Drinking Water State Revolving Fund Project Planning Document

City of Kalamazoo FY 2025
Drinking Water Project Planning Document

Prepared for
City of Kalamazoo

May 2024

2240278

1 INTRODUCTION

The City of Kalamazoo is submitting this Fiscal Year 2025 Drinking Water Revolving Fund application for three individual project areas.

CHAPTER 1: Resubmittal of the previously approved FY2024 project plan which included Lead Service Replacements for Fiscal Years 2024-2028 (EGLE Project Number 7810-01).

CHAPTER 2: Proposed water pump station upgrades to Stations 5 & 14 in the City of Kalamazoo water system.

CHAPTER 3: Water main extensions in Richland and Ross Townships to provide potable water to areas affected by PFAS contamination.

This project plan is structured to provide three individual plan chapters, one for each of the proposed project areas. Because the areas and populations impacted are different for each project, each was treated as a stand-alone project when considering alternatives, impacts, and public communication. Additionally, the station upgrades and water main extensions are intended to be separately permitted given the nature of the proposed improvements.

The entire three area project plan of the proposed lead service replacements, station upgrades, and watermain extensions is estimated to cost $110,264,000. If the entire project plan is DWRF loan funded with an estimated 2.5 % interest rate for a 20 year period, the expected annual debt service for the proposed project based on the DWRF loan criteria will be approximately $7,039,600 per year.

With the current number of 73,440 REU in the entire water system, the potential debt service and added O&M cost associated with the improvements, there will be a usage cost increase of approximately $106.00 per year per REU.

The Project Plan Resolution and the Overburdened Calculation are included in the document prior to the individual project chapters as both cover the entire project plan of the three compiled project areas.

Project Plan Resolution

CITY OF KALAMAZOO

RESOLUTION NO. _____

A RESOLUTION ADOPTING A **FINAL PROJECT PLAN FOR WATER SYSTEM IMPROVEMENTS** AND **DESIGNATING AN AUTHORIZED PROJECT REPRESENTATIVE**

Minutes of a regular meeting of the Kalamazoo City Commission held on May 20, 2024 at 7:00 p.m., local time, in the City Commission Chambers at City Hall, 241 W. South Street.

PRESENT, Commissioners:

ABSENT, Commissioners:

WHEREAS, the City of Kalamazoo recognizes the need to make improvements to its existing water treatment and distribution system; and

WHEREAS, the City of Kalamazoo authorized Prein&Newhof, Inc. to prepare a Project Plan, which recommends the replacement of existing lead/galvanized water services, improvements to water supply Stations 5&14, and water main extensions in Richland and Ross Townships; and

WHEREAS, said Project Plan was presented at public meetings held on April 17, 2023 for the lead service line replacements, on April 15, 2024 for the Richland/Ross extensions, and April 23, 2024 for the Station upgrades. All public comments have been considered and addressed.

NOW THEREFORE BE IT RESOLVED, that the City of Kalamazoo formally adopts said Project Plan and agrees to implement the replacement of existing lead/galvanized water services, improvements to water supply Stations 5&14, and water main extensions in Richland and Ross Townships in the City of Kalamazoo Water System.

BE IT FURTHER RESOLVED, that the City Engineer, a position currently held by James J. Baker, P.E., is designated as the authorized representative for all activities associated with the project referenced above, including the submittal of said Project Plan as the first step in applying to the State of Michigan for a Drinking Water Revolving Fund Loan to assist in the implementation of the selected alternatives.

The above resolution was offered by _____ and supported by _____.

AYES, Commissioners:
NAYS, Commissioners:

ABSTAIN, Commissioners:

RESOLUTION DECLARED ADOPTED

CERTIFICATE

The foregoing is a true and complete copy of a resolution adopted by the City Commission of the City of Kalamazoo at a regular meeting held on May 20, 2024. Public notice was given and the meeting was conducted in compliance with the Michigan Open Meetings Act (PA 267 of 1976). Minutes of the meeting will be available as required by the Act.

_____

City Clerk

Overburdened Calculation

Overburdened and Significantly Overburdened Calculation Worksheet

2. Median Annual Household Income (blended if necessary)	$60,624		
3. Taxable Value Per Capita (blended if necessary)	$32,779		
4. Amount of anicipated debt - FY25 SRF loan only	$110,264,000		
Terms	20		
Rate	2.50%		
New Annual debt from SRF loan	$7,073,119		
5. Annual Payments on existing debt	$8,649,102		
6. Total OM&R	$30,561,522		
7. Number of REUs	73440		
Total Annual Cost	$46,283,743		
Annual User Cost	$630		
MAHI Threshold $ Amount	**$606**		
Loan Threshold $ Amount	$82,800,723		**Result**
125% of Federal Poverty MAHI	$39,000	**Significantly Overburdened**	**NO**
Lowest 10% TVPC	$16,634	**Significantly Overburdened**	**NO**
Lowest 20% TVPC	$23,778	**Overburdened without calculation needed**	**NO**
Michigan MAHI	**$66,986**	**Overburdened with calculation**	**YES**

Letter of Support

May 15, 2024

James Baker, PE
Department of Public Services
415 Stockbridge
Kalamazoo, MI 49001

RE: Letter of Support

Dear James Baker:

I am writing in support of the City of Kalamazoo's application for the State of Michigan's Drinking Water State Revolving Loan Fund (DWSRF) low interest financing for planned Kalamazoo Public Water Supply (WSSN 03520) projects. The City of Kalamazoo's proposed projects for the DWSRF financing include those that will improve water quality and public health throughout the entire Kalamazoo County through PFAS treatment at Kalamazoo Water Treatment Plants, extensions of municipal water supply to provide alternatives to PFAS contaminated residential wells in Richland and Ross Townships and continued lead/galvanized service replacements. Our departments have a long history of collaborating on matters concerning PFAS response and actions to improve water quality in both municipal water supplies and private residential wells.

You and your department have been a leader on issues related to PFAS response and mitigation and have worked diligently to address community concerns related to PFAS. I believe the projects you propose in your application for DWSRF financing are important, valuable, and will further benefit the surrounding community by addressing sources of PFAS within the community.

I strongly support your application for DWSRF financing and look forward to our continued collaboration. Please let me know if I can be of any assistance to you on this matter.

Sincerely,

James A. Rutherford
Health Officer/Director

Drinking Water State Revolving Fund Project Chapter 1 – Resubmittal of FY24 Multi-Year Project Plan for Lead Service Replacements

1 INTRODUCTION

In Fiscal Year 2024, the City of Kalamazoo submitted a multi-year DWSRF project plan that was approved by EGLE. The projects slated for FY2024 were funded under DWSRF Project Number 7810-01. A copy of that agreement is in Appendix A.

This FY2025 Project Plan includes the continuation of the previously submitted and approved FY24 DWSRF Project Plan for Non-copper water service replacements.

Table 1, from the FY24 PP, indicates the number of service replacements planned for the multi-year project.

Fiscal Year	2024	2025	2026	2027	2028
Services	2,500	1,700	1,500	1,200	1,100

2 BACKGROUND

The FY25 service area can be seen in Figure 1. The current population of the FY25 project area is 7,567. Based on the population projections from the 2022 City of Kalamazoo Water Reliability Study, the 2044 projected population for the project area is 8,444. The area is currently nearly fully developed and land use is not expected to change.

3 SCHEDULE FOR DESIGN AND CONSTRUCTION

Milestone	Date
Hold Public Meeting	April 2024
Submit Final Project Plan to EGLE	June 2024
Receive Funding Determination	September 2024
User Charge System Approved	January 2025
Plans and Specifications Approved	May 2025
Bid Advertisement	May 2025
Receive Construction Bids	June 2025
EGLE Order of Approval	August 2025
Begin Construction	April 2026
Construction Completed	October 2027

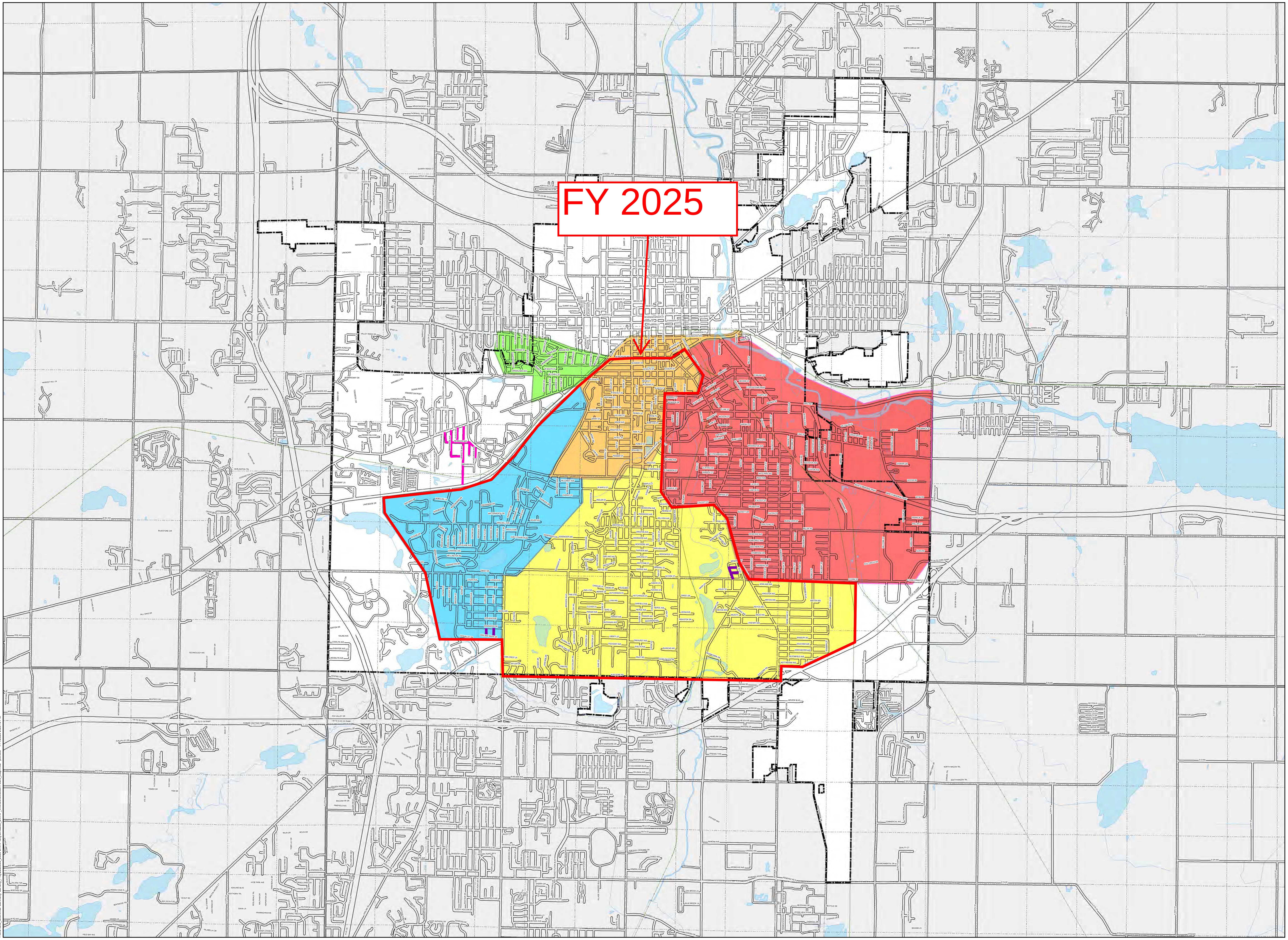
4 COST SUMMARY

The City of Kalamazoo has performed additional investigations for non-copper services in the FY25 project area bringing the total number of services to be replaced down to 1,300.

A revised cost estimate for FY25 service replacements can be found in Appendix B.

Based on a project cost of $13,000,000, a project loan funded at 2.5% for 20 years would require an annual payment of $829,960. Given the calculated number of 73,440 Residential Equivalent Units in the system, the anticipated annual cost of $11.30/REU is anticipated for the FY25 Non-copper service replacement project.

Figures



LEGEND

DWRF Construction Years

- FY 2024
- FY 2025
- FY 2026
- FY 2027
- FY 2028
- Lining Project
- Various Streets Project (2025)
- City of Kalamazoo Limits

0 1,000 2,000 4,000 6,000 Feet

Scale: 1" = 2,000'

City of Kalamazoo

Kalamazoo County, Michigan

Water Distribution System

DWRF Construction Year Map

Prein&Newhof

January 2023

2220555

Appendices

Appendix A FY24 DWRF Agreement
Appendix B Project Area Cost Estimate

Appendix A

FY24 DWRF AGREEMENT

Michigan Department of Environment, Great Lakes, and Energy (EGLE)
Drinking Water State Revolving Fund (DWSRF) Project Milestone
Schedule for 4th Quarter Financing in Fiscal Year 2024
Anticipated Loan Closing on August 28, 2024

Applicant Name: City of Kalamazoo

Project Number: 7810-01

Project Description: Water Main Replacement and Lining and Lead Service Line Replacement

Milestone	By No Later Than
EGLE Comments on Project Plan Submittal	01/12/2024
Submittal of Answers to EGLE Comments	02/02/2024
Equivalency Federal Cross-cutter Approvals	02/02/2024
Publication of Environmental Assessment (EA)	04/24/2024
Public Notice Clearance	05/24/2024
EGLE Approval of Project Plan	05/24/2024
Submittal of Draft Plans & Specifications	01/19/2024
EGLE Comments on Draft Plans & Specifications	02/23/2024
Submittal of Final Plans & Specifications	04/03/2024
Issuance of Construction Permit	05/17/2024
EGLE Approval of Plans & Specifications	05/24/2024
Submittal of DWSRF Application Part I	05/15/2024
Submittal of DWSRF Application Part II	05/15/2024
Submittal of DWSRF Application Part III (including Resolution of Tentative Contract Award)	07/08/2024
Publication of Bid Advertisement	05/24/2024
Opening of Bids	06/26/2024
Resolution of Tentative Contract Award by Governing Body	07/05/2024
EGLE Order of Approval	08/07/2024

As the authorized representative for this project, I understand that failure to adhere to this schedule may result in the bypass of this project and the assignment of funds reserved for it to other projects on Michigan's Project Priority List in accordance with the provisions of Section 5406 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

As the authorized representative for this project, I understand that failure to adhere to this schedule may result in the deferral of EGLE action on this project until a subsequent fiscal year.

Accepted on 11/29/2023 By: James J. Baker, PE
Applicant's Authorized Representative

Accepted on 11/29/2023 By: Valorie White
Project Manager, Finance Division
Water Infrastructure Funding and Financing Section

Approved on 11/29/2023 By: Eric Pocan
Unit Supervisor, Finance Division
Water Infrastructure Funding and Financing Section

Appendix B

PROJECT AREA COST ESTIMATE

City of Kalamazoo
FY 2025 Non-copper Water Service Replacements

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EXTENDED PRICE
1	Mobilization	1	LS	$100,000.00	$100,000.00
2	Water Service Potholing	850	EA	$605.00	$514,250.00
3	Water Service - Long	500	EA	$3,369.01	$1,684,507.00
4	Water Service - Short	500	EA	$2,237.38	$1,118,689.00
5	Water Service - Yard	1000	EA	$2,609.50	$2,609,497.00
6	Water Service - Private	45	EA	$3,575.00	$160,875.00
7	Ford Box	45	EA	$1,595.00	$71,775.00
8	2" Service	4	EA	$4,950.00	$19,800.00
9	Copper Tubing, Additional Length, 2"	100	FT	$93.50	$9,350.00
10	2" Meter Vault	1	EA	$7,425.00	$7,425.00
11	Abandon Blind	400	EA	$522.50	$209,000.00
12	Plumber	2200	HR	$214.50	$471,900.00
13	Sidewalk Remove & Replace	45,000	SF	$9.35	$420,750.00
14	Curb Remove & Replace	10,000	LF	$51.23	$512,270.00
15	Road or Driveway Remove & Replace COK (Exhibit A)	7,700	SY	$95.82	$737,821.70
16	Road or Driveway Remove & Replace COK Winter (Exhibit B)	3700	SY	$129.37	$478,672.70
17	Road or Driveway Remove & Replace RCKC (Exhibit C)	130	SY	$36.30	$4,719.00
18	HMA Driveway Remove & Replace	350	SY	$89.05	$31,165.75
19	Stamp Concrete	370	SY	$217.23	$80,374.36
20	Traffic Control	1	LS	$400,000.00	$400,000.00
21	HMA 13A	500	TON	$259.88	$129,937.50
22	HMA, MDOT 4E	1100	TON	$259.88	$285,862.50
23	HMA, MDOT 5E	1350	TON	$158.13	$213,468.75
24	Milling, 2"	250	SY	$2.53	$632.50
25	Milling, 1.5"	5000	SY	$1.21	$6,050.00
26	Gravel Driveway, 8" 22A	100	SY	$34.65	$3,465.00
27	Water Filter	1300	EA	$26.40	$34,320.00
28	Meter Setting	1300	EA	$623.98	$811,167.50
29	Curb Valve	10	EA	$220.00	$2,200.00
30	Curb Box	10	EA	$247.50	$2,475.00
31	Miscellaneous Repair Allowance	1	LS	$10,000.00	$10,000.00
TOTAL BID:					$11,142,420.26
Total w/ 25% Contingency:					$13,928,025.33

Drinking Water State Revolving Fund Project
Chapter 2 – Stations 5 & 14 Upgrades

THE CITY OF Kalamazoo

2025 Drinking Water State Revolving Fund Project Plan

Pump Station 5 and 14 Upgrades

DWSRF Project Number: To Be Determined
May 2024

TETRA TECH

2025 Drinking Water State Revolving Fund Project Plan

PUMP STATIONS 5 AND 14 UPGRADES

DWSRF Project Number: To Be Determined
May 2024

PRESENTED TO

City of Kalamazoo
Department of Public Services
1415 North Harrison Street
Kalamazoo, MI 49007

PRESENTED BY

Tetra Tech
3497 Coolidge Road
East Lansing, MI 48823

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TETRA TECH

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ATS	Automatic Transfer Switch
DNR	Michigan Department of Natural Resources
DWSRF	Drinking Water State Revolving Fund
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EPA	United States Environmental Protection Agency
FEMA	United States Federal Emergency Management Agency
FWS	United States Fish and Wildlife Service
GAC	Granular Activated Carbon
gpm	Gallons per Minute
LSL	Lead Service Line
MCL	Maximum Contaminant Level
MDOT	Michigan Department of Transportation
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MNFI	Michigan Natural Features Inventory
NREPA	Natural Resources and Environmental Protection Act
O&M	Operations and Maintenance
PFAS	Per- and Polyfluoroalkyl Substances
PO_4	Phosphate
PPT	Parts per Trillion
psi	Pounds per Square Inch
SHPO	State Historical Preservation Office
SRF	State Revolving Fund
USEPA	United States Environmental Protection Agency
WIFFS	Water Infrastructure Funding and Financing Section
WPS	Well Pump Station
WTP	Water Treatment Plant

1.0 SUMMARY AND RECOMMENDATIONS

1.1 SUMMARY

The City submitted an intent to apply for Fiscal Year 2025 Drinking Water State Revolving Fund (DWSRF) financing to fund pump stations 5 and 14 upgrades. The DWSRF provides financial assistance in the form of low interest loans to assist water suppliers meet the requirements of the Safe Drinking Water Act. The current interest rate for Fiscal Year 2024 loans is 2.5% for a 20-year loan. Interest rates may change for Fiscal Year 2025.

The DWSRF program requires a Project Plan to be submitted to Michigan Department of Environment, Great Lakes, and Energy (EGLE) by June 1, 2024, in order to be on the project priority list for Fiscal Year 2025 (October 1, 2024, to September 30, 2025). The City's Project Plan was prepared using the *DWSRF Project Plan Preparation Guidance Manual* with assistance from the EGLE Water Infrastructure Funding and Financing Section (WIFFS).

1.2 RECOMMENDATIONS

The City's drinking water system was reviewed to evaluate existing and projected future conveyance and treatment capacities, the condition of major equipment and facilities, and operations and maintenance tasks. The Project Plan details the project recommended for implementation within the next five years. This project is recommended because it improves the existing infrastructure and protects human health. The total opinion of cost to implement the recommended alternative is $51.3 million. The proposed project is summarized as follows:

Project 1, Pump Stations 5 and 14 Upgrades

Project 1 proposes to upgrade Pump Stations 5 and 14 with additional water treatment to remove iron and PFAS to meet regulatory standards. The existing pump stations do not currently have a way to remove these pollutants. Water treatment is recommended to remove levels of iron and per- and polyfluoroalkyl substances (PFAS) that may negatively impact human health if not treated.

2.0 PROJECT BACKGROUND

The City's drinking water needs are based on comprehensive reviews of its water system and other planning information. This Project Plan was developed using the information presented in the following reports:

- *DWSRF Project Plan for City of Kalamazoo*, May 2023
- *Kalamazoo Water System Capacity Study*, April 2022
- *Water System Reliability Study, December 2022*
- *Water Asset Management Plan, December 2017*
- *Kalamazoo Master Plan*, October 2017

2.1 DELINEATION OF STUDY AREA

The existing service area includes all of the City and portions of the cities of Parchment and Portage as well as Kalamazoo, Comstock, Cooper, Oshtemo, Texas, Pavillion, and Richland Townships. The City has almost 200,000 customers in the 170 square mile service area. The study area includes a portion of the existing service area from Spring Valley Drive to Schippers Lane along Henson, Junction, Trimble, and Wallace Avenues. ***Figure 2-1*** shows the study area.

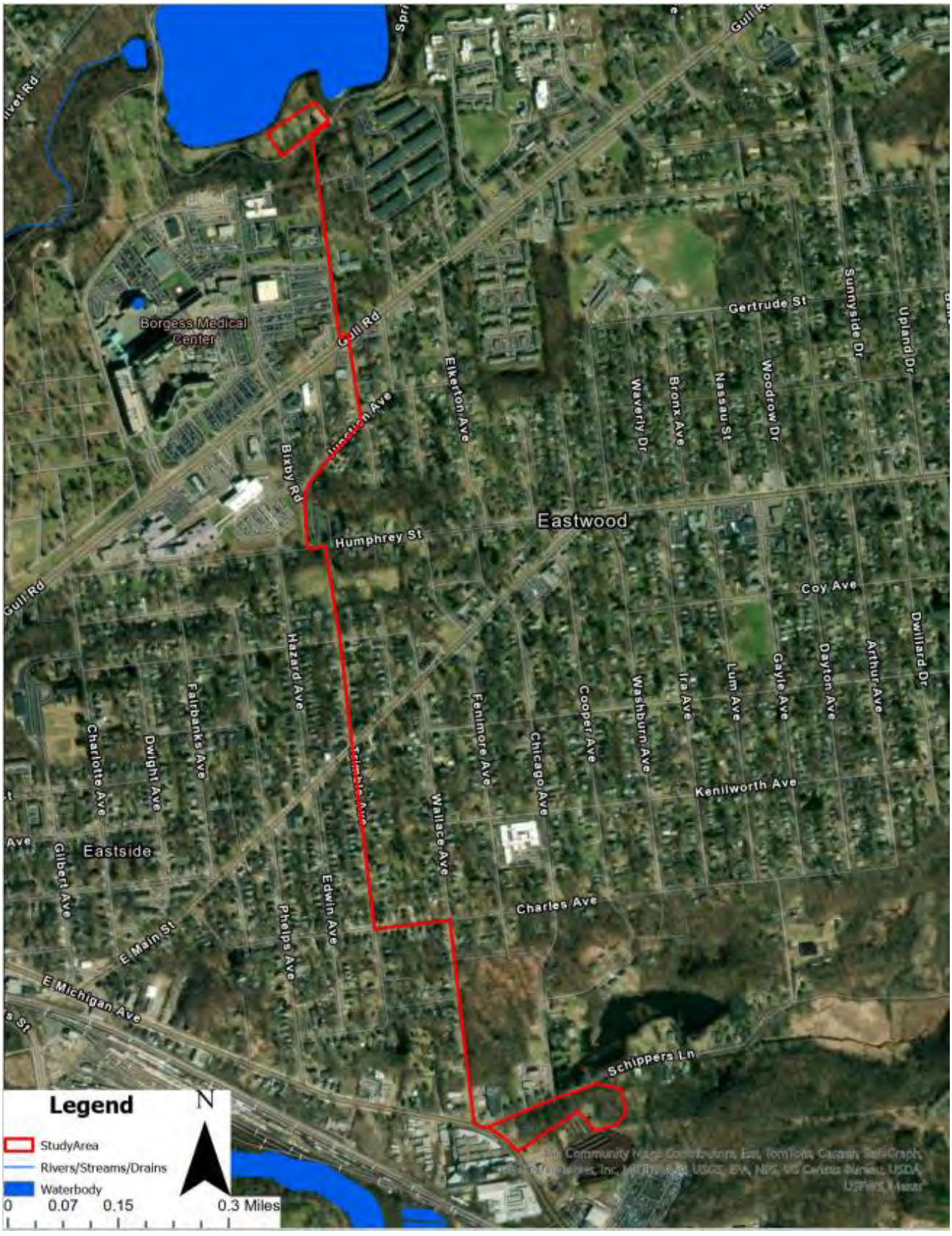
2.2 POPULATION PROJECTIONS

The City's population declined between 2010 and 2020, but the City projects the population will increase by 0.5 percent per year during the planning period. ***Table 2-1*** summarizes population projections for the entire City and the water service area, which includes additional cities and townships.

Table 2-1. Population Projections

Year	Kalamazoo Service Area	City of Kalamazoo
2010 Census	-	74,262
2020 Census	196,292	73,598
2022 U.S. Census Bureau Estimate	-	72,873
2024 projection	200,247	73,604
2029 projection	205,304	75,462
2044 projection	221,252	83,378

Figure 2-1. Study Area Map



2.3 EXISTING ENVIRONMENT EVALUATION

2.3.1 Cultural and Historic Resources

Orbis Environmental Consulting conducted a historical evaluation which is included in Appendix A. There are no anticipated impacts to any historical, archeological, or cultural resources. Additional evaluation for potential resources will be completed during the design phase.

2.3.2 Air Quality

National Ambient Air Quality Standards are health-based standards set by the United States Environmental Protection Agency (USEPA). The City is in attainment for carbon dioxide, lead, nitrogen dioxide, particulate matter, sulfur dioxide, and ozone. The project is not anticipated to negatively impact the air quality.

2.3.3 Wetlands

Wetlands are located north of Spring Valley Drive along Spring Valley Lake and along Schippers Lane in the study area. Wetlands are within the project limits at Schippers Lane and a delineation was completed. The delineation is included in the basis of design from Wightman in Appendix G. The necessary permit will be obtained and impacts to wetlands will be minimized and/or mitigated. ***Figure 2-2*** shows wetlands from the National Wetland Inventory within the study area.

2.3.4 Great Lakes Shorelands, Coastal Zones, and Coastal Management Areas

There are no coastal zones within the study area.

2.3.5 Floodplains

There are no floodplains within the study area. ***Figure 2-3*** shows the 100-year floodplains from FEMA within the surrounding area.

2.3.6 Natural or Wild and Scenic Rivers

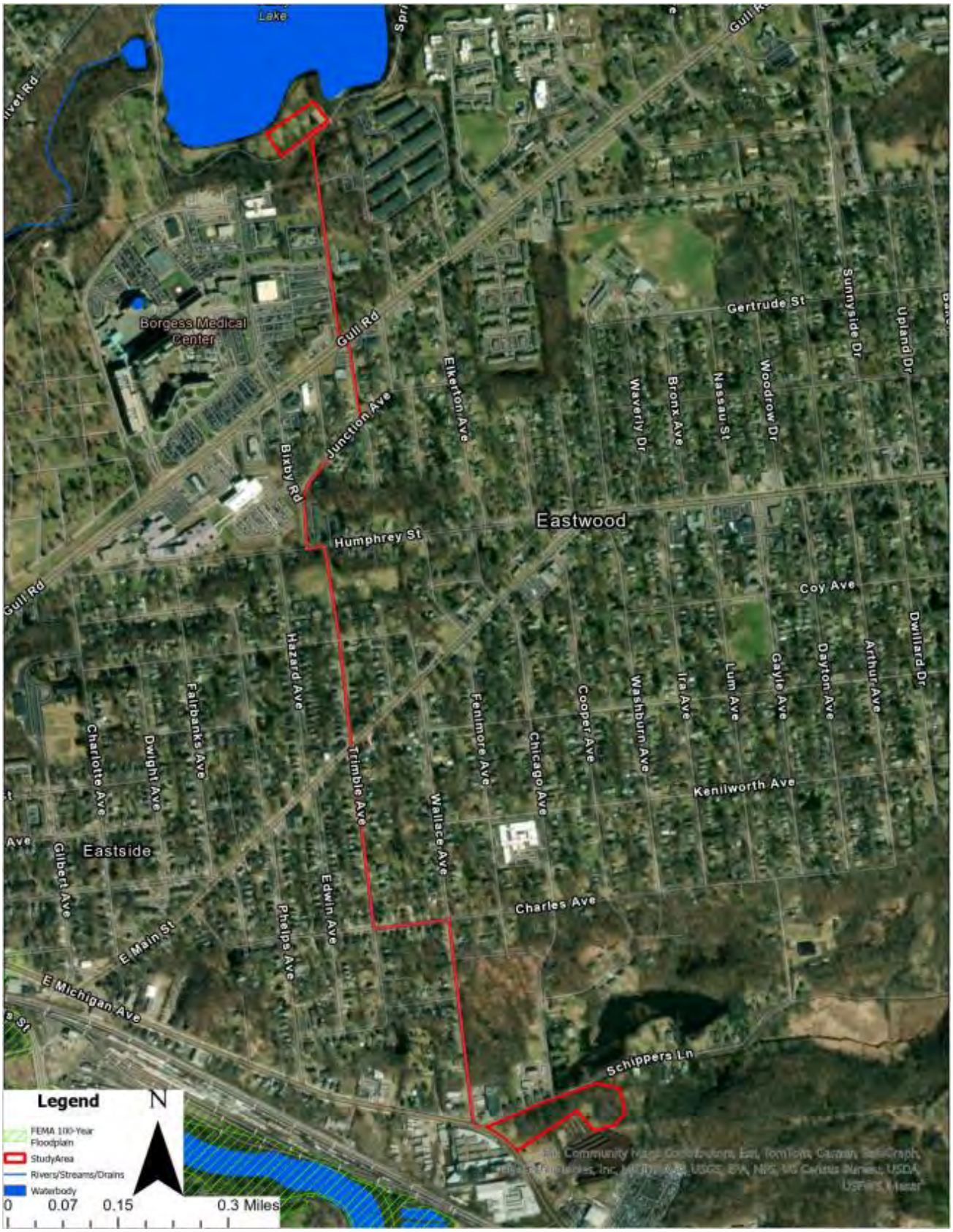
There are no designated Michigan Natural Rivers listed by the Michigan Department of Natural Resources (DNR) or National Wild and Scenic Rivers listed by the United States Fish and Wildlife Service (FWS) within the study area.

2.3.7 Major Surface Waters

The Kalamazoo River and Portage Creek are within the service area, but not the study area. No project work will impact any major surface waters.

Figure 2-2. Wetlands Map

Figure 2-3. Floodplain Map



2.3.8 Topography

Some topography changes are expected within the project scope for grading at Station 5. ***Figure 2-4*** includes the existing topography of the study area.

2.3.9 Geology

No proposed geology changes or dewatering are included within the project scope.

2.3.10 Soil Types

Soil within the study area is mostly sand and gravel. No removal or additional soil is anticipated outside of the study area. Appendix B includes a map of the existing soil types in the project area.

2.3.11 Agricultural Resources

The proposed project is in a residential area and not anticipated to be constructed near farmland.

2.3.12 Recreational Areas

The study area includes a park along Spring Valley Lake. Impacts to local recreational areas will be minimized as much as possible.

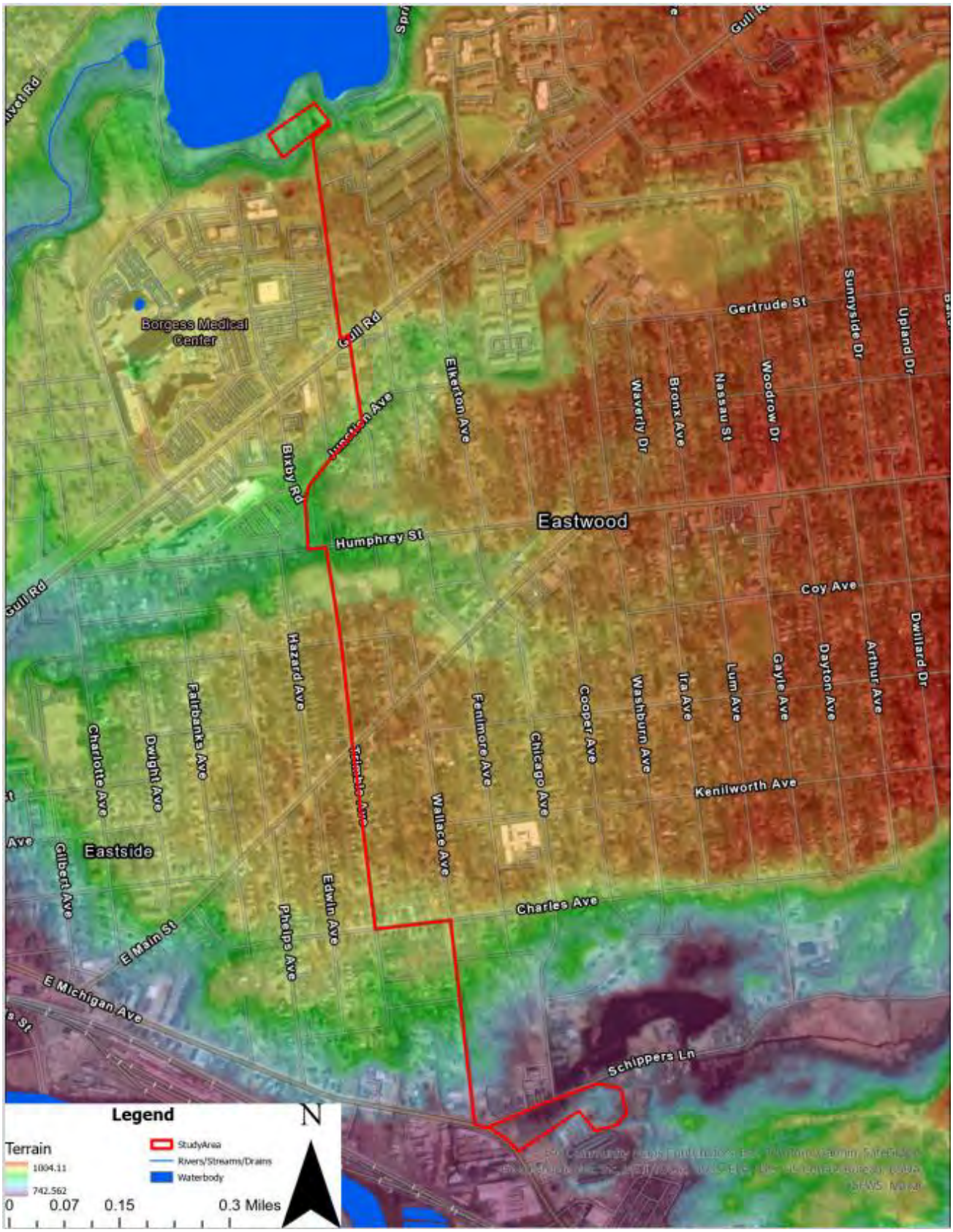
2.3.13 Fauna and Flora

The existing plant and animal species are typical to urbanized areas. No habitat for animals of economic or sport value is within the study area. Appendix C contains the *Orbis Threatened and Endangered Species Desktop Review* with correspondence from applicable environmental agencies.

Project work located in already-developed areas where there is minimal habitat present for threatened and endangered species is expected to have “no effect” on the listed species, their habitats, or proposed or designated critical habitat.

Project work in undeveloped areas around PS 5 and 14 may impact local wildlife and plants. During the design phase, additional reviews will be made to determine if the habitat or species will be impacted. If there are any concerns, appropriate actions will be taken to avoid these areas and/or mitigate any disturbance so that the species are protected.

Figure 2-4. Topography Map



2.4 EXISTING SYSTEM

The City operates and maintains its own water distribution system for its residents and surrounding municipalities. The *Water System Capacity Study* provides details on the City's drinking water system.

2.4.1 Water Supply, Pump Stations, and Treatment

The system is supplied by 90 groundwater wells which are operated by 13 well pump stations (WPS). WPS 2, 17, and 18 are not in use due to water quality concerns. ***Table 2-2*** modified from the *Water System Capacity Study* provides a summary of the well pump stations.

Water treatment is provided at each WPS. The water may be treated depending on the well by chlorination, fluoridation, addition of phosphate for corrosion control, air stripping and aeration for volatile organic compound removal, and iron and manganese removal. All the active well pump stations are equipped to treat water with chlorination, fluoridation, and phosphate addition. WPS 1 and 11 are also set up for air stripping as well as iron and manganese removal.

Table 2-2. Summary of Well Pump Stations

WPS	Station Name	Number of Wells	Total Well Capacity (gpm)	Number of Pumps	Firm Pumping Capacity (gpm)	Station Capacity Total Pumping Capacity (gpm)
1	Central Water Treatment Plant	6	9,000	4	7,500	7,500
2+	Born Court	1	2,000	1	0	1,300
3/7	Balch Street	7	3,100	2	1,900	3,800
4	Maple Street	8	4,000	3	2,200	2,200
5	Schippers Lane	4	1,400	1	0	1,200
8	East Kilgore Road	5	2,350	1	0	2,400
9	West Kilgore Road	12	4,400	3	3,200	3,200
11	Kendal Avenue	7	2,350	2	1,800	1,800
12	DeHaan	4	1,600	1	0	1,200
14	Spring Valley	5	1,750	1	0	1,600
17+	Konkle Avenue	1	500	1	0	500
18+	Emerald Drive	2	1,250	2	500	1,250
22	Colony Farm	6	3,300	1	2,200	4,400
24	Atwater	16	9,700	4	9,600	9,600

WPS	Station Name	Number of Wells	Total Well Capacity (gpm)	Number of Pumps	Firm Pumping Capacity (gpm)	Station Capacity Total Pumping Capacity (gpm)
25	Campbell	9	4,550	3	3,350	4,500
39	Morrow Lake	1	2,600	2	1,300	2,600

[+]Station is decommissioned.

2.4.2 Storage Tanks

The City has 10 storage tanks with a total storage volume of 18.95 MG, which are listed in ***Table 2-3*** with their locations, years constructed, types, and volumes. The *Water System Capacity Study* provides further details about the storage tanks.

