of the existing WTP.

Figure 5.04-3 Preliminary Site Plan–North Lakefront WTP Location

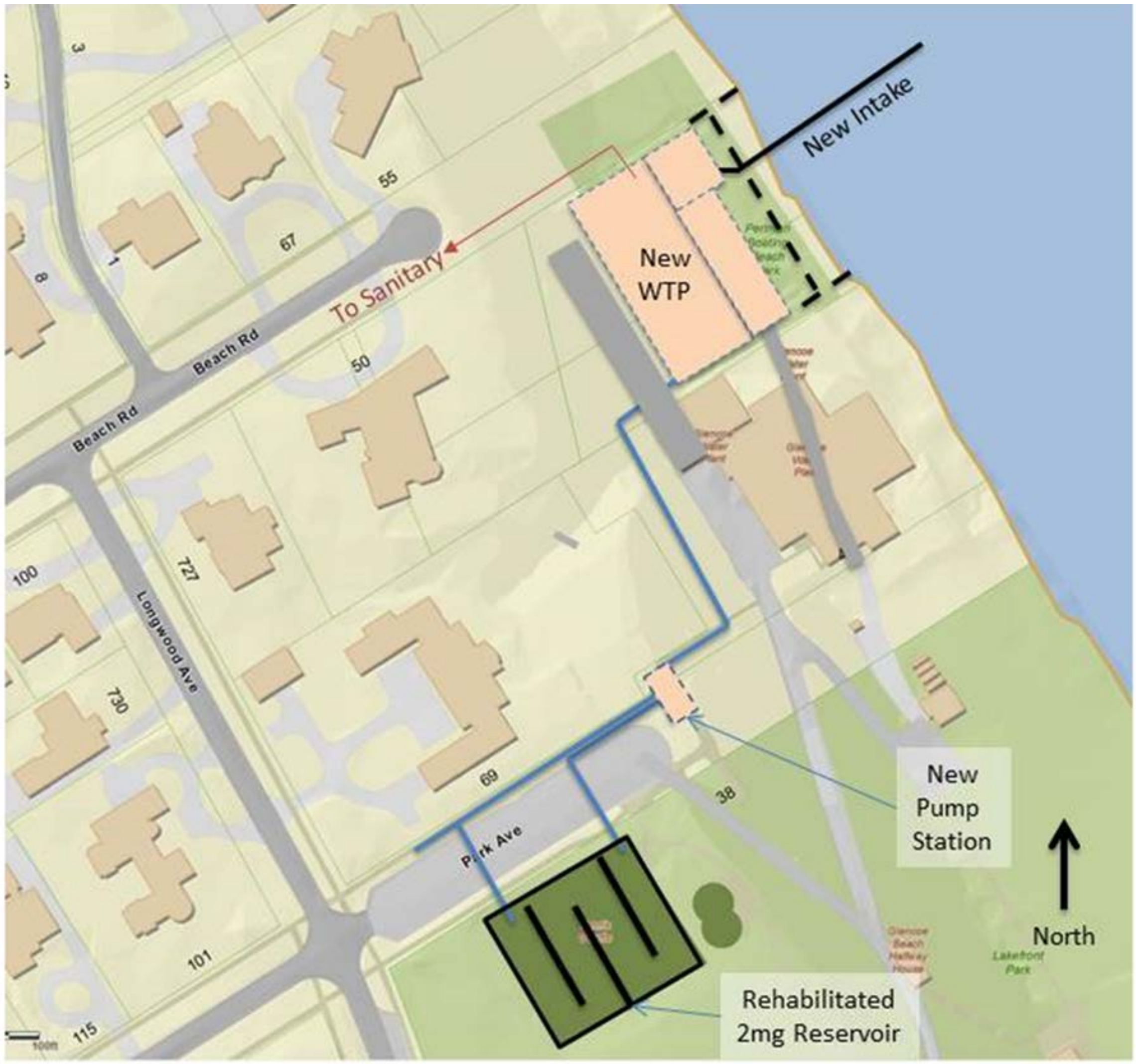


Table 5.04-3 details the OPCC of a new direct membrane filtration WTP at the north Lakefront location and the costs to install the interconnection facilities with the City of Highland Park for water supply during construction outages.

Table 5.04-3 New Lakefront Membrane Filtration WTP–North Location OPCC

Description	OPCC
6 mgd Intake Facility	$7,416,000
6 mgd Direct Membrane Filtration Treatment Facility	$22,012,000
WTP Demolition	$379,000
6 mgd Booster Station and 16-inch Transmission Main	$4,100,000
2 mgd Booster Station at Existing Reservoir	$1,500,000
Construction Probable Cost Subtotal	$35,407,000
Professional Services and Contingency (35 percent)	**$12,393,000**
Total Construction Probable Cost	**$47,800,000**

Note: Does not include the cost to purchase water during construction or the costs associated with land acquisition.

Table 5.04-4 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Table 5.04-4 Advantages and Project Challenges of New WTP North Lakefront Location

Advantages	Project Challenges
Existing plant operational during construction.	More challenging construction access.
Existing distribution system does not need reinforcement.	Neighboring residential property concerns.
Smaller footprint than existing WTP.	Loss of separate and distinct boating beach.
Contiguous beach operations.	Requires property exchange.
New modern WTP infrastructure with expected life of 75 years.	WTP access ramp would require modification for construction to allow heavy equipment access.
Freedom of Architectural Design	

2. <u>Construction of a New WTP south of the Existing WTP site</u>

Construction of a new direct membrane filtration WTP south of the existing WTP site would allow the consolidation of the beachfront area to the north of the new WTP. But, this option would also leave some public beach area south of the new plant as well, thus splitting up the public beach areas like the current plant does.

Figure 5.04-4 shows the proposed preliminary site plan for the new WTP. The proposed WTP process would take advantage of the existing WTP facilities in a similar fashion to the north WTP location and require a similar four-month temporary supply of water to modify the existing 2-MG reservoir.