Table 2-3. Summary of Storage Tanks

Location	Year Constructed	Type	Volume (MG)
Edgemoor	1939	Elevated	0.75
Siesta	2019	Elevated	2.50
Gull Road	1982	Elevated	1.50
Mount Olivet	1955	Elevated	0.50
Parchment	1973	Elevated	0.20
Stadium Drive	2005	Elevated	1.50
6th Street South	2005	Elevated	1.00
6th Street North	2023	Elevated	1.50
Beech	2007	Elevated	2.50
Blakeslee	1932	Below Ground	7.00

2.4.3 Booster and Bleeder Stations

The City operates 16 booster and bleeder stations to adequately distribute water to all 11 pressure districts. ***Table 2-4*** from the *Water System Capacity Study* provides a summary of the booster and bleeder stations.

Table 2-4. Summary of Booster and Bleeder Stations

	Station Name	Type	Boost (gpm)	Firm Boost (gpm)	Number of Pumps	Bleed (gpm)
6	Parker	Booster/Bleeder	2,400	0	1	700
10	East Main	Booster/Bleeder	2,000	0	1	1,000
11A	Kendall	Booster	1,600	500	4	-

	Station Name	Type	Boost (gpm)	Firm Boost (gpm)	Number of Pumps	Bleed (gpm)
21	Miller Road	Bleeder	-	-	-	1,400
23	Gull Road	Booster/Bleeder	1,000	0	1	650
26	North Westnedge Avenue	Bleeder	-	-	-	750
27	North 28th Street	Booster/Bleeder	750	0	1	500
28	Beech	Booster/Bleeder	1,600	800	2	800
29	9th Street	Booster	1,600	800	2	-
30	Siesta	Bleeder	-	-	-	2,400
31	Prairie	Booster	3,200	1,600	2	-
32	Almena	Bleeder	-	-	-	2,500
33	33rd Street	Bleeder	-	-	-	1,300
34	KL Avenue	Bleeder	-	-	-	2,500
35	KL Avenue – US131	Booster/Bleeder	1,000	0	3	750
36	West Main	Bleeder	-	-	-	5,700
40	Q Avenue	Booster	1,630	630	4	-
41	West Main/Josaine	Bleeder	-	-	-	8,800
42	Spanish	Bleeder	-	-	-	3100
43	East G Avenue	Bleeder	-	-	-	3100
44	Park Avenue	Bleeder	-	-	-	3100
60	Mt Olivet & Riverview	Bleeder	-	-	-	100
62	Big Rock	Bleeder	-	-	-	100

2.4.4 Water Distribution System

The City owns over 800 miles of water main, almost entirely cast or ductile iron, and with diameters ranging in size from 2- to 30-inch. The oldest water mains that are still in use were constructed in 1887.

2.4.5 Residuals Handling

Treatment processes and residual handling at the Water Treatment Plant are not being changed. Therefore, there are no negative impacts associated with residuals.

2.4.6 Water Meter and Reading Infrastructure

The City maintains an active water efficiency program to minimize water loss, maintain accurate records, and maximize revenue. Water meter testing and replacement is included in the program. A replacement schedule with refurbished or new meters is set up for meters every 10 years in residential areas or 3 years in commercial and industrial areas.

2.4.7 Design Capacity

Table 2-5 summarizes the recent and projected future demands for Pump Stations 5 and 14. The *Water Reliability Study* provides details on the demand development.

Table 2-5. Recent and Projected Future Demand

	Demand (MGD) Stations 5 and 14		
	2022	2027	2042
Average Day Demand	0.88	0.90	0.95
Maximum Day Demand	2.80	1.67	1.76
Peak Hour Demand	4.20	2.51	2.64

2.5 SUMMARY OF PROJECT NEED

2.5.1 Compliance with Drinking Water Standards

The City's water system is not in compliance with EPA drinking water standards for PFAS. Station 14 is in exceedance of the newly established EPA regulations with 4.2 parts per trillion (ppt) out of a maximum contaminant level of 4.0 ppt. The proposed project will ensure compliance with drinking water standards and reduce the risk of any potential non-compliance by addressing water quality concerns of PFAS and iron concentrations.

2.5.2 Orders of Enforcement Actions

There are two ongoing enforcement orders against the City. An Administrative Consent Order was issued December 3, 2020 for the *Water System Capacity Study*. There are also ongoing corrosion control upgrades following an enforcement order to complete system-wide corrosion control optimization.

2.5.3 Water Quality

The City has documented water quality problems of detectable PFAS and iron concentrations at pump stations 5 and 14 as described in Section 2.5.1. The proposed project is expected to provide water quality benefits by adding water treatment for iron and PFAS removal at those pump stations.

2.5.4 Projected Needs for the Next 20 Years

Project needs for the next 20 years beyond those listed in the Project Plan are documented in the *Water System Reliability Study*. Future needs are primarily related to maintaining existing infrastructure, replacing old, undersized water main and constructing new water main to connect existing mains for improved water quality and distribution.

2.6 EXPLORATORY WELL INVESTIGATIONS/WELL SITE SELECTION/TEST WELL DRILLING PROCEDURES

No new water supply wells are included in the proposed project.

3.0 ANALYSIS OF ALTERNATIVES

The alternatives analysis examines the project objectives, constraints, and cost-effectiveness over a 20-year planning period.

3.1 NO ACTION

No action would retain the existing, aging infrastructure. Not treating the raw water from PS 5 and 14 will negatively impact future water quality leading to non-compliance with state and federal regulations.

3.2 OPTIMUM PERFORMANCE OF EXISTING FACILITIES

The existing water system is performing as well as it can and additional staffing, staff training, and operational changes are not likely to improve the performance of the system because the primary concerns are related to the condition of the infrastructure. Therefore, this alternative was not considered further.

3.3 REGIONALIZATION

There are no regional alternatives since the City of Kalamazoo water system is the regional system.

3.4 CONSTRUCTION ALTERNATIVES

3.4.1 Pump Station 5 and 14 Upgrades

3.4.1.1 Alternative 1, Pump Station 5 and 14 Consolidated WTP

Alternative 1 proposes the implementation of a single consolidated 3,000-gpm capacity water treatment plant near PS 5. This facility would treat the combined flows from PS 5 (1,400 gpm) and from PS 14 (1,600 gpm), which is located approximately 1.3-miles north of proposed plant site. Improvements and upgrades to the pumps and treatment processes at each station are included in alternative 1 as well as a new 9,000-feet raw water transmission main to convey flows from PS 14. Details of these improvements, including a summary of the treatment processes the plant will be equipped, with are outlined below:

- **Upgrades to Well Pumps (PS 5 and 14):** The existing well pumps at both pump stations need replacement due to their age. The existing wells will be cleaned and inspected for leaks. Consequently, all wells at these stations will undergo replacement with new units having similar flow rates to the existing pumps, ensuring enhanced performance. The recommendation involves installing a total of four replacement well pumps at PS 5 and five well pumps at PS 14. These replacements are designed to efficiently handle the rated capacities of 1,400 gpm at PS 5 and 1,600 gpm at PS 14. Dedicated well pump houses will be constructed to house these newly installed replacement pumps.
- **Booster Pumps Upgrades (PS 5 and PS 14)**: At PS 14, the current configuration includes a single horizontal split case booster pump, rated at 1600 gpm flow and 180 feet head. The recommendation is to replace this existing horizontal split case booster pump with two new vertical turbine pumps rated at 1600 gpm each rated at 120-feet of head. The pump type is recommended to be vertical turbine pumps instead of the horizontal split case pumps due to space constraints at the existing PS 14 building. The purpose of these pumps is to convey flow from PS 14 to PS 5 for further treatment before pumping into distribution system. The total head (120-feet) calculated for pumping is explained in detail in the next section. The new pumps will be on variable frequency drives to account for pumping with flow and head variations. This

arrangement ensures a firm capacity of 1600 gpm with the one pump out of service. The existing pump will be demolished, and new pumps will be housed in the existing PS 14 building.

Pump Station 5 improvements within this alternative include four new high-service pumps; three pumps are rated at 1,500 gpm each, and one rated at 700 gpm. These high-service pumps will be housed in a pump room located in a new treatment building at PS 5. This new facility will house all the recommended treatment processes for PS 5. This arrangement ensures a firm capacity of 3,700 gpm with the largest pump out of service.

- **New transmission main from PS 14 to PS 5**

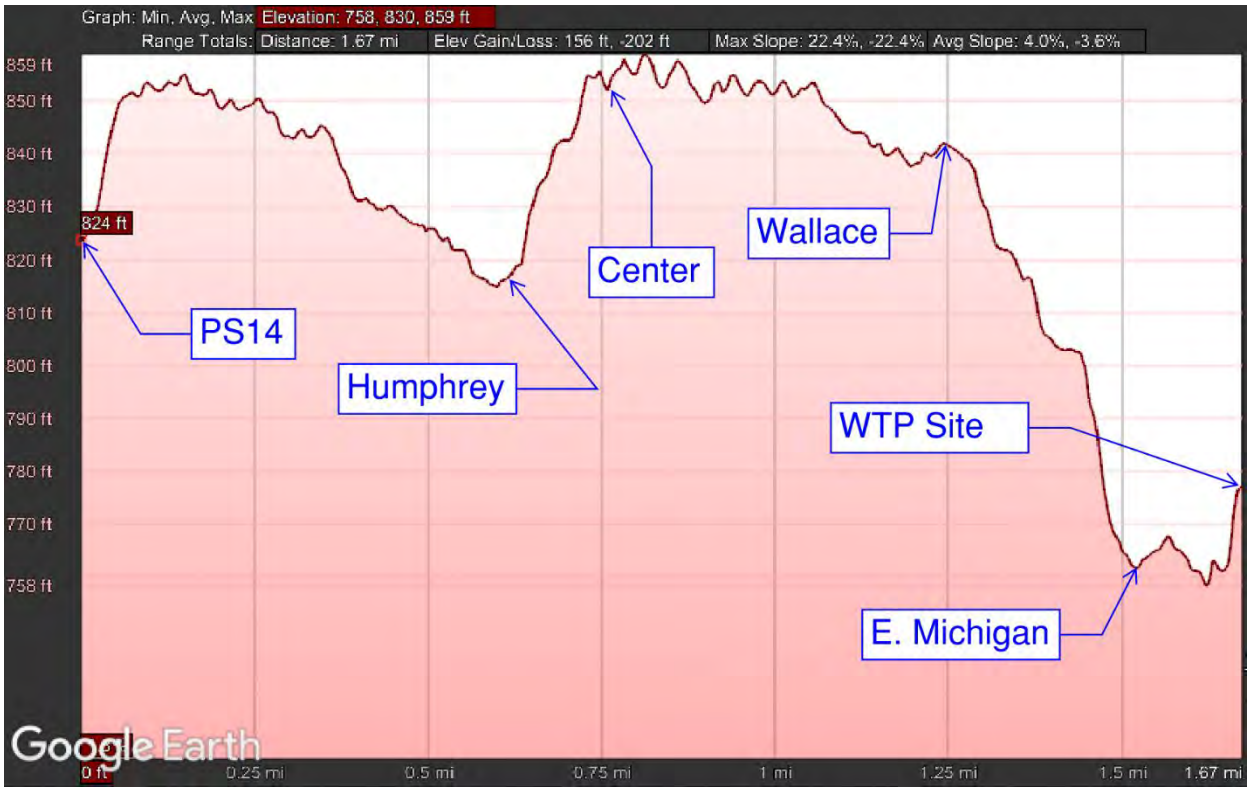
  As mentioned above, a new raw transmission main will be required to convey a flow rate of 1,600 gpm from PS 14 to the proposed consolidated treatment plant. PS 14 is located south of Spring Lake within the Spring Valley Park property. PS 5 and the plant site are located near the corner of E. Michigan Ave and Schippers Lane. A fairly direct alignment is possible routing the water main within public road rights-of-ways totaling approximately 9,000-feet. ***Figure 2-1*** shows the proposed transmission line.

  The proposed alignment is routed from PS 14 along Henson Ave to Junction Ave, where it shifts west to Humphrey St. There it jogs east 150-feet to Trimble Ave and continues south, crossing Main St to Charles Ave. At Charles Ave, the alignment again jogs east to Wallace Ave. Wallace Ave intersects E. Michigan Ave near Schippers Lane. The plant site is approximately 660-feet east on Schippers from the corner of E. Michigan Ave and Schippers Lane. Most of the alignment can be installed via open cut construction, however, jack and bore crossings may be required at Gull Rd and Main St. The main will likely be under the pavement and would require a minimum of one lane of pavement replacement. The final alignment may vary from this and will be based on the best route available while maintaining the required separation from existing water distribution mains and storm and sanitary sewer lines.

  The profile of this route is presented in ***Figure 3-1*** below with PS 14 being on the left and the WTP site on the right. Spring Valley Park is a regionally depressed area compared to the immediately surrounding grade, as indicated by the initial immediate 25-feet change in elevation from 824-feet to 850-feet. From there it is a gradual downhill slope to the low point of 815-feet at Humphrey St. There is a sharp incline along Trimble Ave to Center St, where the profile generally levels off to Charles Ave and across to Wallace Ave. At Wallace, the profile drops steeply, dropping 80-feet in elevation in a quarter mile.

  The 10-States Standards stipulate a minimum pressure of 20 psi at ground level at all points is required. Therefore, a static head of 60-feet is required. A 12-inch diameter pipe would result in velocities of 4.5-feet per second at 1,600 gpm and friction losses of 55-feet to reach Wallace, where a pressure control valve would be located to regulate pressures the remaining distance. The pumps would see a total dynamic head of 115 to 120-feet of head at 1,600 gpm. Combination air / vacuum valves will also be required at points along the transmission main.

Figure 3-1. Transmission Main Route Elevation Profile



- **Treatment Plant Processes at PS 5**

  Figure 3-2**Error! Reference source not found.** shows the proposed water treatment plant layout at PS 5.

  - **Groundwater Oxidation:** Water from the well pumps will be pumped into water holding tanks. Prior to reaching these holding tanks, chlorine will be injected into the well water. Chlorine feed rates shall be determined as required to oxidize iron and manganese removal levels in the raw water at a combined flow capacity of 3000-gpm.
  - **Oxidation/Detention Tanks:** The raw water to which chlorine has been added will be pumped into one of two water holding tanks. This step provides extended detention time and allows for complete oxidation of dissolved iron and manganese present in the groundwater supply. This pre-filtration process occurs before the water undergoes pressure filtration. Additionally, the presence of Oxidation/Detention Basins contributes to improved process efficiency and pump control. Two 24-feet diameter and 13-feet tall oxidation/detention tanks are proposed to handle the combined flow from PS 5 and 14. These tanks will be located on the site outside of the new pump and treatment building.
  - **Pre-Filter Oxidation:** Greensand filters require "oxidizing conditions" within the filters to effectively reduce and capture remaining soluble iron and manganese on filter media. It is considered beneficial to minimize chlorine residuals from the detention basin and Greensand Pressure Filters to reduce adsorption capacity impacts on granular activated carbon (GAC). Therefore, "tweaking" of chlorine residual prior to the Greensand Pressure Filters will enhance process control and operation flexibility.
  - **Booster/High Service Pumps:** The pressure of the water in the oxidation/detention tanks will be raised by a set of booster/high service pumps. These pumps will provide the pressure to

overcome the losses through the greensand filters and GAC contactors and provide the necessary pressure to enter the distribution system. A set of 4 pumps will be provided, three with a capacity of 1,500 gpm each and one with a capacity of 700 gpm, to provide a firm capacity of 3,700 gpm.

- **Pressure Filters (Greensand Filters):** Analysis of groundwater sampling data spanning from 2017 to 2019, as detailed in the Wightman Basis of Design report, has identified elevated levels of iron and manganese surpassing the secondary Maximum Contaminant Levels (MCLs). To address this, Greensand filters will be employed with the specific goal of reducing iron and manganese concentrations to levels below the secondary MCLs. This approach meets regulatory standards and also prevents potential fouling of GAC filters by iron and manganese particulates. A total of eight 12-feet diameter cylindrical type pressure filters are proposed to handle the combined flow of 3000 gpm from PS 5 and 14. These filters will be located in the treatment building.
- **PFAS Treatment (GAC Adsorption):** Analysis of individual well sampling data for Station 5 in 2020, as outlined in the Wightman Basis of Design report, shows elevated levels of PFAS compounds like Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonic Acid (PFOS), Perfluorohexane Sulfonic Acid (PFHxS), Perfluorobutane Sulfonic Acid (PFBS), and Perfluorohexanoic Acid (PFHxA). These concentrations were observed to be approaching or exceeding the proposed EPA regulatory maximum contaminant levels.

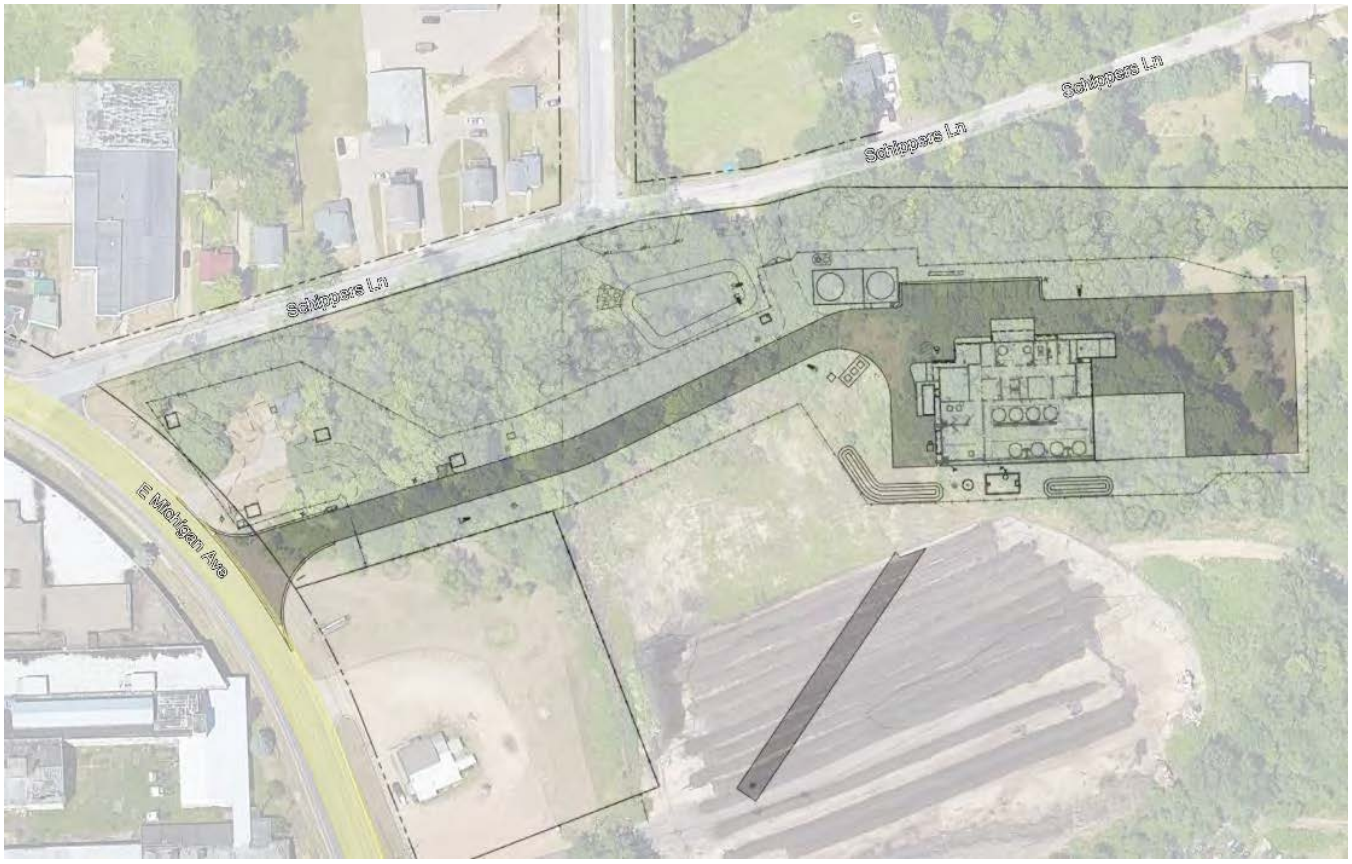
  Similarly, well sampling data at station 14 showed detected concentration levels for PFOS that were slightly above the proposed EPA regulatory maximum contaminant levels.

  To address, the recent PFAS compounds detected, GAC filters will be installed after the removal of iron and manganese through Greensand filters, to effectively eliminate PFAS substances from the water. This process aims to reduce PFAS levels to below the Michigan drinking water MCLs established for PFAS and the proposed USEPA regulations. Thus, for the combined flow of 3000 gpm, four trains of 12-feet diameter lead-lag configuration of GAC adsorption contactors are recommended. This results in a total of eight vessels with two vessels per train.
- **Backwash Holding Tank:** The greensand filter and GAC adsorption filters will require periodic backwashing, where water is reversed through the filter media to eliminate accumulated particles and rejuvenate the filters' efficiency. The backwash holding tank will serve as a reservoir to store water utilized during the backwashing operation for both greensand and GAC adsorption filters. Assuming a backflow rate of 1000 gpm and a detention time of 40 mins, the required backwash tank volume needed is 40,000 gallons. Thus, a belowground 40,000 gallon tank is provided in the site with approximate dimensions of 20-feet by 30-feet area with an approximate depth of 10-feet.
- **Final Disinfection: The** majority of iron and manganese will be removed through the oxidation and greensand pressure filtration system. In addition to PFAS, the GAC adsorption system will also reduce total organic carbon (TOC) concentrations. To complete the treatment process, chlorine will be introduced into the finished water as a final disinfection step. This addition of chlorine will serve as a disinfectant and also ensure the maintenance of a minimum residual chlorine concentration throughout the distribution system. Based on a chlorine demand of 2 mg/L and a total of 3000 gpm, a total feed of 72 pounds per day of chlorine injection is required.
- **Corrosion Control:** The city has been feeding sodium hexametaphosphate at their existing pump station which acts as a sequestering agent for iron, manganese, and calcium as well as a corrosion control measure. Currently, the City is changing to a liquid corrosion control chemical for ease of application and to provide a higher level of corrosion control against lead and other

metallic components in the distribution system. This alternative presents a similar strategy of using orthophosphate storage and feed systems for corrosion control. Based on the target orthophosphate dose of 4 mg/L as phosphate (PO_4), the design dosage value is determined to be 5.5 mg/L as PO_4 at the injection point. For the combined flow of 3000 gpm, a total feed of 200 pounds per day of blended orthophosphate injection is required.

- **Fluoridation:** Fluoridation is a public health measure aimed at preventing tooth decay and improving dental health in communities. This alternative includes fluoridation using Hydrofluorosilicic Acid storage and feed to provide a design dose of 0.99 mg/L to maintain minimum fluoride levels in the distribution system. For the combined flow of 3000 gpm, a total feed of 36 pounds per day of Hydrofluorosilicic Acid injection is required.
- **New Pump and Treatment Building:** A new approximately 21,000 square foot building, is proposed at the site to serve as a dedicated Pump and Treatment Building. The new treatment facilities shall be located east of the existing well field site with access from East Michigan Ave on land currently owned by the City. This facility is designed to accommodate various components crucial to the water treatment process. There is dedicated space within this building allocated for high-service pumps, pressure filters, GAC adsorption filters, chemical feed systems, chemical feed storage, an electrical room, and other areas essential for the operation and maintenance of the water treatment system.
- **Standby Power** A full load natural gas standby generator with ATS is recommended for station 5 and 14 as an emergency standby power source to maintain station operations during power outages.

Figure 3-2. Treatment Plant Footprint at PS 5



3.4.1.2 Alternative 2, Individual WTPs at Pump Station 5 and 14

Alternative 2 proposes the construction of two water treatment plants, with the first one being a 1,600 gallons per minute (gpm) WTP located at PS 14, and the second one being a 1,400 gpm WTP at PS5. ***Figure 3-2*****Error! Reference source not found.** shows the proposed site layout at PS 5. ***Figure 3-3*****Error! Reference source not found.** shows the proposed site layout at PS 14.

A. Station 14 Upgrades

- **Well Pumps Upgrades:** Station 14 consists of 5 vertical turbine well pumps in service. These pumps need replacement due to their age. The existing wells will be cleaned and inspected for leaks. Consequently, all wells will undergo replacement with new units having similar flow rates to the existing pumps, ensuring enhanced performance. The recommendation under this alternative involves installing a total of five well pumps with a firm capacity of 1600 gpm. Dedicated well pump houses will be constructed to house these newly installed replacement pumps.
- **Booster Pumps Upgrades:** At PS 14, the current configuration includes a single horizontal split case booster pump, rated at 1600 gpm flow and 180 feet head. The recommendation is to replace this existing horizontal split case booster pump with two new horizontal split case pumps rated at 1600 gpm each rated at 240-feet of head. This arrangement ensures a firm capacity of 1600 gpm with the one pump out of service. The purpose of these pumps is to effectively continue the existing production capacity of PS 14. The existing pump at the current PS 14 building will be decommissioned. Due to spatial constraints in the existing pump building at PS 14, the new pump will be housed in a new treatment building. This new building is designed to house the booster pumps and various other process components for water treatment at this station. Additional costs associated with land acquisition will be considered, given the limited space near the current building.
- **New Pump and Treatment Building:** A new building measuring approximately 110 feet by 140 feet, is proposed at the site to serve as a dedicated Pump and Treatment Building. This facility is designed to accommodate various components crucial to the water treatment process. There is dedicated space within this building allocated for high-service pumps, pressure filters, GAC adsorption filters, chemical feed systems, chemical feed storage, an electrical room, and other areas essential for the operation and maintenance of the water treatment system. There is space for the facility in the existing park near PS14, however, due to the community impacts this would have, land acquisition costs for a separate parcel nearby were included.
- **Groundwater Oxidation:** This process will be similar to the description outlined in alternative 1. Chlorine feed rates shall be determined to feed chlorine required for iron and manganese removal levels at the individual flow of 1,600 gpm for PS 14.
- **Oxidation/Detention Basins:** This process will be similar to the description outlined in alternative 1. One 24-feet diameter and 16-feet tall oxidation/detention tank is proposed to handle the individual flow of 1,600 gpm for PS 14. This tank will be located on the site outside the new pump and treatment building.
- **Pre-Filter Oxidation:** This process will be similar to the description outlined in alternative 1.
- **Pressure Filters:** This process will be similar to the description outlined in alternative 1. A total of four 14-feet diameter cylindrical type pressure filters are proposed to handle the flow of 1600 gpm for PS 14. These filters will be located in the new treatment building.
- **PFAS Treatment (GAC Adsorption):** As mentioned in alternative 1, station 14 well sampling data showed significant PFOS levels exceeding the proposed EPA MCLs. Thus, for this alternative, GAC adsorption filters are recommended. The individual PS 14 station flow of 1600 gpm required two

trains of 12-feet diameter lead-lag configuration of GAC Adsorption filters. This results in a total of four vessels with two lead-lag vessels per train.

- **Backwash Holding Tank:** This alternative includes a backwash holding tank for the backwash flow storage from the greensand filters and the GAC filters. Assuming a backflow rate of 400 gpm and a detention time of 40 mins, the required backwash tank volume needed is 16,000 gallons. Thus, a belowground 20,000 gallon tank is provided at the site with approximate dimensions of 20-feet by 15-feet area with an approximate depth of 10-feet.
- **Final Disinfection** This process will be similar to the description outlined in alternative 1. Based on the chlorine demand of 2 mg/L and for the PS 14 flow of 1600 gpm, a total feed of 38 pounds per day of chlorine injection is required.
- **Corrosion Control** This process will be similar to the description outlined in alternative 1 Based on the target orthophosphate dose of 4 mg/L as PO_4, the design dosage value is determined to be 5.5 mg/L as PO_4 at the injection point. Thus, a total feed of 110 pounds per day of blended orthophosphate injection is required for 1600 gpm flow for PS 14.
- **Fluoridation** This process will be similar to the description outlined in alternative 1. Based on the target Hydrofluorosilicic Acid demand of 0.99 mg/L, a total feed of 20 pounds per day of Hydrofluorosilicic Acid injection is required for 1600 gpm flow for PS 14.
- **Standby Power** A full load natural gas standby generator with ATS is recommended for station 14 as an emergency standby power source to maintain station operations during power outages.

Figure 3-3. Treatment Plant Footprint at PS 14

B. Station 5 Upgrades

- **Well Pumps Upgrades** Station 5 consist of four 350 gpm vertical turbine well pumps. These pumps need replacement due to their age. The existing wells will be cleaned and inspected for leaks. Consequently, all wells will undergo replacement with new units having similar flow rates to the existing pumps, ensuring enhanced performance. The recommendation under this alternative involves installing a total of four well pumps for a total capacity of 1,400 gpm. Dedicated well pump houses will be constructed to house these newly installed replacement pumps.

- **Booster Pumps** Although the status will currently be upgraded to pump 1,400 gpm flow from the wells, a higher booster pumping capacity is provided. For this alternative, it is recommended to install three new horizontal split case booster/high service pumps: two pumps rated at 1400 gpm each and one at 800 gpm. This brings up a firm capacity of 2200 gpm even with the largest pump out of service when needed. The new pumps will be housed in a new treatment building. This new building is designed to house the booster pumps and various other process components for water treatment at this station. The booster pumps will be sized to boost pressure to go through the filters and GAC contactors and then provide the necessary pressure for the distribution system.

- **Groundwater Oxidation** This process will be similar to the description outlined in alternative 1. Chlorine feed rates shall be determined to feed chlorine required iron and manganese removal levels at the individual flow of 1,400 gpm for PS 5.
- **Oxidation/Detention Basins** This process will be similar to the description outlined in alternative 1. One 24-feet diameter and 16-feet tall oxidation/detention tank is proposed to handle the total flow of 1,400 gpm for PS 5. This tank will be located on the site outside the pump and treatment building.
- **Pre-Filter Oxidation** This process will be similar to the description outlined in alternative 1.
- **Pressure Filters** This process will be similar to the description outlined in alternative 1. A total of four 12-feet diameter cylindrical type pressure filters are proposed to handle the flow of 1400 gpm for PS 5. These filters will be located in the new pump and treatment building.
- **PFAS Treatment (GAC Adsorption)** As mentioned in alternative 1, the analysis of individual well sampling data for Station 5 in 2020, as outlined in the Wightman Basis of Design report, shows elevated levels of PFAS compounds. Thus, for this alternative, GAC adsorption filters are recommended. The PS 5 station flow of 1400 gpm requires two trains of 12-feet diameter lead-lag configuration of GAC Adsorption filters. This results in a total of four vessels with two vessels per train.
- **Backwash Holding Tank:** This alternative includes a backwash holding tank for the backwash flow storage from the greensand filters and the GAC filters. Assuming a backwash flow rate of 400 gpm and a detention time of 40 mins, the required backwash tank volume needed is 16,000. Thus, a below ground 20,000 gallon tank is provided in the site with approximate dimensions of 20-feet by 15-feet area with an approximate depth of 10-feet.
- **Final Disinfection** This process will be similar to the description outlined in alternative. Based on the chlorine demand of 2 mg/L and for the PS 5 flow of 1400 gpm, a total feed of 34 pounds per day of chlorine injection is required.
- **Corrosion Control** This process will be similar to the description outlined in alternative 1. Based on the target orthophosphate dose of 4 mg/L as PO_4, the design dosage is determined to be 5.5 mg/L as PO_4 at the injection point. Thus, a total feed of 100 pounds per day of blended orthophosphate injection is required for 1400 gpm flow for PS 5.
- **Fluoridation** This process will be similar to the description outlined in alternative 1. Based on the target Hydrofluorosilicic Acid dose of 0.99 mg/L, a total feed of 17 pounds per day of Hydrofluorosilicic Acid injection is required for 1400 gpm flow for PS 5.
- **New Pump and Treatment Building** A new building measuring approximately 110 feet by 140 feet, is proposed at the site to serve as a dedicated Pump and Treatment Building. The new treatment facilities shall be located east of the existing well field site with access from East Michigan Avenue on land currently owned by the City. This facility is designed to accommodate various components crucial to the water treatment process. There is dedicated space within this building allocated for booster/high-service pumps, pressure filters, GAC adsorption filters, chemical feed systems, chemical feed storage, an electrical room, and other areas essential for the operation and maintenance of the water treatment system.
- **Standby Power** A full load natural gas standby generator with ATS is recommended for station 5 as an emergency standby power source to maintain station operations during power outages.

Figure 3-4. Treatment Plant Footprint at PS 5

3.5 MONETARY EVALUATION

The monetary evaluation compares the present worth of the alternatives over a 20-year planning period. It does not include costs accrued before or during the Project Plan phase. The real discount rate used for the present worth analysis is 2.5 percent (from the United States Office of Management and Budget when the project planning began in December 2023). Appendix D includes the detailed cost opinions and present worth calculations with weighted useful life for each alternative.

3.5.1 Pump Station 5 and 14 Upgrades

Alternative 2 has a higher capital cost than Alternative 1 due to construction of two WTPs. Operations and maintenance costs include the cost to maintain the equipment, chemicals, energy consumption, and labor. ***Table 3-1*** provides the present worth of Project 1 Alternatives 1 and 2.

Table 3-1. Alternatives 1 and 2 Present Worth

Cost Category	Alternative 1	Alternative 2
Capital Cost	$51,304,000	$66,424,000
Present Worth of Salvage Value	($14,863,000)	($18,345,000)
Present Worth of Annual OM&R	$11,614,000	$14,561,000
Total Present Worth	**$45,055,000**	**$62,640,000**

3.6 ENVIRONMENTAL EVALUATION

The principal alternatives have potential environmental impacts which can be beneficial or adverse, short- or long-term, and reversible or irreversible. Both alternatives require work in undeveloped areas. The proposed water main for Alternative 1 will be placed within the existing right-of-way and will not have an impact on previously undisturbed land.

No cultural or historical resources, agricultural resources, coastal zones, floodplains, wild and scenic or natural rivers, or major surface waters will be impacted by either alternative as discussed in Section 2.3.

3.6.1 Recreational Areas

Recreational areas will be impacted by Alternative 2. Alternative 2 includes construction of treatment plants near Spring Valley Lake Park. Alternative 1 is the preferred alternative to minimize impacts to recreational areas.

3.6.2 Wetlands

Wetlands exist primarily along Spring Valley Lake and Schippers Lane. Both alternatives are expected to have wetlands present in the construction area. During the design phase of the project, all necessary permits will be obtained and impacts to wetlands will be minimized and/or mitigated. Alternative 1 is the preferred alternative to minimize impacts to wetlands since it is limited to one area.

3.6.3 Existing Plant and Animal Communities

Threatened or endangered species or their habitat may be affected by either alternative. During the design phase, additional reviews will be made to determine if the habitat or species will be impacted. If there are any concerns, appropriate actions will be taken to avoid these areas and/or mitigate any disturbance so that the species are protected. Alternative 1 is the preferred alternative to minimize impacts to wildlife since it is limited to one area.

3.7 TECHNICAL CONSIDERATIONS

The principal alternatives comply with Safe Drinking Water Act and are designed to meet the standard recommended guidelines established in the “Recommended Standards for Waterworks.” Sufficient pumping capacity to meet design flows, a minimum of two units for each treatment process, adequate storage volume, and stand-by power requirements were all met for each alternative considered. Technical considerations are detailed in Sections 3.4.1.

3.8 NEW/INCREASED WATER WITHDRAWALS

There is no proposed increase in water withdrawals associated with this project.

4.0 SELECTED ALTERNATIVE

The selected alternative includes the following project:

- **Project 1, Alternative 1**: A consolidated water treatment plant will be constructed near PS 5 with a transmission main pumping raw water from PS 14 for iron and PFAS treatment. This alternative has the lowest capital, operation and maintenance, and present worth costs. The project also minimizes potential negative impacts such as the loss of park land and wetlands at PS 14.

4.1 DESIGN PARAMETERS

The project will meet local and state water distribution standards while improving water quality. More information on the calculations and assumptions made for the design parameters are found in Section **Error! Reference source not found.**.

The selected alternative includes:

- A single consolidated 3,000-gpm capacity water treatment plant near PS 5 to treat the combined flows from PS 5 (1,400 gpm) and from PS 14 (1,600 gpm).
- Four replacement well pumps at PS 5 and five well pumps at PS 14 to handle the rated capacities of 1,400 gpm at PS 5 and 1,600 gpm at PS 14.
- Two new vertical turbine pumps rated at 1,600 gpm each rated at 120 feet of head with variable frequency drives at PS 14 to account for pumping with flow and head variations to convey water from PS 14 to PS 5 for treatment.
- Four new high-service pumps at PS 5 to handle incoming flow from PS 14; three with a capacity of 1,500 gpm each and one with a capacity of 700 gpm.
- 9,000 feet of 12-inch transmission main from PS 14 to PS 5.
- Treatment Plant Processes at PS 5
    - Groundwater oxidation.
    - Two 24-feet diameter and 13-feet tall oxidation/detention tanks.
    - Pre-filter oxidation.
    - Eight 14-feet diameter cylindrical type pressure filters.
    - Eight vessels with two vessels per train of 12-feet diameter lead-lag configuration of GAC adsorption filters.
    - A 40,000-gallon backwash holding tank with approximate dimensions of 40-feet by 30-feet area with an approximate depth of 10 feet.
    - Final Disinfection with a total feed of 72 pounds per day of chlorine injection.
    - Corrosion control with a design dosage valve of 5.5 mg/L (total feed of 200 pounds per day) of blended orthophosphate injection.
    - Fluoridation using hydrofluorosilicic acid storage and feed to maintain minimum fluoride levels of 0.99 mg/L (total feed of 200 pounds per day) in the distribution system.
    - A new pump and treatment building measuring approximately 170 feet by 140 feet.

4.2 USEFUL LIFE

The selected alternative is expected to have a useful life of 43 years.

4.3 WATER AND ENERGY EFFICIENCY

The selected alternative is the most energy efficient of the project alternatives because it consolidates water treatment operations to one area. This alternative does require pumping water from PS 14 to PS 5, which is an additional energy cost, but is less than maintaining two WTPs.

Water loss may become an issue for the transmission main but can be avoided with regular maintenance.

4.4 SCHEDULE FOR DESIGN AND CONSTRUCTION

Table 4-1 provides a proposed schedule for the Project Plan submittal. ***Table 4-2*** presents the anticipated funding schedule for the project proposed for implementation within five years.

Table 4-1. Proposed SRF Project Schedule

Task	Complete By
Public Meeting Notice	April 12, 2024
Place Draft Project Plan on Public Record	April 23, 2024
Formal Public Meeting	May 6, 2024
Commission Approval of Project Plan	May 20, 2024
Submit Final Project Plan to EGLE	June 1, 2024

Table 4-2. Anticipated Funding Schedule for Proposed Project

Project	SRF Fiscal Year
Project 1: Pump Stations 5 and 14 Upgrades	2025

4.5 COST SUMMARY

Table 4-3 lists the selected alternative for the project and the associated costs. Project 1 is fully eligible for SRF funding.

Table 4-3. Selected Alternative Cost Summary

Project	Project Cost	Present Worth	SRF Eligible	SRF Eligible Cost	Annual Equivalent Cost
Project 1: Pump Stations 5 and 14 Upgrades	$51,304,000	$48,055,000	100%	$51,304,000	$3,292,000

The costs for the project described herein will be paid for by user charges. ***Table 4-4*** shows the user charges calculated over the useful life of the project. The City intends to implement this project over a five-year period, so the rate increases also will be staged as the project proceeds. ***Table 4-2*** lists the planned construction years for each project,

Table 4-4 estimates the typical quarterly user charge per typical residential user in the City for each project.

The quarterly user charge in the last column is calculated per the following steps:

Column 2: SRF Eligible Project Cost

Column 3: Annual Debt Service = Project Cost times Capital Recovery Factor based on 20-year SRF loan at 2.5%

Column 4: Additional Annual O&M Cost

Column 5: Total Annual Cost

Column 6: Quarterly User Charge = Total Annual Cost/73,440 residential equivalent units/4 billing periods per year

Table 4-4. Estimated User Charge Summary

Column 1: Project	Column 2: SRF Project Cost	Column 3: Annual Debt Service = Col 2 x 0.06415	Column 4: Additional Annual O&M	Column 5: Total Annual Cost = Col 3 + Col 4	Column 6: Quarterly User Charge = Col 5/293,760
Project 1: Pump Stations 5 and 14 Upgrades	$51,304,000	$3,291,152	$745,000	$4,036,152	$13.69

4.6 IMPLEMETABILITY

The City Commission has the sole legal authority to implement the Project Plan. A copy of the resolution is provided in Appendix F.

The City's Department of Public Services maintains a full-time engineering staff and will implement the selected alternative with in-house engineering staff and assistance from engineering consultants. The City has the managerial capability and financial means to implement the selective alternatives.

5.0 ENVIRONMENTAL AND PUBLIC HEALTH IMPACTS

The anticipated environmental impacts resulting from the construction of the selected alternative include beneficial and adverse, short-term and long-term, and irreversible and irretrievable impacts.

5.1 DIRECT IMPACTS

5.1.1 Construction/Operational Impacts

Construction of the proposed facilities will be coordinated and sequenced to minimize disruptions to residential and natural areas.

The following impacts are anticipated:

- Tree removal: Tree removal will be needed for the new treatment facilities at WPS 5.
- Traffic patterns: Traffic may need to be stopped or redirected in project areas.
- Construction chemicals, dust, air emissions, and noise: Use of construction chemicals will follow safety procedures. Water will be used for dust control. Well maintained equipment will be used to minimize air emissions. Construction will occur during daylight on work weekdays to reduce noise unless significant traffic changes are required. If night work is necessary, proper permitting will be acquired.
- Groundwater/dewatering impacts and proximity to wetlands: Proper permitting will be acquired for dewatering and work near wetlands.
- Soil erosion: Soil erosion prevention will be implemented during excavation activities and the project area will be revegetated shortly after construction completion.

5.1.2 Social/Economic Impact

Short-term social and economic impacts may occur during the construction phase. Increased construction traffic may occur near the proposed project and reduced traffic capacity may create longer travel times. Most of the project is in residential or undeveloped areas, so reduced commercial activity to businesses within the project area is expected to be limited. The local economy may be stimulated for contractors and suppliers of the materials, labor, and equipment necessary to construct the project.

Increased user costs are a long-term negative impact.

5.2 INDIRECT IMPACTS

5.2.1 Changes in Development and the Associated Transportation Changes

There are no changes anticipated to development or transportation upon completion of the project. There may be temporary traffic disruptions during construction that will be managed with traffic control.

5.2.2 Changes in Land Use

Changes to land use are anticipated around PS 5. There will be tree removal to place the water treatment plant. The ground surface will be restored to existing conditions as much as possible with the new infrastructure.

5.2.3 Changes in Air or Water Quality due to Facilitated Development

There are no anticipated negative impacts to air or water quality. Upon completion of the project, water quality will be improved due to the additional treatment of iron and PFAS removal at WPS 5 and 14.

5.2.4 Changes to the Natural Setting or Sensitive Features Resulting from Secondary Growth

There are no anticipated changes to the natural setting or sensitive features resulting from secondary growth. Tree removal and ground disturbance activities will be scheduled during hibernation periods to avoid negative impacts to sensitive animals and plants.

5.2.5 Impacts of Community Aesthetics

The proposed treatment facility at WPS 5 may affect community aesthetics since it is undeveloped land with trees near a residential area. Any concerns regarding the impact on community aesthetics will be addressed during the public comment period.

5.2.6 Impacts on Cultural, Human, Social, and Economic Resources

The project will improve water quality for residents. Beneficial impacts include the creation of construction and equipment manufacturing related jobs, and local contractors will have an equal opportunity to bid on the construction contracts.

5.3 CUMULATIVE IMPACTS

5.3.1 Siltation

Siltation may occur during the construction phase of the project. Proper soil erosion and sedimentation control practices will be followed to reduce the impacts of siltation on surrounding areas.

5.3.2 Development

The project will not cause an increase in development. It is necessary to improve the performance of the existing system.

5.3.3 Multiple Projects

Construction will be completed with specified staging plans and seasonally between April 1 and October 15 to avoid significant traffic delays/detours for multiple years. If multiple projects are planned in the same vicinity of the selected alternative, an implementation plan will be used to coordinate projects and minimize disruptions to people and the natural environment.

5.3.4 Fiscal Impacts

The proposed project is necessary to improve water quality and maintain compliance with Michigan drinking water standards. The lowest cost alternative was selected to minimize negative fiscal impacts.

6.0 MITIGATION

6.1 SHORT-TERM, CONSTRUCTION-RELATED MITIGATION

The short-term adverse impacts caused by construction will be minimal and mitigatable, relative to the resulting long-term beneficial impacts. Short-term impacts include traffic disruption, dust, and noise.

Environmental disruption will occur during construction. Guidelines will be established for cover vegetation removal, dust reduction, traffic control, and accident prevention. Once construction is completed those short-term effects will end and the area will be returned to the original conditions, as practical.

The soil erosion impact will be mitigated through the contractor's compliance with a soil erosion and sedimentation control program, as required in Part 91 of Michigan Act 451, P.A. of 1994. The use of soil erosion and sedimentation controls, such as straw bales, sedimentation basins, and silt fence, will protect nearby waterways and local stormwater facilities.

Floodplain and wetland fill will require a compensating cut if the fill exceeds thresholds in Part 31 or Part 303 regulations, respectively. No impacts are expected to floodplains, but wetlands may be affected. Disturbance to wetlands will be minimized by limiting construction activities near wetlands as much as possible.

Impacts to threatened and endangered species will be minimized by removing trees and vegetation during inactive periods (October 1 to March 31). Design and construction will follow requirements for the protection of rare species.

Construction equipment will be maintained in good condition to decrease noise. The City's noise ordinance will limit construction times to avoid disturbing surrounding residential areas during evenings and weekends. Access roads will be swept to avoid tracking dirt onto public roads.

6.2 MITIGATION OF LONG TERM AND INDIRECT IMPACTS

No long-term negative impacts are anticipated. The long-term positive impacts include improved water quality.

7.0 PUBLIC PARTICIPATION

The City welcomes public participation in the planning process for transparency, to garner support for the project from the citizens, and accept comments on the Project Plan.

7.1 PUBLIC MEETING

The public meeting was held April 23, 2024, to review the work associated with the proposed Project Plan, including estimated user costs, and to receive comments and views of interested persons. A summary of the public meeting and attendance list is included in Appendix E.

7.1.1 Advertisement

A legal notice of the availability of this Project Plan for review to the public was placed online at the City's website for review by the public by April 12, 2024. In addition, copies were sent to the EGLE Water Infrastructure Financing Section and District Engineer for review.

7.1.2 Public Meeting Summary

A summary of the meeting presentation, public comments, attendees, and a final Project Plan was provided to the EGLE project manager for review.

The public meeting agenda covered the drinking water system problems targeted in the Project Plan, possible alternatives to each improvement, anticipated user costs and financing, and potential community impacts and mitigation.

7.1.3 Comments Received and Answered

No comments were received from the public.

7.2 ADOPTION OF PROJECT PLAN

The City Commission adopted the Project Plan on May 20, 2024. The signed Resolution of Adoption is included in Appendix F.

APPENDIX A: CITY OF KALAMAZOO HISTORICAL SITES

TETRA TECH

March 6, 2024
Match-E-Be-Nash-Shee-Wish Band of Pottawatomi Indians
2872 Mission Drive
Shelbyville, MI 49344
lakota.hobia@glt-nsn.gov
kaila.akina@glt-nsn.gov
shawn.mckenney@glt-nsn.gov

RE: **Notice and Opportunity to Comment**
City of Kalamazoo Water Main Installation

Lakota/Kaila/Shawn:

On behalf of the City of Kalamazoo, we are submitting the information noted below for the City of Kalamazoo Water Main Project for which we are completing a Section 106 review. This is required as part of the environmental review process associated with a State of Michigan Drinking Water State Revolving Fund (DWSRF) project. The City will be using the DWSRF funds to install water main in Kalamazoo Township.

We are proposing to install water main within Sections 11 and 14 in Township 2 South, Range 11 West. The work will include trenching for water main within the right of way. The project will involve disturbance to the surface within the right of way. A project map is attached.

We would appreciate your response within 30 days of this request, so that we might include the correspondence with the environmental application submittal and have time to respond to any questions you might have.

We appreciate your time to review this matter. If you need any additional information to complete your review, please feel free to contact me at (517) 316-3936, lauryn.roberts@tetratech.com.

Sincerely,

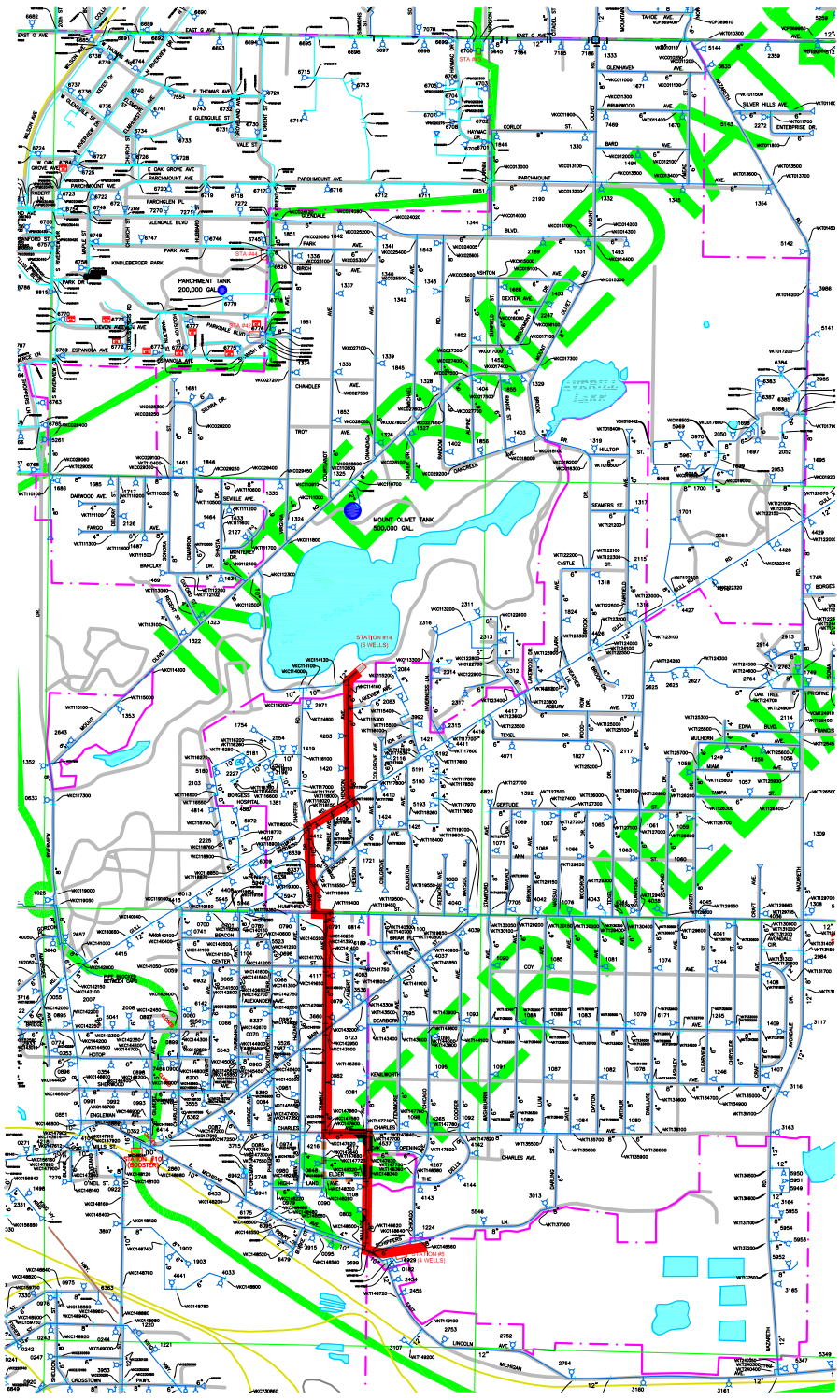
Tetra Tech

Lauryn Roberts

Enclosure: Project Location Map

Tetra Tech
3497 East Lansing, MI 48823
Tel +1-517-316-3930 | tetratech.com

CITY OF KALAMAZOO
WATER VALVES 1:2200
1/10/24



Roberts, Lauryn

From: J Ryan Duddleson <ryan@orbisec.com>
Sent: Thursday, April 11, 2024 9:43 AM
To: Brian Vilmont; Roberts, Lauryn; Cooperwasser, Victor
Subject: Fwd: Confirmation - Michigan SHPO Section 106 Consultation

Hi everyone,

See the submission confirmation from MSHPO below for the Kalamazoo Station 5 and 14 DWSRF project. We recommended no change to the determination and no further work.

Ryan

---------- Forwarded message ---------
From: **Smartsheet Forms** <forms@app.smartsheet.com>
Date: Thu, Apr 11, 2024 at 9:40 AM
Subject: Confirmation - Michigan SHPO Section 106 Consultation
To: <rduddleson@orbisec.com>

Thank you for submitting your additional materials for Section 106 consultation with the Michigan State Historic Preservation Office. A copy is included below for your records.

Michigan SHPO Section 106 Consultation

Project ER Number	ER23-617
Project Name	City of Kalamazoo Waterline Improvement, FY 2024
Project County	Kalamazoo
Project Municipal Unit	Kalamazoo
Your Name and Agency	J Ryan Duddleson, Orbis Environmental Consulting
Your Email Address	rduddleson@orbisec.com

File Attachments

20240409_Cultural_Dekstop_Kalamazoo_Water_System_ER23-617.pdf (10533k)

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J Ryan Duddleson, M.A.
Senior Archaeologist

Phone (574) 635-1338
Cell (574) 303-7512
Address P.O. Box 10235, South Bend, Indiana 46680
Email rduddleson@orbisec.com
www.orbisec.com

APPLICATION FOR SHPO SECTION 106 CONSULTATION

For areas to be constructed FY2024

Submit one application for each project for which comment is requested. Consult the *Instructions for the Application for SHPO Section 106 Consultation Form* when completing this application.

Mail form, all attachments, and check list to: Michigan State Historic Preservation Office, 300 North Washington Square, Lansing, MI 48913

I. GENERAL INFORMATION

☒ New submittal

☐ More information relating to SHPO ER# SHPO Project #

☐ Submitted under a Programmatic Agreement (PA)

PA Name/Date: PA name/date, if applicable

a. **Project Name:** Kalamazoo Waterline Improvement
b. **Project Municipality**: City of Kalamazoo
c. **Project Address** (*if applicable*): Multiple
d. **County:** Kalamazoo

II. FEDERAL AGENCY INVOLVEMENT AND RESPONSE CONTACT INFORMATION

a. **Federal Agency:** Michigan Department of Environment, Great Lakes, and Energy (EGLE)
Contact Name: Jonathan M. Berman, State Revolving Fund Compliance Specialist
Contact Address: P.O. Box 30457 **City:** Lansing **State:** MI **Zip:** 48909-7957
Email: BermanJ@Michigan.gov
Specify the federal agency involvement in the project:
State Revolving Fund (EPA project for which EPA has delegated to EGLE for compliance)

b. **If HUD is the Federal Agency: 24 CFR Part 50** ☐ **or Part 58** ☐
Responsible Entity (RE): Name of the entity that is acting as the Responsible Entity
Contact Name: RE Contact name
Contact Address: RE mailing address **City:** RE city **State:** RE State **Zip:** RE zip code
RE Email: RE contact's email **Phone:** RE contact's phone #

c. **State Agency Contact (*if applicable*):** Michigan Department of Environment, Great Lakes, and Energy
Contact Name: Valorie White
Contact Address: PO Box 30457 **City:** Lansing **State:** MI **Zip:** 48909-7957
Email: WhiteV1@Michigan.gov **Phone:** 517-599-5879

d. **Applicant (if different than federal agency):** City of Kalamazoo
Contact Name: Anna Crandall, P.E.
Contact Address: 415 Stockbridge Ave. **City:** Kalamazoo **State:** MI **Zip:** 49001
Email: crandalla@kalamazoocity.org **Phone:** 269-337-8055

e. **Consulting Firm (if applicable):** Prein&Newhof
Contact Name: Brian Vilmont
Contact Address: 3355 Evergreen Drive NE **City:** Grand Rapids **State:** MI **Zip**: 49525
Email: bvilmont@preinnewhof.com Phone: 616-364-8491

III. PROJECT INFORMATION

a. **Project Location and Area of Potential Effect (APE)**

i. **Maps.** Please indicate all maps that will be submitted as attachments to this form.

☒Street map, clearly displaying the direct and indirect APE boundaries
☐Site map
☒USGS topographic map Name(s) of topo map(s): Kalamazoo, MI and Schoolcraft, MI
☒Aerial map
☐Map of photographs
☐Other: Identify type(s) of map(s)

ii. **Site Photographs**

iii. **Describe the APE:**

The APE for direct effects includes the construction limits within the selected streets in the city. The construction activities will be limited replacing existing waterlines in roadways. The waterlines extending to individual structures will be installed in the same place as the existing waterlines, without excavating trenches.

The APE for indirect effects includes the area immediately adjacent to the construction limits and includes temporary visual and noise effects from the replacement.

iv. **Describe the steps taken to define the boundaries of the APE:**
The APE for direct effects was defined by the extent of construction activities. The APE for indirect effects was defined as the extent of temporary visual and noise from construction activities because the proposed road improvement involves activities in the ground.

b. **Project Work Description**

Describe all work to be undertaken as part of the project:

Replacement of non-copper water service lines and replacement of existing water mains that heave reached the end of useful service life.

IV. IDENTIFICATION OF HISTORIC PROPERTIES

a. **Scope of Effort Applied**

i. **List sources consulted for information on historic properties in the project area** (including but not limited to SHPO office and/or other locations of inventory data).

MSHPO Records, Historic atlas maps

ii. Provide documentation of previously identified sites as attachments.
iii. **Provide a map** showing the relationship between the previously identified properties and sites, your project footprint and project APE.
iv. Have you reviewed existing site information at the SHPO: ☒Yes ☐ No
v. Have you reviewed information from non-SHPO sources: ☒Yes ☐ No

b. **Identification Results**

i. **Above-ground Properties**
A. Attach the appropriate Michigan SHPO Architectural Identification Form for each resource or site 50 years of age or older in the APE. Refer to the *Instructions for the Application for SHPO Section 106 Consultation Form* for guidance on this.
B. **Provide the name and qualifications of the person who made recommendations of eligibility for the above-ground identification forms.**

Name James L. Ingermann Heimlich **Agency/Consulting Firm:** Orbis Environmental Consulting

Is the individual a 36CFR Part 61 Qualified Historian or Architectural Historian ☒ Yes ☐ No

Are their credentials currently on file with the SHPO? ☒ Yes ☐ No

If NO attach this individual's qualifications form and resume.

ii. **Archaeology** (complete this section if the project involves temporary or permanent ground disturbance)

Submit the following information using attachments, as necessary.

A. **Attach Archaeological Sensitivity Map.**
B. **Summary of previously reported archaeological sites and surveys:**

See attached cultural resources desktop review

C. **Town/Range/Section or Private Claim numbers:** T02S R11W Sec 10, 15, 21, 22, 25, 27, 28, 29, 32, 33, and 36

D. **Width(s), length(s), and depth(s) of proposed ground disturbance(s):** Water Service work may disturb one 10'x10' x 6'deep area at the connection to the existing water main. Water main replacement may disturb a 10'wide by 6' deep excavation trench along the length of the water main.
E. **Will work potentially impact previously undisturbed soils?** ☐ Yes ☒ No

***If YES,* summarize new ground disturbance:**
Summary of new ground disturbance
F. **Summarize past and present land use:**

The project area contains existing waterlines slated for replacement.

G. **Potential to adversely affect significant archaeological resources**:

☒ Low ☐ Moderate ☐ High

For moderate and high potential, is fieldwork recommended? ☐ Yes ☐ No

Briefly justify the recommendation:

Justification for recommendation of fieldwork

H. **Has fieldwork already been conducted?** ☐ Yes ☒ No

If YES:
☐ Previously surveyed; refer to A. and B. above.
☐ Newly surveyed; attach report copies and provide full report reference here:
Full report reference

I. **Provide the name and qualifications of the person who provided the information for the Archaeology section:**

Name: J Ryan Duddleson **Agency/Firm:** Orbis Environmental Consulting
Is the person a 36CFR Part 61 Qualified Archaeologist? ☒ Yes ☐ No
Are their credentials currently on file with the SHPO? ☒ Yes ☐ No
If NO, attach this individual's qualifications form and resume.

Archaeological site locations are legally protected.

This application may not be made public without first redacting sensitive archaeological information.

V. IDENTIFICATION OF CONSULTING PARTIES

a. **Provide a list of *all* consulting parties,** including Native American tribes, local governments, applicants for federal assistance/permits/licenses, parties with a demonstrated interest in the undertaking, and public comment:

Prein& Newhof

b. **Provide a summary of consultation with consultation parties:**

Prein&Newhof provides water main design and construction document preparation for the project.

c. **Provide summaries of public comment and the method by which that comment was sought:**

Two public meetings and a noticed Public Hearing were held to receive public comment and provide presentation of all proposed project activities.

VI. DETERMINATION OF EFFECT

Guidance for applying the Criteria of Adverse Effect can be found in *the Instructions for the Application for SHPO Section 106 Consultation Form*.

a. **Basis for determination of effect**:

The records on file at the MSHPO show two archaeological sites within one mile of the project. Site 20KZ275 is an isolated artifact. The other sites (20KZ17/KZ26) are likely associated with a significant precontact occupation in Kalamazoo, however, this site has not been field verified and is in a heavily developed area in Kalamazoo. The project is unlikely to encounter intact archaeological deposits because of this substantial development.

The records list hundreds of historic structures and over twenty historic districts in Kalamazoo, including one historic district adjacent to one of the project segments - the Vine Area Historic District. While the cultural context shows extensive occupation of the region in and around Kalamazoo from precontact through historic periods, the proposed project is unlikely to affect significant intact archaeological resources or historic structures because project activities will be limited to replacing existing waterlines in roadways. The waterlines extending to individual structures will be installed in the same place as the existing waterlines, without excavating trenches (Figure 6). The project is adjacent to the NRHP listed Vine Area Historic District. Recent images show that historic structures are present, but the streets are modern asphalt paved.

Given that excavation is limited to replacing existing waterlines in the existing road, project activities remain consistent with the current use of the area and the project is unlikely to alter the significant aspects of this district that make it eligible for the NRHP. We recommend that no further work is necessary and determination of "No Historic Properties Affected" or "No Adverse Effect" is appropriate because the project is unlikely to affect intact archaeological deposits or significant historic structures or districts. However, if project plans change, additional work may be necessary.

b. **Determination of effect**

☒ **No historic properties will be affected**

☐ **Historic properties will be affected** and the project will (check one):

☐ have **No Adverse Effect** on historic properties within the APE.

☐ have an **Adverse Effect** on one or more historic properties in the APE and the federal agency, or federally authorized representative, will consult with the SHPO and other parties to resolve the adverse effect under 800.6.

☐ **More Information Needed:** We are initiating early consultation. A determination of effect will be submitted to the SHPO at a later date, pending results of survey.

APPLICATION FOR SHPO SECTION 106 CONSULTATION

Federally Authorized Signature: Jonathan M. Berman Date: 04/10/2023

Type or Print Name: Jonathan M. Berman

Title: State Revolving Fund Compliance Specialist

ATTACHMENT CHECKLIST

Identify any materials submitted as attachments to the form:

☐ Additional federal, state, local government, applicant, consultant contacts

☒ Maps of project location

Number of maps attached: 18

☒ Site Photographs – select photos

☒Map of photographs

☐ Plans and specifications

☒ Other information pertinent to the work description: Address list

☐ Documentation of previously identified historic properties

☐ Architectural Properties Identification Forms

☒ Map showing the relationship between the previously identified properties, your project footprint, and project APE

☐ Above-ground qualified person's qualification form and resume

☒ Archaeological sensitivity map

☐ Survey report

☐ Archaeologist qualifications and resume

☐ Other: Cultural Resources Destkop Review

J Ryan Duddleson <ryan@orbisec.com>

Confirmation - Michigan State Historic Preservation Office Section 106 Consultation

1 message

Smartsheet Forms <forms@app.smartsheet.com>
To: rduddleson@orbisec.com

Mon, Apr 10, 2023 at 10:25 AM

Thank you for submitting your request for consultation under Section 106 of the National Historic Preservation Act of 1966, as amended. A copy is included below for your records.

If you have concerns about your submission or were not able to attach all of your documents, please contact Scott Slagor at SlagorS2@Michigan.gov.

Michigan State Historic Preservation Office Section 106 Consultation

Project Name:	Kalamazoo Waterline Development
Project Street Address:	Multiple
Project Municipal Unit:	City of Kalamazoo
Project County:	Kalamazoo
Federal Agency:	EGLE
Federal Agency Contact Name:	Jonathan M. Berman
Federal Agency Mailing Address (street, city, state, zip code):	PO Box 30457 Lansing, MI 48909-7957
Consultant/Applicant Name	Anna Crandall, P.E.
Consultant/Applicant Agency/Firm:	City of Kalamazoo
Consultant/Applicant Mailing Address:	415 Stockbridge Ave. Kalamazoo, MI 49001
Consultant/Applicant Phone Number:	269-337-8055
Consultant/Applicant Email Address:	crandalla@kalamazoocity.org

File Attachments

0_PN_Kalamazoo_Waterline_2024_Section 106 Application edited signed.pdf (422k)

20230331_PN_Kalamazoo Water System 2024.pdf (6977k)

APPLICATION FOR SHPO SECTION 106 CONSULTATION

For areas to be constructed
FY2025-FY2028

Submit one application for each project for which comment is requested. Consult the *Instructions for the Application for SHPO Section 106 Consultation Form* when completing this application.

Mail form, all attachments, and check list to: Michigan State Historic Preservation Office, 300 North Washington Square, Lansing, MI 48913

I. GENERAL INFORMATION

☒ New submittal

☐ More information relating to SHPO ER# SHPO Project #

☐ Submitted under a Programmatic Agreement (PA)

PA Name/Date: PA name/date, if applicable

a. **Project Name:** Kalamazoo Waterline Improvement
b. **Project Municipality**: City of Kalamazoo
c. **Project Address** (*if applicable*): Multiple
d. **County:** Kalamazoo

II. FEDERAL AGENCY INVOLVEMENT AND RESPONSE CONTACT INFORMATION

a. **Federal Agency:** Michigan Department of Environment, Great Lakes, and Energy (EGLE)
Contact Name: Jonathan M. Berman, State Revolving Fund Compliance Specialist
Contact Address: P.O. Box 30457 **City:** Lansing **State:** MI **Zip:** 48909-7957
Email: BermanJ@Michigan.gov
Specify the federal agency involvement in the project:
State Revolving Fund (EPA project for which EPA has delegated to EGLE for compliance)

b. **If HUD is the Federal Agency: 24 CFR Part 50** ☐ **or Part 58** ☐
Responsible Entity (RE): Name of the entity that is acting as the Responsible Entity
Contact Name: RE Contact name
Contact Address: RE mailing address **City:** RE city **State:** RE State **Zip:** RE zip code
RE Email: RE contact's email **Phone:** RE contact's phone #

c. **State Agency Contact (*if applicable*):** Michigan Department of Environment, Great Lakes, and Energy
Contact Name: Valorie White
Contact Address: PO Box 30457 **City:** Lansing **State:** MI **Zip:** 48909-7957
Email: WhiteV1@Michigan.gov **Phone:** 517-599-5879

d. **Applicant (if different than federal agency):** City of Kalamazoo
Contact Name: Anna Crandall, P.E.
Contact Address: 415 Stockbridge Ave. **City:** Kalamazoo **State:** MI **Zip:** 49001
Email: crandalla@kalamazoocity.org **Phone:** 269-337-8055

e. **Consulting Firm (if applicable):** Prein&Newhof
Contact Name: Brian Vilmont
Contact Address: 3355 Evergreen Drive NE **City:** Grand Rapids **State:** MI **Zip**: 49525
Email: bvilmont@preinnewhof.com Phone: 616-364-8491

III. PROJECT INFORMATION

a. **Project Location and Area of Potential Effect (APE)**

i. **Maps.** Please indicate all maps that will be submitted as attachments to this form.

☒Street map, clearly displaying the direct and indirect APE boundaries
☐Site map
☒USGS topographic map Name(s) of topo map(s): Kalamazoo, MI, Kalamazoo SW, and Portage, MI
☒Aerial map
☐Map of photographs
☒Other: Identify type(s) of map(s)

ii. **Site Photographs**

iii. **Describe the APE:**

The APE for direct effects includes the construction limits within the selected streets in the city. The construction activities will be limited replacing existing waterlines in roadways. The waterlines extending to individual structures will be installed in the same place as the existing waterlines, without excavating trenches.

The APE for indirect effects includes the area immediately adjacent to the construction limits and includes temporary visual and noise effects from the replacement.

iv. **Describe the steps taken to define the boundaries of the APE:**
The APE for direct effects was defined by the extent of construction activities. The APE for indirect effects was defined as the extent of temporary visual and noise from construction activities because the proposed road improvement involves activities in the ground.

b. **Project Work Description**

Describe all work to be undertaken as part of the project:

Replacement of non-copper water service lines and replacement of existing water mains that heave reached the end of useful service life.

IV. IDENTIFICATION OF HISTORIC PROPERTIES

a. **Scope of Effort Applied**

i. **List sources consulted for information on historic properties in the project area** (including but not limited to SHPO office and/or other locations of inventory data).

MSHPO Records, Historic atlas maps

ii. Provide documentation of previously identified sites as attachments.
iii. **Provide a map** showing the relationship between the previously identified properties and sites, your project footprint and project APE.
iv. Have you reviewed existing site information at the SHPO: ☒Yes ☐ No
v. Have you reviewed information from non-SHPO sources: ☒Yes ☐ No

b. **Identification Results**

i. **Above-ground Properties**
A. Attach the appropriate Michigan SHPO Architectural Identification Form for each resource or site 50 years of age or older in the APE. Refer to the *Instructions for the Application for SHPO Section 106 Consultation Form* for guidance on this.
B. **Provide the name and qualifications of the person who made recommendations of eligibility for the above-ground identification forms.**

Name James L. Ingermann Heimlich **Agency/Consulting Firm:** Orbis Environmental Consulting

Is the individual a 36CFR Part 61 Qualified Historian or Architectural Historian ☒ Yes ☐ No

Are their credentials currently on file with the SHPO? ☒ Yes ☐ No

If NO attach this individual's qualifications form and resume.

ii. **Archaeology** (complete this section if the project involves temporary or permanent ground disturbance)

Submit the following information using attachments, as necessary.

A. **Attach Archaeological Sensitivity Map.**
B. **Summary of previously reported archaeological sites and surveys:**

See attached cultural resources desktop review

C. **Town/Range/Section or Private Claim numbers:** T02S R11W Sec 15, 16, 17, 20, 23, 22, 27, 28, 29, 30, 31, 32, 33, 34, 35, and 36

D. **Width(s), length(s), and depth(s) of proposed ground disturbance(s):** Water Service work may disturb one 10'x10' x 6'deep area at the connection to the existing water main. Water main replacement may disturb a 10'wide by 6' deep excavation trench along the length of the water main.
E. **Will work potentially impact previously undisturbed soils?** ☐ Yes ☒ No

***If YES,* summarize new ground disturbance:**
Summary of new ground disturbance
F. **Summarize past and present land use:**

The project area contains existing waterlines slated for replacement.

G. **Potential to adversely affect significant archaeological resources**:

☒ Low ☐ Moderate ☐ High

For moderate and high potential, is fieldwork recommended? ☐ Yes ☐ No

Briefly justify the recommendation:

Justification for recommendation of fieldwork

H. **Has fieldwork already been conducted?** ☐ Yes ☒ No

If YES:
☐ Previously surveyed; refer to A. and B. above.
☐ Newly surveyed; attach report copies and provide full report reference here:
Full report reference

I. **Provide the name and qualifications of the person who provided the information for the Archaeology section:**

Name: J Ryan Duddleson **Agency/Firm:** Orbis Environmental Consulting
Is the person a 36CFR Part 61 Qualified Archaeologist? ☒ Yes ☐ No
Are their credentials currently on file with the SHPO? ☒ Yes ☐ No
If NO, attach this individual's qualifications form and resume.

Archaeological site locations are legally protected.

This application may not be made public without first redacting sensitive archaeological information.

V. IDENTIFICATION OF CONSULTING PARTIES

a. **Provide a list of *all* consulting parties,** including Native American tribes, local governments, applicants for federal assistance/permits/licenses, parties with a demonstrated interest in the undertaking, and public comment:

Prein& Newhof

b. **Provide a summary of consultation with consultation parties:**

Prein&Newhof provides water main design and construction document preparation for the project.

c. **Provide summaries of public comment and the method by which that comment was sought:**

Two public meetings and a noticed Public Hearing were held to receive public comment and provide presentation of all proposed project activities.

VI. DETERMINATION OF EFFECT

Guidance for applying the Criteria of Adverse Effect can be found in *the Instructions for the Application for SHPO Section 106 Consultation Form*.

a. **Basis for determination of effect**:

The records on file at the MSHPO show 21 historic districts and five archaeological sites occur in one or more portions of the Project Area.

Many of the known archaeological sites are associated with a significant precontact and postcontact occupation in Kalamazoo, however, these sites have not been field verified and are in heavily developed areas in Kalamazoo. The project is unlikely to encounter intact archaeological deposits because of this substantial development.

The records list hundreds of historic structures and many historic districts in Kalamazoo, including 21 historic districts that occur within at least one of the portions of the Project Area. Eleven of these historic districts are listed in the NHRP. Given that excavation is limited to replacing existing waterlines in the existing road, project activities remain consistent with the current use of the area and the project is unlikely to alter the significant aspects of the listed historic districts. Construction activities should not affect buildings within the eligible and unevaluated districts. Buildings within the ineligible district have already been significantly altered.

While the cultural context shows extensive occupation of the region in and around Kalamazoo from precontact through postcontact periods, the proposed project is unlikely to affect significant intact archaeological resources or historic structures because project activities will be limited to replacing existing waterlines in roadways. The waterlines extending to individual structures will be installed in the same place as the existing waterlines, without excavating trenches.

We recommend that no further work is necessary and determination of "No Adverse Effect" is appropriate because the project is unlikely to affect intact archaeological deposits or significant historic structures or districts. However, if project plans change, additional work may be necessary.

b. **Determination of effect**

☐ **No historic properties will be affected**

☒ **Historic properties will be affected** and the project will (check one):

☒ have **No Adverse Effect** on historic properties within the APE.

☐ have an **Adverse Effect** on one or more historic properties in the APE and the federal agency, or federally authorized representative, will consult with the SHPO and other parties to resolve the adverse effect under 800.6.

☐ **More Information Needed:** We are initiating early consultation. A determination of effect will be submitted to the SHPO at a later date, pending results of survey.

APPLICATION FOR SHPO SECTION 106 CONSULTATION

Federally Authorized Signature: Jonathan M. Berman Date: 04/10/2023

Type or Print Name: Jonathan M. Berman

Title: State Revolving Fund Compliance Specialist

ATTACHMENT CHECKLIST

Identify any materials submitted as attachments to the form:

☐ Additional federal, state, local government, applicant, consultant contacts

☒ Maps of project location

Number of maps attached: 14

☐ Site Photographs – select photos

☐Map of photographs

☐ Plans and specifications

☐ Other information pertinent to the work description: Identify the type of materials attached

☐ Documentation of previously identified historic properties

☐ Architectural Properties Identification Forms

☒ Map showing the relationship between the previously identified properties, your project footprint, and project APE

☐ Above-ground qualified person's qualification form and resume

☒ Archaeological sensitivity map

☐ Survey report

☐ Archaeologist qualifications and resume

☐ Other: Cultural Resources Desktop Review

J Ryan Duddleson <ryan@orbisec.com>

Confirmation - Michigan State Historic Preservation Office Section 106 Consultation

1 message

Smartsheet Forms <forms@app.smartsheet.com>
To: rduddleson@orbisec.com

Mon, Apr 10, 2023 at 10:42 AM

Thank you for submitting your request for consultation under Section 106 of the National Historic Preservation Act of 1966, as amended. A copy is included below for your records.

If you have concerns about your submission or were not able to attach all of your documents, please contact Scott Slagor at SlagorS2@Michigan.gov.