Figure 5.04-4 Preliminary Site Plan–South Lakefront WTP Location

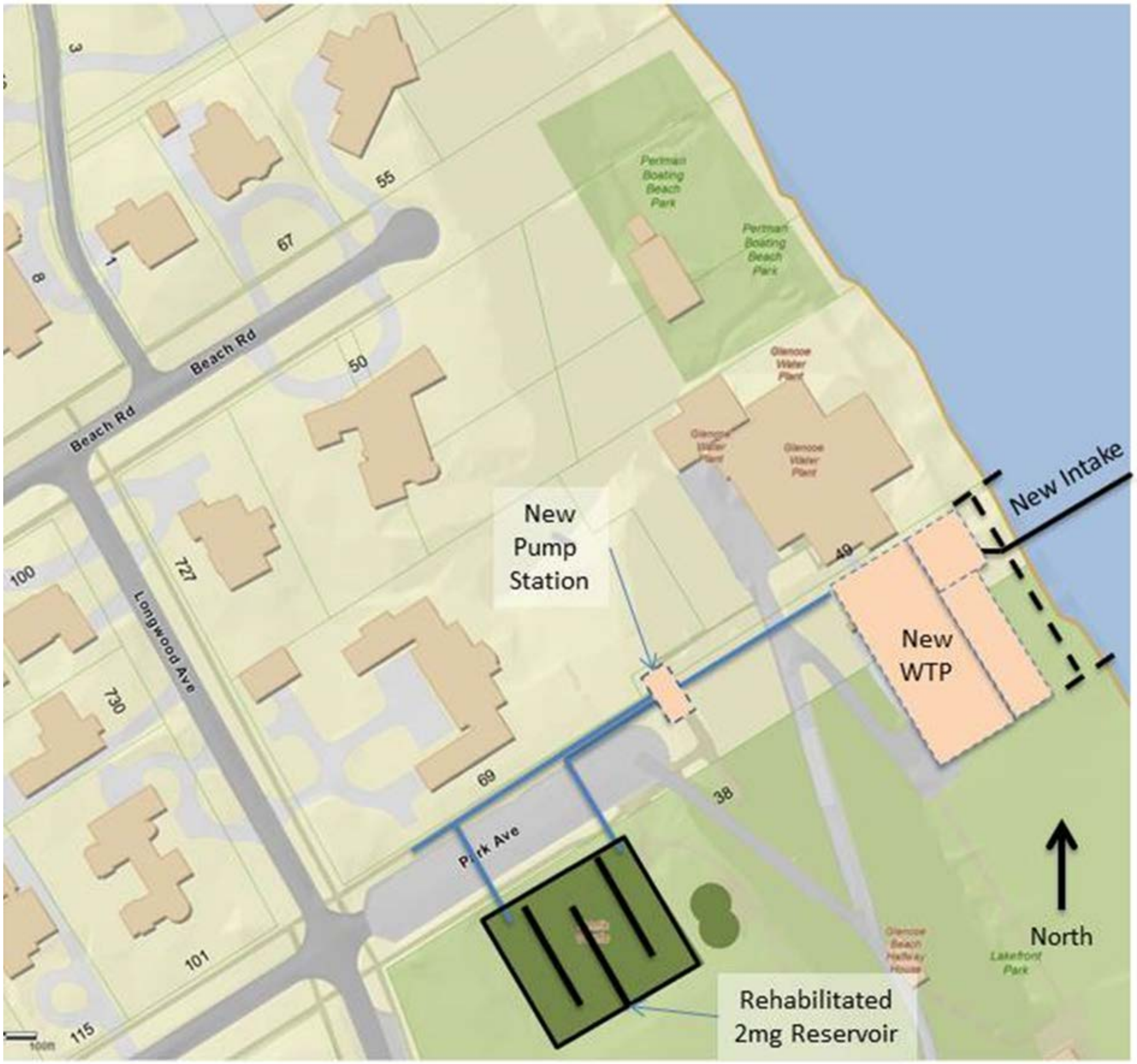


Table 5.04-5 details the OPCC of a new direct membrane filtration WTP at the South Lakefront location and the costs to install and interconnection with the City of Highland Park for water supply during construction outages.

Table 5.04-5 New Lakefront Membrane Filtration WTP–South Location OPCC

Description	OPCC
6 mgd Intake Facility	$7,416,000
6 mgd Direct Membrane Filtration Treatment Facility	$22,012,000
WTP Demolition	$379,000
6 mgd Booster Station and 16-inch Transmission Main	$4,100,000
2 mgd Booster Station at Existing Reservoir	$1,500,000
Construction Probable Cost Subtotal	$35,407,000
Professional Services and Contingency (35 percent)	**$12,393,000**
Total Construction Probable Cost	**$47,800,000**

Note: Does not include cost to purchase water during construction or costs associated with land acquisition.

Table 5.04-6 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Table 5.04-6 Advantages and Project Challenges of New WTP (South) Option

Advantages	Project Challenges
Existing plant remains operational during construction.	Requires property exchange.
Smaller footprint for new WTP.	Restricted access to boater beach (Short/Long-Term).
Mainly on existing Village-owned property. Some property transfer required.	Potentially longer construction time/impact to beach operations.
New modern WTP infrastructure with expected life of 75 years.	Water Plant access ramp would require modification for construction to allow heavy equipment access.
Freedom of architectural design.	

3. <u>Construction of a New WTP over the Existing WTP site</u>

Construction of a new conventional or new direct membrane filtration WTP on the footprint of the existing WTP site, as shown in Figure 5.04-5, is possible only with the interconnection to a neighboring water supply. Demolition and construction of the new WTP would be delayed by approximately 1 to 2 years to allow construction of the necessary water system interconnections, as previously described. The interconnection would be in-service for a period of approximately 2 years to allow construction and startup of the new WTP facility.

The proposed WTP process would take advantage of the existing WTP facilities. In particular, the construction of the new WTP alongside the existing WTP would be based on using the existing 2 mg reservoir for clearwell disinfection. The rehabilitation of the 2 mg reservoir would occur at the start of the WTP construction to allow construction, over a four-month period, and tie-in of the new WTP before demolition of the existing WTP.

Figure 5.04-5 Preliminary Site Plan–Existing WTP Lakefront Location

Table 5.04-7 details the OPCC of a new direct membrane filtration plant over the existing WTP site and the construction costs associated with installation of an interconnect with the City of Highland Park to supply water throughout the construction process.

Table 5.04-7 New Lakefront Membrane Filtration WTP–Existing WTP Location OPCC

Description	OPCC
6 mgd Intake Facility	$7,416,000
6 mgd Direct Membrane Filtration Treatment Facility	$22,012,000
WTP Demolition	$379,000
6 mgd Booster Station and 16-inch Transmission Main	$4,100,000
2 mgd Booster Station at Existing Reservoir	$1,500,000
Construction Probable Cost Subtotal	$35,407,000
Professional Services and Contingency (35 percent)	**$12,393,000**
Total Construction Probable Cost	**$47,800,000**

Note: Does not include the costs to purchase water during construction.

Table 5.04-8 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Table 5.04-8 Advantages and Project Challenges of New WTP at the Existing WTP Location

Advantages	Project Challenges
Smaller footprint for new WTP.	Long-term (two years) temporary connections required
Existing Village-owned property.	Managing water pressure from two different sources.
New modern WTP infrastructure with expected life of 75 years.	Most costly of lakefront options
Freedom of architectural design.	Restricted access to boater beach (Short/Long-Term).
	Impact to current WTP staffing during construction.
	Water Plant access ramp would require modification for construction for heavy equipment access.
	Long construction period.

C. Construction of a New WTP at Inland Locations.

Four locations, as shown in Figure 5.04-6, were identified and evaluated as potential locations for a new WTP. Three of the locations identified as possible inland WTP locations would represent a significant challenge as the Village would have to acquire property from various internal and external agencies to allow construction at any of these locations. Along with the probable costs of a new direct membrane filtration WTP as presented in previous sections, there are additional costs presented below for the additional transmission main improvements required to make any of the inland locations a viable source of supply to the Village.

These locations are described as follows:

Location 1: West Dundee Road
Location 2: Forestway Drive
Location 3: Public Works Garage site
Location 4: Village Water Tower site

One advantage of the construction of an inland WTP is that it does not require a water supply interconnection with a neighboring community.

The water tower site on Frontage Road location (Location 4) is owned by the Village and is where the existing water main is located, which is an advantage. However, there would be significant environmental site factors to consider as a result of the IEPA status of this former landfill site. The raw water and treated water piping associated with this option makes it very costly and unfavorable. While reviewed and discussed as an option with the Village staff, the difficulties associated with this site did not warrant further evaluation within this report.

Figure 5.04-6 Potential Inland WTP Locations

The following is a summary of the three remaining inland WTP probable costs considered in more detail.

A. West Dundee Road Location (Location No. 1)

This location would involve the acquisition of significant Glencoe Park and School District Property on the order of 3.8 acres to locate a direct membrane filtration plant. The existing site is currently occupied by a recreational tennis courts and ball fields.

Water supply from this location would require significant improvements to the distribution system to maintain existing system pressure and available fire flows. From the WTP location, a 20-inch transmission main would be extended east approximately 500 feet to the intersection of Dundee Road and Forestway Drive. From that point, a 12-inch transmission main would be extended north approximately 2,600 feet to connect to the existing 10-inch water main at the intersection of Hohlfelder Road and Westley Road. From the intersection of Dundee Road and Forestway Drive, a 16-inch transmission main would be extended south approximately 2,800 feet to connect to the existing 16-inch transmission main on Forestway Drive. From that point, a 16-inch transmission main would be extended east, parallel to the existing 16-inch transmission main, approximately 3,100 feet to the intersection of Park Avenue and Bluff Street.

In addition to water transmission main improvements, the new WTP would be supplied by approximately 10,000 feet of new 24-inch raw water transmission main from the lake front to this location. The raw water transmission main installation would be complicated by railroad and state road crossings through the Village. Due to the difficulties of acquiring this site and higher anticipated cost, compared to other options, this site was not evaluated in further detail

Table 5.04-9 describes the advantages compared to all other options in this report and recognized challenges associated with selecting the particular option as discussed with Village staff.

Table 5.04-9 Advantages and Project Challenges of New Inland Membrane Filtration WTP on West Dundee Road

Advantages	Project Challenges
WTP located off lakefront	Requires significant property acquisitions.
Accessibility of site (construction and operations)	Loss of Athletic Fields/Open Space.
New modern WTP infrastructure with expected life of 75 years	Long-term residential impact (construction/operations) from municipal WTP facility.
Existing WTP operational during construction	This site would require significant transmission/distribution system improvements.
	Impact to Village gateway.
	Requires pumping station presence at lakefront
	Higher cost than lakefront WTP sites .

B. Forestway Drive Location (Location No. 2)

This location would involve the acquisition of significant Cook County Forest Preserve District property to construct a direct membrane filtration plant within a 3.8-acre footprint.

Water supply from this location would require significant improvements to the distribution system to maintain existing system pressure and available fire flows. From the WTP location, a 20-inch transmission main would be extended east, along the existing 16-inch transmission main, approximately 3,100 feet to the intersection of Park Avenue and Bluff Street. From that point, a 16-inch transmission main would be extended east approximately 2,000 feet to the existing 10-inch main at the intersection of Park Avenue and Green Bay Road.