Michigan State Historic Preservation Office Section 106 Consultation

Project Name:	Kalamazoo Waterline Improvement
Project Street Address:	FY 2025_2028 on DWRF Construction Year Map
Project Municipal Unit:	City of Kalamazoo
Project County:	Kalamazoo
Federal Agency:	EGLE
Federal Agency Contact Name:	Jonathan M. Berman
Federal Agency Mailing Address (street, city, state, zip code):	PO Box 30457 Lansing, MI 48909-7957
Consultant/Applicant Name	Anna Crandall, P.E.
Consultant/Applicant Agency/Firm:	City of Kalamazoo
Consultant/Applicant Mailing Address:	415 Stockbridge Ave. Kalamazoo, MI 49001
Consultant/Applicant Phone Number:	269-337-8055
Consultant/Applicant Email Address:	crandalla@kalamazoocity.org

File Attachments

0_PN_Kalamazoo_Waterline_2025_2028_Section 106 Application edited signed.pdf (425k)

20230410_PN_Kalamazoo Water System 2025_ 2028.pdf (9170k)

LEGEND

DWRF Construction Years

- FY 2024
- FY 2025
- FY 2026
- FY 2027
- FY 2028

- Lining Project
- Various Streets Project (2024)
- City of Kalamazoo Limits

0 1,000 2,000 4,000 6,000 Feet

Scale: 1" = 2,000'

City of Kalamazoo

Kalamazoo County, Michigan

Water Distribution System

DWRF Construction Year Map

Prein&Newhof

January 2023

2220555

File: J:\GIS_Client\Kal-a\DWC\cy-GIS\City_Proj\2220555_2023 DWRF\City\Kazoo_DWRF_WithConstructionYears_Map.mxd - jblobaum - 1/11/2023 2:23:16 PM

APPENDIX B: SOILS MAP

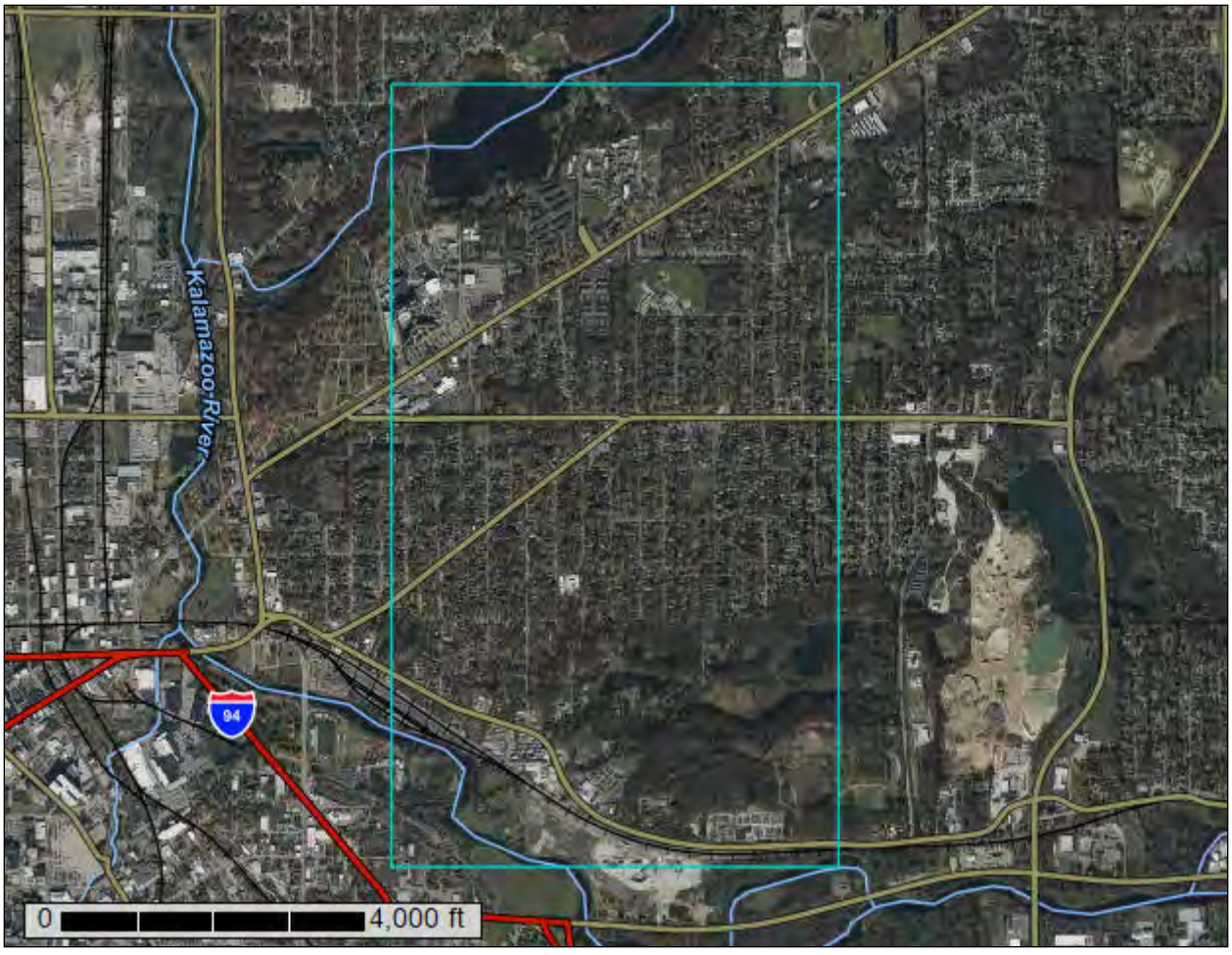
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Kalamazoo County, Michigan



March 6, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:18,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 250 500 1000 1500

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kalamazoo County, Michigan
Survey Area Data: Version 18, Aug 25, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 4, 2022—Nov 7, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BdA	Brady sandy loam, 0 to 3 percent slopes	6.8	0.5%
Gn	Glendora sandy loam	0.2	0.0%
Hs	Houghton and Sebewa soils, ponded	2.9	0.2%
OsB	Oshtemo sandy loam, 0 to 6 percent slopes	6.3	0.4%
OsC	Oshtemo sandy loam, 6 to 12 percent slopes	15.7	1.1%
OsD	Oshtemo sandy loam, 12 to 18 percent slopes	23.1	1.6%
Ua	Udipsamments, level to steep	5.8	0.4%
Ub	Urban land	622.6	44.4%
Ug	Urban land-Glendora complex	31.9	2.3%
UkB	Urban land-Kalamazoo complex, 0 to 6 percent slopes	295.7	21.1%
UkC	Urban land-Kalamazoo complex, 6 to 12 percent slopes	97.4	6.9%
UoD	Urban land-Oshtemo complex, 12 to 25 percent slopes	226.1	16.1%
W	Water	67.6	4.8%
Totals for Area of Interest		**1,402.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion

of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Kalamazoo County, Michigan

BdA—Brady sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 68n2
Elevation: 600 to 1,200 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Brady and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brady

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

Ap - 0 to 12 inches: sandy loam
Bt - 12 to 24 inches: sandy loam
2BC - 24 to 56 inches: loamy sand
2C - 56 to 68 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Available water supply, 0 to 60 inches: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Minor Components

Bronson

Percent of map unit: 10 percent

Landform: Flats on outwash plains
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Gn—Glendora sandy loam

Map Unit Setting

National map unit symbol: 68nb
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Glendora and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glendora

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 10 inches: sandy loam
C - 10 to 60 inches: stratified sand to loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Ecological site: F098XA004MI - Wet Floodplains
Hydric soil rating: Yes

Minor Components

Sebewa
Percent of map unit: 5 percent
Landform: Depressions on outwash plains
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

Adrian
Percent of map unit: 4 percent
Landform: Depressions on lake plains
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Houghton
Percent of map unit: 4 percent
Landform: Depressions
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Hs—Houghton and Sebewa soils, ponded

Map Unit Setting
National map unit symbol: 68nf
Elevation: 360 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Houghton and similar soils: 45 percent
Sebewa and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton

Setting
Landform: Depressions, outwash plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material

Typical profile
Oa1 - 0 to 10 inches: muck
Oa2 - 10 to 60 inches: muck

Properties and qualities
Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Description of Sebewa

Setting

Landform: Outwash plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy over sandy and gravelly outwash

Typical profile

Ap - 0 to 11 inches: loam
Btg - 11 to 23 inches: clay loam
2Cg - 23 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 25 percent
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

Minor Components

Glendora

Percent of map unit: 3 percent
Landform: Flood plains
Ecological site: F098XA004MI - Wet Floodplains

Hydric soil rating: Yes

Adrian

Percent of map unit: 3 percent
Landform: Depressions on lake plains
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Edwards

Percent of map unit: 3 percent
Landform: Depressions on lakebeds
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Granby

Percent of map unit: 3 percent
Landform: Depressions on lake plains
Ecological site: F098XA020MI - Wet Sandy Drift Depressions
Hydric soil rating: Yes

Gilford

Percent of map unit: 3 percent
Landform: Depressions on outwash plains
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

OsB—Oshtemo sandy loam, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2v2cd
Elevation: 710 to 1,010 feet
Mean annual precipitation: 30 to 41 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 140 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Oshtemo and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oshtemo

Setting

Landform: Outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Loamy drift over calcareous sandy and gravelly drift

Typical profile

Ap - 0 to 8 inches: sandy loam
E - 8 to 13 inches: sandy loam
Bt - 13 to 36 inches: sandy loam
E and Bt - 36 to 55 inches: loamy sand
2C - 55 to 80 inches: gravelly sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 34 percent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F098XA015MI - Dry Loamy Drift Plains
Hydric soil rating: No

Minor Components

Brady

Percent of map unit: 3 percent
Landform: Outwash terraces, outwash plains, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Bronson

Percent of map unit: 3 percent
Landform: Outwash terraces, outwash plains, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Spinks

Percent of map unit: 3 percent
Landform: Outwash terraces, outwash plains, moraines
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

Gilford

Percent of map unit: 1 percent
Landform: Outwash terraces, outwash plains, moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

OsC—Oshtemo sandy loam, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2v2cf
Elevation: 740 to 1,030 feet
Mean annual precipitation: 30 to 41 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of local importance

Map Unit Composition

Oshtemo and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oshtemo

Setting

Landform: Moraines, outwash plains, outwash terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Loamy drift over calcareous sandy and gravelly drift

Typical profile

Ap - 0 to 8 inches: sandy loam
E - 8 to 13 inches: sandy loam
Bt - 13 to 36 inches: sandy loam
E and Bt - 36 to 55 inches: loamy sand
2C - 55 to 80 inches: gravelly sand

Properties and qualities

Slope: 6 to 12 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 34 percent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: F098XA015MI - Dry Loamy Drift Plains
Hydric soil rating: No

Minor Components

Bronson

Percent of map unit: 3 percent
Landform: Moraines, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Brady

Percent of map unit: 3 percent
Landform: Moraines, outwash terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Spinks

Percent of map unit: 3 percent
Landform: Moraines, outwash plains, outwash terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

Gilford

Percent of map unit: 1 percent
Landform: Moraines, outwash terraces, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

OsD—Oshtemo sandy loam, 12 to 18 percent slopes

Map Unit Setting

National map unit symbol: 2w64x
Elevation: 760 to 1,030 feet
Mean annual precipitation: 30 to 41 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 140 to 230 days
Farmland classification: Farmland of local importance

Map Unit Composition

Oshtemo and similar soils: 89 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oshtemo

Setting

Landform: Outwash plains, moraines, outwash deltas
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Loamy drift over calcareous sandy and gravelly drift

Typical profile

A - 0 to 7 inches: sandy loam
E - 7 to 12 inches: sandy loam
Bt - 12 to 35 inches: sandy loam
E and Bt - 35 to 54 inches: loamy sand
2C - 54 to 80 inches: gravelly sand

Properties and qualities

Slope: 12 to 18 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 34 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F098XA022MI - Loamy Slopes
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Minor Components

Plainfield

Percent of map unit: 5 percent
Landform: Outwash plains, moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F098XA021MI - Sandy Slopes
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Hillsdale

Percent of map unit: 2 percent
Landform: Moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F098XA022MI - Loamy Slopes
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Spinks

Percent of map unit: 2 percent
Landform: Moraines, outwash plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F098XA021MI - Sandy Slopes
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Brady

Percent of map unit: 2 percent
Landform: Moraines, outwash plains, outwash deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Ua—Udipsamments, level to steep

Map Unit Setting

National map unit symbol: 68p3
Elevation: 740 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Udipsamments and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udipsamments

Setting

Landform: Outwash plains
Landform position (three-dimensional): Side slope
Down-slope shape: Concave, linear
Across-slope shape: Convex, linear
Parent material: Sandy drift

Typical profile

H1 - 0 to 60 inches: sand

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

Ub—Urban land

Map Unit Setting

National map unit symbol: 68p4
Mean annual precipitation: 30 to 36 inches

Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Ug—Urban land-Glendora complex

Map Unit Setting
National map unit symbol: 68p5
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 50 percent
Glendora and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glendora

Setting
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile
A - 0 to 10 inches: sandy loam
C - 10 to 60 inches: stratified sand to loamy sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D

Ecological site: F098XA004MI - Wet Floodplains
Hydric soil rating: Yes

Minor Components

Adrian
Percent of map unit: 5 percent
Landform: Depressions on lake plains
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

Sebewa
Percent of map unit: 5 percent
Landform: Depressions on lake plains, depressions on outwash plains
Ecological site: F098XA012MI - Wet Loamy Depressions
Hydric soil rating: Yes

Houghton
Percent of map unit: 5 percent
Landform: Depressions
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

UkB—Urban land-Kalamazoo complex, 0 to 6 percent slopes

Map Unit Setting
National map unit symbol: 2w5m5
Elevation: 770 to 970 feet
Mean annual precipitation: 30 to 41 inches
Mean annual air temperature: 43 to 52 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 65 percent
Kalamazoo and similar soils: 30 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Properties and qualities
Slope: 0 to 6 percent
Depth to restrictive feature: 0 inches to manufactured layer

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Kalamazoo

Setting

Landform: Outwash plains, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Loess-influenced loamy outwash over sandy and gravelly outwash

Typical profile

Ap - 0 to 10 inches: loam
Bt1 - 10 to 27 inches: sandy clay loam
Bt2 - 27 to 35 inches: sandy loam
2BC - 35 to 52 inches: loamy sand
2C - 52 to 80 inches: gravelly sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 22 percent
Maximum salinity: Nonsaline (0.1 to 0.3 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F098XA015MI - Dry Loamy Drift Plains
Hydric soil rating: No

Minor Components

Spinks

Percent of map unit: 2 percent
Landform: Outwash plains, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

Bronson

Percent of map unit: 2 percent

Landform: Outwash plains, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

Sleeth

Percent of map unit: 1 percent
Landform: Outwash plains, outwash terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

UkC—Urban land-Kalamazoo complex, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: 68p7
Elevation: 400 to 1,360 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 50 percent
Kalamazoo and similar soils: 45 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Outwash plains
Landform position (two-dimensional): Backslope

Description of Kalamazoo

Setting

Landform: Outwash plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy over sandy outwash

Typical profile

Ap - 0 to 11 inches: loam
Bt - 11 to 38 inches: clay loam
2B - 38 to 55 inches: loamy coarse sand
2C - 55 to 60 inches: gravelly sand

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F098XA015MI - Dry Loamy Drift Plains
Hydric soil rating: No

Minor Components

Coloma

Percent of map unit: 3 percent
Landform: Knolls on outwash plains
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

Sleeth

Percent of map unit: 2 percent
Landform: Drainageways on outwash plains
Ecological site: F098XA011MI - Moist Loamy Drift Plains
Hydric soil rating: No

UoD—Urban land-Oshtemo complex, 12 to 25 percent slopes

Map Unit Setting

National map unit symbol: 68p8
Elevation: 580 to 1,360 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 58 percent
Oshtemo and similar soils: 25 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Convex

Description of Oshtemo

Setting

Landform: Moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy outwash

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt - 9 to 29 inches: sandy loam
B - 29 to 69 inches: sand

Properties and qualities

Slope: 12 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F098XA022MI - Loamy Slopes
Hydric soil rating: No

Minor Components

Coloma

Percent of map unit: 9 percent
Landform: Ridges on outwash plains
Landform position (two-dimensional): Backslope
Ecological site: F098XA021MI - Sandy Slopes

Hydric soil rating: No

Plainfield

Percent of map unit: 8 percent
Landform: Flats on outwash plains
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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APPENDIX C: MICHIGAN NATURAL FEATURES INVENTORY

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Kalamazoo County, Michigan

Local office

Michigan Ecological Services Field Office

(517) 351-2555
(517) 351-1443

2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Indiana Bat *Myotis sodalis* Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat *Myotis septentrionalis* Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat *Perimyotis subflavus* Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

Birds

NAME	STATUS

NAME	STATUS
Whooping Crane Grus americana No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/758	EXPN

Reptiles

NAME	STATUS
Eastern Massasauga (=rattlesnake) Sistrurus catenatus Wherever found This species only needs to be considered if any of the following conditions apply: • For all Projects:Project is within Tier1 Habitat • For all projects:Project is within Tier2 Habitat • For all Projects: Project is within EMR Range No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2202	Threatened

Insects

NAME	STATUS
Mitchell's Satyr Butterfly Neonympha mitchellii mitchellii Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8062	Endangered
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models

detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Golden-plover Pluvialis dominica This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Black-billed Cuckoo Coccyzus erythropthalmus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink Dolichonyx oryzivorus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler Cardellina canadensis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10

Cerulean Warbler Dendroica cerulea — Breeds Apr 22 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/2974

Chimney Swift Chaetura pelagica — Breeds Mar 15 to Aug 25

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Eastern Whip-poor-will Antrostomus vociferus — Breeds May 1 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds elsewhere

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Golden-winged Warbler Vermivora chrysoptera — Breeds May 1 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8745

Henslow's Sparrow Ammodramus henslowii — Breeds May 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3941

Lesser Yellowlegs Tringa flavipes This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Red-headed Woodpecker Melanerpes erythrocephalus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Rusty Blackbird Euphagus carolinus This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Wood Thrush Hylocichla mustelina This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (▪)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

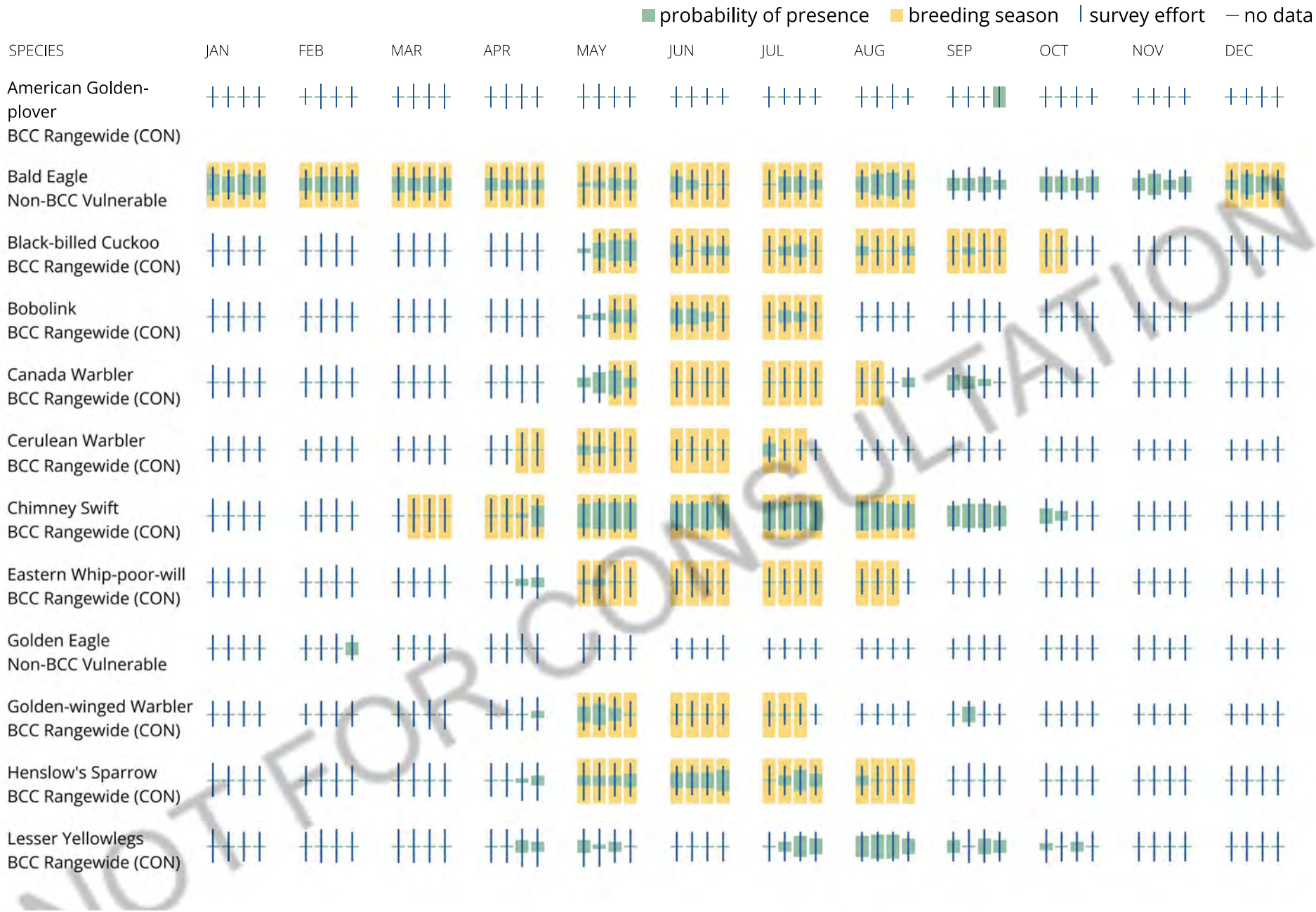
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

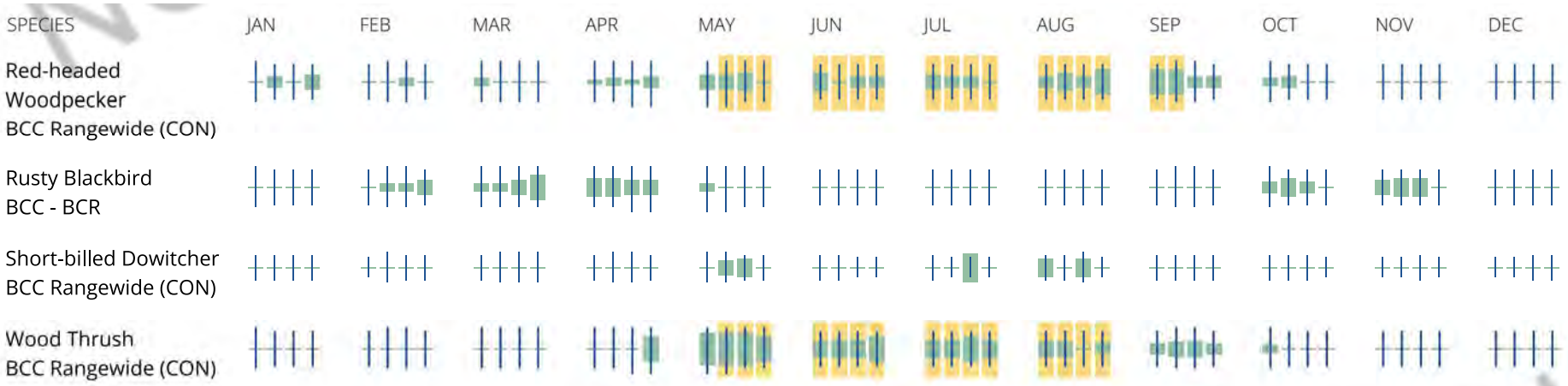
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Wetland information is not available at this time

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
Phone: (517) 351-2555 Fax: (517) 351-1443

In Reply Refer To: April 26, 2023
Project Code: 2023-0074609
Project Name: City of Kalamazoo FY2024 DWRF

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Official Species List
The attached species list identifies any Federally threatened, endangered, proposed and candidate species that may occur within the boundary of your proposed project or may be affected by your proposed project. The list also includes designated critical habitat if present within your proposed project area or affected by your project. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Under 50 CFR 402.12(e) (the regulations that implement section 7 of the Endangered Species Act), the accuracy of this species list should be verified after 90 days. You may verify the list by visiting the IPaC website (https://ipac.ecosphere.fws.gov/) at regular intervals during project planning and implementation. To update an Official Species List in IPaC: from the My Projects page, find the project, expand the row, and click Project Home. In the What's Next box on the Project Home page, there is a Request Updated List button to update your species list. Be sure to select an "official" species list for all projects.

Consultation requirements and next steps
Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize Federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-Federal representative) must consult with the Fish and Wildlife Service if they determine their project may affect listed species or critical habitat.

There are two approaches to evaluating the effects of a project on listed species.

Approach 1. Use the All-species Michigan determination key in IPaC. This tool can assist you in making determinations for listed species for some projects. In many cases, the determination key

will provide an automated concurrence that completes all or significant parts of the consultation process. Therefore, we strongly recommend screening your project with the **All-Species Michigan Determination Key (Dkey)**. For additional information on using IPaC and available Determination Keys, visit https://www.fws.gov/media/mifo-ipac-instructions (and click on the attachment). Please carefully review your Dkey output letter to determine whether additional steps are needed to complete the consultation process.

Approach 2. Evaluate the effects to listed species on your own without utilizing a determination key. Once you obtain your official species list, you are not required to continue in IPaC, although in most cases using a determination key should expedite your review. If the project is a Federal action, you should review our section 7 step-by-step instructions before making your determinations: https://www.fws.gov/office/midwest-region-headquarters/midwest-section-7-technical-assistance. If you evaluate the details of your project and conclude "no effect," document your findings, and your listed species review is complete; you do not need our concurrence on "no effect" determinations. If you cannot conclude "no effect," you should coordinate/consult with the Michigan Ecological Services Field Office. The preferred method for submitting your project description and effects determination (if concurrence is needed) is electronically to EastLansing@fws.gov. Please include a copy of this official species list with your request.

For all **wind energy projects** and **projects that include installing communications towers that use guy wires**, please contact this field office directly for assistance, even if no Federally listed plants, animals or critical habitat are present within your proposed project area or may be affected by your proposed project.

Migratory Birds
Please see the "Migratory Birds" section below for important information regarding incorporating migratory birds into your project planning. Our Migratory Bird Program has developed recommendations, best practices, and other tools to help project proponents voluntarily reduce impacts to birds and their habitats. The Bald and Golden Eagle Protection Act prohibits the take and disturbance of eagles without a permit. If your project is near an eagle nest or winter roost area, see our Eagle Permits website at https://www.fws.gov/program/eagle-management/eagle-permits to help you avoid impacting eagles or determine if a permit may be necessary.

Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your consideration of threatened and endangered species during your project

planning. Please include a copy of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
(517) 351-2555

PROJECT SUMMARY

Project Code: 2023-0074609
Project Name: City of Kalamazoo FY2024 DWRF
Project Type: Distribution Line - Maintenance/Modification - Below Ground
Project Description: The project is for lead service line replacement and water main lining in the Kalamazoo Area water system. The project is scheduled for 2024 construction season.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.269793449999995,-85.58449642214381,14z

Counties: Kalamazoo County, Michigan

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Indiana Bat *Myotis sodalis* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949 General project design guidelines: https://ipac.ecosphere.fws.gov/project/PZ4LMVWLBNHN5JH7M5YMOCPSAE/documents/generated/6982.pdf	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 General project design guidelines: https://ipac.ecosphere.fws.gov/project/PZ4LMVWLBNHN5JH7M5YMOCPSAE/documents/generated/6983.pdf	Endangered
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Whooping Crane *Grus americana* Population: U.S.A. (AL, AR, CO, FL, GA, ID, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, NM, OH, SC, TN, UT, VA, WI, WV, western half of WY) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/758	Experimental Population, Non-Essential

REPTILES

NAME	STATUS
Eastern Massasauga (=rattlesnake) *Sistrurus catenatus* No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ For all Projects:Project is within Tier1 Habitat ▪ For all projects:Project is within Tier2 Habitat ▪ For all Projects: Project is within EMR Range Species profile: https://ecos.fws.gov/ecp/species/2202 General project design guidelines: https://ipac.ecosphere.fws.gov/project/PZ4LMVWLBNHN5JH7M5YMOCPSAE/documents/generated/5280.pdf	Threatened

INSECTS

NAME	STATUS
Mitchell's Satyr Butterfly *Neonympha mitchellii mitchellii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8062	Endangered
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Golden-plover *Pluvialis dominica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31

NAME	BREEDING SEASON
Black-billed Cuckoo *Coccyzus erythropthalmus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler *Cardellina canadensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10
Cerulean Warbler *Dendroica cerulea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/2974	Breeds Apr 22 to Jul 20
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 25
Eastern Whip-poor-will *Antrostomus vociferus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Aug 20
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds elsewhere
Golden-winged Warbler *Vermivora chrysoptera* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20
Henslow's Sparrow *Ammodramus henslowii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3941	Breeds May 1 to Aug 31
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10

NAME	BREEDING SEASON
Rusty Blackbird *Euphagus carolinus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Wood Thrush *Hylocichla mustelina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

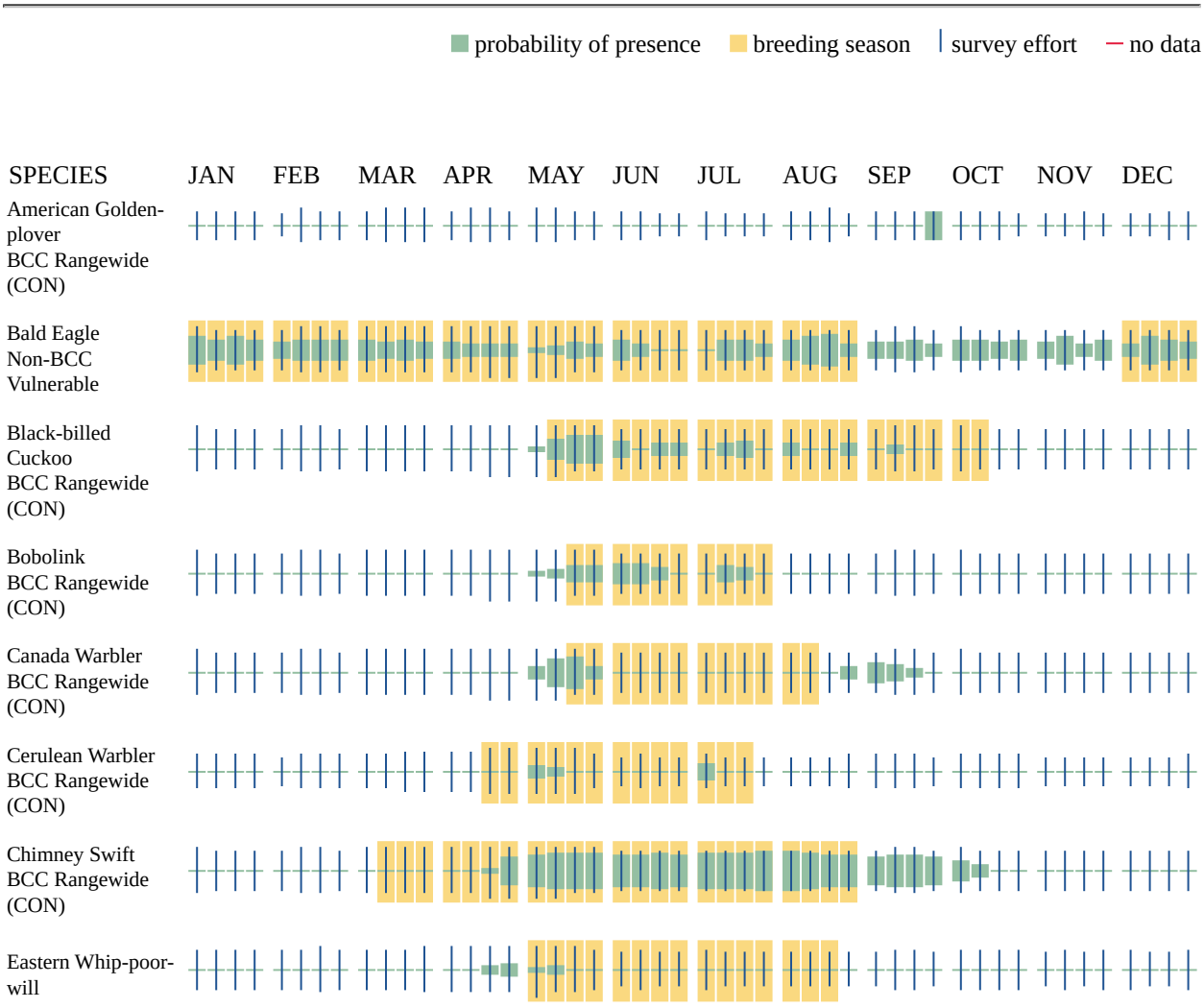
Breeding Season (■)

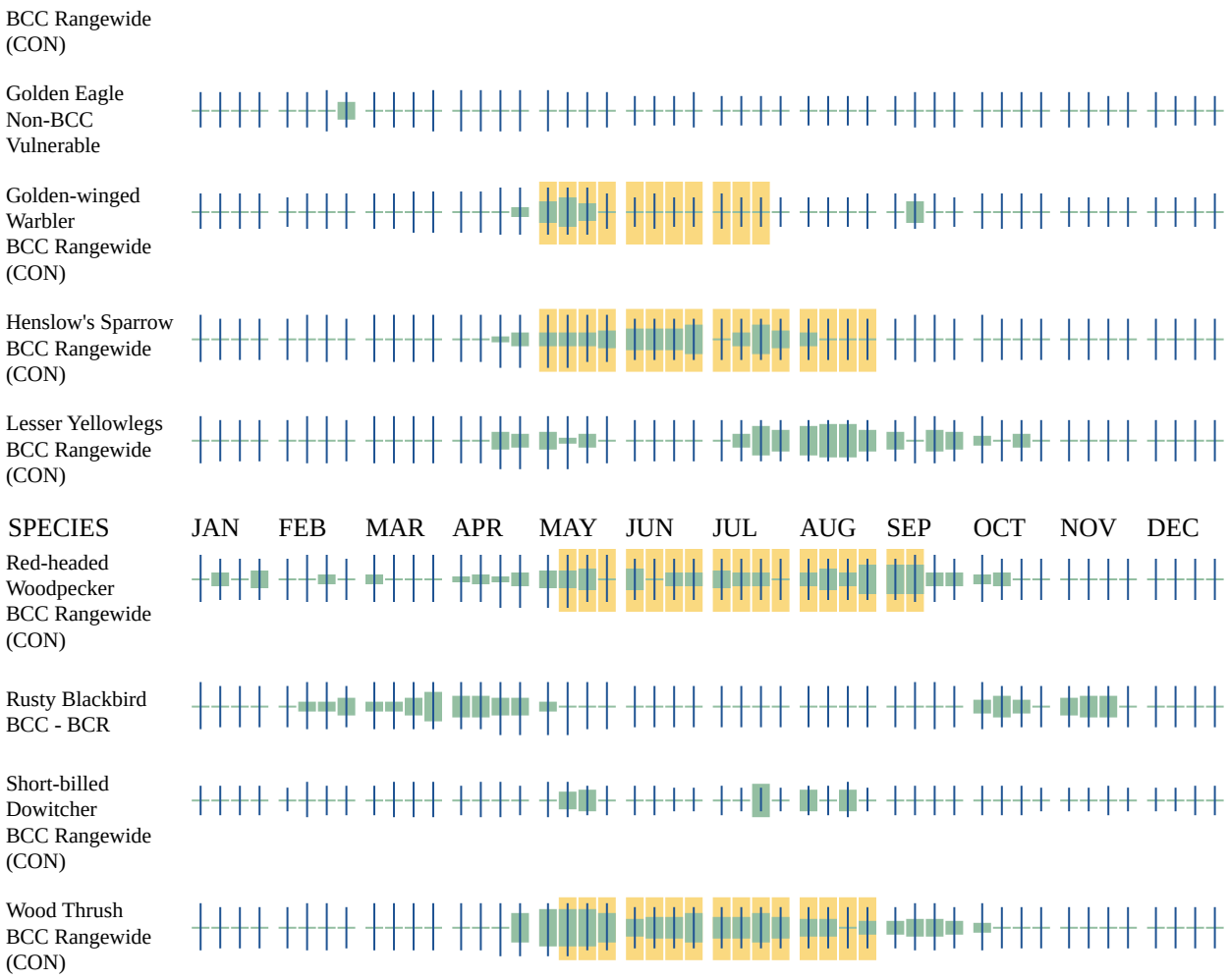
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

MIGRATORY BIRDS FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits

may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);

2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities,

should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER POND

- PABG
- PUBGx
- PUBFx
- PUBK
- PUBG

LAKE

- L2ABH
- L1UBH
- L1UBHh
- L2EM2G

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1/EM1C
- PFO1/SS1Cd
- PFO1A
- PFO1C
- PSS1F
- PSS1C
- PFO5F

RIVERINE

- R5UBFx
- R5UBH

FRESHWATER EMERGENT WETLAND

- PEM2F
- PEM1C
- PEM1F

- PEM1Cd

IPAC USER CONTACT INFORMATION

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LEAD AGENCY CONTACT INFORMATION

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
Phone: (517) 351-2555 Fax: (517) 351-1443

In Reply Refer To: April 26, 2023
Project code: 2023-0074609
Project Name: City of Kalamazoo FY2024 DWRF

Federal Nexus: no
Federal Action Agency (if applicable): Kalamazoo city

Subject: Technical assistance for 'City of Kalamazoo FY2024 DWRF'

Dear Brian Vilmont:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on April 26, 2023, for 'City of Kalamazoo FY2024 DWRF' (here forward, Project). This project has been assigned Project Code 2023-0074609 and all future correspondence should clearly reference this number. **Please carefully review this letter. Your Endangered Species Act (Act) requirements are not complete.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into the IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat Rangewide Determination Key (Dkey), invalidates this letter.

Determination for the Northern Long-Eared Bat

Based upon your IPaC submission and a standing analysis, your project is not reasonably certain to cause incidental take of the northern long-eared bat. Unless the Service advises you within 15 days of the date of this letter that your IPaC-assisted determination was incorrect, this letter verifies that the Action is not likely to result in unauthorized take of the northern long-eared bat.

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination for the northern long-eared bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Eastern Massasauga (=rattlesnake) *Sistrurus catenatus* Threatened
- Indiana Bat *Myotis sodalis* Endangered
- Mitchell's Satyr Butterfly *Neonympha mitchellii mitchellii* Endangered
- Monarch Butterfly *Danaus plexippus* Candidate
- Tricolored Bat *Perimyotis subflavus* Proposed Endangered
- Whooping Crane *Grus americana* Experimental Population, Non-Essential

You may coordinate with our Office to determine whether the Action may cause prohibited take of the animal species and/or critical habitat listed above. Note that if a new species is listed that may be affected by the identified action before it is complete, additional review is recommended to ensure compliance with the Endangered Species Act.

Next Steps

Coordination with the Service is complete. This letter serves as technical assistance. All conservation measures should be implemented as proposed. Thank you for considering federally listed species during your project planning.

We are uncertain where the northern long-eared bat occurs on the landscape outside of known locations. Because of the steep declines in the species and vast amount of available and suitable forest habitat, the presence of suitable forest habitat alone is a far less reliable predictor of their presence. Based on the best available information, most suitable habitat is now expected to be unoccupied. During the interim period, while we are working on potential methods to address this uncertainty, we conclude take is not reasonably certain to occur in areas of suitable habitat where presence has not been documented.

If no changes occur with the Project or there are no updates on listed species, no further consultation/coordination for this project is required for the northern long-eared bat. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place before project implements any changes which are final or commits additional resources.

If you have any questions regarding this letter or need further assistance, please contact the Michigan Ecological Services Field Office and reference Project Code 2023-0074609 associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

City of Kalamazoo FY2024 DWRF

2. Description

The following description was provided for the project 'City of Kalamazoo FY2024 DWRF':

> The project is for lead service line replacement and water main lining in the Kalamazoo Area water system. The project is scheduled for 2024 construction season.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.269793449999995,-85.58449642214381,14z

DETERMINATION KEY RESULT

Based on the answers provided, the proposed Action is consistent with a determination of "may affect, but not likely to adversely affect" for the Endangered northern long-eared bat (*Myotis septentrionalis*).

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of the northern long-eared bat or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No

2. Do you have post-white nose syndrome occurrence data that indicates that northern long-eared bats (NLEB) are likely to be present in the action area?