In addition to water transmission main improvements, the new WTP would be supplied by approximately 8,000 feet of new 24-inch raw water transmission main from the existing WTP to this location. The raw water transmission main installation would be complicated by railroad and state road crossings through the Village.

Due to the difficulties of acquiring this site and higher anticipated cost, compared to other options, this site was not evaluated in further detail.

Table 5.04-10 provides the advantages and disadvantages of locating an inland WTP at this location.

Table 5.04-10 Advantages and Project Challenges of New Inland Membrane Filtration WTP on Forestway Drive

Advantages	Project Challenges
Residential and open space corridor	Cook County Forest Preserve District-Owned Property--Not consistent with its mission
Existing plant operational during construction	Constructability/Access Issues--Roads, Deliveries, and Utilities
WTP located off the lakefront	Impact to existing Stormwater storage/flood control
New modern WTP infrastructure with expected life of 75 years	Access to other utilities (Com Ed, NS Gas, Comcast)
	Requires pumping station presence at lakefront
	Loss of trees, green space
	Long-term residential impact (construction/operations) from municipal WTP facility
	Floodplain issues
	Higher cost than lakefront WTP sites

C. Existing Public Works Garage Site (Location No. 3)

While a more confined site at 1.8 acres, the existing public works garage site represents the most efficient inland location to locate a new WTP site relative to the existing water distribution system. This particular site would require demolition and relocation of the existing public works facility and closure of the Temple Court street and right-of-way and a significant portion of the Temple Court parking lot. Also, the public works garage would need to be located to another site. The probable construction cost for a new Public Works Garage facility would be approximately $10,000,000, based on input from Village staff.

The facility would also impact the Village’s public parking lot south of Temple court. At least half the 164-stall parking lot would be taken up by the plant site improvements and operations. This creates the need to replace these important parking stalls, presumably with a parking deck estimated to add $5,000,000 to the overall cost of this option.

Improvements to raw water transmission mains would be minimized compared to the other three inland WTP sites.

No additional water system transmission mains are recommended for this particular site because the location of the site is not hydraulically different than the existing WTP site.

The new WTP would be supplied by approximately 4,000 feet of new 24-inch raw water transmission main from the existing WTP to this location. The raw water transmission main installation would be complicated by railroad and state road crossings through the Village.

Unlike the other two inland locations, WTP construction would involve a multistory building, similar to the WTP lakefront layouts, to make use of the limited rectangular property. With the demolition of the existing public works garage, a new public works garage would be necessary and costly to reconstitute at another location within the Village and could further delay the WTP project.

Finally, it is assumed that construction operations associated with the new intake and at the existing reservoir may cause water supply outages. This option will also include installation of an interconnection with the City of Highland Park to maintain supply throughout construction.

Table 5.04-11 details the OPCC for construction of a new inland direct membrane filtration WTP and associated transmission main improvements for this location.

Table 5.04-11 New Inland Membrane Filtration WTP on the Existing Public Works Property OPCC (2nd Quarter 2015)

Description	OPCC
6 mgd Intake Facility	$7,416,000
6 mgd Direct Membrane Filtration Treatment Facility	$22,012,000
WTP Demolition	$569,000
Raw Water Transmission Main	$1,472,000
6 mgd Booster Station and 16-inch Transmission Main	$4,100,000
2 mgd Booster Station at Existing Reservoir	$1,500,000
Construction Probable Cost Subtotal	$37,069,000
Professional Services and Contingency (35 percent)	**$12,975,000**
New Parking Deck	$5,000,000
New Public Works Garage Facility	$10,000,000
Total Construction Probable Cost	**$65,044,000**

Table 5.04-12 provides the advantages and disadvantages of locating an inland WTP at this location.

Table 5.04-12 Advantages and Project Challenges of New Inland Membrane Filtration WTP on Existing Public Works Site

Advantages	Project Challenges
Lower construction costs compared to other inland options because of reduced water main costs	Requires relocation/construction of new Public Works garage
Existing Village-owned property	Loss of public access through street (Temple Court)
Proximity to existing distribution system	Loss of public parking (Temple Court Lot)
Existing plant operational during construction	Loss of future tax-producing opportunities
WTP off lakefront	Incompatible with Village's comprehensive plan and downtown plan update.
	Long-term residential impact (construction operations) from municipal WTP facility
	Undersized site
	Access/delivery issues
	Difficult site security

5.05 SUMMARY OF WATER SUPPLY ALTERNATIVES

While not previously discussed, additional costs must be contemplated whether rehabilitating the existing WTP or constructing a new WTP. During construction, there would be a temporary period of time where water must be purchased from a neighboring community. For the purpose of this analysis, it is assumed water would be purchased from Highland Park.

For construction of a new WTP at the existing lakefront site, it is anticipated this time period would be two years and would cost approximately $3,777,000. For construction of a new WTP or rehabilitation of the existing, this period of time is estimated to be four months and would cost approximately $621,000. The improvements needed to purchase water are as previously described in Section 5.02 for pumped supply from Highland Park and include 16-inch transmission main upgrades and a 6.0 mgd booster station. Construction of these improvements would also allow for long-term emergency supply to or from Highland Park.

Table 5.05-1 presents a summary of all the previously described water supply alternatives and OPCCs.

Table 5.05-1 Water Supply OPCC Summary

Water Supply Alternative	OPCC	Purchased Water Cost During Construction	Total OPCC
Rehabilitate Existing WTP	$31,253,000	$621,000	$31,874,000
New WTP-Existing Site	$47,800,000	$3,777,000	$51,577,000
New WTP-South of Existing Site	$47,800,000	$621,000	$48,421,000
New WTP-North of Existing Site	$47,800,000	$621,000	$48,421,000
New WTP-Existing Public Works Garage Site	$65,044,000	$621,000	$65,665,000
Purchase Water from Highland Park	$11,717,000		$11,717,000

SECTION 6
RECOMMENDATIONS

6.01 WATER SUPPLY ALTERNATIVES

The previous sections developed and analyzed nine options for the future water supply for the Village. These options were developed through extensive discussions and reviews with the Village Staff. Figure 6.01-1 shows the locations of the nine options with colors indicating different levels of viability based on our analysis and Village input. The nine options are described as follows:

1. Rehabilitation of the existing plant.
2. Demolition of the existing plant and construction of a new plant within the Village-owned property and rights-of-way.
3. Construction of a new plant north of the existing plant.
4. Construction of a new plant south of the existing plant.
5. Construction of a new plant at property acquired along Dundee Road near Forestway Drive.
6. Construction of a new plant at property acquired along Forestway Drive near Elder Court.
7. Construction of a new plant at property owned near the water tower along Frontage Road.
8. Construction of a new plant at the existing public works garage site on Temple Court at Green Bay Road.
9. Construction of facilities required to permanently purchase water from the City of Highland Park.

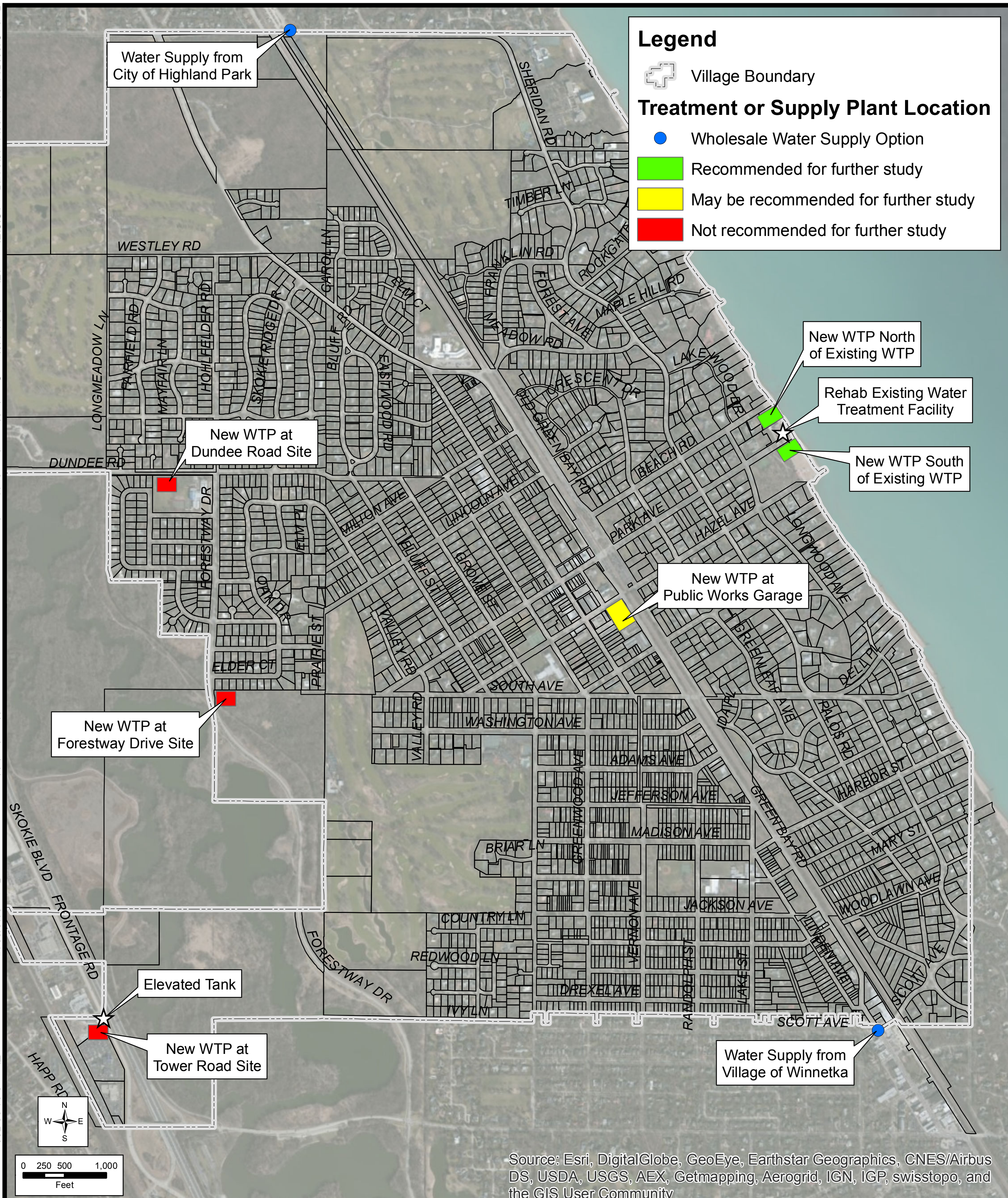
Table 6.01-1 shows a summary of these options with some additional details and their opinions of probable cost. After analysis, several of the options can be eliminated from further consideration. These options are and further explained below.

6.02 ELIMINATED WATER SUPPLY ALTERNATIVES

A. New Plant at Water Tower Site

This option was eliminated earlier in the process due to cost, environmental factors, and significant geographical location issues. The option would require raw water to be delivered to a site west of the Edens, which results in the longest installation of raw water transmission main of all options investigated. Additionally, the only feasible route for the raw water and finished water mains would be across the Skokie Lagoons, increasing the cost of installation and long term maintenance. Lastly, the Water Tower Site was the location of the former Village incinerator site, and has received a closed cover landfill status with the IEPA. Any development on this site must adhere to the IEPA's requirements as well as extraordinary construction requirements.

As a result of each of these significant challenges, this option will not be recommended for further review and analysis.