   Bat occurrence data may include identification of NLEBs in hibernacula, capture of NLEBs, tracking of NLEBs to roost trees, or confirmed acoustic detections. With this question, we are looking for data that, for some reason, may have not yet been made available to U.S. Fish and Wildlife Service.

   No

3. Does any component of the action involve construction or operation of wind turbines?

   Note: For federal actions, answer 'yes' if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

   No

4. Is the proposed action authorized, permitted, licensed, funded, or being carried out by a Federal agency in whole or in part?

   No

PROJECT QUESTIONNAIRE

IPAC USER CONTACT INFORMATION

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LEAD AGENCY CONTACT INFORMATION

Lead Agency: Kalamazoo city
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Phone: 2693378055

Michigan Endangered Species Determination Key
Standing Analysis
April 2023 (version 4.0)

Introduction

This standing analysis supports the "All-species Michigan Endangered Species Determination Key" (Dkey) delivered by the U.S. Fish and Wildlife Service (Service)'s Information for Planning and Consultation (IPaC) system. The Service's Michigan Ecological Services Field Office (MIFO) developed this DKey to streamline the process of reviewing certain routine and predictable projects that are not likely to result in adverse effects (or take) of Federally threatened and endangered species in Michigan.

In Fiscal Year 2019, the MIFO received over 1,270 projects that it reviewed and determined would not significantly affect or result in the prohibited take of species or habitats listed under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). The routine nature of the review of various Federal and non-Federal projects provides an opportunity for the MIFO to programmatically evaluate the effects of common activities on threatened and endangered species. Most incoming projects overlap with the Area of Influence (AOI) of multiple listed species in Michigan. The availability of a DKey covering all threatened and endangered species and critical habitats in Michigan will eliminate the need for the MIFO to individually review large numbers of projects and will provide Federal Action Agencies, consultants, and project proponents an immediate and consistent response to their requests for consultation, technical assistance, or conservation planning assistance.

To use this Dkey, applicants enter their project area in IPaC, and the program determines whether the project's geographic extent intersects AOI of any Federally listed species. The applicant will have the option to complete an available determination key, including this Dkey, for those species for which their project area intersects an AOI. The Dkey starts by asking a series of questions to determine if the project qualifies for the Dkey (see General Exclusions below). If they don't qualify for the Dkey, they will be notified that they must consider effects to threatened and endangered species outside of the Dkey. If the user's project qualifies for the Dkey, they will receive questions based on the specific species that may be present in the action area. Depending on how they answer the questions and the corresponding determinations that are reached, they will receive an output letter from IPaC. For Federal projects that reach a "not likely to adversely affect (NLAA)" determination, there is a 30 day "verification period" to allow the Service to review the project details and ensure the action meets the criteria for a NLAA determination. Output letters will indicate that if the project proponent does not hear otherwise within that timeframe, the NLAA determination is verified and they can proceed with their action as described in the IPaC report and concurrence verification letter. This verification period allows the Michigan Ecological Services Field Office to apply local knowledge to evaluation of the action and ensure actions do not have unanticipated impacts. Thus, there may be a small subset of actions for which the Michigan Ecological Services Field Office may request additional information during this timeframe to verify the effects determination reached through the DKey. There is no verification period for non-Federal projects or for "no effect" determinations. If the user gets a "may affect" determination for any species, they are advised to contact the Michigan Field Office to complete consultation outside of the Dkey. All output

letters include reinitiation language as follows: “The Service recommends that your agency contact the Service or re-evaluate the project in IPaC if: 1) the scope or location of the proposed Action is changed; 2) new information reveals that the action may affect listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the Action is modified in a manner that causes effects to listed species or designated critical habitat; or 4) a new species is listed or critical habitat designated. If any of the above conditions occur, additional consultation with the Service should take place before project changes are final or resources committed”.

Proposed Action

The proposed Action is the compilation of many different types of projects that depending on their size and specific location often do not significantly affect any Federally listed threatened or endangered species or critical habitats in Michigan. Common project types include, but are not limited to, the following:

- Vegetation management, including mowing, forestry activities, prescribed burning and harvest
- Construction, maintenance, operation, and/or removal of:
    - Roads and trails
    - Communication towers
    - Transmission and utility lines
    - Bridges and culverts
    - Oil and gas pipelines
    - Solar power facilities
    - Hydroelectric facilities/dams
    - Mines/quarries
    - Canals/levees/dikes
- Commercial, residential and recreational developments
- Agricultural activities
- Site/habitat restoration/enhancement
- Shoreline protection/beach nourishment
- Dredging and filling of wetlands/waterbodies
- Military operations

General Exclusions:

To use this standing analysis and receive a conclusion from IPaC through the DKey, projects may NOT include the following:

1. Long-term (i.e., greater than 10 years) permits, plans or other actions (e.g., FERC licenses)
2. Construction or operation of wind turbines
3. Projects for which there are less than 30 days prior to action occurring
4. Construction of a communications tower that don’t use proper lighting, is located within three miles of dedicated conservation lands, has guy wires, or is over 450 feet in height
5. Water withdrawals greater than 10,000 gallons/day, or
6. Aerial or other broad application of chemicals

To ensure compliance with the ESA, project-specific consultation (or other programmatic consultation, if applicable) with the Service may be necessary for projects including the actions listed above. Those projects would not necessarily result in significant adverse effects to listed species or habitats.

Additionally, to use this standing analysis and receive a conclusion from IPaC, projects must include the species/taxon-specific conservation measures detailed below, as appropriate (Species-Specific Conservation Measures).

Action Area

The Action Area is the entire State of Michigan. Because the DKey is intended for use by future projects, we cannot identify the specific action areas of individual projects.

Covered Species/Habitats

Species and habitats covered by the Michigan Endangered Species DKey include all Federally listed species and critical habitats that occur within the state, as follows[1]:

Animals

- *Birds*
  - Whooping Crane (*Grus americana*)- NEP
  - Piping Plover (*Charadrius melodus*)- E
  - Rufa Red Knot (*Calidris canutus rufa*)- T
- *Freshwater Mussels*
  - Clubshell (*Pleurobema clava*)- E
  - Northern Riffleshell (*Epioblasma torulosa rangiana*)- E
  - Rayed Bean (*Villosa fabalis*)- E
  - Snuffbox (*Epioblasma triquetra*)- E
- *Insects*
  - Hine's Emerald Dragonfly (*Somatochlora hineana*)- E
  - Hungerford's Crawling Water Beetle (*Brychius hungerfordi*)- E
  - Karner Blue Butterfly (*Lycaeides melissa samuelis*)- E
  - Mitchell's Satyr (*Neonympha mitchelli mitchelli*)- E
  - Poweshiek Skipperling (*Oarisma poweshiek*)- E
  - Monarch butterfly (*Danaus plexippus*) - Candidate
- *Mammals*
  - Canada Lynx (*Lynx canadensis*)- T
  - Gray Wolf (*Canis lupus*)- E
  - Indiana Bat (*Myotis sodalis*)- E
  - Northern Long-eared Bat (*Myotis septentrionalis*)- T
  - Tricolored Bat (*Permyotis subflavus*)- P
- *Reptiles*
  - Copperbelly Water Snake (*Nerodia erythogaster neglecta*)- T

[1] C = candidate, CH = critical habitat, E = endangered, NEP = nonessential experimental population, P = proposed, T = threatened

- Eastern Massasauga Rattlesnake (*Sistrurus catenatus*)- T

Plants

- American Hart's-Tongue Fern (*Asplenium scolopendrium* var. *americana*)- T
- Dwarf Lake Iris (*Iris lacustris*)- T
- Eastern Prairie Fringed Orchid (*Platanthera leucophaea*)- T
- Houghton's Goldenrod (*Solidago houghtonii*)- T
- Lakeside Daisy (*Hymenoxys herbacea*)- T
- Michigan Monkey-Flower (*Mimulus michiganensis*)- E
- Pitcher's Thistle (*Cirsium pitcheri*)- T

Critical Habitats (CH)

- Hine's Emerald Dragonfly CH
- Piping Plover CH
- Poweshiek Skipperling CH

Species Descriptions/Status within the Action Area

Nonessential Experimental Population of Whooping Crane (Grus americana)

The whooping crane breeds, migrates, winters, and forages in a variety of wetland and other habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields. Bulrush is the dominant vegetation type in the potholes used for nesting, although cattail, sedge, musk-grass, and other aquatic plants are common. Nest sites are primarily located in shallow diatom ponds that contain bulrush. During migration, whooping cranes use a variety of habitats; however wetland mosaics appear to be the most suitable. For feeding, whooping cranes primarily use shallow, seasonally and semi permanently flooded palustrine wetlands for roosting, and various cropland and emergent wetlands.

The whooping crane has been Federally listed as endangered since 1967 due to habitat loss and over-hunting. Wild whooping cranes currently exist in two flocks, a non-migratory flock in Florida, and a migratory flock that summers in Wood Buffalo National Park in Canada and winters near and at Aransas National Wildlife Refuge in Texas along the Gulf coast. It is possible that all or most of these birds could be wiped out from a single event such as a hurricane, disease outbreak, toxic spill, or prolonged drought, making the species vulnerable to extinction. To ensure that the whooping crane survives, the International Whooping Crane Recovery Team recommended that an additional flock of whooping cranes be established that is separate from the single remaining natural wild migratory population. On June 26, 2001, the Service published a final rule in the Federal Register to establish a Nonessential Experimental Population (NEP) within a 20-state area in the eastern U.S., which includes Michigan.

For the purposes of section 7 of the ESA, we treat NEPs as threatened species when the NEP is located within a National Wildlife Refuge (NWR) or National Park (NP), and therefore section 7(a)(1) and the consultation requirements of section 7(a)(2) of the ESA apply in NWRs and NPs. Section 7(a)(1) requires all Federal agencies to use their authorities to conserve listed species. Section 7(a)(2) requires that Federal agencies consult with the Service before authorizing, funding, or carrying out any activity that would likely jeopardize the continued existence of a listed species or adversely modify its critical habitat.

For Federal projects outside a NWR or NP, we treat the population as proposed for listing and only two provisions of section 7 would apply: section 7(a)(1) and section 7(a)(4). In these instances, NEPs provide additional flexibility because Federal agencies are not required to consult with us under section 7(a)(2). Section 7(a)(4) requires Federal agencies to confer with the Service on actions that are likely to jeopardize the continued existence of a proposed species. The results of a conference are advisory in nature and do not restrict agencies from carrying out, funding, or authorizing activities.

For purposes of section 9 of the ESA, individual species within a NEP area are treated as threatened regardless of the species' designation elsewhere in its range. Under section 4(d) of the ESA, we have greater discretion in developing management programs and special regulations for threatened species than we have for endangered species. Section 4(d) of the ESA allows us to adopt whatever regulations are necessary to provide for the conservation of a threatened species. The special 4(d) rule contains the prohibitions and exemptions necessary and appropriate to conserve that species. Because of the flexibility, regulations issued under a 4(d) rule are generally compatible with routine human activities in the reintroduction area. For whooping crane in the NEP in Michigan, purposeful take is prohibited under the special rule; actions that cause take that is accidental and occurred incidentally to an otherwise lawful activity that was being carried out in full compliance with all applicable laws and regulations, is not prohibited under the ESA. In the case of an intentional actions (e.g., intentional shooting), the full protection of the ESA could apply.

For additional information on the whooping crane, including a five-year status review and recovery plan, please see the species profile.

Piping Plover (Charadrius melodus)

The piping plover is a small shorebird that nests in three separate geographic populations in the U.S.: the Great Plains states, the shores of the Great Lakes, and the shores of the Atlantic coast. Birds from all populations winter on the southern Atlantic and Gulf coasts in the U.S.

In the Great Lakes, piping plovers nest, feed, and rear their young in open, sparsely vegetated sandy areas, including sand spits and sand beaches with wide, unforested dunes and swales or in the flat pans behind the primary dune. Piping plovers begin arriving in Michigan in late April, and most mated pairs are nesting by mid to late May. Eggs typically hatch from late May to late July, with chicks fledging 21 to 30 days after hatching. Although piping plovers typically produce one brood per year, they sometimes bring off two broods during a summer. Piping plovers feed on exposed beach surfaces by pecking for invertebrates that are 1/2 inch or less below the surface. They feed mostly during the day and eat insects, marine worms, crustaceans, and mollusks as well as eggs and larvae of flies and beetles. Most adults depart for their wintering grounds by mid-August. Young birds hatched during the summer start their migration a few weeks later than adults, and most are gone from the Great Lakes by late August.

The Great Lakes population of the piping plover was listed as endangered in 1986. An active recovery program in Michigan, aided by many volunteers, has helped the plover population to steadily increase. In 2019, there were 71 breeding pairs (142 individuals) (USFWS unpubl. data 2020). Of these, 49 pairs nested in Michigan, while 22 pairs were found outside the state, including one pair in Chicago, Illinois, one pair in Pennsylvania, ten pairs in Wisconsin, and nine pairs in Ontario, Canada. A single breeding pair discovered in 2007 in the Great Lakes region of

Canada represented the first confirmed piping plover nest there in over 30 years. In 2019, a pair of piping plovers had their first successful nesting site at Montrose Beach in Chicago, Illinois in more than 60 years.

The species remains extremely vulnerable to extinction from factors that include disease, habitat destruction, and unpredictable changes in the environment. Recent studies of Great Lakes Piping Plovers indicate that predation and human-caused disturbance also continue to negatively affect the population. During 2019, as many as 11 adults were lost due to predation by merlins, snowy owls, and off-leash dogs (USFWS unpubl. data 2020).

For additional information on the piping plover, including a recent five-year status review and recovery plan, check out the species profile.

Under the terms of a court order, the Service designated CH for the Great Lakes breeding population of the piping plover on May 7, 2001. This includes 35 units in 8 states, including 23 units in Michigan:

- St. Louis County, Minnesota
- Douglas, Ashland, Marinette, and Manitowoc Counties, Wisconsin
- Lake County, Illinois
- Porter County, Indiana
- Erie and Lake Counties, Ohio
- Erie County, Pennsylvania
- Oswego and Jefferson Counties, New York
- Alger, Schoolcraft, Luce, Mackinac, Chippewa, Iosco, Presque Isle, Cheboygan, Emmet, Charlevoix, Leelanau, Benzie, Mason and Muskegon Counties, Michigan.

The final CH designation includes approximately 201 miles (325 km) of mainland and island shoreline for the Great Lakes breeding population in these 26 counties. Within the 35 critical habitat units, only the areas that contain the primary constituent elements of piping plover habitat, as described above, are designated as CH. See https://www.fws.gov/species-publication-action/etwp-final-determination-critical-habitat-great-lakes-breeding for more information about piping plover CH in Michigan.

Rufa Red Knot (Calidris canutus rufa)

The rufa red knot is a migratory shorebird that breeds in the Canadian Arctic and winters in parts of the United States, the Caribbean, and South America. Some red knots fly more than 9,300 miles from south to north every spring and repeat the trip in reverse every autumn, making this bird one of the longest-distance migrants in the animal kingdom. Major migration stopover areas occur along the Gulf coast and Atlantic coasts of North and South America. However, red knots have been regularly sighted in inland areas of the United States within the Atlantic and central flyways, including the coasts of the Great Lakes in Michigan.

The Service listed the rufa subspecies of red knot as threatened under the ESA on December 11, 2014. The reason for listing was due to loss of both breeding and nonbreeding habitat; likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

For additional information on the rufa red knot, including a recovery outline, please see the species profile.

Federally Listed Freshwater Mussel in Michigan

The Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (https://www.fws.gov/media/michigan-freshwater-mussel-survey-protocols-and-relocation-procedures-rivers-and-streams) provide project proponents with guidance to minimize impacts to mussel species that are currently identified as threatened or endangered by the USFWS. These protocols are designed to document the potential presence or absence of state or Federally listed mussel species as well as provide guidance for survey and relocation activities to minimize impacts to native mussels in Michigan.

As part of the Michigan Freshwater Mussel Survey Protocols and Relocation Procedures Michigan rivers and streams have been grouped according to existing knowledge of mussel distribution and individual species conservation status. The Mussel Protocol Stream Groups are designed to document the potential presence or absence of state or Federally listed mussel species. The layer was created by modeling the habitat suitability for each mussel species and may not correspond directly with a documented location for a listed mussel. A segment may be predicted as suitable for a number of mussel species, so the stream group number was assigned to the most restrictive of the potential mussel species present. The watersheds have associated mussel species data and can be queried to generate a species list. These stream groups determine the necessary level of coordination by project proponents with the USFWS as well as the appropriate survey protocol applicable to the project site. Below are the stream groupings, which are available via Michigan Natural Features Inventory Mussel Map Viewer (https://mnfi.anr.msu.edu/resources/michigan-mussels). The Mussel Map Viewer is an interactive tool to allow users to explore listed native mussels across the Michigan landscape. Watershed level species lists are available alongside the Mussel Protocol Stream Groups.

- Group 1: Stream and rivers known to support mussels considered to be special concern by the State, but lacking mussel occurrence data at the project site.
- Group 2: Streams and rivers known to support populations of State threatened and endangered mussels.
- Group 3a: Small and medium streams and rivers with a drainage area less than 300 mi^2 that support populations of Federally listed mussels.
- Group 3b: Large rivers (drainage area greater than 300 mi^2) that support populations of Federally listed mussels.

Clubshell (Pleurobema clava)

The clubshell is a freshwater mussel that prefers clean, loose sand and gravel in medium to small rivers and streams. Clubshells will bury themselves in the bottom substrate to depths of up to four inches. Reproduction requires a stable, undisturbed habitat and a sufficient population of fish hosts to complete the mussel's larval development. The striped shiner (*Notropis chrysocephalus*), central stoneroller (*Campostoma anomalum*), blackside darter (*Percina maculata*), and logperch (*Percina caprodes*) have been capable of serving as hosts of the clubshell under laboratory conditions.

Clubshell was listed as endangered in 1993. The clubshell was once found from Michigan to Alabama, and from Illinois to West Virginia. Clubshell originally inhabited 100 streams across

this range; however, the current distribution is limited to 13 extant populations occurring in 21 streams. Of those 13 populations, only 7 show signs of successful reproduction. The distribution of clubshell is very limited in Michigan and only occurs in the East Branch of the West Fork of the St. Joseph River, Maumee drainage. Reasons for its decline in the upper Ohio and Wabasha watersheds have been principally due to pollution from agricultural runoff and industrial wastes, and extensive impoundments for navigation. These are thought to be also responsible for its decline elsewhere as well. An added threat now is the zebra mussel, a fast-spreading exotic species accidentally introduced in ballast water from the Caspian Sea area. These tiny mussels reproduce in enormous numbers which tend to cover and suffocate native mussels. In the St. Joseph watershed, water quality degradation as a result of land-based activities such as agriculture and development is a major threat. These types of activities result in excess sedimentation and pollutants that may affect clubshell survival, growth, and reproduction. It is likely that there are barriers within the watershed that also have altered habitat, hydrology, temperature, and sediment transport, limiting the range of clusbshell as well as potentially directly affecting certain localized populations. Lastly, instream activities such as bridge and road construction also have the potential to impact localized populations of clubshell.

For additional information on the clubshell mussel, including a recent five-year status review, please see the species profile.

Northern Riffleshell (Epioblasma torulosa rangiana)

This mussel is found in a wide variety of streams, including large streams and small rivers, where it buries itself in firmly packed sand or gravel in riffle areas. It is also found in Lake Erie. Like all freshwater mussels, northern riffleshell require a stable, undisturbed habitat and a sufficient population of host fish for reproduction. The mottled sculpin (*Cottus bairdi*), banded darter (*Etheostoma zonale*), bluebreast darter (*Etheostoma camurum*), and brown trout (*Salmo trutta*) are potential host species (Watters 1996).

Northern riffleshell was listed as endangered in 1993. Historically, the northern riffleshell was found in the Ohio river drainage in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and west Virginia, and into southeastern Michigan and southwestern Ontario. Of the 54 streams once known to be occupied by northern riffleshell, it is known to currently occur in 13 populations, 4 of which are stable and recruiting. Of the four recruiting populations, three are apparently large and occur in the Allegheny River, French Creek, and East Branch Sydenham River. A fourth, smaller population occurs, as of 2006, in the AuSable River. In Michigan the current status of northern riffleshell is unknown with only shells found during a 2007/2008 survey of the Detroit River and Lake St. Clair. It is possible that these populations are extirpated as a result of the introduction of nonnative zebra and quagga mussels (USFWS 2019). Numerous threats persist for the remaining northern riffleshell populations, including invasive species, the effects of small population sizes, habitat alteration, land-use changes, changing precipitation and temperature patterns, and point and non-point source pollution.

For additional information on the northern riffleshell mussel, including a recent five-year status review, please see the species profile.

Rayed Bean (Villosa fabalis)

The rayed bean generally lives in smaller, headwater creeks, but it is sometimes found in large rivers and wave-washed areas of glacial lakes. It prefers gravel or sand substrates, and is often

found in and around roots of aquatic vegetation. Adults spend their entire lives partially or completely buried in substrate, filtering water through their gills to remove algae, bacteria, detritus, microscopic animals, and dissolved organic material for food. Juvenile mussels, called glochidia, use fish as hosts, allowing the species to move upstream and populate habitats it could not otherwise reach. At the time of listing, the Tippecanoe darter (*Etheostoma tippecanoe*) was the only reported known host fish for the rayed bean. Gibson et al. (2011) also verified the spotted darter (*Etheostoma maculatum*) as a suitable host fish (USFWS 2018a).

Rayed bean was listed as endangered in 2012. The rayed bean historically was found across a wide expanse that included parts of the Midwest and eastern United States, north to Ontario, Canada. Once found in at least 115 streams, canals, and lakes, the rayed bean now occurs in only 31 streams and one lake; a 73 percent reduction in the number of occupied streams and lakes. The species has been extirpated from Illinois, Kentucky, and Virginia but is still found in Indiana, Michigan, New York, Ohio, Pennsylvania, and Ontario, Canada. After extirpation from Tennessee and West Virginia, reintroductions have restored the rayed bean to these states. Major threats to rayed bean are modification and destruction of river and stream habitat, primarily by the construction of impoundments. Other factors contributing to the reduction in range include dredging and channelization, chemical contamination, oil and gas production, sand and gravel mining, and siltation.

In addition, there are other emerging threats such as disease and climate change. Little is known about diseases in freshwater mussels (Grizzle and Brunner 2007, USFWS 2018a). However, mussel die-offs have been documented in streams within the range of rayed bean, some researchers believe that disease may be a factor contributing to the die-offs (USFWS 2018a).

For additional information on the rayed bean mussel, including a recent five-year status review, please see the species profile.

Snuffbox (Epioblasma triquetra)

The snuffbox is usually found in small- to medium-sized creeks, inhabiting areas with a swift current, although it is also found in Lake Erie and some larger rivers. Adults often burrow deep in sand, gravel or cobble substrates, except when they are spawning or the females are attempting to attract host fish, including log perch. They are suspension feeders, typically feeding on algae, bacteria, detritus, microscopic animals, and dissolved organic material.

Snuffbox was listed as endangered in 2012. Snuffbox was historically known from 211 streams and lakes in 18 states and Canada (USFWS 2018b). The current distribution has been reduced to only 84 streams in 14 states (Alabama, Arkansas, Illinois, Indiana, Kentucky, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Wisconsin) and Ontario, Canada (USFWS 2018b, USFWS unpubl. data 2020). Currently there are 7 stronghold populations, 24 significant populations, and 51 marginal populations of snuffbox. Two new element occurrences were detected in new streams in Michigan in 2019 and therefore have not been evaluated yet (USFWS unpubl. data 2020). Most populations are small and geographically isolated from one another, further increasing their risk of extinction.

Habitat loss and degradation continues to be one of the major threats to snuffbox (USFWS 2018b). Water quality degradation from point and non-point sources including agricultural runoff, municipal effluents, industrial sources, and spills continue to contribute sediment, organic compounds, heavy metals, pesticides, and a wide variety of newly emerging contaminants to the

aquatic environment. Other factors contributing to the reduction in range include dredging and channelization, oil and gas production (including water withdrawal), and sand and gravel mining, and development. Exotic species, including the zebra mussel, Asian clam, round goby, and black carp, threaten the snuffbox, or its host fish, or both, through mechanisms such as habitat modification, competition, and predation (USFWS 2018b).

For additional information on the snuffbox mussel, including a recent five-year status review, please see the species profile.

Hine's Emerald Dragonfly (Somatochlora hineana)

The Hine's emerald dragonfly lives in calcareous (high in calcium carbonate) spring-fed marshes and sedge meadows overlaying dolomite bedrock. Adults males defend small breeding territories, pursuing and mating with females who enter. The female lays eggs by repeatedly plunging the tip of her body into shallow water. Later in the season or the following spring, immature dragonflies, called nymphs, hatch from the eggs. The nymph lives in the water for two to four years, eating smaller aquatic insects and shedding its skin many times. The nymph then crawls out of the water and sheds its skin a final time, emerging as a flying adult. The adults may live only four to five weeks.

The principal threat to the species is habitat destruction and alteration. Commercial and residential development, quarrying, landfills, roadways, construction of pipelines, and filling of wetlands could decrease the area of suitable habitat available to the species and fragment populations (USFWS 2001). Changes in surface and sub-surface hydrology could also be detrimental to this species. Alteration of hydrologic regimes could adversely affect the larval and breeding habitat of the species by changing water temperature, flow, chemistry, and volume. Municipal and private wells, addition of impervious surfaces, and alteration of surface drainage patterns could all cause reductions in the suitability of habitat or the outright loss of suitable larval and breeding habitat.

The Hine's emerald dragonfly was listed as endangered on January 26, 1995 (60 FR 5267). Historically, the Hine's emerald dragonfly was found in Alabama, Indiana, and Ohio, and probably has been extirpated in those states. Today, the dragonfly can only be found in Illinois, Michigan, Missouri, and Wisconsin. Hine's emerald dragonfly was first discovered in Michigan at seven sites in 1997 (Steffens 1997). Known sites in the state are in both the Upper and Lower Peninsulas. Most are near the Straits of Mackinac, with the exception of the Menominee County site. The species is known from 20 sites in six counties in Michigan. Ten of these sites occur on the Hiawatha National Forest, and five sites are owned and managed by the Michigan Department of Natural Resources.

For additional information on the Hine's emerald dragonfly, including a recent five-year status review, please see the species profile.

Critical habitat for the species was first designated on September 5, 2007 (72 FR 51101) and later revised on April 23, 2010 (75 FR 21393). A total of 37 units, encompassing approximately 26,531.8 acres (10,737 hectares) in Cook, DuPage, and Will Counties in Illinois; Alpena, Mackinac, and Presque Isle Counties in Michigan; Crawford, Dent, Iron, Phelps, Reynolds, Ripley, Washington, and Wayne Counties in Missouri; and Door and Ozaukee Counties in Wisconsin, were included in the designation. These are lands of wet meadows, groundwater seeps, and associated wetlands that lie over dolomite bedrock and provide breeding and foraging

habitat for the dragonfly. For more information on CH for Hine's emerald dragonfly in Michigan, see https://www.fws.gov/species-publication-action/final-revised-critical-habitat-hines-emerald-dragonfly-somatochlora.

Hungerford's Crawling Water Beetle (Brychius hungerfordi)

Hungerford's crawling water beetles (HCWB) are found in the cool riffles of clean, slightly alkaline streams. All streams where this beetle has been found have moderate to fast water flow, good stream aeration, inorganic substrate, and alkaline water conditions. The highest densities of HCWB have been found below beaver dams or immediately below structures (e.g., culverts) that provide similar conditions.

Adults appear to be generalists in their food choice, feeding on algae including *Chara*, *Cladophora*, and *Dichotomosiphon*, as well as the epiphytic diatom *Cocconeis* (Grant and Vande Kopple 2009). The diet of adults may also change seasonally (Grant and Vande Kopple 2003). Larvae appear to prefer the alga *Dichotomosiphon tuberosus* (Grant and Vande Kopple 2009). *Dichotomosiphon*, although widespread, is not common. Its presence may be an important factor in determining the distribution of HCWB (Grant and Vande Kopple 2009).

At the time of listing in 1994, HCWB was known to occur in only three streams range wide. Currently, it is known to occur in 13 streams, with ten of these streams in northern Michigan and three in Ontario, Canada. It is unknown whether HCWB has a wider distribution or if the species' status is stable, increasing or decreasing. Species of *Brychius* tend to be highly localized and difficult to collect. Even when present, it is possible to sample an area and collect no specimens (Mousseau 2004; Grant et al. 2011). Additional surveys are necessary to determine the extent of HCWB's distribution. There is reason to believe HCWB may be more widely distributed than the streams where it has been previously documented. The types of streams inhabited by this species do not appear to be rare. In fact, streams similar to those in which the species is found appear to be common in northern Michigan and other surrounding states.

Hungerford's crawling water beetle was added to the List of Endangered and Threatened Wildlife and Plants on April 6, 1994 (59 FR 10580). The primary threat to the species is modification of its habitat. Actions that are potentially harmful include dredging, channelization, bank stabilization, and impoundment. Fish introductions or removals may also pose a threat to the species. The introduction of brown trout, for example, can result in increased predation of HCWB. Other management practices, such as the use of chemical treatments, may also be harmful to this rare beetle.

For additional information on the Hungerford's crawling water beetle, including a recovery plan and recent biological opinions, please see the species profile.

Karner Blue Butterfly (Lycaeides melissa samuelis)

The Karner blue butterfly was historically associated with native barrens and savanna ecosystems, but is now found in remnant barrens, savannas, highway and utility rights-of-way, gaps within forest stands, young forest stands, trails, and military camps that occur on the landscapes previously occupied by native prairie and savannas. The larvae are dependent upon wild lupine (*Lupinus perennis*), the only known larval food source, while wild adults use a variety of wild flowers for nectar.

The Karner blue butterfly was Federally listed as an endangered species in 1992. The butterfly is most widespread in Wisconsin, but is also found in portions of Indiana, Michigan, Minnesota, New Hampshire, New York, and Ohio. It may also be present in Illinois. Habitat throughout the range of the Karner blue butterfly has been lost as a result of land development and lack of natural disturbance, primarily wildfire. Such disturbance helps maintain the butterfly's habitat by setting back encroaching forests and encouraging lupine and flowering plant growth. Additionally, the Karner blue butterfly's rarity and beauty make it a desirable addition to butterfly collections. Because butterfly numbers are so low, the collection of even a few individuals could harm the species' populations.

For additional information on the Karner blue butterfly, including a recent five-year status assessment, please see the species profile.

Mitchell's Satyr (Neonympha mitchelli mitchelli)

In Michigan and Indiana, Mitchell's satyrs are found exclusively in prairie fens and open parts of rich tamarack swamps. These systems are a mosaic of open, shrubby, and forested communities, with peat soils and alkaline groundwater seeps. Thin-leaved sedges usually dominate the ground layer in the fens. Mitchell's satyr butterflies are rarely found in open fens without trees or tamarack swamps without openings.

The greatest threat to Mitchell's satyr is direct destruction and modification of its habitat. Prairie fens supporting Mitchell's satyr have disappeared or been altered for agricultural or urban development, which has led to species extirpation and further isolation of populations. Hydrological disruptions also constitute a serious threat, as groundwater diversion, pollution, warming of water sources, and other groundwater alterations lead to less-than-optimal habitat conditions. Offsite activities that affect groundwater flowing into prairie fens could inadvertently impact Mitchell's satyr. For example, a prairie fen's recharge source may be located near or far away from the fen, in a different watershed, county or state. As such, no matter the distance, altering the fen's groundwater source will affect the quality, quantity, or flow of groundwater into the fen (Abbas 2011). Groundwater alteration leads to, among other things, drying of the fen and/or facilitating encroachment of invasive species.

Invasive species, such as buckthorn, hybrid cattail, narrowleaf cattail, multiflora rose, purple loosestrife, reed canary grass, and others, represent additional threats and can be a significant management problem. Removal of these plants is required at many occupied sites to maintain suitable habitat conditions.

Satyr populations in the northern part of the range have decreased drastically; however, multiple new populations of what appears to be Mitchell's satyr continue to be discovered in the southeastern U.S. (Alabama, Mississippi, and Virginia). Ongoing genetics research will confirm and compare the taxonomy of the southern butterflies.

For additional information on the Mitchell's satyr, including the recovery plan, please see the species profile.

Poweshiek Skipperling (Oarisma poweshiek)

The Poweshiek skipperling is an endemic tallgrass prairie butterfly species. Historically, this species occurred in Illinois, Indiana, Iowa, Michigan, Minnesota, North Dakota, South Dakota, Wisconsin, and Manitoba, Canada. However, the butterfly's range has contracted significantly in the last decade, and can now only be found only at a few sites in a single Michigan county, in

very limited numbers at one site in Wisconsin, and in Canada at the single Manitoba site. In Michigan, the skipperling occurs exclusively in prairie fens, specifically in peat domes within larger prairie fen complexes in a community typically composed of multiple, distinct zones of vegetation, some of which contain prairie grasses and forbs (Cuthrell and Slaughter 2012). In other locales (outside of Michigan), the species has or currently occurs in mesic prairies (Pogue et al. 2015; Selby 2016). Also within Michigan, Poweshiek skipperlings are rarely found a great distance from either prairie dropseed or mat muhly (Cuthrell and Slaughter 2012).

Poweshiek skipperling was listed as endangered in 2014. Habitat for this species been affected by altered hydrology, water pollution, sedimentation, invasive species, fire suppression, cattle grazing, and filling for development or dredging to create ponds or lakes (Kost and Hyde 2009). As a result, prairie fens are now very rare and those that remain require management to maintain appropriate habitat that supports native fen biota. Management of Poweshiek skipperling habitat is needed to maintain the basic high-quality native prairie conditions on which the species depends. Management is needed to prevent secondary succession to woody habitat types; to control invasive species; and, to ensure sufficient abundance and diversity of nectar plants. Control of invasive plants species is required to maintain important qualities of habitat, but care must be taken to ensure that treatments do not have adverse effects.

For additional information on the Poweshiek skipperling, including a recent five-year status assessment, check out the species profile.

CH for the Poweshiek skipperling was designated on October 1, 2015. CH comprises approximately 25,900 acres in 56 units in Iowa, Michigan, Minnesota, North Dakota, South Dakota and Wisconsin. See https://fws.gov/species/poweshiek-skipperling-oarisma-poweshiek for more information about CH for the Poweshiek skipperling in MI.

Monarch butterfly (Danaus plexippus)

Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic.

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.), and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic chemicals (cardenolides) as a defense against predators. The larva then pupates into a chrysalis before emerging 6 to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months.

In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites. This migration can take monarchs distances of over 3,000 km and last for over two months. In early spring (February-March), surviving monarchs break diapause and mate at the overwintering sites before dispersing. The same individuals that undertook the

initial southward migration begin flying back through the breeding grounds and their offspring start the cycle of generational migration over again.

For additional information on the monarch, check out the species profile.

Canada Lynx (Lynx canadensis)

Canada lynx and snowshoe hares are strongly associated with moist, cool, boreal spruce-fir forests. Landscapes with high snowshoe hare densities are optimal for lynx survival and reproduction, and research suggests that hare densities consistently at or above 0.5 hares per hectare (0.2 hares/acre) are needed to support persistent lynx populations. Hares are most abundant in young regenerating or mature multistoried forests with dense understory vegetation that provides food and cover. In the northern contiguous U.S., boreal forests become naturally patchy and marginal for lynx as they transition to temperate forest types that support lower hare densities. Such forests cannot support lynx populations, even though snowshoe hares may still be present. Snow also influences lynx distribution, and populations typically occur where continuous snow cover lasts four months or longer. Such areas are believed to provide lynx with a seasonal competitive advantage over other terrestrial hare predators like bobcats and coyotes.

Lynx are broadly distributed across most of Canada and Alaska, which combined encompass about 98% of the species breeding range. The contiguous U.S. distinct population segment (DPS) accounts for the other two percent, and includes resident breeding populations in northern Maine, northeastern Minnesota, northwestern Montana/northern Idaho, and north-central Washington. An introduced population also occurs in western Colorado, and several other areas may have historically supported small resident populations (e.g., northern New Hampshire, Isle Royale, Michigan, northeastern Washington, and the Greater Yellowstone area of southwestern Montana and northwestern Wyoming). Lynx also have occurred temporarily in many other states, typically during irruptions (mass dispersal events) from Canada, when northern hare populations underwent dramatic cyclic declines roughly every 10 years. The Contiguous U.S. DPS of lynx was listed as threatened in 2000 because regulations on some Federal lands at that time were inadequate to ensure the conservation of lynx populations and habitats.

Currently, the best available information, including historic records and recent surveys, indicates that Canada lynx, if present in Michigan, are likely limited to a small number of dispersing individuals in the Upper Peninsula. There is no indication of recent or current lynx breeding within the state. Verified sightings of lynx in Michigan are infrequent and dispersed. In 2003, a lynx was incidentally captured in a bobcat trap on the Hiawatha National Forest, and in 2010 a lynx was observed on Sugar Island near Sault Ste. Marie. Most recently, a Canada lynx was trapped in the Lower Peninsula in early 2019, and was subsequently released in Schoolcraft County. Detection of a very low number of dispersing individuals may be difficult, however project assessment for potential effects to lynx in the Upper Peninsula may be prudent.

For additional information on the Canada lynx, please see the species profile.

Gray Wolf (Canis lupus)

Gray wolves are highly social animals that live in groups, called packs, which typically include a breeding pair, their offspring, and other non-breeding adults. Wolves are capable of mating by age one or two and sometimes form a lifelong bond. On average, four to five pups are born in early spring and are cared for by the entire pack. For the first six weeks, pups are reared in dens. Dens are often used year after year, but wolves may also dig new ones or use some other type of

shelter, such as a cave. After a year or two, young wolves often leave their packs to try to find a mate and form a pack or join other existing packs. Wolf packs occupy and defend territories, which range in size from less than 50 square miles to more than 1,000 square miles, depending on habitat and seasonal movements of available prey. Wolves travel over large areas to hunt, as far as 30 miles in a day. Although they usually trot along at five miles per hour, wolves can run as fast as 40 miles per hour for short distances.

Wolves occur throughout Michigan's Upper Peninsula, and efforts to reintroduce a population of 20-30 wolves to Isle Royale were initiated in 2018. On November 3, 2020, the Service issued a final rule (effective January 4, 2021) removing from the List of Endangered and Threatened Wildlife the gray wolf entities in the lower 48 United States and Mexico, except for the Mexican wolf (*C. l. baileyi*), that will remain listed (85 FR 69778). On February 10, 2022, a district court vacated and remanded the delisting rule, resulting in return to the List of Endangered and Threatened Wildlife.

For additional information on the gray wolf, please see the species profile.

Indiana Bat (Myotis sodalis)

Indiana bats may summer in a wide range of habitats, from highly altered landscapes to intact forests. Roost trees vary considerably in size. Although trees used by Indiana bat maternity colonies are typically greater than 9 inches diameter at breast height (dbh), those used by males and non-reproductive females or as alternate roosts for maternity colonies may be as small as 5 inches dbh. Indiana bats typically roost beneath peeling bark but may also use cracks or crevices. As such, roost trees tend to be dead or dying trees with some bark remaining, or live trees with naturally exfoliating bark, such as shagbark hickory (*Carya ovata*); see Appendix III for more information. Rarely do Indiana bats roost in structures, such as barns, sheds, or bridges. During winter, the species hibernates in caves, abandoned mine portals or similar structures.