WATER SUPPLY ALTERNATIVE LOCATION MAP

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 6.01-1
1410.015

Table 6.01-1 WTP Options Comparison with Breakdown

		Description	Details	Opinion of Probable Cost Breakdown		Cost
Lake Front Options	Rehab Existing Plant	Rehabilitate and Retrofit existing plant: structural repair/replacement and modification of water treatment process to include current technologies and membrane filtration. Connection to Highland Park to supply water during construction.	WTP Technology	WTP Probable Cost	$ 13,924,000	$31,874,000
			Conventional Plus Membrane	Intake Probable Cost	$ 3,625,000	
				Demolition	$ -	
			Intake Sizing	Raw Water Transmission	$ -	
			6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			Finished Water Storage	Contingency and Professional Services (35%)	$ 8,103,000	
			2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
			Clearwell Storage			
			430,000 gallons			
	New WTP Existing Site	Demolition of existing plant, construct new 6 MGD WTP, modifications/upgrades to existing reservoir, upgrade transmission mains. Connection to Highland Park to supply water during construction.	WTP Technology	WTP Probable Cost	$ 22,012,000	$51,577,000
			Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
				Demolition	$ 379,000	
			Intake Sizing	Raw Water Transmission	$ -	
			6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			FInished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
			2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 2 years)	$ 3,777,000	
			Clearwell Storage			
			500,000 gallons			
	New WTP Adjacent to Existing (Sout	Phased redevelopment - construction of new WTP to the south of existing WTP/Partial demolition of existing plant/construction of final treatment process (membrane/UV). Connection to Highland Park to supply water during construction.	WTP Technology	WTP Probable Cost	$ 22,012,000	$48,421,000
			Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
				Demolition	$ 379,000	
			Intake Sizing	Raw Water Transmission	$ -	
			6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			Finished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
			2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
			Clearwell Storage			
			430,000 gallons			
	New WTP Adjacent to Existing (Nort	Partial demolition of existing WTP facilities/construction of new fully modernized 6 MGD WTP/Demolition of remaining existing WTP. Connection to Highland Park to supply water during construction.	WTP Technology	WTP Probable Cost	$ 22,012,000	$48,421,000
			Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
				Demolition	$ 379,000	
			Intake Sizing	Raw Water Transmission	$ -	
			6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			Finished Water Storage	Contingency and Professional Services (35%)	$ 12,393,000	
			2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
			Clearwell Storage			
			500,000 gallons			
Inland Plant Options	Current Public Works Garage Site New WT	Demolition of existing plant, construction of new water plant and storage, 24" raw water transmission main. Connection to Highland Park to supply water during construction.	WTP Technology	WTP Probable Cost	$ 22,012,000	$65,665,000
			Direct Membrane Filtration	Intake Probable Cost	$ 7,416,000	
				Demolition	$ 569,000	
			Intake Sizing	Raw Water Transmission	$ 1,472,000	
			6-8 mgd installed	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			Finished Water Storage	Contingency and Professional Services (35%)	$ 12,975,000	
			2 MG + 0.5 MG	Purchase Water Cost ($2.15/100CF @ 1.8 mgd for 4 months)	$ 621,000	
			Clearwell Storage	Parking Garage	$ 5,000,000	
			500,000 gallons	New Public Works Facility	$ 10,000,000	
Purchased Water Optic	Purchase Water from Highland Par	Demolition of existing plant, new 2 MG reservoir and 2 mgd booster station, new 2 mgd pumping station at existing reservoir, new 6 mgd pumping station in Highland Park, and 16" distribution main improvements.	WTP Technology	WTP Probable Cost	$ -	$11,717,000
			None	Intake Probable Cost	$ -	
				Demolition	$ 379,000	
			Intake Sizing	Raw Water Transmission	$ -	
			None	6 mgd Booster Station and 16-inch Transmission Main	$ 4,100,000	
				2 mgd Booster Station at Existing Reservoir	$ 1,500,000	
			Finished Water Storage	2 MG Reservoir and 2 mgd Booster Station	$ 2,700,000	
			4 MG + 0.5 MG	Contingency and Professional Services (35%)	$ 3,038,000	

B. New Plant at Dundee Road near Forestway Drive

It is recommended that this option be eliminated because of cost, impact to an established residential neighborhood, and significant impact to Park District and School District open space that cannot be replaced elsewhere in the Village. This option would require raw water to be delivered 10,000 feet to a site in west Glencoe, as well as significant water distribution system improvements.

Therefore, this option will not be recommended for further analysis.

C. New Plant at Forestway Drive south of Elder Court

It is recommended that this option be eliminated due to cost, but primarily because of need to acquire property from Forest Preserve District. The Forest Preserve District has provided the Village with a written statement indicating that a request for the location of a water treatment facility on District property would not align with the District's Land Use Policy and their mission..

Therefore, this option will not be recommended for further analysis.

D. Rehabilitation of the Existing Plant

This option is the lowest cost option; however, it is also the option with the shortest useful life. Rehabilitating a nearly 90-year-old plant will only upgrade and renew portions of the plant. Many of the new systems and process equipment upgrades will be built on or attached to infrastructure nearing the end of its useful life. Maintenance costs will continue to be higher than typical because of the continued replacement of items that were not rehabilitated. The other challenge with rehabilitation of this facility on the existing site is the need to 'shoe horn' newer technology and required process equipment into the existing layout. The end result may not be ideal from an operational perspective.

Because the plant is near the end of its useful life and technological advancements offer equipment that will achieve better treatment results but may not be able to be adapted to the current WTP process and existing space, we would recommend the rehabilitation of the existing WTP not be included in the considerations for alternative water supply options. It should be compared with chosen alternative water supply option to justify the additional cost for the new plant or supply and the useful life.

E. New WTP North or South of the Existing WTP

As part of this study, sites immediately north and south of the existing WTP were investigated. In order to review an alternative treatment process in the new plant, the south plant was investigated as a conventional filtration plant, which developed a cost comparison between the two processes. When comparing the costs and impacts of alternative plant sites, reducing the number of variables, like the treatment process, helps better compare and focuses on the factors caused by the site location, rather than the treatment process. This is especially true here because the WTP footprint and envelope are not affected between either Direct Membrane Filtration or Conventional Filtration. Therefore, for the water supply options analysis, this study will consider only direct membrane filtration WTPs in the cost analysis, giving the most conservative opinions of probable cost and present worth.

For this reason, a new WTP either south or north of the existing WTP has the same opinion of probable project cost and can be combined into a single option. If this option is chosen as most desirable for the Village, the determination of a north or south location can be based on the availability and suitability of land.

6.03 RECOMMENDED WATER SUPPLY ALTERNATIVES COMPARISON ANALYSIS

Following the elimination and refinement of the options as outlined in 6.02, the number of water supply alternatives reduces to four for consideration as follows, in order of opinion of probable project cost for construction:

1. Construction of facilities required to permanently purchase water from the City of Highland Park.

2. Construction of a new plant north or south of the existing plant.

3. Construction of a new plant at the existing public works garage site on Hazel and Green Bay Road.

4. Demolition of the existing plant and construction of a new plant within the Village-owned property and rights-of-way.

The following provide discussion and analysis of these options for Village consideration.

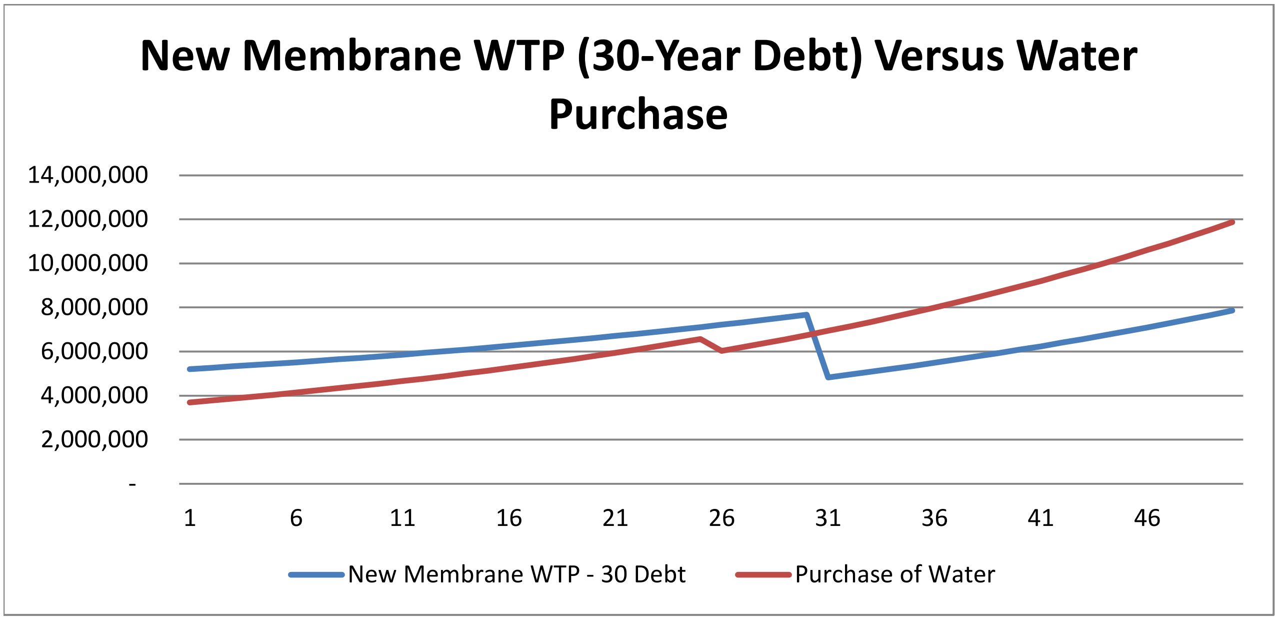
A. Break-Even Analysis for New Plant Versus Purchase of Water from Highland Park

If construction costs alone are considered in the options analysis, a connection to Highland Park clearly presents itself as the lowest cost option. However, the cost for residents to purchase the water from Highland Park is higher than if the Village produces the water. In order to determine the long term costs and if there is a point in which the new plant has paid for itself and becomes less expensive than purchasing water, the Village staff assisted in a long term cost analysis. The cost analysis included an escalating cost of water purchase at 3 percent per year to simulate inflation and the capital cost to construct the infrastructure was financed over a 25 year period at a 3.5 percent interest rate.

This was compared with the highest new WTP on the lake front option with a capital cost of $51,577,00 paid back over 30 years at 4.0 percent interest rate. The cost to staff, operate, and maintain the new plant was included with those costs of about $975,000 in 2015 then increasing 3 percent annually.

Figure 6.03-1 shows that the new WTP costs break even with the expiring of the loan repayments in 30 years, and then continue to show savings over the purchase of water beyond that term.

Figure 6.03-1 50-Year Annual Payment Trends For Purchased Water Versus New WTP



B. Construction of a New WTP at the Existing Public Works Site

This option would require removal of the Public Works Garage from its present location and construct a new direct membrane filtration plant on this downtown site. The Public Works Garage is located near a large water transmission main that would allow a new WTP at this location to feed the Village's distribution system with little noticeable differences in pressures or performance compared to the existing plant site. The site is currently used for municipal purposes, so there would technically be no change in use. However, redeveloping this property on the south end of the downtown business district for a new municipal/industrial use is not consistent with the Comprehensive Plan of the Village or the downtown plan update currently under review with the Village Plan Commission.

The construction of a new raw water transmission main to serve a WTP at this site would also be a costly and disruptive construction process. The other factor to take into account with the cost opinion for this alternate is the cost to construct a new public works garage facility estimated to be $10 million.