The Indiana bat was listed as endangered in 1967 due to episodes of people disturbing hibernating bats in caves during winter, which resulted in the death of substantial numbers of bats. Indiana bats are vulnerable to disturbance because they hibernate in large numbers in only a few sites, with major hibernacula supporting 20,000 to 50,000 bats. Since its listing, the range-wide Indiana bat population has declined by nearly 60%. Several threats are believed to have contributed to the Indiana bat's decline, including the commercialization of caves, loss and degradation of forested habitat, pesticides and other contaminants, and most recently, the disease white-nose syndrome.

Indiana bats have been documented at many sites in Lower Michigan and are believed to range throughout the southern five county tiers, as well as parts of the thumb and the western coastal counties up to (and including) the Leelanau peninsula. Indiana bats that summer in Michigan roost in trees in riparian, bottomland, and upland forests from approximately April through September. Michigan is home to a single known Indiana bat hibernaculum: a hydroelectric dam in Manistee County. Although the dam supports about 20,000 hibernating bats, Indiana bats comprise less than 1% of the winter population. Research suggests that the majority of the Indiana bats that summer in Michigan migrate to hibernacula in nearby states, including Indiana and Kentucky. See the Appendices for more information on suitable Indiana bat habitat in Michigan.

For additional information on the Indiana bat, please see the species profile.

Northern Long-eared Bat (Myotis septentrionalis)

Northern long-eared bats spend winter hibernating in caves, mines, or similar structures, preferring areas with constant temperatures, high humidity, and no air currents. During the summer, the species typically roosts underneath bark or in cavities, crevices, or hollows of both live and dead trees and/or snags (typically ≥3 inches dbh; see Appendix IV). On occasion, northern long-eared bats will roost in manmade structures, such as barns and sheds. These bats forage for insects in upland and lowland woodlots and tree-lined corridors.

The northern long-eared bat is one of the species most impacted by white-nose syndrome. The northern long-eared bat was proposed for federal listing as endangered on October 2, 2013. On April 2, 2015, the species was given a proposed listing of threatened with an interim 4(d) rule, which was finalized on January 14, 2016 (USFWS 2016a). No critical habitat has been proposed for the species. On March 22, 2022, the Service published a Species Status Assessment Report for the Northern Long-eared Bat (USFWS 2022a), and on the following day (March 23, 2022), published a proposal to reclassify the northern long-eared bat as endangered under the ESA. On November 29, 2022, the Service published a final rule reclassifying the northern long-eared bat from threatened to endangered. The final rule, effective March 31, 2023, addresses a court order requiring the Service to reconsider the previous listing decision for the northern long-eared bat within 18 months of completing a species status assessment, or by November 30, 2022 (Case 1:15-cv-00477, March 1, 2021), and removes its species-specific 4(d) rule.

To streamline the formal section 7 process for any projects that are completed by **April 1, 2024** and consistent with the previous 4(d) rule, the Service is providing an Interim Consultation Framework that provides take authorization for northern long-eared bat. The framework applies to a wide variety of ongoing projects with a federal nexus (federal permit or funding), such as timber harvest, prescribed fire, and infrastructure projects. For projects where take is likely to occur that meet the requirements of the framework, agencies will fill out a template Biological Assessment form, and Field Offices will provide a completed template Biological Opinion and Incidental Take Statement in a timely manner.

During the Interim Consultation Framework period (March 31, 2023, through April 1, 2024), the Service is incorporating known northern long-eared bat locations into project reviews and IPaC assisted determination keys to help project proponents decide where take of northern long-eared bats is reasonably certain to occur. We have integrated the Interim Consultation Framework and known locations into our analysis and All Species Michigan Determination Key and will update these again at the end of the Interim period.

The northern long-eared bat has been documented in many Michigan counties and is believed to range throughout the entire state. The species is present in the state year-round, migrating between summer and winter habitat during the spring and fall. Many northern long-eared bat hibernacula have been documented in Michigan, most of which are abandoned mines located in the western Upper Peninsula. See the Appendices for more information on suitable northern long-eared bat habitat in Michigan.

For additional information on the northern long-eared bat, including the previous 4(d) rule, Species Status Assessment, reclassification rule, and details on the 2023 Interim Consultation Framework, please see the species profile.

Tricolored Bat (Perimyotis subflavus)

A petition to list the tricolored bat as threatened was received by the Service on June 16, 2016. On December 20, 2017, the Service found that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted and commenced a review (as a 12-month finding) to determine if listing of the tricolored bat is warranted (82 C.F.R. 60362; December 20, 2017). On September 14, 2022, the Service posted a completed Species Status Assessment (SSA) Report for the Tricolored Bat (USFWS 2021) and published a proposed rule to list the tricolored bat as endangered. The proposed rule noted that WNS has caused estimated declines of more than 90% in affected tricolored bat colonies and is currently present across 59% of the species' range.

In Michigan, the tricolored bat was rare pre-WNS and is exceedingly rare post-WNS. The species has been observed in 12 Michigan counties to date, largely during the fall or winter. With very few exceptions, the species has not been observed in Michigan in the summer months, and no maternity colonies have been found. During winter, tricolored bats hibernate in caves, abandoned mines, and abandoned tunnels. During spring, summer and fall months, they roost primarily among leaf clusters of live or recently dead deciduous/hardwood trees.

For additional information on the tricolored bat, please see the species profile.

Copperbelly Water Snake (Nerodia erythogaster neglecta)

Copperbelly water snakes require a mosaic of shallow wetlands or floodplain wetlands surrounded by forested uplands. Seasonally flooded wetlands without fish are favored foraging areas, and copperbellies frequently move from one wetland to another. The species feeds primarily on amphibians, mostly frogs and tadpoles, and requires shallow wetlands along the edges of larger wetlands complexes where they can hunt for frogs, as well as multiple wetland types and adjacent uplands. Copperbellies hibernate, often in crayfish burrows, in forested wetlands and immediately adjacent forested uplands. They remain underground from late October until late April.

The copperbelly water snake is found in two geographically separated areas. The northern distinct population segment (DPS) includes southern Michigan, northeastern Indiana and northwestern Ohio. This DPS was listed as threatened under the ESA in 1997. The southern DPS is not Federally listed. Over the last 20 years, surveys have shown a continuing decline in the overall number of snakes in the northern DPS. At present, only five small sub-populations persist within the tri-state area, including Hillsdale County in Michigan. Threats to copperbelly watersnake include habitat fragmentation and loss, predation, persecution, and emerging stressors such as climate change and disease.

For additional information on the copperbelly watersnake, including a recent five-year status assessment, please see the species profile.

Eastern Massasauga Rattlesnake (Sistrurus catenatus)

The Eastern massasauga rattlesnake (EMR)'s habitat is typically associated with open to forested wetlands and adjacent uplands. During colder months (generally October through April), EMR hibernate below the frostline in crayfish or small mammal burrows, tree root networks or rock cervices in areas where the water table is near the surface (areas where the soil is saturated but not inundated) and with consistent hydrology to support overwinter survival. Hibernacula are

typically near wetland edges, or slightly upland (typically within 500 meters of regulated wetland). EMR stay in the area around their hibernacula until overnight temperatures warm up enough for them to move to their active season range.

The Service listed the EMR as a threatened species under the ESA on September 30, 2016. Once common across its range, the EMR has declined dramatically since the mid-1970s as a result of habitat loss and fragmentation, a lack of proper habitat management, and eradication by humans. The most prominent threats include habitat loss and fragmentation through development and vegetative succession, mortality of individuals as a result of roads, hydrologic alteration resulting in drought or flooding, persecution, collection, and post-emergent prescribed fire, mowing, and disking. Disease is a relatively recent threat with still unknown consequences. The effects of threats on extinction risk to EMR populations were included in model evaluations (Faust *et al.* 2011), while the Species Status Assessment (Szymanski *et al.* 2016) considered the total number of sites range wide where specific threats were reported.

Michigan currently supports more EMR populations than any other state or province, although the species has declined within the state. The range within Michigan includes most of the Lower Peninsula and Bois Blanc Island in Mackinac County (Lake Huron). The EMR is highly secretive and cryptic in nature, and can persist in low densities, which makes them difficult to detect. Further, there are extensive areas of the state that have never been surveyed for EMR. To assist project proponents in determining the likelihood of EMR presence in their project areas, the Service has identified occupied and likely occupied habitat using a tiered system in Michigan. Tiered habitat is based on the proximity to a known element occurrence and the suitability of the habitat according to available spatial data and population modeling. Tier 1 habitat are those areas known to be occupied or highly likely to be occupied by EMR. Tier 2 habitat includes areas with high potential habitat (and may be occupied by EMR). Projects can also be "within the known range" of EMR. Areas within the known range but outside of Tier 1 and Tier 2 are considered less likely to be occupied. However, it is likely that there are additional and yet-unknown occurrences throughout the Lower Peninsula of Michigan.

For additional information on the eastern massasauga, including a recent Species Status Assessment and draft recovery plan, please see the species profile.

American Hart's-Tongue Fern (Asplenium scolopendrium var. americana)

American hart's-tongue fern is found in close association with outcrops of dolomitic limestone, in coulees, gorges and in cool limestone sinkholes in mature hardwood forests. It requires high humidity and deep shade provided by mature forest canopies or overhanging rock cliffs. It prefers soils high in magnesium.

Although American hart's-tongue is found over a very wide area, from Alabama to Canada, its populations tend to be very small and isolated due to its unique habitat. Because of its natural rarity, it is particularly vulnerable to disturbance. Many activities threaten the American hart's-tongue. Quarrying, recreation, and residential development have all destroyed these plants and their habitat. Canadian populations are threatened by lumbering and the development of land for ski resorts and country estates, among other activities. By removing shade trees, logging raises light levels and lowers humidity, decimating any American hart's-tongue ferns in that area. The Service officially listed American hart's-tongue on July 14, 1989.

In Michigan, all known American hart's-tongue populations occur on prominent highlands of the Niagara escarpment in the eastern Upper Peninsula, typically in relatively young forest dominated by sugar maple. It is commonly found in association with northern holly fern (*Polystichum lonchitis*), common polypody (*P. virginianum*), maidenhair spleetwort (*Asplenium trichomanes*), fragile fern (*Cystopteris fragilis*), and herb-robert (*Geranium robertianum*).

For additional information on the Hart's-tongue fern, including a recent Species Status Assessment, please see the species profile.

Dwarf Lake Iris (Iris lacustris)

Occurring close to Great Lakes shorelines in cool, moist lakeshore air, dwarf lake iris is found on sand or in thin soil over limestone-rich gravel or bedrock. Habitat is along old beach ridges or behind open dunes. Changing water levels can open new habitat for the plants.

Dwarf lake iris was added to the U.S. List of Endangered and Threatened Wildlife and Plants in 1988. Dwarf lake iris only grows around the Great Lakes and occurs near the northern shores of Lakes Huron and Michigan in Michigan, Wisconsin, and Ontario, Canada. The lakeshore habitat of dwarf lake iris has been greatly reduced by shoreline development. Residential and vacation homes as well as associated road-widening, chemical spraying and salting, and off-road vehicle use have caused disturbance and destruction of habitat.

For additional information on the dwarf lake iris, including a recovery plan, please see the species profile.

Eastern Prairie Fringed Orchid (Platanthera leucophaea)

The eastern prairie fringed orchid occurs in a wide variety of habitats, from mesic prairie to wetlands such as sedge meadows, marsh edges, even bogs. It requires full sun for optimum growth and flowering and a grassy habitat with little or no woody encroachment. A symbiotic relationship between the seed and soil fungi, called mycorrhizae, is necessary for seedlings to become established. This fungi helps the seeds assimilate nutrients in the soil. This orchid is a perennial herb that grows from an underground tuber. Flowering begins from late June to early July, and lasts for 7 to 10 days. Blossoms often rise just above the height of the surrounding grasses and sedges. The more exposed flower clusters are more likely to be visited by the hawkmoth pollinators, though they are also at greater risk of being eaten by deer. Seed capsules mature over the growing season and are dispersed by the wind from late August through September.

Historically, eastern prairie fringed orchid was found in more than 20 Michigan counties, including the southern Lower Peninsula and Cheboygan County. Following extensive habitat loss, it now persists in fewer than 10 counties and is largely limited to the remnant lakeplain prairies of Saginaw Bay and western Lake Erie. Since the 1980s, inventories have demonstrated a continued decline of the orchid within known habitats, likely as a result of high lake levels and drought.

The eastern prairie fringed orchid was listed as threatened on September 28, 1989. Early decline was attributed to loss of habitat, mainly conversion of natural habitats to cropland and pasture. Habitat loss, including from the drainage and development of wetlands, is a continued threat to the species. Other current threats include succession to woody vegetation, competition from non-native species, and over-collection.

For additional information on the eastern prairie fringed orchid, please see the species profile.

Houghton's Goldenrod (Solidago houghtonii)

Houghton's goldenrod typically grows on moist sandy beaches and shallow depressions between low sand ridges along the shoreline, called interdunal wetlands. Fluctuating water levels of the Great Lakes play a role in maintaining this unique goldenrod. During high water years, colonies of Houghton's goldenrod may be submerged. When water levels recede, some plants survive the inundation and new seedlings establish on the moist sand. Other plants that often grow with Houghton's goldenrod include Grass-of-Parnassus, Kalm's lobelia, shrubby cinquefoil, twigrush, and other goldenrods.

Houghton's goldenrod occurs almost exclusively on Great Lakes shoreline, growing primarily along the northern shores of Lakes Michigan and Huron in the Straits region. Most populations occur in Chippewa, western Mackinac, northern Emmet, Cheboygan, and northern Presque Isle counties. There are also interior populations in Mackinac County (a few miles from the Great Lakes shoreline). Interior populations in Kalkaska and Crawford Counties have been determined to be another species, *S. vossii* (Laureto and Pringle 2010).

Houghton's goldenrod was listed as threatened on July 18, 1988 (53 FR 27134). High lake levels are a potential threat to some population that occur along Great Lakes shorelines, particularly in recent years. Residential development continues to be a threat, especially along the shores of Lake Huron in Cheboygan and Presque Isle Counties, Michigan. Invasive species, including *Phragmites australis* (common reed) and *Typha spp.* (cattails) threaten some populations (Leopold and Weber 2019).

For additional information on Houghton's goldenrod, including a recent five-year status review, please see the species profile.

Lakeside Daisy (Hymenoxys herbacea)

Lakeside daisy is a long-lived perennial daisy that grows on alvars, a type of limestone with little plant cover, in full sunlight. All individuals within a given population tend to bloom about the same time, typically in late spring. After about a week, the double notched petals fade before falling. Seed dispersal takes place about a month later. Lakeside daisy also reproduces vegetatively by rhizomatous growth.

Lakeside daisy is an endemic restricted to the Great Lakes area, within which it is one of the region's rarest plants, naturally occurring at only a handful of sites. In the U.S., it is known only from the Marblehead Peninsula area in northern Ohio, three restored populations in northern Illinois (where it was known historically from two sites), and a single, extremely small colony in Michigan's Upper Peninsula. In Ontario, Canada, where lakeside daisy is most abundant, it occurs along much of the southern coast of Manitoulin Island and in several restricted areas near the tip of the Bruce Peninsula.

The lakeside daisy was listed as threatened on June 23, 1988. The wide area encompassing known lakeside daisy sites suggests that the species was once widespread in prairie habitats throughout the Midwest and along Huron's northern shore. Fire suppression practices have eliminated the wildfires which once regularly cleared prairie grasslands of the encroaching woods. Now the expansion of shrubs and trees threatens the daisy, which needs full sun to survive. Limestone quarrying, which has increased in recent years, destroys the daisy's habitat. Finally, collectors may also pose a threat, since the daisy is now found in just a handful of sites.

For additional information on lakeside daisy, please see the species profile.

Michigan Monkey-Flower (Mimulus michiganensis)

The Michigan monkey-flower (MMF) is a rare Michigan endemic plant with a range restricted to Great Lakes shorelines in the Mackinac Straits and Grand Traverse regions. It is semi-aquatic and forms mats over mucky soil and sand saturated or covered by cold, flowing spring water.

The MMF was listed as endangered on June 21, 1990 55 FR 25596 25599). The greatest threat to MMF is direct destruction and modification of its habitat. The MMF's habitat has been developed for recreational and residential purposes, which has led to severe impacts to and, in some cases, extirpation of historical populations. Hydrological disruptions also constitute a serious threat, as water diversion, warming of water sources, and other groundwater alterations lead to less-than-optimal habitat conditions.

Consequently, this species may be inadvertently impacted by offsite activities. Populations of MMF are particularly vulnerable to extirpation due to low numbers and limited capability for sexual reproduction. Additionally, periodic high-water levels of the Great Lakes and strong winter storms impact MMF habitat that occurs near the Great Lakes shoreline by redirecting seepage streams and opening the overstory by felling cedars. However, opening of the overstory may also benefit MMF by allowing for colonization.

Invasive species, including forget-me-not (*Myosotis scirpoides*), coltsfoot (*Tussilago farfara*), reed canary grass (*Phalaris arundinacea*), and Canada thistle (*Cirsium arvense*) represent an additional threat. Some of the MMF colonies at the Maple River site are in pockets of habitat with up to 99% invasive species (Canada thistle and forget-me-not), with only scattered MMF stems remaining. Coltsfoot and reed canary grass are known to occur at or in the vicinity of other MMF sites.

For additional information on the MMF, including a recent five-year status review, please see out the species profile.

Pitcher's Thistle (Cirsium pitcheri)

Pitcher's thistle is a native thistle occurring on the open sand dunes and low open beach ridges of Great Lakes shoreline. It is most often found in near-shore plant communities but it can grow in all non-forested areas of a dune system. It is now found in Indiana, Michigan, Wisconsin, and Ontario, Canada. Pitcher's thistle was extirpated from Illinois but has been reintroduced in Lake County.

Pitcher's thistle was added to the List of Endangered and Threatened Wildlife and Plants on July 18, 1988 (53 FR 27137). The primary threats are invasive plants and recreational use of the dunes, but there is continued concern regarding the potential impact of seed-eating weevils. Surveys have been done in portions of the range, indicating increased abundance and potential stability in parts of the range (i.e., Upper Peninsula of Michigan) and decreased abundance or even extirpation of previously known populations in other parts of the range (i.e., southern Michigan).

Survey work by Michigan Natural Features Inventory in 2012-2016 has shown that the Pitcher's thistle population in Michigan may be larger than previously believed and could exceed 1,000,000 individuals (Slaughter and Cuthrell 2017). Conversely, research on the invasive weevil species (*Larinus planus* and *Rhinocyllus conicus*) in recent years has shown cause for

concern, with demonstrated declines in population growth rates that could lead to localized extinctions of some populations (Havens et al. 2012a). More information is needed in order to assess the magnitude and extent of this threat.

For additional information on Pitcher's thistle, including a recent five-year status review, please see the species profile.

Specific Conservation Measures

In addition to the general exclusions, this section details species- or taxon-specific exclusions and/or conservation measures that must be met in order to use this standing analysis and receive a conclusion from IPaC through the DKey. To ensure compliance with the ESA, project-specific consultation (or other programmatic consultation, if applicable) with the Service may be necessary for projects that cannot make a "no effect" determination for any listed species that may occur in the project area and cannot apply the following conservation measures. Such projects would not necessarily result in significant adverse effects to Federally listed species or their habitats.

Whooping Crane

Projects that intersect the whooping crane NEP AOI must not occur within a National Wildlife Refuge or National Park. For Federal projects for which the action agency cannot conclude "no effect" to whooping crane within NWRs or NPs, agencies must consult with the Service outside of the determination key. Outside of NWRs or NPs, agencies must confirm that their project is not likely to jeopardize the continued existence of whooping crane. If they cannot confirm no jeopardy, they must conference to complete their section 7 requirement outside of the determination key.

Piping Plover and Piping Plover Critical Habitat

Projects that intersect the piping plover AOI, occur within ¼ mile onshore and ¼ mile offshore of Great Lakes shoreline, and contain suitable piping plover habitat; or intersect piping plover critical habitat containing the primary constituent elements, must not result in:

1. Any changes to the quality, quantity, or availability[2] of suitable piping plover habitat[3] during the breeding season (April 15 through August 15) or to CH at any time of year
2. Any permanent changes to suitable piping plover habitat[4] or CH
3. Increased activity[5] within suitable piping plover habitat or CH

If the project does not occur in suitable habitat along the Great Lakes shoreline, or if the critical habitat doesn't contain the physical and biological features essential to the conservation of piping plover (for details, refer to 66 FR 22938), piping plovers are not likely to be present in the action area. As such, adverse effects are discountable. Projects that increase human disturbance or potential for predation need further evaluation and do not qualify for the Dkey.

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[2]For example, beach grooming, boardwalk actions, breakwaters, development, dredge deposition, etc.
[3]Piping plover habitat consists of Great Lakes islands and mainland shorelines that support, or have the potential to support, open, sparsely vegetated sandy habitats, such as sand spits or sand beaches that are associated with wide, non-forested systems of dunes and inter-dune wetlands.
[4]In this context, we define permanent to be effects lasting in duration more than 3 weeks
[5]For example, human disturbance, dog activity, or an increase in potential predators such as merlins, or mammalian predators.

Rufa Red Knot

Projects that intersect the rufa red knot AOI and occur within 0.25 mi of a Great Lakes shoreline or inland wetland buffer must not:

1. Permanently modify beaches, dunes, mudflats, peat banks, sandbars, shoals, or other red knot habitats[6] during the red knot migration windows (May 15 through June 15 in the spring OR July 1 through September 30 in the fall)
2. Result in increased human disturbance or predation[7] during the red knot migration windows (May 15 through June 15 in the spring OR July 1 through September 30 in the fall)

During migration, habitat loss, disturbance and increased predation could result in adverse effects and warrant additional evaluation separate from the DKey. If these actions occur outside of the migration window, adverse effects are discountable.

Freshwater Mussels

Projects that intersect the AOI for rayed bean, northern riffleshell, snuffbox, or clubshell mussels must have no permanent effects on local hydrology. If any portion of the project area intersects a Group 3 stream or the 0.5-mi area upstream of a Group 3 stream, the project must not:

1. Have any direct impacts to a stream or river (e.g., stream/road crossings, new stormwater outfall discharge, dams, other in-stream work, etc.)
2. Have potential to indirectly impact the stream/river or the riparian zone (e.g., cut and fill, horizontal directional drilling, construction, vegetation removal, discharge, etc.)

The AOI for mussels is currently a county-based list. The Group 3 is a more specific list of stream segments within known counties that contain habitat likely to be occupied by listed mussels (see https://www.fws.gov/media/michigan-freshwater-mussel-survey-protocols-and-relocation-procedures-rivers-and-streams for additional information). Avoiding direct or indirect impacts to the stream, including changes to hydrology, will ensure adverse effects are insignificant and/or discountable.

In addition, some Michigan EGLE/Army Corps of Engineer joint permit application Minor Permit (MP) and General Permit (GP) categories (https://www.michigan.gov/documents/deq/wrd-general-permit-categories_555828_7.pdf) have been evaluated and determined to have discountable effects to listed mussels, including:

- MP 3 - Boat Hoist;

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[6]For example, the following actions may modify red knot habitat: groins, jetties, sea walls, revetments, bulkheads, rip-rap, beach nourishment, nearshore dredging, dredge spoil disposal, sand mining/borrowing, beach bulldozing, sandbagging, sand fencing, vegetation planting/alteration/removal, deliberate or possible introduction of non-native vegetation, beach raking/mechanized grooming, boardwalks, aquaculture development.

[7]For example, the action is likely to indirectly increase access or use of red knot habitats by humans and/or predators at times of year that the birds are typically present (e.g., commercial/residential development, beach access structures, boardwalks, pavilions, bridges/roads/ferries/trails, marinas, posts or other avian predator perches, structures or habitat features likely to encourage predator nesting/denning, trash cans or other predator attractants, feral cat colonies, policy changes likely to increase human use).

- MP 5 - Boat Wells;
- MP 7 - Completed Enforcement Actions;
- MP 13 - Dock;
- MP 22 - Fish and Wildlife Habitat Structures;
- MP 25 - Ford Stream Crossings for Commercial Forestry Operations;
- MP 31 - Maintenance and Repair of Serviceable Structures;
- MP 52 - Temporary Recreational Structures;
- MP 54 - Wetland Habitat Restoration and Enhancement;
- GP A - Aids to Navigation;
- GP C - Clear Span Bridge;
- GP G - Culverts - Small;
- GP J - Dry Fire Hydrant;
- GP O - Minor Permit Revisions and Transfers;
- GP Q - Mooring Buoy;
- GP V - Scientific Measuring Devices;
- GP W - Snow Road Stream Crossings for Forestry Operations;
- GP Y - Spring Piles and Piling Clusters

Group 2 Streams are those that are likely to have state listed mussels. Note that if the project intersects a Group 2 stream, the output letter will include language notifying the applicant that state-listed mussels may occur in the area, and to contact the Michigan Department of Natural Resources to determine effects to state-listed mussels.

Hine's Emerald Dragonfly and Hine's Emerald Dragonfly CH

Projects that intersect the Hine's emerald dragonfly AOI or CH must not:

1. Disturb the ground or existing vegetation within 500 meters of a calcareous wetland, fen, sedge meadow, or marsh[8]
2. Affect local hydrology (permanently or temporarily)
3. Include construction or modification of a road or trail within occupied or CH buffered habitat

The main threats to Hine's emerald dragonfly are habitat destruction, urban sprawl, off-road vehicles, road and pipeline construction – all of which result in ground disturbance. Avoiding ground disturbance will preclude direct effects to Hine's emerald dragonfly. Avoiding alterations to hydrology will preclude indirect effects.

Hungerford's Crawling Water Beetle

Projects that intersect the HCWB AOI must not:

1. Involve any road or stream actions (e.g., bridge or culvert actions) or in-stream disturbance within or adjacent to (i.e., within 100m of) a stream or river including loss of riparian vegetation
2. Affect local hydrology (permanently or temporarily)

[8]This includes any off road vehicle access, soil compaction, digging, seismic survey, directional drilling, heavy equipment, grading, trenching, placement of fill, pesticide application, vegetation management (including removal or maintenance using equipment or chemicals), cultivation, development, etc.

Avoiding direct and indirect impacts to streams will avoid impacts to suitable HCWB habitat. Projects that involve work within or adjacent to streams within the HCWB's AOI do not qualify for this key.

Karner Blue Butterfly

Projects that intersect the KBB AOI must avoid the following within suitable habitat[9]:

1. Disturbance to any areas containing wild lupine
2. Chemical use
3. Any activities that may result in habitat loss

Avoiding areas containing wild lupine (the host plant for KBB) will ensure disturbance will have no adverse effects to KBB. Additional consultation (outside of the Dkey) is needed if loss of habitat will occur to ensure effects are insignificant or discountable.

Mitchell's Satyr

Projects that intersect the Mitchell's satyr AOI must not:

1. Include alteration or fill of more than 3 acres of wetland
2. Affect local hydrology (permanently or temporarily)
3. Disturb the ground or existing vegetation within 0.5 miles of a Mitchell's satyr occurrence in suitable habitat (prairie fen, shrub carr, tamarack swamp, tamarack savanna, wet meadow, or wet prairie habitat)

Projects must avoid disturbing the ground or existing vegetation, which includes any off road vehicle access, soil compaction, digging, seismic survey, directional drilling, heavy equipment, grading, trenching, placement of fill, pesticide application, vegetation management (including removal or maintenance using equipment or chemicals), cultivation, development, etc. Avoiding ground disturbance (defined to include use of chemicals) in suitable habitat will ensure direct effects are discountable. Avoiding changes to hydrology will avoid indirect effects to Mitchell's satyr within an occupied watershed.

Poweshiek Skipperling and Poweshiek Skipperling Critical Habitat

Projects that intersect the Poweshiek skipperling AOI or CH must not:

1. Include alteration or fill of more than 3 acres of wetland
2. Affect local hydrology (permanently or temporarily)
3. Disturb the ground or existing vegetation within 0.5 miles of a population that has been extant within the last 5 years in suitable habitat (prairie fen, sedge meadow, or tall grass prairie habitat)

Projects must avoid disturbing the ground or existing vegetation, which includes any off road vehicle access, soil compaction, digging, seismic survey, directional drilling, heavy equipment, grading, trenching, placement of fill, pesticide application, vegetation management (including removal or maintenance using equipment or chemicals), cultivation, development, etc. Avoiding ground disturbance (defined to include use of chemicals) in suitable habitat will ensure direct

[9]This includes a variety of habitats containing wild lupine, including oak savanna, oak or pine barrens, openings within oak forest (including rights-of-way), or old fields in association with oak forest.

effects are discountable. Avoiding changes to hydrology will avoid indirect effects to Poweshiek skipperling within an occupied watershed.

Canada Lynx

Projects that intersect the Canada lynx AOI must not include any actions that would harm the species directly (e.g., mammal trapping, poison bait, etc.).

Gray Wolf

Projects that intersect the gray wolf AOI must not:

1. Overlap with a known gray wolf denning or rendezvous area (users are directed to contact the lead gray wolf biologist with the Michigan Department of Natural Resources for assistance in determining whether their project area may overlap known denning or rendezvous areas)
2. Have any potential for the action to harm wolves directly (e.g., mammal trapping, poison bait), or indirectly (e.g., increasing vehicle use that may result in vehicle strikes, exposure to potential human persecution)

Indiana Bat

Projects that intersect the Indiana bat AOI must not:

1. Contain any known or potential hibernacula (including natural caves, abandoned mines, or underground quarries) within 0.25 miles of the project area
2. Remove/modify a human structure (barn, house or other building) known to contain roosting Indiana bats

Additionally, projects that contain known or potential Indiana bat habitat[10] and include tree cutting/trimming, prescribed fire, and/or pesticide (including insecticide and rodenticide) application must not:

1. Clear >10 contiguous acres of forest habitat within 5 miles of a known Indiana bat hibernaculum (Tippy Dam)
2. Clear >10 contiguous acres of modeled summer habitat (see Appendix I, II)
3. Fragment a connective corridor between 2 or more forest patches of at least 5 acres (see Appendix II)

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[10]Suitable summer habitat for Indiana bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats, such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥5 inches dbh that have exfoliating bark or cracks/crevices), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit characteristics of suitable roost trees and are within 1,000 feet of other forested/wooded habitat. Southern Michigan maternity roost trees are typically dead or dying trees in open areas exposed to solar radiation. Infrequently, Indiana bats are observed roosting in human-made structures, such as buildings, barns, bridges, and bat boxes.
The Michigan Field Office has modeled suitable Indiana bat habitat across the species' expected range in Michigan based on available data. See Appendix I for details on how the habitat suitability model was developed and incorporated into the DKey.

4. Cut or trim any potential Indiana bat roost trees (trees ≥5 inches in diameter [at breast height] with cracks, crevices and/or exfoliating bark; see Appendix III), conduct prescribed burning, or apply pesticides (including insecticides and rodenticides) during the following location-specific periods:
    a. Within 5 miles of a known hibernaculum (Tippy Dam): April 1 through October 31 (i.e., activities limited to November 1 through March 31)
    b. In modeled summer habitat and >5 mi from Tippy Dam: April 1 through September 30 (i.e., activities limited to October 1 through April 14)
    c. Outside modeled summer habitat and >5 miles from Tippy Dam: June 1 through July 31 (i.e., activities limited to August 1 through May 31)

Projects that contain known or potential Indiana bat habitat and include herbicide application must follow all label instructions and limit application to targeted methods such as spot-spraying, hack-and-squirt, basal bark, injections, cut-stump, or foliar spraying on individual plants.

Projects that include removal/modification of an existing bridge or culvert suitable for day-roosting Indiana bats[11] must not:

1. Result in the permanent loss of known or potential roosting spaces
    a. Perform construction activities during the active season of April 15 through September 30 (i.e., construction activities limited to October 1 through April 14)

Lastly, projects that include temporary or permanent lighting of roadway(s), facility(ies), and/or parking lot(s) must:

1. When installing new or replacing existing permanent lights, use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those transportation agencies using the BUG system developed by the Illuminating Engineering Society, the goal is to be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable.
2. Direct temporary lighting away from suitable habitat when bats may be present

Northern Long-eared Bat

During the northern long-eared bat Interim Consultation Period (March 31, 2023 – April 1, 2024), projects within known northern long-eared bat occurrence buffers (including 5 miles of a known hibernaculum, 3 miles of a post-WNS mist net capture or verified, post-WNS acoustic detection, and/or 1.5 miles of a post-WNS roost tree) must not:

1. Contain any known or potential hibernacula (including natural caves, abandoned mines, or underground quarries) within 0.25 miles of the project area
2. Remove/modify a human structure (barn, house or other building) known to contain roosting northern long-eared bats

[11]Suitable bridges and culverts include those located below the third county tier of Michigan and within 1,000 feet of suitable forested habitat that contain suitable roosting spaces (e.g., expansion joints, cracks/crevices). Suitable culverts are limited to those at least 4 feet (1.2 meters) high and 50 feet (15 meters) long. If the bridge/culvert been inspected for signs of roosting bats (guano, urine staining, bat vocalizations, and/or bats) during the summer roosting season (May 15 through August 15) and no bats or signs of bats were observed, work on the bridge/structure can proceed at any time of year.

Additionally, projects within the Interim Period occurrence buffers that contain potential northern long-eared bat habitat[12] and include tree cutting/trimming, prescribed fire, and/or pesticide (including insecticide and rodenticide) application must not:

1. Clear >10 acres of forest habitat within 5 miles of a known northern long-eared bat hibernaculum
2. Clear >10 acres of modeled summer habitat within the Indiana bat range/AOI (see Appendix I, II)
3. Clear >20 acres of modeled habitat outside the Indiana bat range/AOI (see Appendix I, II)
4. Fragment a connective corridor between 2 or more forest patches of at least 5 acres (see Appendix II)
5. Cut or trim any potential northern long-eared bat roost trees (trees ≥3 inches in diameter [at breast height] with cracks, crevices, cavities/hollows and/or exfoliating bark; see Appendix IV), conduct prescribed burning, or apply pesticides (including insecticides and rodenticides) during the following location-specific periods:
    a. Within 5 miles of a known hibernaculum in the Upper Peninsula: April 15 through October 14 (i.e., activities limited to October 15 through April 14)
    b. Within 5 miles of a known hibernaculum in the Lower Peninsula: April 1 through October 31 (i.e., activities limited to November 1 through March 31)
    c. In modeled summer habitat and >5 mi from known hibernacula in the Upper Peninsula: May 15 through August 31 (i.e., activities limited to September 1 through May 14)
    d. In modeled summer habitat and >5 mi from known hibernacula in the Lower Peninsula within the Indiana bat range/AOI: April 15 through September 30 (i.e., activities limited to October 1 through April 14)
    e. In modeled summer habitat and >5 mi from known hibernacula in the Lower Peninsula outside of the Indiana bat range/AOI: May 1 through August 31 (i.e., activities limited to September 1 through April 30)
    f. Outside modeled summer habitat and >5 miles from known hibernacula: June 1 through July 31 (i.e., activities limited to August 1 through May 31)

Projects within the Interim Period occurrence buffers that contain potential northern long-eared bat habitat and include herbicide application must follow all label instructions and limit

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[12]Suitable summer habitat for northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats, such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches dbh that have exfoliating bark, cracks/crevices, and/or cavities/hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit characteristics of suitable roost trees and are within 1,000 feet of other forested/wooded habitat. Infrequently, northern long-eared bats are observed roosting in human-made structures, such as buildings, barns, bridges, and bat boxes.
The Michigan Field Office has modeled suitable Indiana bat habitat across the species' expected range in Michigan based on available data. See Appendix I for details on how the habitat suitability model was developed and incorporated into the DKey.

application to targeted methods such as spot-spraying, hack-and-squirt, basal bark, injections, cut-stump, or foliar spraying on individual plants.

Projects within the Interim Period occurrence buffers that include removal/modification of an existing bridge or culvert suitable for day-roosting northern long-eared bats[13] must not:

2. Result in the permanent loss of known or potential roosting spaces
    a. Perform construction activities during the active season of April 15 through September 30 (i.e., construction activities limited to October 1 through April 14)

Lastly, projects within the Interim Period occurrence buffers that include temporary or permanent lighting of roadway(s), facility(ies), and/or parking lot(s) must:

3. When installing new or replacing existing permanent lights, use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those transportation agencies using the BUG system developed by the Illuminating Engineering Society, the goal is to be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable
4. Direct temporary lighting away from suitable habitat when bats may be present

Copperbelly Water Snake

Projects that intersect the copperbelly water snake AOI and buffered habitat must not:

1. Involve construction or maintenance of a road or other barrier (e.g., paved trail)
2. Affect local hydrology (permanently or temporarily)
3. Disturb the ground or existing vegetation[14] within 0.5 miles of a copperbelly occurrence

Projects that fragment habitat, affect hydrology, or result in ground disturbance need project-specific review in areas where copperbelly occur.

Eastern Massasauga Rattlesnake

The following projects are not covered by the Dkey in Tier 1 or Tier 2 habitat[15]:

1. Prescribed fire
2. New roads, widening existing roads, and other types of projects that create a permanent barrier to snake movement
3. Projects that permanently alter hydrology
4. Projects that temporarily alter hydrology during the inactive season

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[13]Suitable bridges and culverts include those located below the third county tier of Michigan and within 1,000 feet of suitable forested habitat that contain suitable roosting spaces (e.g., expansion joints, cracks/crevices). Suitable culverts are limited to those at least 4 feet (1.2 meters) high and 50 feet (15 meters) long. If the bridge/culvert been inspected for signs of roosting bats (guano, urine staining, bat vocalizations, and/or bats) during the summer roosting season (May 15 through August 15) and no bats or signs of bats were observed, work on the bridge/structure can proceed at any time of year.

[14]This includes any off road vehicle access, soil compaction, digging, seismic survey, directional drilling, heavy equipment, grading, trenching, placement of fill, pesticide application, vegetation management (including removal or maintenance using equipment or chemicals), cultivation, development, etc.

[15]In Tier 1 habitat, contact the Service regarding the potential applicability of surveys to determine EMR absence in suitable habitat.