The development of this site for a new WTP will also consume half of the 164-space Temple Court parking lot as well as the Temple Court street and right-of-way, closing off vehicle access for this important transportation link at the south end of the downtown. Figure 6.03-2 shows an aerial depiction of the required site for the WTP operation for this proposed alternative location.

C. Lakefront Options

The original WTP, like many Lake Michigan WTPs, was built at the lakefront for one key reason, which is the cost. It is more cost effective to collect and treat the water closest to the source, rather than lift the water up to an inland plant and treat it before sending it to the distribution system. That trend continues today and the lakefront options where a new plant is constructed on vacant land are still the most affordable.

Because the probable cost to construct the new plant on the existing site requires the Village to demolish the existing plant, then purchase water from Highland Park for the entire duration of construction, its cost is higher than the other lakefront options at $51,577,000. This is compared to a probable cost of $48,421,00 if constructed to the north or to the south of the existing plant, which requires less expected water purchase from Highland Park during construction. However, this cost does not take into consideration any land purchase costs or the considerations of the intangible costs associated with the existing beach.

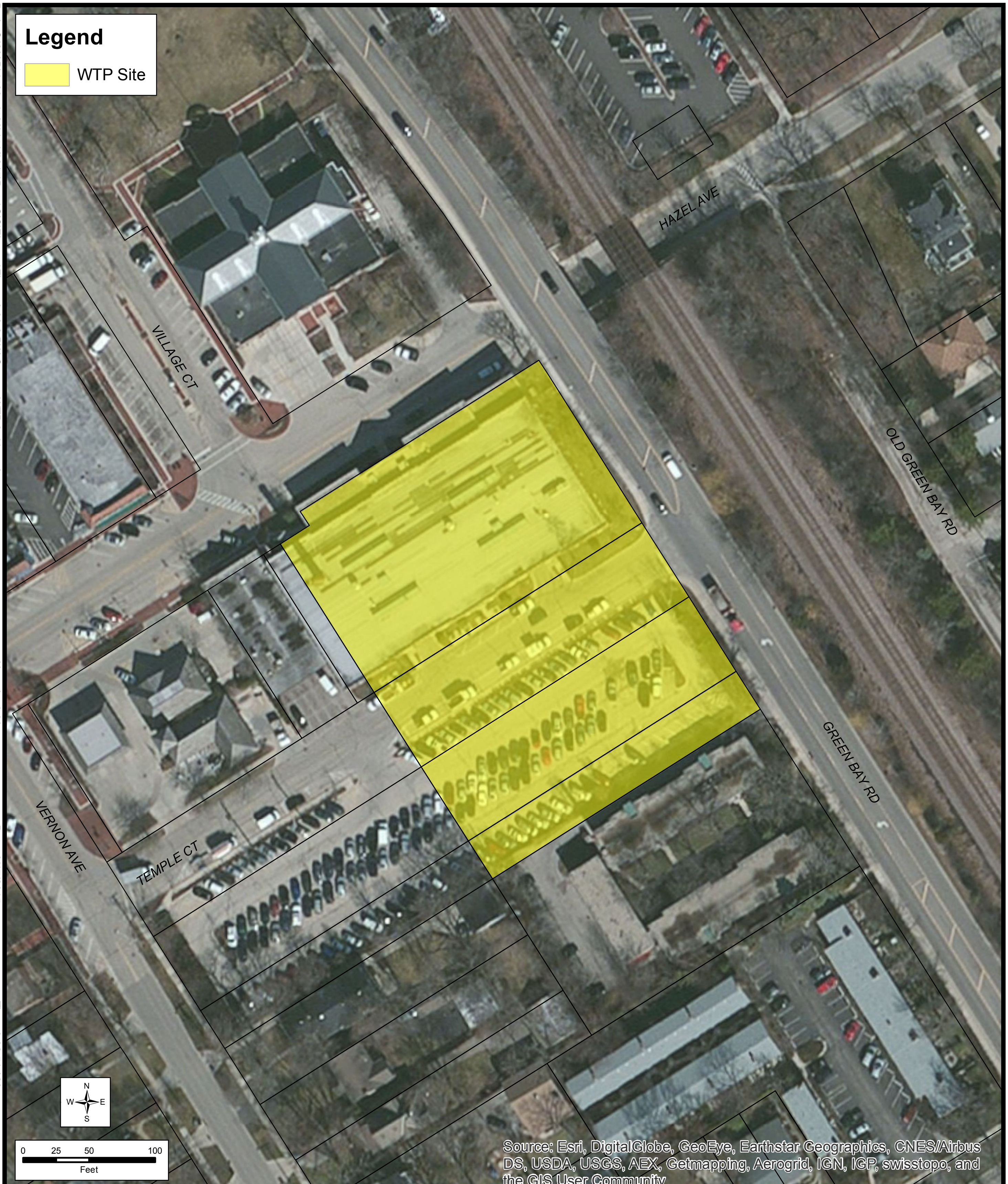
Construction of the plant on the lakefront, whichever of the three options are selected, has the lowest probable construction cost compared to other new WTP options. It provides a completely renewed facility with the latest treatment technology, and it also provides an overall probable cost savings every year starting in about 30 years. If the Village Board determines that a new plant is the appropriate long-term water supply option, we recommend a lakefront option be selected.

Path: S:\MAD\1400--1499\1410\015\Data\GIS\Figures\Figure 6.03-2 PW Garage WTP 8x11.mxd

User: justinbi

Date: 3/17/2015

Time: 9:32:51 AM



PUBLIC WORKS GARAGE SITE ALTERNATIVE

WATER SUPPLY PLANNING STUDY
VILLAGE OF GLENCOE
COOK COUNTY, ILLINOIS

STRAND ASSOCIATES®

FIGURE 6.03-2
1410.015