5. In Tier 1, projects that impact more than 0.5 acres of EMR habitat, or in Tier 2, greater than 1 acre of EMR habitat
6. Projects that include mowing vegetation (non-turf grass) during the active season

In addition, in order to reach a not likely to adversely affect determination:

7. In Tier 1, projects cannot result in ground disturbance in areas where potential hibernacula occur. (If present in Tier 1, projects must avoid ground disturbance any time of year). In Tier 2, projects cannot result in ground disturbance to potential hibernacula during the inactive season (if present in Tier 2, ground disturbance must be well within the active season to avoid when snakes are present underground).
8. If conducting ground disturbing work in Tier 1 or Tier 2 habitat, the following best management practices (BMPs) must be implemented (if applicable):
    a. Use existing roads and minimize speeds at facilities and access roads (e.g., <15 mph on two track roads), during the active season.
    b. Use low impact equipment such as lightweight track mounted vehicles with low ground pressure OR limit vehicle use to the inactive season, when the ground is completely frozen.
    c. Revegetate all disturbed areas with appropriate plant species (i.e., native species or other suitable non-invasive species present on site prior to disturbance). Monitor all restoration plantings for proper establishment and implement supplemental plantings as necessary to ensure restorations are of equal to or better habitat quality than previous conditions.
    d. Avoid the spread of invasive species into suitable EMR habitat by following best practices such as inspecting and cleaning equipment and vehicles for invasive plant materials and seeds before entering EMR habitat areas.
    e. Ensure fill is clean and free of contaminants/invasive species.
9. For projects during the active season, in Tier 1 and Tier 2, projects must include the following BMPs (if applicable):
    a. In Tier 1, for projects involving earth work, properly install exclusionary fencing, clear the area before work begins using a qualified person, and remove all fencing following project completion.
    b. Keep turf grass short (<6 inches) throughout the active season. In non-turf grass, mow tall (>6 inches) vegetation during the inactive season (for Tier 1), or raise the deck height to greater than 8 inches (for Tier 2).
10. For projects using chemical treatments (e.g., herbicides), they must agree to follow all appropriate label instructions regarding which herbicide formulation and proper use in potential EMR habitat AND avoid spray drift beyond the target species/area (observing label instructions regarding optimal wind speed and direction, boom height, droplet size calibration, precipitation forecast, etc.).

For all Projects within the range, including Tier 1 and Tier 2, projects must include all General BMPs:

    a. Use wildlife-safe materials for erosion control and site restoration throughout the project area. Do not use erosion control products containing plastic mesh netting or other similar material that could entangle eastern massasauga rattlesnake (EMR). Several products for soil erosion and control exist that do not contain

plastic netting including net-less erosion control blankets (for example, made of excelsior), loose mulch, hydraulic mulch, soil binders, unreinforced silt fences, and straw bales. Others are made from natural fibers (such as jute) and loosely woven together (often referred to as "leno weave") in a manner that allows wildlife to wiggle free.

b. To increase human safety and awareness of EMR, those implementing the project should first watch MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://youtu.be/~PFnXe_e02w), review the EMR factsheet (available at https://www.fws.gov/media/eastern-massasauga-rattlesnake-fact-sheet), or call (517) 351-2555.
c. During project implementation, require reporting of any Federally listed species, including EMR, to the Service within 24 hours.

Based on implementation of the recommended BMPs, and avoidance of the excluded actions, adverse effects to eastern massasauga are expected to be discountable.

Plants

In Michigan, threatened plants include American hart's tongue fern, dwarf lake iris, eastern prairie fringed orchid, Houghton's goldenrod, lakeside daisy, and Pitcher's thistle. Michigan monkey flower is Michigan's only endangered plant species. Plants in Michigan are protected by state law in additional to the Federal ESA.

Projects that are funded, authorized, or carried out by a Federal agency, intersect the AOI and/or buffered habitat of a Federally listed plant, and have either determined presence through a survey or have not conducted a survey and are assuming presence must not:

1. Indirectly alter the habitat or resources of the listed plant(s)[16]
2. Directly harm the listed plant(s)[17]

If the project does not have a Federal nexus but has the potential to affect a listed plant, the user will receive output language advising them to contact the Michigan Department of Natural Resources regarding compliance with state law and to determine whether a state permit is needed. We also encourage landowners to maintain habitat for listed plant species and avoid disturbing listed plants to the extent possible.

For projects with a Federal nexus, avoiding direct and indirect effects to plants will ensure effects are insignificant or discountable.

Bald eagle

Although no longer listed under the ESA, bald eagles are protected under the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d). The Dkey provides the user with information on the BGEPA and directs users to contact the MIFO for more information on the BGEPA if their action may impact bald or golden eagles.

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[16]For example, actions that cause a change in canopy cover, microclimate, humidity, increase in invasive species, hydrologic alterations, etc.

[17]For example, through prescribed fire, herbicide application, trampling, increased herbivory, cutting/clearing, cultivation, crushing by vehicle, reduction to possession, etc.

Effects Analysis

Projects that meet all of the following criteria can get to a “no effect” determination for all species:

1. Occurs entirely within an already-developed area (e.g., within an existing structure, graveled or paved lot, industrial site) that does not provide habitat for listed species.
2. Does not have any potential for indirect effects to listed species or the habitats they depend on (e.g., water discharge into adjacent habitat or waterbody, changes in hydrology (e.g., surface flows, discharges, groundwater elevation, etc.), sound, introduction of an exotic plant species).
3. Will not impact structures that may serve as roosts for listed bats.

Note that we define "already-developed area", for the purpose of the Dkey, as highly disturbed habitat that does not provide potential feeding, breeding, or sheltering resources for any listed species. This does not include areas such as road or transmission line rights-of-way, other roadside habitat, bridges/culverts, or other developed or disturbed areas that still provide resources to listed species.

For the most part, the species-specific conservation measures ensure projects are not occurring in suitable (occupied) habitat and will not have direct or indirect effects, as described above. For projects where listed species may be present, activities may involve some or all of the following stressors:

Insignificant Habitat Loss/Degradation

Some projects that qualify for use of this DKey may result in minor loss/fragmentation or temporary degradation of available habitat for one or more Federally listed species. However, we believe that adherence to the specific conservation measures will ensure that any reduction or modification of available habitat will result in only insignificant effects to listed species and critical habitats. Conservation measures that control for significant loss/degradation of habitat include restrictions on the extent and timing of certain activities (e.g., acreage thresholds for tree clearing projects within the Indiana bat AOI, seasonal restrictions on temporary surface- and groundwater elevation changes in potential eastern massasauga hibernation habitat), restrictions on stream/hydrology-impacting or vegetation/ground-disturbing activities within the AOIs/buffered habitat of several species (e.g., copperbelly water snake, listed insects), and restrictions on actions that may fragment habitat or create barriers to movement/dispersal within the AOIs of several species (e.g., dams within Group 3 streams, roads/trails/fences within listed snake habitats).

Noise and Vibration

Noise and/or vibration resulting from some projects are typically produced temporarily during the construction phase (e.g., construction vehicles and equipment, blasting) and may be permanently produced during the operation phase (e.g., roads/trails/bridges, commercial/recreational facilities, military operations, etc.). However, we believe that adherence to the specific conservation measures will ensure that any disturbance related to an increase in noise and/or vibration will result in only insignificant effects to listed species and critical habitats. Conservation measures that limit exposure to these stressors and control for significant disturbance include restrictions on the timing of certain activities (e.g., tree cutting during the Indiana bat active season, modifications to beaches, dunes, mudflats or other potential habitats

during the red knot migration windows), restrictions on ground-disturbing activities within the AOIs of several species (e.g., listed snakes, insects), and restrictions on in-stream disturbance within the AOIs of Hungerford's crawling water beetle and listed mussels).

Smoke, Dust, Chemicals, and Odor

Smoke, dust, chemicals, and/or odor resulting from some project activities are typically produced temporarily during the construction phase (e.g., construction vehicles and equipment, blasting, invasives treatment/pesticide application, prescribed burning) and may be permanently produced during the operation phase (e.g., mines/quarries, commercial/residential developments, military operations, etc.). However, we believe that adherence to the specific conservation measures will ensure that any disturbance related to an increase in smoke, dust, chemicals, and/or odor will result in only insignificant effects to listed species and critical habitats. Conservation measures that limit exposure to these stressors and control for significant disturbance include restrictions on the timing of certain activities (e.g., prescribed burning and pesticide use in potential habitat during the Indiana bat and eastern massasauga active seasons), restrictions on chemical use and vegetation-disturbing activities within the AOI of listed insects, restrictions on direct and indirect river/stream impacts in Group 3 streams, and disturbance buffers around sensitive areas (e.g., known gray wolf denning or rendezvous sites).

Night Lighting

Night lighting produced by some projects may occur temporarily during the construction phase (e.g., equipment lighting) and/or permanently during the operation phase (e.g., road/trail and facility lighting). However, we believe that application of the specific conservation measures will ensure that any disturbance related to night lighting will result in only insignificant effects to listed species and critical habitats. Most Federally listed species are not expected to be affected by night lighting; however, certain species that are active at night (e.g., listed mammals, snakes, migrating birds) may be sensitive to an increase in lighting at night. Conservation measures that limit exposure to this stressor and control for significant disturbance include the general exclusion for communications towers more than 200 feet in height (which require night lighting), the timing of certain activities (e.g., actions that may increase human activity in potential habitat during the red knot migration windows), and disturbance buffers around sensitive areas (e.g., known gray wolf denning or rendezvous sites).

Conclusion

If a project is not consistent with the general and species/taxon-specific conservation measures and/or exclusions detailed above, the DKey will provide a response indicating that it cannot generate a conclusion (i.e., "no effect" [NE] or "may affect – not likely to adversely affect" [NLAA] determinations) for all species and will recommend project-specific coordination with the MIFO. In other words, for any species for which the user gets a "may affect" (MA) determination, further consultation with MIFO is required and their endangered species review cannot be completed using the Dkey. On the other hand, if the user provides project-specific information consistent with the conservation measures, IPaC will generate a consistency letter (for non-Federal action agencies) or a concurrence letter (for Federal action agencies) concluding that the project is consistent with NE and/or NLAA determinations for all listed species. We base these conclusions on the effects analysis above, which are summarized in Table 1.

Table 1. A summary of the effects of the stressors from qualifying projects on Federally listed species in Michigan.

Stressor	Effect
Habitat Loss/Degradation	None or insignificant
Noise and Vibration	None or insignificant
Smoke, Dust, Chemicals, and Odor	None or insignificant
Night Lighting	None or insignificant
Conclusion	**"May affect – not likely to adversely affect"**

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APPENDIX I

Development of a Habitat Suitability Model for the Indiana Bat (*Myotis septentrionalis*) and Northern Long-eared Bat (*M. sodalis*) in Michigan

In 2018, the Michigan Ecological Services Field Office (MIFO) contracted with Dr. Eric McCluskey of Grand Valley State University to develop a habitat model for the Indiana bat in Michigan. In 2021, MIFO again contracted with Dr. McCluskey to develop a habitat model for the northern long-eared bat in Michigan, which we combined with the Indiana bat model. A shapefile of the combined habitat model is available here: Michigan Listed Bat Habitat Model

Indiana Bat Model

To develop the model, we compiled all available Indiana bat summer capture (foraging) and roost occurrence data for Michigan and applied a 500-m spatial filter as a minimum distance between occurrence records to minimize overemphasis of habitat importance based on clusters of individuals. After filtering the occurrence data, 44 locations remained (20 capture and 24 roost locations). We developed models using capture and roost occurrences separately as well as with all occurrences combined to determine which model was best suited for identifying foraging and roost habitat.

Due to the small number of occurrences, we used an ensemble of small models (ESM) approach that permits more predictor variables to be used by running each pairwise combination of variables and then weighting these final models in an ensemble. The ESMs were run in the R package ecospat. Presence only modeling requires the selection of background area from which background points will be randomly sampled to compare to the occurrence data. The background area should represent parts of the landscape that are accessible to the focal organism. We created a convex hull around our occurrence data using ArcMap, a polygon formed by connecting straight lines between points. We then buffered this convex hull by 25 km to include areas beyond the known core distribution of Indiana Bat in southern Michigan that should be physically accessible and may have undetected presences. We set background point selection for this entire buffered area except for within 5 km of Indiana Bat occurrences where background points are most likely to unintentionally represent true presences.

We selected predictor variables by removing the worse performing variable from highly correlated pairs (>0.75) using the 'corSelect' function from the fuzzySim R package. Then we then used Maxent's internal variable importance (permutation importance) and jackknife measures to determine which of the remaining variables were important to retain for separate capture and roost models. We selected two model types, Artificial neural network (ANN) and Maxent, for the ESMs. We compared five runs for each model type with the capture, roost, and combined datasets using area under the ROC curve (AUC) and true skill statistic (TSS). We then calculated the Boyce Index value using ecospat to compare the ANN and Maxent models from each dataset in their ability to identify capture and roost locations. We used Boyce Index as the primary assessment metric as it allowed for comparisons across all three model types for capture and roost data.

Based on the Boyce Index assessment, we selected the Maxent presence-only roost model as the strongest fit model. Using the 10th percentile threshold, we converted the model output to a binary raster. The binary raster was then converted to a shapefile using non-simplified

shapes. Because considerable portions of the modeled habitat contained clearly non-suitable cover types, particularly near highly developed urban areas, we further refined the model by clipping the binary shapefile by the most recent available National Land Cover Database (NLCD 2019) data. Land cover categories excluded ("Clipped") from modeled habitat included open water, perennial ice/snow, developed (low, medium, and high intensity), and barren land (sand, rock, clay).

Northern Long-eared Bat Model

To develop the model, we compiled all available northern long-eared bat summer capture (foraging) and roost occurrence data for Michigan's Lower Peninsula and applied a 1-km spatial filter as a minimum distance between occurrence records to reduce the potential for biased results from over-represented sites. After filtering the occurrence data, 56 locations remained.

We screened a diverse set of candidate variables (30 m resolution) representing different habitat elements, including land cover, hydrology, and elevation. First, we identified and removed highly correlated variables (>0.75) with the 'corSelect' function in the fuzzySim R package, keeping the better performing variable from each correlated pair. We further evaluated the remaining variables using the jackknife of variable importance and training gain output in Maxent. The final northern long-eared bat variables were mean canopy at 100 m, canopy range at 500 m, percentage of emergent wetland at 50 ha, percentage of forested wetland at 5 ha, wetland diversity index at 25 ha, and wetland diversity index at 1,000 ha.

Once the occurrence data were thinned, we used a buffered region to clip the selected variable rasters to serve as the area for background point selection by ecospat. We used a 25-km buffer for background point selection (10,000 random points). The sample size was low enough (n=56) that we opted to use the R package ecospat, that was developed for datasets with few occurrences. Ecospat uses an ESM approach where separate models are produced with each pair of variables before an ensemble is created under a weighting scheme. We used Maxent and ANN for the ecospat ESMs. The ecospat models used five-fold cross validation (80% training partitions). We used Boyce Index implemented in ecospat as the primary model selection metric using the 'ecospat.boyce' function for the ESMs. Finally, we converted the continuous habitat suitability values from each species SDM to a binary raster of habitat and non-habitat to represent the distribution of habitat patches. We used the maximum sum of sensitivity and specificity (MSSS) threshold for the ecospat ESM models (equivalent to the maximum true skill statistic (TSS)).

Combined Listed Bat Model

To combine and further refine the habitat models, we created a grid of five-acre hexagons for Michigan using the "Generate Tessellation" tool in ArcPro 2.9. Five acres was selected as the patch size based on available literature and data suggesting that Indiana and northern long-eared bats are unlikely to occupy an isolated forest stand of less than five acres. The total acres of modeled habitat were summarized by hexagon using the "Summarize Within" tool. Hexagons with less than one acre of either bat's habitat were then removed. These small model fragments were typically isolated from other modeled hexagons, likely artifacts of imprecise raster data, and were considered unlikely to provide sufficient habitat to support roosting listed bats. Hexagons containing more than one acre of modeled habitat of either species were

retained, helping to fill gaps and buffer edges among smaller but closely connected modeled patches and increasing the overall acreage of modeled habitat across the state.

The remaining hexagons were then aggregated using the “Dissolve” tool allowing for multipart features. The “Summarize Within” tool was run again to obtain acres of modeled habitat within each hexagon cluster. We then ran a “Near Neighbor” analysis to identify forest patches that were greater than 1,000 feet from forested areas to remove isolated patches unlikely to be used by roosting listed bats. We removed hexagons that were more than 1,000 feet from their nearest neighbor and that contained less than five acres of modeled habitat. These isolated forest patches are considered unlikely to support roosting listed bats due to their insufficient size and distance from other suitable, modeled areas. The final layer was then checked against known listed bat roosting areas and detections. An additional three hexagons were added to the model to capture locations that fell outside of the modeled habitat.

APPENDIX II

Projects that may cause indirect adverse effects/harm to ESA-listed bats

Indiana bats and northern long-eared bats are forest dependent and require a network of forested tracts for roosting, commuting, and foraging. The Service defines suitable roosting habitat for Indiana bats as forest patches containing trees of 5 inches diameter at breast height (DBH) or larger, and suitable roosting habitat for the northern long-eared bat as forest patches containing trees of 3 inches DBH or larger. However, early successional habitat with small diameter trees may also be used as important foraging and/or commuting habitat by listed bats.

Indiana and northern long-eared bat exhibit high interannual site fidelity, with maternity colonies roosting together in the same area over multiple years (USFWS 2007, Foster and Kurta 1999, Johnson et al. 2009, Silvis et al. 2015). Because their roosts (typically dead/dying trees) are naturally ephemeral, listed bats are expected to be adapted to some amount of roost loss. However, largescale loss or degradation of occupied habitat could lead to maternity colony fragmentation and/or reproductive failure if a substantial number of roost trees (particularly primary maternity roosts) are removed or if a sufficient amount of suitable roosting, foraging, swarming/staging, and/or commuting habitat will no longer be available, even if the clearing takes place during times of the year when bats are not present on the landscape (inactive season).

Although project specifics (e.g., timing, availability of nearby habitat, quality of remaining habitat, etc.) can modify a risk assessment, the Michigan Ecological Services Field Office generally views the following project activities as having potential to cause adverse effects and/or harm to federally listed bats if they are present (or when assuming potential presence without survey data[18]) without further considerations. In other words, projects involving the following activities are not eligible to receive automated concurrence through our All Species Michigan Dkey:

1. Clearing >10 contiguous[19] acres of forest within 5 miles of a known listed bat hibernaculum;
2. Clearing >10 contiguous[20] acres of modeled bat habitat in the Indiana bat range;
3. Clearing >20 contiguous[21] acres of modeled bat habitat outside the Indiana bat range;
4. Fragmenting[22] a connective corridor (e.g., tree line) between two or more forest patches of at least 5 acres

Acreage Thresholds

To better characterize potential habitat and focus conservation efforts, the Michigan Ecological Services Field Office developed a habitat suitability model for listed bats in Michigan. Potentially suitable habitat for listed bats may occur outside of modeled areas, but occupancy of

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[18]Surveys conducted in accordance with the Service's Range-wide Indiana bat and Northern Long-eared Bat Survey Guidelines may be used to demonstrate presence or probable absence of listed bats within a project area. Lacking presence/absence survey data, presence is assumed in suitable habitat.

[19]Connected by 1,000 feet or less

[20]Connected by 1,000 feet or less

[21]Connected by 1,000 feet or less

[22]Creating a gap of 1,000 feet or more between previously connected forest

such areas is expected to be less likely.

As listed bat maternity home ranges contain multiple primary and secondary roost trees, it is extremely unlikely that loss of up to 10 contiguous acres of habitat would eliminate all primary roost trees within a maternity roosting area anywhere in Michigan. Available literature suggests that northern long-eared bat maternity colonies can tolerate loss of a single primary roost or up to 20% of available secondary roosts in the inactive season before abandoning roosting areas or substantially altering roosting behaviors (Silvis et al. 2014, 2015), and Indiana bats are expected to respond similarly. Loss of up to 10 contiguous acres of habitat is also unlikely to noticeably degrade the quality of an occupied roosting or foraging area or render a travel corridor unsuitable anywhere in Michigan. For these reasons, the Michigan Ecological Services Field Office believes it is extremely unlikely that loss of up to 10 contiguous acres during the inactive season would lead to detectable adverse effects/harm, even where listed bats are most likely present (e.g., within 5 miles of known hibernacula) and forest habitat is most limited/fragmented (e.g., modeled habitat within the Indiana bat range). Because of the abundance of forest habitat outside the Indiana bat's range in Michigan (e.g,, northern Lower Peninsula and Upper Peninsula), we believe that removal of up to 20 contiguous acres of modeled habitat during the inactive season is unlikely to cause adverse effects/harm. Finally, because of the low probability of occupancy, we do not believe that any amount of inactive season tree removal outside modeled habitat and >5 mi from known hibernacula is likely to cause harm or adverse effects to listed bats.

Michigan projects that will clear >10 contiguous acres within 5 mi of a known listed bat hibernaculum, >10 acres of modeled habitat in the Indiana bat range, and/or >20 contiguous acres of modeled habitat outside the Indiana bat range or that will fragment a connective corridor between two or more forest patches of at least 5 acres may warrant further project-specific consideration or coordination with the Service in order to evaluate and minimize potential impacts.

Minimum Patch Size

Based on life history information and available literature for Indiana bats (e.g., average foraging distances and occupied forest patch sizes), the Service believes that it is unlikely that an isolated forest stand of 10 acres or less would provide sufficient resources for an Indiana bat. However, available data indicate that Indiana bats may infrequently use isolated forest patches as small as 5.6 acres (Keith Lott, personal communication). The Michigan Ecological Services Field Office believes a conservative minimum patch size of 5 acres is appropriate for both Indiana and northern long-eared bats. Although listed bats rarely traverse non-forested areas of 1,000 feet or more, they are frequently observed using vegetated corridors, such as tree lines, to travel among suitable forest patches. Because they may connect important foraging and roosting habitats, removal of forested corridors (regardless of size/area of corridor) could severely fragment available habitat and result in adverse effects or indirect take of listed bats. Therefore, projects that remove connective corridors between forest patches warrant project-specific consideration and coordination with the Service.

Northern Long-eared Bat Interim Consultation Period (March 31, 2023 - April 1, 2024)

During the Interim Consultation period, the Service does not consider take of northern long-eared bats to be reasonably certain except within the specified distance buffers of known occurrences. During the Interim Consultation period, projects outside of these buffers may conclude that take of northern long-eared bats is not reasonably certain and that adverse effects

are unlikely. During the Interim Consultation period, this framework has been integrated into the Michigan All Species Determination Key. Additionally, to assist private landowners and stakeholders with non-Federal actions, the Service has published range-wide Interim Voluntary Guidance for Forest Habitat Modification and Wind Energy Operation.

However, please note that the Interim Consultation Framework and associated Standing Analysis only consider and address the effects of covered actions that are expected to occur from March 31, 2023, until April 1, 2024. In other words, the Standing Analysis and Interim Consultation Framework do not consider any effects or incidental take resulting from the covered actions that may occur after April 1, 2024. Additionally, they do not consider effects to or take of Indiana bats or other federally listed bats. After April 1, 2024, any action agency that was issued an individual BO that relied on the Interim Consultation Framework will need to reinitiate consultation if its continuing, discretionary action is expected to affect the northern long-eared bat (i.e., cause incidental take). If the action agency fails to reinitiate consultation on or before April 1, 2024, its individual BO will no longer be based on the best available information, which means the action agency's section 7 compliance and incidental take exemptions provided by section 7(o)(2) may lapse. Please see the USFWS northern long-eared bat page for more information.

Supporting Documents

The following Service web pages provide further information and background on the potential for indirect adverse effects via habitat loss or fragmentation.

- Section 7 Technical Assistance, Summary of Indiana Bat Ecology
- Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects
- Range-wide Indiana bat and Northern Long-eared Bat Survey Guidelines
- Standing Analysis and Implementation Plan for the Rangewide Northern Long-eared Bat Assisted Determination Key

Literature Cited

Foster, R.W. and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80: 659-672.

Johnson, J.B., J.W. Edwards, W.M. Ford, and J.E. Gates. 2009. Roost tree selection by northern myotis (*Myotis septentrionalis*) maternity colonies following prescribed fire in a Central Appalachian Mountains hardwood forest. Forest Ecology and Management 258:233-242.

Silvis, A., W.M. Ford, E.R. Britzke, and J.B. Johnson. 2014. Association, roost use and simulated disruption of *Myotis septentrionalis* maternity colonies. Behavioural Processes 103:283-290.

Silvis, A., W.M. Ford, and E.R. Britzke. 2015. Effects of Hierarchical Roost Removal on Northern Long-Eared Bat (*Myotis septentrionalis*) Maternity Colonies. PLoS ONE 10(1):e0116356.

U.S. Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife FWS, Fort Snelling, MN. 258 pp.

APPENDIX III

Potential Indiana bat roost trees

The Service defines suitable Indiana bat roost tree as any tree ≥5 inches in diameter (at breast height) with cracks, crevices and/or exfoliating bark that is within 1,000 feet of forested/wooded habitat.

Although live trees may be used, Indiana bat roosts are most typically snags in early to mid-decay stages. When healthy live trees are used, they tend to be species with naturally sloughing bark, such as shagbark hickory (*Carya ovata*). While over 40 Indiana bat roost tree species have been documented, including coniferous species, deciduous trees are most frequently used, and all the Indiana bat roosts reported in Michigan have been deciduous species. Generally, roost quality improves with tree height, diameter, amount of peeling bark, and solar exposure. Maternity roosts (roost trees used by reproductive female bats and their young) are typically high-quality roosts (i.e., large, tall trees with peeling bark and/or large cracks/crevices that receive a high degree of solar radiation).

Examples of Indiana bat roost trees:

APPENDIX IV

Potential northern long-eared bat roost trees

The Service defines suitable northern long-eared bat roost tree as any tree ≥3 inches in diameter (at breast height) with cracks, crevices, exfoliating bark, and/or cavities/hollows that is within 1,000 feet of forested/wooded habitat.

Although northern long-eared bat roosts are often dead or dying trees, live trees with defects are also commonly used. Northern long-eared bats have been reported to use over 35 roost tree species, but deciduous species are most frequently selected. Maternity roosts (roost trees used by reproductive female bats and their young) are typically higher-quality roosts (i.e., large-diameter, tall trees with peeling bark and/or notable defects and adequate solar exposure); however, compared to sympatric Indiana bat roosts, northern long-eared bat roosts (even maternity roosts) are often smaller, shorter trees with a higher degree of canopy cover and are more likely to be living.

Examples of northern long-eared bat roost trees:

APPENDIX D: OPINIONS OF PROBABLE COST AND PRESENT WORTH ANALYSIS

OPINION OF PROBABLE CONSTRUCTION COST

3497 Coolidge Rd, East Lansing, MI 48823

Telephone: (517) 316-3930 FAX: (517) 484-8140

PROJECT:	City of Kalamazoo, MI DWSRF Project Plan	**DATE:**	3/27/2024
LOCATION:	Kalamazoo, MI	**PROJECT NO.**	200-19743-24005
BASIS FOR ESTIMATE:	[X] CONCEPTUAL [ ] PRELIMINARY [ ] FINAL	**ESTIMATOR:**	D. Warren
WORK:	Pump Station 5 and 14 Consolidated WTP	**CHECKED BY:**	N. Raut
	Alternative 1	**CURRENT ENR:**	13532

ITEM NO.	DESCRIPTION	QUANT.	UNIT	UNIT AMOUNT	TOTAL AMOUNT		Civil/Site/Piping		Structures		Mechanical/ Electrical		Other
	Consolidated WTP												
1	Yard Piping and Site Work	1	Lump Sum	$ 3,604,000	$ 3,604,000.00	TRUE	$3,604,000		$0		$0		$0
2	Building Costs	1	Lump Sum	$ 5,180,000	$ 5,180,000.00		$0	TRUE	$5,180,000		$0		$0
3	Electrical and I&C	1	Lump Sum	$ 6,630,000	$ 6,630,000.00		$0		$0	TRUE	$6,630,000		$0
4	Utilities	1	Lump Sum	$ 100,000	$ 100,000.00		$0		$0	TRUE	$100,000		$0
5	Process Interconnections	1	Lump Sum	$ 3,178,000	$ 3,178,000.00	TRUE	$3,178,000		$0		$0		$0
6	Process Gas and Liquid Handling, Purification, and Storage Equipment	1	Lump Sum	$ 1,483,000	$ 1,483,000.00	TRUE	$1,483,000		$0		$0		$0
7	Water and Wastewater Equipment	1	Lump Sum	$ 6,800,000	$ 6,800,000.00	TRUE	$6,800,000		$0		$0		$0
8	Land Acquisition	4	Acres	$ 750,000	$ 3,000,000.00	TRUE	$3,000,000						
	Raw Water Main												
9	PS 14 3,000 GPM Pumps	2	Each	$ 100,000	$ 200,000.00	TRUE	$200,000						
10	Mobilization (5% of Pipe Construction Cost, Max $75,000)	1	LS	$ 46,000	$ 46,000		$0		$0		$0	TRUE	$46,000
11	Traffic Control	1	LS	$ 50,000	$ 50,000		$0		$0		$0	TRUE	$50,000
12	12-inch Raw Water Main	9,000	LF	$ 250	$ 2,250,000	TRUE	$2,250,000		$0		$0		$0
13	Jack / Bore at Gull Rd	100	LF	$ 600	$ 60,000	TRUE	$60,000		$0		$0		$0
14	Jack / Bore at Main St	100	LS	$ 600	$ 60,000	TRUE	$60,000		$0		$0		$0
15	Pressure Control Valve	1	EA	$ 15,000	$ 15,000	TRUE	$15,000		$0		$0		$0
16	Air Vacuum Valves	1	LS	$ 25,000	$ 25,000	TRUE	$25,000		$0		$0		$0
	Subtotal				$ 32,681,000								
						Sewers	$20,675,000	Structures	$5,180,000	Mech	$6,730,000	Other	$96,000
	General Conditions and Requirements	5	%		$ 1,635,000	General	$1,034,000	General	$259,000	General	$337,000	General	$5,000
	Administrative, Legal, and Engineering	15	%		$ 5,148,000	Admin	$3,257,000	Admin	$816,000	Admin	$1,060,000	Admin	$15,000
	Contingencies	30	%		$ 11,840,000	Contingency	$7,490,000	Contingency	$1,877,000	Contingency	$2,438,000	Contingency	$35,000
	TOTAL CONSTRUCTION COST				**$ 51,304,000.00**	**Total**	**$32,456,000.00**		**$8,132,000.00**		**$10,565,000.00**		**$151,000.00**

Assumptions

1. Building costs increased 40% from original estimate to include additional flow from PS 14.
2. Process interconnection costs increased 40% from original estimate to include additional flow from PS 14.
3. Water and wastewater equipment costs increased 200% from original estimate to include additional flow from PS 14.
4. Electrical costs increased 30% from original estimate to include additional flow from PS 14.

OPINION OF PROBABLE CONSTRUCTION COST

TETRA TECH

3497 Coolidge Rd, East Lansing, MI 48823 Telephone: (517) 316-3930 FAX: (517) 484-8140

PROJECT:	City of Kalamazoo, MI CWSRF Project Plan	DATE:	3/27/2024
LOCATION:	Kalamazoo, MI	PROJECT NO.	200-19743-24005
BASIS FOR ESTIMATE:	[X] CONCEPTUAL [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	J. Christopher
WORK:	Pump Station 5 and 14 Consolidated WTP	CHECKED BY:	N. Raut
	Alternative 1	CURRENT ENR:	13532

Construction and Equipment Costs Summary

	Total Project Costs	Service Life	Present Worth of Capital Investments	Salvage Value at End of Planning Period (NPW)	Net Present Worth (Cost)
Civil/Site Work/Piping	$32,456,000	50	$32,456,000	$11,885,000	$20,571,000
Structures	$8,132,000	50	$8,132,000	$2,978,000	$5,154,000
Mechanical/Electrical	$10,565,000	20	$10,565,000	$0	$10,565,000
Other	$151,000	20	$151,000	$0	$151,000
Total	$51,304,000			Total	$36,441,000

Annual Costs (O&M) Summary

Type	Annual Cost	Net Present Worth of O&M
O&M	$745,000.00	$11,614,000
	Total	$11,614,000

Net Present Worth	$48,055,000
Weighted Useful Life (years)	43.73

Assumptions:

Present Worth Factor Salvage Value	0.610270943
Present Worth Factor O&M	15.58916229
Discount Rate (%)	2.5

Weighted Useful Life = ((Item Cost A * Service Life A)+(Item Cost B * Service Life B) + (etc.)) / (Total Capital Cost)

OPINION OF PROBABLE CONSTRUCTION COST

3497 Coolidge Rd, East Lansing, MI 48823

Telephone: (517) 316-3930 FAX: (517) 484-8140

PROJECT:	City of Kalamazoo, MI DWSRF Project Plan	**DATE:**	3/27/2024
LOCATION:	Kalamazoo, MI	**PROJECT NO.**	200-19743-24005
BASIS FOR ESTIMATE:	[X] CONCEPTUAL [ ] PRELIMINARY [ ] FINAL	**ESTIMATOR:**	L. Roberts
WORK:	Individual WTPs at Pump Station 5 and 14	**CHECKED BY:**	N. Raut
	Alternative 2	**CURRENT ENR:**	13532

ITEM NO.	DESCRIPTION	QUANT.	UNIT	UNIT AMOUNT	TOTAL AMOUNT		Civil/Site/Piping		Structures		Mechanical/ Electrical		Other
	Pump Station 14 WTP												
1	Yard Piping and Site Work	1	Lump Sum	$ 3,604,000	$ 3,604,000.00	TRUE	$3,604,000		$0		$0		$0
2	Building Costs	1	Lump Sum	$ 3,700,000	$ 3,700,000.00		$0	TRUE	$3,700,000		$0		$0
3	Electrical and I&C	1	Lump Sum	$ 5,100,000	$ 5,100,000.00		$0		$0	TRUE	$5,100,000		$0
4	Utilities	1	Lump Sum	$ 100,000	$ 100,000.00		$0		$0	TRUE	$100,000		$0
5	Process Interconnections	1	Lump Sum	$ 2,270,000	$ 2,270,000.00	TRUE	$2,270,000		$0		$0		$0
6	Process Gas and Liquid Handling, Purification, and Storage Equipment	1	Lump Sum	$ 1,483,000	$ 1,483,000.00	TRUE	$1,483,000		$0		$0		$0
7	Water and Wastewater Equipment	1	Lump Sum	$ 3,400,000	$ 3,400,000.00	TRUE	$3,400,000		$0		$0		$0
8	Land Acquisition	4	Acres	$ 750,000	$ 3,000,000.00	TRUE	$3,000,000						
	Pump Station 5 WTP												
9	Yard Piping and Site Work	1	Lump Sum	$ 3,604,000	$ 3,604,000.00	TRUE	$3,604,000		$0		$0		$0
10	Building Costs	1	Lump Sum	$ 3,700,000	$ 3,700,000.00		$0	TRUE	$3,700,000		$0		$0
11	Electrical and I&C	1	Lump Sum	$ 5,100,000	$ 5,100,000.00		$0		$0	TRUE	$5,100,000		$0
12	Utilities	1	Lump Sum	$ 100,000	$ 100,000.00		$0		$0	TRUE	$100,000		$0
13	Process Interconnections	1	Lump Sum	$ 2,270,000	$ 2,270,000.00	TRUE	$2,270,000		$0		$0		$0
14	Process Gas and Liquid Handling, Purification, and Storage Equipment	1	Lump Sum	$ 1,483,000	$ 1,483,000.00	TRUE	$1,483,000		$0		$0		$0
15	Water and Wastewater Equipment	1	Lump Sum	$ 3,400,000	$ 3,400,000.00	TRUE	$3,400,000		$0		$0		$0
	Subtotal				$ 42,314,000								
						Sewers	$24,514,000	Structures	$7,400,000	Mech	$10,400,000	Other	$0
	General Conditions and Requirements	5	%		$ 2,116,000	General	$1,226,000	General	$370,000	General	$520,000	General	$0
	Administrative, Legal, and Engineering	15	%		$ 6,665,000	Admin	$3,861,000	Admin	$1,166,000	Admin	$1,638,000	Admin	$0
	Contingencies	30	%		$ 15,329,000	Contingency	$8,880,000	Contingency	$2,681,000	Contingency	$3,768,000	Contingency	$0
	TOTAL CONSTRUCTION COST				**$ 66,424,000.00**	**Total**	**$38,481,000.00**		**$11,617,000.00**		**$16,326,000.00**		**$0.00**

Assumptions

1. Original costs increased 200% from original estimate to include 2 WTPs.
2. Land will be purchased for WTP at PS 14.

$66,424,000.00

OPINION OF PROBABLE CONSTRUCTION COST

TETRA TECH

3497 Coolidge Rd, East Lansing, MI 48823 Telephone: (517) 316-3930 FAX: (517) 484-8140

PROJECT:	City of Kalamazoo, MI CWSRF Project Plan	DATE:	3/27/2024
LOCATION:	Kalamazoo, MI	PROJECT NO.	200-19743-24005
BASIS FOR ESTIMATE:	[X] CONCEPTUAL [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	J. Christopher
WORK:	Individual WTPs at Pump Station 5 and 14	CHECKED BY:	N. Raut
	Alternative 2	CURRENT ENR:	13532

Construction and Equipment Costs Summary

	Total Project Costs	Service Life	Present Worth of Capital Investments	Salvage Value at End of Planning Period (NPW)	Net Present Worth (Cost)
Civil/Site Work/Piping	$38,481,000	50	$38,481,000	$14,091,000	$24,390,000
Structures	$11,617,000	50	$11,617,000	$4,254,000	$7,363,000
Mechanical/Electrical	$16,326,000	20	$16,326,000	$0	$16,326,000
Other	$0	20	$0	$0	$0
Total	$66,424,000			Total	$48,079,000

Annual Costs (O&M) Summary

Type	Annual Cost	Net Present Worth of O&M
O&M	$934,000.00	$14,561,000
	Total	$14,561,000

Net Present Worth	$62,640,000
Weighted Useful Life (years)	42.63

Assumptions:

Present Worth Factor Salvage Value	0.610270943
Present Worth Factor O&M	15.58916229
Discount Rate (%)	2.5

Weighted Useful Life = ((Item Cost A * Service Life A)+(Item Cost B * Service Life B) + (etc.)) / (Total Capital Cost)

Station 5 Operation and Maintenance Cost

Labor	hrs/yr	Rate[13]	
Iron Filters	1900	$ 36.20	$ 68,780.00
GAC Contactors	460	$ 36.20	$ 16,652.00
Chlorine Gas	500	$ 36.20	$ 18,100.00
Phosphate	65	$ 36.20	$ 2,353.00
Fluoride	62	$ 36.20	$ 2,244.40
Wells	530	$ 36.20	$ 19,186.00
Booster Pumps	0	$ 36.20	$ -
High Service	530	$ 36.20	$ 19,186.00
Admin, Lab and Maintenance	2200	$ 36.20	$ 79,640.00
Total			$ 226,141.40

Chemicals	Flow, MGD	Dose, mg/L	PPD	PPY	Cost/lb	Total Annual
Chlorine-Pre-Ox	0.27	0.74	1.66993488	609.526231	$ 1.32	804.5746252
Fluoride	0.27	0.89	2.004102	731.49723	$ 0.32	234.0791136
Phosphate	0.27	5.3	11.93454	4356.1071	$ 1.76	7666.748496
Chlorine-Disinfection	0.27	2.69	6.057342	2210.92983	$ 1.32	2918.427376
Total						$ 11,623.83

Energy	Flow, MGD	Head, feet	Efficiency	KWH/Year	$/KWH	Total Annual
Pumping						
Wells	0.27	50	0.71	21,543	$0.14	$3,015.96
Booster	0	120	0.71	0	$0.14	$0.00
High Service	0.27	209	0.73	88,124	$0.14	$12,337.30
Process						
Iron Pressure Filters				115000	$0.14	$16,100.00
Pressure Carbon Contactors				2200		
Chlorine Gas				505	$0.14	$70.70
Fluoride				3000	$0.14	$420.00
Phosphate				3000	$0.14	$420.00
Building						
Iron Filters				230000	$0.14	$32,200.00
Pressure Carbon Contactors				230000	$0.14	$32,200.00
Chlorine Gas				2250	$0.14	$315.00
Fluoride				1200	$0.14	$168.00
Phosphate				3100	$0.14	$434.00
Admin, Lab and Maintenance				85000	$0.14	$11,900.00
Total				784,921		$109,580.96

			Cost/Year	Escalation[12]	Total $/year
Maintenance Materials					
Iron Filter Maintenance			3200	3.59	11,488
Pressure Carbon Contactors			2350	3.59	8,437
GAC Media Regen/Replace	40,000 lbs/year	@$1.50/lb	60000	1.00	60,000
Chlorine Gas			2000	3.59	7,180

Fluoride Feed System	74	3.59	266
Phosphate	74	3.59	266
Admin, Lab and Maintenance	2200	3.59	7,898
Raw Water/Well Pumps	460	3.59	1,651
Booster Pumps	0	3.59	0
High Service Pumps	480	3.59	1,723
Total			$ 98,908.42
Total Annual O&M			$446,254.61

1 Design Flow: Sta 14 1600 gpm, 2.304 MGD; Sta 5 1,400 gpm, 2.016 MGD; Combined 3,000 gpm, 4.32 MGD
2 Estimating WTP Costs, EPA, 1979, Figure 107 with filter area of 450 sq ft
3 Estimating WTP Costs, EPA, 1979, Figure 18 for <1 pph
4 Estimating WTP Costs, EPA, 1979, Figure 203 for 2 MGD capacity
5 Estimating WTP Costs, EPA, 1979, Figure 215 for 2 MGD capacity
6 Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
7 Estimating WTP Costs, EPA, 1979, Figure 202 for 2 MGD capacity
8 Estimating WTP Costs, EPA, 1979, Figure 205 for 2 MGD capacity
9 Estimating WTP Costs, EPA, 1979, Figure 206 for 2 MGD capacity
10 Estimating WTP Costs, EPA, 1979, Figure 136 for 450 sq ft* .2 adjust for no backwashing and reduced replacement freq
11 Estimating WTP Costs, EPA, 1979, Figure 135 for 450 sq ft
Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
12 Escalation October 1978 Producer Price Index Finished Goods = 71.6 to February 2024 = 256.872
13 Mean wage $25.83 Michigan W & WW treatment operator BLS May 2022 x 1.4 fringe.
14 2 vessels @ 40,000 lbs.every 730 days = 40000
15 Estimating WTP Costs, EPA, 1979, Figure 17 for <1 pph
17 Estimating WTP Costs, EPA, 1979, Figure 2 for 60 ppd
18 Estimating WTP Costs, EPA, 1979, Figure 3 for 60 ppd
19 Estimating WTP Costs, EPA, 1979, Figure 17 for <4 pph
20 Estimating WTP Costs, EPA, 1979, Figure 18 for <4 pph

Station 14 Operation and Maintenance Cost

Labor					hrs/yr	Rate[13]	
Iron Filters					1900	$ 36.20	$ 68,780.00
GAC Contactors					460	$ 36.20	$ 16,652.00
Chlorine Gas					500	$ 36.20	$ 18,100.00
Phosphate					65	$ 36.20	$ 2,353.00
Fluoride					62	$ 36.20	$ 2,244.40
Wells					530	$ 36.20	$ 19,186.00
Booster Pumps					0	$ 36.20	$ -
High Service					530	$ 36.20	$ 19,186.00
Admin, Lab and Maintenance					2200	$ 36.20	$ 79,640.00
Total							$ 226,141.40

Chemicals	Flow, MGD	Dose, mg/L	PPD	PPY	Cost/lb	Total Annual
Chlorine-Pre-Ox	0.808	0.47	3.18672691	1163.15532	$ 1.32	1535.365023
Fluoride	0.808	0.89	5.99870336	2189.52672	$ 0.32	700.6485519
Phosphate	0.808	5.3	35.7226155	13038.7547	$ 1.76	22948.20819
Chlorine-Disinfection	0.808	2.26	15.2326625	5559.9218	$ 1.32	7339.09677
Total						$ 32,523.32

Energy	Flow	Head	Efficiency	KWH/Year	$/KWH	Total Annual
Pumping						
Wells	0.808	50	0.71	64,481	$0.14	$9,027.40
Booster	0	120	0.71	0	$0.14	$0.00
High Service	0.808	151	0.73	190,573	$0.14	$26,680.15
Process						
Iron Pressure Filters				115000	$0.14	$16,100.00
Pressure Carbon Contactors				2200		
Chlorine Gas				505	$0.14	$70.70
Fluoride				3000	$0.14	$420.00
Phosphate				3000	$0.14	$420.00
Building						
Iron Filters				230000	$0.14	$32,200.00
Pressure Carbon Contactors				230000	$0.14	$32,200.00
Chlorine Gas				2250	$0.14	$315.00
Fluoride				1200	$0.14	$168.00
Phosphate				3100	$0.14	$434.00
Admin, Lab and Maintenance				85000	$0.14	$11,900.00
Total				930,309		$129,935.25

				Cost/Year	Escalation[12]	Total $/year
Maintenance Materials						
Iron Filter Maintenance				3200	3.59	11,488
Pressure Carbon Contactors				2350	3.59	8,437
GAC Media Regen/Replace	40,000	lbs/year	@$1.50/lb	60000	1.00	60,000
Chlorine Gas				2000	3.59	7,180

Fluoride Feed System	74	3.59	266
Phosphate	74	3.59	266
Admin, Lab and Maintenance	2200	3.59	7,898
Raw Water/Well Pumps	460	3.59	1,651
Booster Pumps	0	3.59	0
High Service Pumps	480	3.59	1,723
Total			$ 98,908.42
Total Annual O&M			$487,508.39

1 Design Flow: Sta 14 1600 gpm, 2.304 MGD; Sta 5 1,400 gpm, 2.016 MGD; Combined 3,000 gpm, 4.32 MGD
2 Estimating WTP Costs, EPA, 1979, Figure 107 with filter area of 450 sq ft
3 Estimating WTP Costs, EPA, 1979, Figure 18 for <1 pph
4 Estimating WTP Costs, EPA, 1979, Figure 203 for 2 MGD capacity
5 Estimating WTP Costs, EPA, 1979, Figure 215 for 2 MGD capacity
6 Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
7 Estimating WTP Costs, EPA, 1979, Figure 202for 2 MGD capacity
8 Estimating WTP Costs, EPA, 1979, Figure 205 for 2 MGD capacity
9 Estimating WTP Costs, EPA, 1979, Figure 206 for 2 MGD capacity
10 Estimating WTP Costs, EPA, 1979, Figure 136 for 450 sq ft* .2 adjust for no backwashing and reduced replacement freq
11 Estimating WTP Costs, EPA, 1979, Figure 135 for 450 sq ft
Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
12 Escalation October 1978 Producer Price Index Finished Goods = 71.6 to February 2024 = 256.872
13 Mean wage $25.83 Michigan W & WW treatment operator BLS May 2022 x 1.4 fringe.
14 2 vessels @ 40,000 lbs.every 730 days = 40,000lbs/year; 310 * 1400/561
15 Estimating WTP Costs, EPA, 1979, Figure 17 for <1 pph
17 Estimating WTP Costs, EPA, 1979, Figure 2 for 60 ppd
18 Estimating WTP Costs, EPA, 1979, Figure 3 for 60 ppd
19 Estimating WTP Costs, EPA, 1979, Figure 17 for <4 pph
20 Estimating WTP Costs, EPA, 1979, Figure 18 for <4 pph

Station 5 @ 3,000 gpm Operation and Maintenance Cost

Labor	hrs/yr	Rate[13]	
Iron Filters	2400	$ 36.20	$ 86,880.00
GAC Contactors	560	$ 36.20	$ 20,272.00
Chlorine Gas	550	$ 36.20	$ 19,910.00
Phosphate	65	$ 36.20	$ 2,353.00
Fluoride	62	$ 36.20	$ 2,244.40
Wells	1200	$ 36.20	$ 43,440.00
Booster Pumps	530	$ 36.20	$ 19,186.00
High Service	610	$ 36.20	$ 22,082.00
Admin, Lab and Maintenance	3400	$ 36.20	$ 123,080.00
Total	9,377		$ 339,447.40

Chemicals	Flow, MGD	Dose, mg/L	PPD	PPY	Cost/lb	Total Annual
Chlorine-Pre-Ox	1.063	0.54	4.81091282	1755.98318	$ 1.32	2317.897797
Fluoride	1.063	0.89	7.8913266	2880.33421	$ 0.32	921.7069474
Phosphate	1.063	5.3	46.9932933	17152.552	$ 1.76	30188.49159
Chlorine-Disinfection	1.063	2.46	21.8178925	7963.53077	$ 1.32	10511.86061
Total						$ 43,939.96

Energy	Flow	Head	Efficiency	KWH/Year	$/KWH	Total Annual
Pumping						
Wells	1.063	50	0.71	84,826	$0.14	$11,875.60
Booster	0.532	120	0.71	102,422	$0.14	$14,339.03
High Service	1.063	209	0.73	346,994	$0.14	$48,579.19
Process						
Iron Pressure Filters				210000	$0.14	$29,400.00
Pressure Carbon Contactors				4300		
Chlorine Gas				6000	$0.14	$840.00
Fluoride				3000	$0.14	$420.00
Phosphate				3000	$0.14	$420.00
Building						
Iron Filters				360000	$0.14	$50,400.00
Pressure Carbon Contactors				360000	$0.14	$50,400.00
Chlorine Gas				3200	$0.14	$448.00
Fluoride				1500	$0.14	$210.00
Phosphate				4800	$0.14	$672.00
Admin, Lab and Maintenance				130000	$0.14	$18,200.00
Total				1,620,042		$226,203.82

				Cost/Year	Escalation	Total $/year
Maintenance Materials						
Iron Filter Maintenance				5400	3.59	19,386
Pressure Carbon Contactors				4000	3.59	14,360
GAC Media Regen/Replace	49,650	lbs/year	@$1.50/lb	74475	1.00	74,475
Chlorine Gas				2150	3.59	7,719

Fluoride Feed System	74	3.59	266
Phosphate	74	3.59	266
Admin, Lab and Maintenance	3000	3.59	10,770
Raw Water/Well Pumps	800	3.59	2,872
Booster Pumps	460	3.59	1,651
High Service Pumps	800	3.59	2,872
Total			$ 134,636.22
Total Annual O&M			$744,227.39

1 Design Flow: Sta 14 1600 gpm, 2.304 MGD; Sta 5 1,400 gpm, 2.016 MGD; Combined 3,000 gpm, 4.32 MGD
2 Estimating WTP Costs, EPA, 1979, Figure 107 with filter area of 450 sq ft
3 Estimating WTP Costs, EPA, 1979, Figure 18 with feed rate xx lb/hr
4 Estimating WTP Costs, EPA, 1979, Figure 19 with feed rate xx lb/hr
5 Estimating WTP Costs, EPA, 1979, Figure 215 for 2 MGD capacity
6 Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
7 Estimating WTP Costs, EPA, 1979, Figure 202 for 2/4.32 MGD capacity
8 Estimating WTP Costs, EPA, 1979, Figure 205 for 4.322 MGD capacity
9 Estimating WTP Costs, EPA, 1979, Figure 206 for 2 MGD capacity
10 Estimating WTP Costs, EPA, 1979, Figure 136 for 904 sq ft* .2 adjust for no backwashing and reduced replacement freq
11 Estimating WTP Costs, EPA, 1979, Figure 135 for 450 sq ft
Estimating WTP Costs, EPA, 1979, Figure 216 for 2 MGD capacity
12 Escalation October 1978 Producer Price Index Finished Goods = 71.6 to February 2024 = 256.872
13 Mean wage $25.83 Michigan W & WW treatment operator BLS May 2022 x 1.4 fringe.
14 2 vessels @ 40,000 lbs.every 588 days = 49,650lbs/year; 310*1400/738 gpm
15 Estimating WTP Costs, EPA, 1979, Figure 17 for <1 pph
17 Estimating WTP Costs, EPA, 1979, Figure 2 for 133 ppd
18 Estimating WTP Costs, EPA, 1979, Figure 3 for 133 ppd
19 Estimating WTP Costs, EPA, 1979, Figure 17 for <8pph
20 Estimating WTP Costs, EPA, 1979, Figure 18 for <8 pph

APPENDIX E: PUBLIC MEETING DOCUMENTATION

NOTICE OF PROJECT PLANNING PUBLIC MEETING

The City of Kalamazoo will hold a public meeting on the proposed Pump Station 5 and 14 project for the purpose of receiving comments from interested persons. The meeting will be held at **6 p.m. on April 23, 2024** at the following location:

Kalamazoo Water Reclamation Plant

1415 Harrison Street, Kalamazoo, MI 49007

The purpose of the proposed projects is to improve drinking water quality. The projects will address this by adding iron and PFAS treatment capabilities for Pump Station 5 and 14.

Project construction will occur from approximately 2025 to 2029 and will involve construction of a new transmission main in the Eastside neighborhood area from Spring Valley Drive to Schippers Lane along Henson, Trimble, and Wallace Avenues.

Impacts of the proposed project will include temporary traffic disruptions and noise from construction activities during daylight, weekday hours.

The approximate cost of each project is shown below.

Project	Project Cost
Project 1: Pump Station 5 and 14 Upgrades	$51,304,000

The estimated cost to users if all of the projects are constructed based on these approximate costs will be approximately $13.69 per user per quarter.

Copies of the draft project planning document detailing the proposed projects are available for inspection at the following location(s):

www.kalamazoocity.org

https://twitter.com/KalamazooCity

Written comments received before the meeting record is closed on April 23, 2024 at 6 pm will receive responses in the final project planning document.

Written comments should be sent to:

Anna Crandall, Assistant City Engineer, 415 E. Stockbridge Avenue, Kalamazoo, MI 49001

Order Confirmation

Ad Order Number 0010852076

Customer

CITY OF KALAMAZOO PUBLIC SERVICES DEPT
*Account:*1000665075
CITY OF KALAMAZOO PUBLIC SERVICES DEPT
241 W SOUTH ST
KALAMAZOO MI 49007 USA

(269)337-8658

FAX:
burlinghamw@kalamazoocity.org

Payor Customer

CITY OF KALAMAZOO PUBLIC SERVICES DEPT
Account: 1000665075
CITY OF KALAMAZOO PUBLIC SERVICES DEPT
241 W SOUTH ST
KALAMAZOO MI 49007 USA

(269)337-8658

PO Number	"Burlingham, Wendy" <
Sales Rep.	Joseph Rosa
Order Taker	Joseph Rosa
Order Source	
Special Pricing	

Tear Sheets	0	*TearsheetsCost*	$0.00	*Net Amount*	$139.36
Proofs	0			*Tax Amount*	$0.00
Affidavits	1	*AffidavitsCost*	$10.00	*Total Amount*	$139.36
Blind Box				*Payment Method*	Invoice
Promo Type				*Payment Amount*	$0.00
Materials				*Amount Due*	$139.36

Invoice Text "Burlingham, Wendy" <burlinghamw@kalamazoocity.org>

Ad Schedule

Product	Kalamazoo Gazette	*Placement/Class*	Legals
# Inserts	1	*POS/Sub-Class*	Public Notices
Cost	$117.60	*AdNumber*	0010852076-01
Ad Type	MI CLS Liner	*Ad Size*	1 X 79 li
Pick Up #		*Ad Attributes*	
External Ad #		*Color*	<NONE>
Production Method	AdBooker	*Production Notes*	

Run Dates 04/11/2024 *Sort Text* NOTICEOFPROJECTPLANNINGPUBLICMEETINGTHECITYOFKALAMAZOOWILLHOLDAPUBLICMEETINGONTHEPROP

Product	Inventory	*Placement/Class*	Legals
# Inserts	1	*POS/Sub-Class*	Public Notices
Cost	$11.76	*AdNumber*	0010852076-01
Ad Type	MI CLS Liner	*Ad Size*	1 X 79 li
Pick Up #		*Ad Attributes*	
External Ad #		*Color*	<NONE>
Production Method	AdBooker	*Production Notes*	

Run Dates 04/11/2024 *Sort Text* NOTICEOFPROJECTPLANNINGPUBLICMEETINGTHECITYOFKALAMAZOOWILLHOLDAPUBLICMEETINGONTHEPROP

0010852076-01

Ad Content Proof

NOTICE OF PROJECT PLANNING PUBLIC MEETING

The City of Kalamazoo will hold a public meeting on the proposed Pump Station 5 and 14 project for the purpose of receiving comments from interested persons. The meeting will be held at 6 p.m. on April 23, 2024 at the following location:

Kalamazoo Water Reclamation Plant
1415 Harrison Street,
Kalamazoo, MI 49007

The purpose of the proposed projects is to improve drinking water quality. The projects will address this by adding iron and PFAS treatment capabilities for Pump Station 5 and 14.

Project construction will occur from approximately 2025 to 2029 and will involve construction of a new transmission main in the Eastside neighborhood area from Spring Valley Drive to Schippers Lane along Henson, Trimble, and Wallace Avenues.

Impacts of the proposed project will include temporary traffic disruptions and noise from construction activities during daylight, weekday hours.

The approximate cost of each project is shown below.

Project	Project Cost
Project 1: Pump Station 5 and 14 Upgrades	$51,304,000

The estimated cost to users if all of the projects are constructed based on these approximate costs will be approximately $23.81 per user per quarter.

Copies of the draft project planning document detailing the proposed projects are available for inspection at the following location(s):

www.kalamazoocity.org
https://twitter.com/KalamazooCity

Written comments received before the meeting record is closed on April 23, 2024 at 6 pm will receive responses in the final project planning document.

Written comments should be sent to:

Anna Crandall,
Assistant City Engineer,
415 E. Stockbridge Avenue,
Kalamazoo, MI 49001

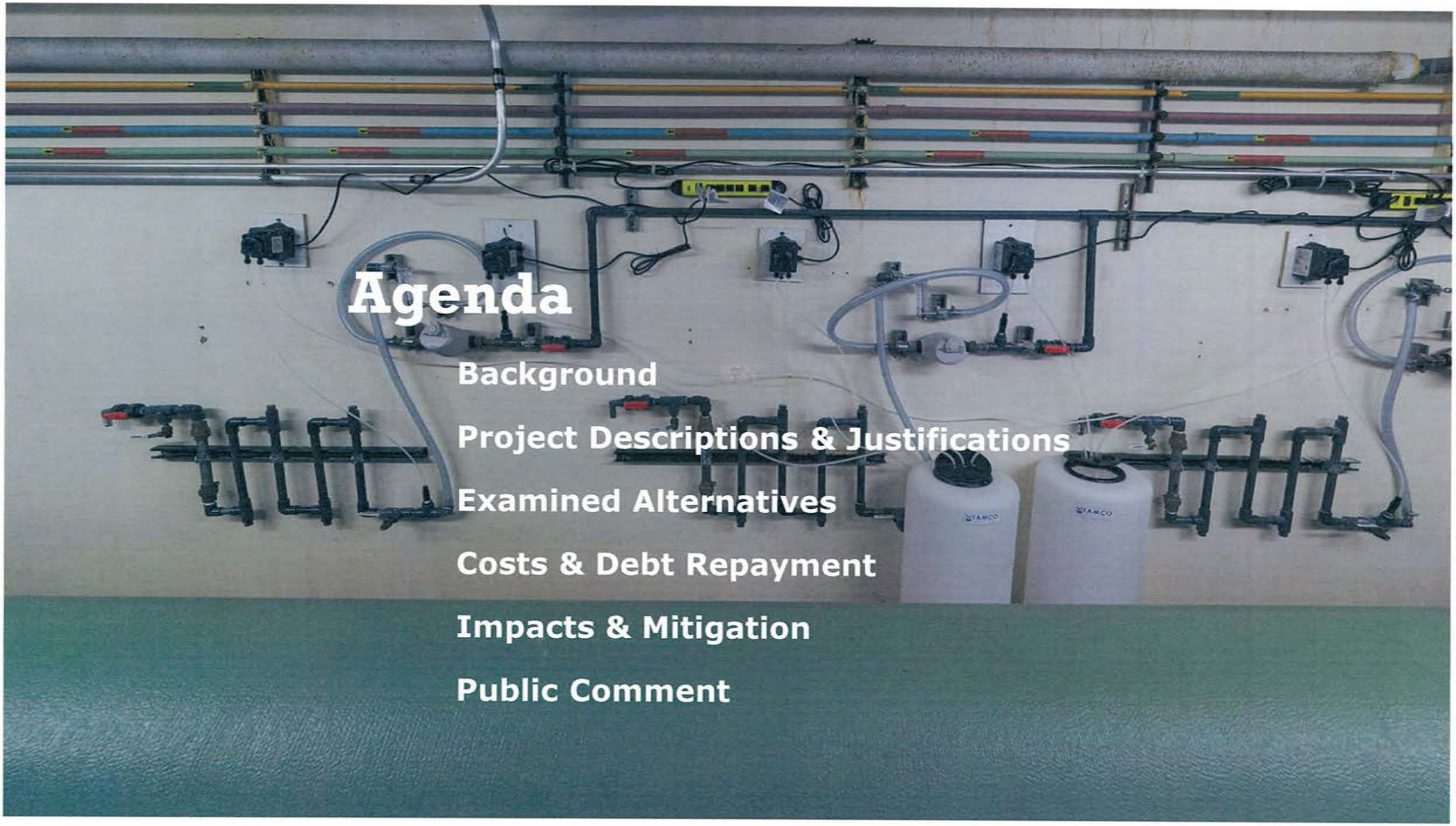
2025 DWSRF Project Plan Public Meeting – Station 14 and 5 Consolidation and Treatment Plan

Sign-In Sheet
Tuesday, April 23, 2024

NAME (Please Print)	CONTACT INFORMATION (Please Print)
JAMES BAKER	bakerj@kalamazoocity.org
Daniel Warren	daniel.warren@tetratech.com
Lauryn Roberts	lauryn.roberts@tetratech.com
Anna Crandall	crandalla@kalamazoocity.org

2025 DWSRF Project Plan Public Meeting – Station 14 and 5 Consolidation and Treatment Plan

KWRP Harrison, Tuesday, April 23, 2024, 6:00 PM



Agenda

- Background
- Project Descriptions & Justifications
- Examined Alternatives
- Costs & Debt Repayment
- Impacts & Mitigation
- Public Comment

Background

- The City is applying for the Drinking Water State Revolving Fund (DWSRF) which is a low interest loan financing program that would allow the City to fund or finance important updates to water infrastructure at a lower cost to users than open market bond financing.

- DWSRF is a Federal financing program administered by the State. In Michigan, the Department of Environment, Great Lakes, and Energy administers the program.

- To be considered for DWSRF, the City must submit a Project Plan that describes the projects we intend to finance and explain why they are necessary.

- Project Plans are scored and prioritized based on need. There is a fixed amount of money available for lending each year and the Project Plan allows the City to state its case as to why its projects are more critical than other submitted Plans.

Background

- Part of the requirements to be considered for DWSRF is that the Public can review the Project Plan and be able to ask questions or comment on the Plan before it is submitted to the State.

- The FY2025 DWSRF Project Plan consist of three (3) smaller project based project plans including the Richland/Ross Township Water Main Extension Plan, the Stations 5 and 14 Upgrades Plan the Replacement of Lead/Galvanized Water Services Plan

- We are here tonight to present the Stations 5 and 14 Upgrades Plan, address questions and comments that were submitted in writing prior to this meeting and allow for further public comment in person at this meeting.

Project Descriptions & Justifications

- The projects included in the Project Plan were chosen based on the City's Asset Management Plan and Capital Improvement Program.

- City staff scored these projects to find the top priority projects based on several Asset Management Scoring Criteria.

Project Descriptions & Justifications

Compound (Parts Per Trillion, PPT)	Michigan MCL (August 2020)	EPA MCLe (Enforceable) (April 2024)	EPA MCLg (Goal)	Kalamazoo Results
PFOA	8	4.0	Zero	2.6
PFOS	16	4.0	Zero	4.2
PFHxS	51	10	10	4.0
PFNA	6	10	10	ND
PFHxA	400,000	Hazard Index	Hazard Index	4.1
PFBS	420	Hazard Index	Hazard Index	6.3
HFPO-DA (GenX)	370	10	10	ND
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, PFBS		Hazard Index	Hazard Index	

Project Descriptions & Justifications

Project Descriptions & Justifications

- Station 5 was constructed in 1914 and is due for replacement
- Station 14 was constructed in 1958 and is due for replacement
- Station 14 production water exceeds new EPA PFOS criteria
- Station 5 is located within 1000 feet or less of a known PFAS contamination site
- Station replacement and PFAS treatment are needed at both sites
- Groundwater supplies must employ iron and manganese removal prior to PFAS removal technologies or fouling and failure of PFAS removal technology may occur

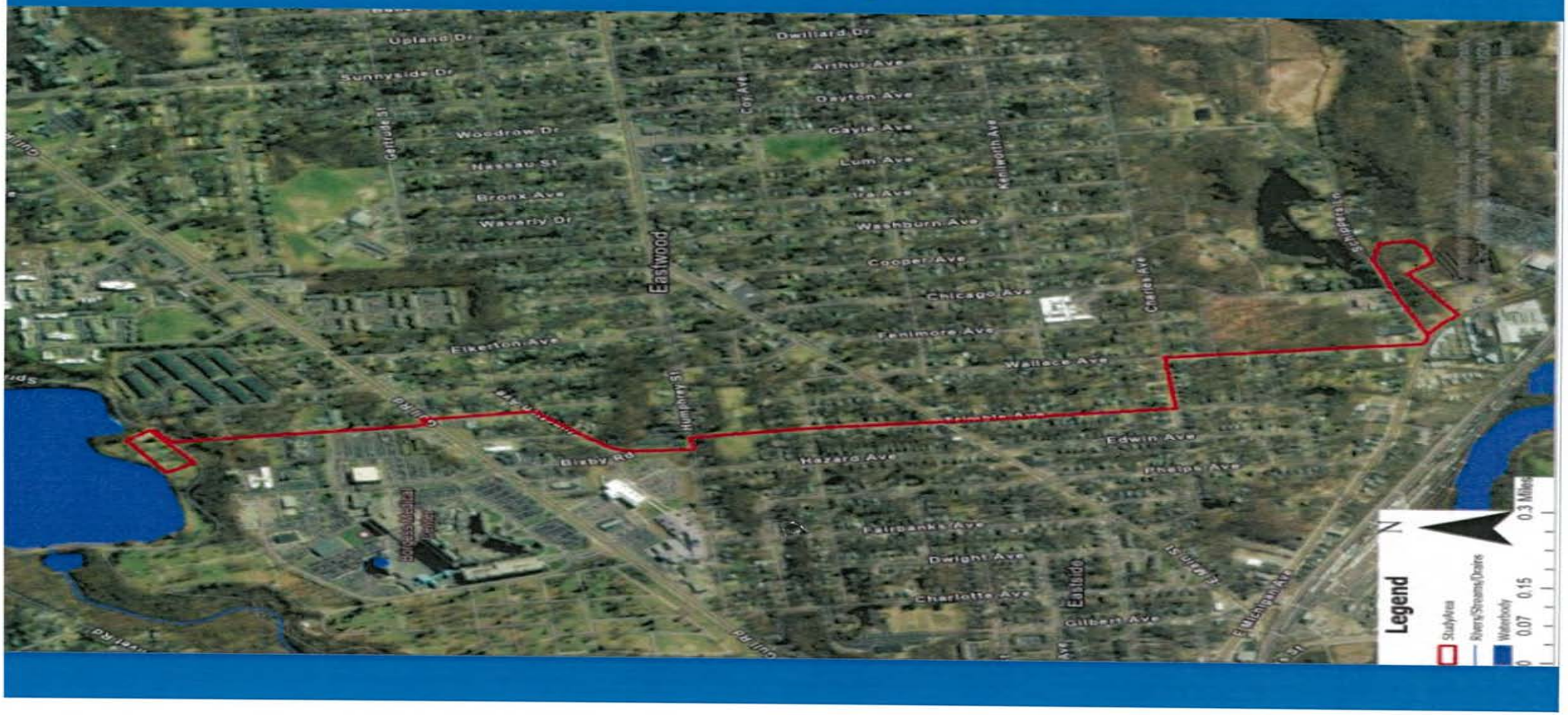
Project Descriptions & Justifications

- The Kalamazoo PWS WSSN 03520 was built and expanded over the years following a model of resiliency and reliability via redundancy
- As regulatory standards, including the Michigan Lead & Copper Rule, PFAS regulations and LOS demands, have changed controlling accuracy and precision across many redundant, often functionally obsolete stations has now contributed to reduced reliability
- As a milestone requirement of the 2021 Administrative Consent Order with EGLE, Kalamazoo studied a plan to reduce the points of entry into the system via a station consolidation plan
- https://www.kalamazoocity.org/files/assets/public/v/1/plans-amp-reports/utility-studies/water-consolidation-study_reduction-of-entry-points_2022.pdf

Project Descriptions & Justifications

- Proposed station consolidation and treatment plan
- One location for treatment
- Raw water from Station 14 pumped to the Station 5 site
- Station 14 and 5 treatment to occur on the Station 5 site
- Treatment to consist of iron removal, manganese removal, PFAS removal to below MCLg, optimized corrosion control, fluoride and chlorination

Project Descriptions & Justifications



Project Descriptions & Justifications

Examined Alternatives

- **No Action: The no-action alternative is evaluated to assess the impact of continuing with the existing system.**
  - **No Action is not a viable alternative to any of the selected project alternatives as all involve either the replacement of antiquated or failing equipment, bringing current systems up to required standards, or improvements to operator safety.**
- **Optimization of Existing Systems: The existing system should be evaluated to determine if it can function more efficiently with operational changes, additional new equipment, or addition and training of operating personnel.**

  The existing water system is performing as well as it can and additional staffing, staff training, and operational changes are not likely to improve the performance of the system because the primary concerns are related to the condition of the infrastructure. Therefore, this alternative was not considered further.

Examined Alternatives

- **Regionalization: Regionalization is evaluated to assess the feasibility of connection to an existing regional system and/or the creation of a regional system with neighboring municipalities.**
    - **As Kalamazoo is already a Regional System this alternative does not apply.**
- **Monetary Evaluation: The monetary evaluation includes a present worth analysis which compares all costs (design, construction, mitigation) for each alternative over the 20-year planning period.**
    - **Included in the project plan for selected Alternatives**

Examined Alternatives

- **Environmental Evaluation: The major environmental impacts expected to result from each alternative must be compared.**
  - **These evaluations are included for the selected Alternatives in the Project Plan.**

Costs & Debt Repayment

- Pump Station 5 and 14 Upgrades
  - $51,304,000
- Richland/Ross Township Water Main Extensions
  - $27,000,000
- Kalamazoo Lead/Galvanized Service Replacements
  - $13,000,000
- FY2025 DWSRF Project Plan Total (all projects)
  - $91,304,000

Costs & Debt Repayment

- These projects are included within our long-term capital plans. Current planned annual rate increases are in the range of 6% to 9% for Water
- Award of much needed grant and/or principal forgiveness would reduce impacts to rate payers
- The actual impact to a household would be based on usage

Costs & Debt Repayment

- Station 14 and 5 Consolidation and Treatment Plan
- Estimated rate increase would be $7.94/REU/month assuming the City meets the requirements for a 20-year loan with a 2.5% interest rate
- The actual impact to a household would be based on usage.

Costs & Debt Repayment

- Richland/Ross Water Main Extensions
- Estimated rate increase would be $3.39/REU/month assuming the City meets the requirements for a 20-year loan with a 2.5% interest rate
- The actual impact to a household would be based on usage.

Costs & Debt Repayment

- Kalamazoo Lead/Galvanized Service Replacements
- Estimated rate increase would be $1.63/REU/month assuming the City meets the requirements for a 20-year loan with a 2.5% interest rate
- The actual impact to a household would be based on usage.

Costs & Debt Repayment

- All FY2025 DWSRF Project Plan projects in total
- Estimated rate increase would be $12.93/REU/month assuming the City meets the requirements for a 20-year loan with a 2.5% interest rate
- The actual impact to a household would be based on usage.

Impacts & Mitigation

Environmental, Public Health, and Other Examined Impacts

- Historical/Archeological
- Geological
- Cultural/Social
- Recreational
- Water Quality/Surface Waters
- Air Quality
- Wetlands
- Coastal Zones
- Floodplains
- Construction Impacts
- Natural or Wild and Scenic Rivers
- Endangered Species
- Prime and Unique Agricultural Land
- Construction Material/Energy Consumption
- Accidents
- Unavoidable Adverse Impacts and Mitigative Measures

Impacts & Mitigation

Construction/Operational Impacts

Construction of the proposed facilities will be coordinated and sequenced to minimize disruptions to residential and natural areas.

The following impacts are anticipated:

- Tree removal: Tree removal will be needed for the new treatment facilities at WPS 5.
- Traffic patterns: Traffic may need to be stopped or redirected in project areas.
- Construction chemicals, dust, air emissions, and noise: Use of construction chemicals will follow safety procedures. Water will be used for dust control. Well maintained equipment will be used to minimize air emissions. Construction will occur during daylight on work weekdays to reduce noise unless significant traffic changes are required. If night work is necessary, proper permitting will be acquired.
- Groundwater/dewatering impacts and proximity to wetlands: Proper permitting will be acquired for dewatering and work near wetlands.
- Soil erosion: Soil erosion prevention will be implemented during excavation activities and the project area will be revegetated shortly after construction completion.

Public Comment

CITY OF KALAMAZOO, MICHIGAN

PUBLIC MEETING

2025 DRINKING WATER STATE REVOLVING

FUND PROJECT PLAN

PUMP STATION 5 AND 14 UPGRADES

Tuesday April 23, 2024 at 6:00 P.M.

KALAMAZOO WATER RECLAMATION PLANT
1415 HARRISON STREET
KALAMAZOO, MI 49007

In attendance: See sign-in sheet.

The City of Kalamazoo has prepared a 2025 Project Plan for upgrades to Pump Station 5 and 14. These projects will improve drinking water quality and ensure continued compliance with drinking water standards. A Project Plan is part of the planning documents for the Michigan Department of Environment, Great Lakes, and Energy (EGLE) low interest Drinking Water State Revolving Fund (SRF) loan. A public meeting is a regulatory requirement for this Project Plan.

According to EGLE regulations this public meeting must describe the following four items:

1. **The water quality problems to be addressed by the project and the alternatives that were considered.**

   The City operates **13** point of entry stations that utilize groundwater from **90** wells. Each well pump station has various treatment technologies to remove pollutants of concern. Pump Station 5 and 14 have detectable iron and PFAS levels that should be mitigated to protect human health. Additional water treatment is recommended at Pump Station 5 and 14 to remove iron and PFAS.

   Alternatives were reviewed to identify a cost-effective approach that allows the City to maintain reliable drinking water service and meet drinking water permit requirements.

   Alternatives considered include:

   Project 1 – Pump Station 5 and 14 Upgrades

   - Alternative 1, Pump Station 5 Consolidated Water Treatment Plant
   - Alternative 2, Pump Station 5 and 14 Water Treatment Plant
   - Alternative 3, Do Nothing

2. **The recommended alternatives, including the capital costs and a cost breakdown by project components.**

   The recommended alternative options and capital costs for the improvements are as follows:
   - Project 1, Alternative 1, Pump Station 5 and 14 Consolidated Water Treatment Plant, has an opinion of probable capital cost of $51,304,000 and a SRF Eligible Cost of $51,304,000.

3. **The project financing and cost to users, including the proposed method of project financing and estimated debt retirement and the proposed charge to the typical residential customer.**

   Based on financing the eligible portion of all of these projects through the low interest EGLE Drinking Water SRF loan program, the estimated total gross cost to the typical residential customer in the City of Kalamazoo would be approximately $13.69 per quarter. The portions of projects that are not eligible for SRF Funding will be paid from cash on hand and will not impact the quarterly rate of residents.

   The FY 2025 DWSRF Project Plan also includes a Richland/Ross Township Water Main Extension Project and a City of Kalamazoo Lead/Galvanized Service Replacement Project for a

total Project Plan estimated cost of $91,304,000 and a total quarterly user charge of $22.38, this quarterly user charge equates to a $7.46 per month user charge.

4. **The anticipated social and environmental impacts associated with the recommended alternative and the measures that will be taken to mitigate adverse impacts.**

   The short-term adverse impacts associated with construction activities would be minimal, and mitigatable, in comparison to the resulting long-term beneficial impacts. Short-term impacts include tree removals, traffic disruption, dust, and noise.

   No long-term negative impacts are anticipated. No historical, archaeological, or tribal resources will be affected during these projects. Surface water and ground water quality will not be negatively impacted from the construction of the proposed projects. No floodplains will be impacted. Wetlands along Schippers Lane may be impacted, however a Joint Permit will be obtained if needed. Threatened or endangered species or their habitat may be affected by the proposed project. Additional reviews and the appropriate environmental agency will be contacted during project design to mitigate disturbances to listed species. Loss of recreational area may be a concern from the community and comments will be addressed.

The City Commission must adopt the Project Plan prior to the June 1, 2024, Project Plan submittal deadline date. Public attendance must be noted. Public comments must be noted and publicly addressed.

I will now open this Public Meeting to any Public Comments. Written public comments will be received until May 3, 2024, and will be included in the Final Project Plan, which will be delivered to EGLE. EGLE will rank Project 1 Pump Station 5 and 14 Upgrades to determine if it is eligible for a FY 2025 low interest SRF loan in mid-August 2024. The Draft Project Plan is available for review at:

- The City of Kalamazoo Website: www.kalamazoocity.org
- Kalamazoo Water Reclamation Plant: 1415 Harrison St, Kalamazoo, MI 49007
- City Hall: 241 W South St, Kalamazoo, MI 49007
- The City of Kalamazoo Twitter page: twitter.com/KalamazooCity

Public Meeting Transcript

0:2:12.540

Well, good evening, everybody.

Ladies and gentlemen, thanks for attending tonight.
My name is James Baker.
I'm the public services director and city engineer for City Kalamazoo.
We're presenting today the 2025 drinking water State Revolving Fund project plan.
Specifically, one project within that project plan we're going to be talking about Pump Station 5 and 14 upgrades.
I've got just a real quick sheet I want to read through here.
These are some very important items that that we want to make sure we cover.
Following this I'm going to be going into a presentation that goes into some more detail on some of these things.
So at this point, we'll open the public meeting and we'll go ahead and get started.
There is a sign in sheet in the back for anybody that hasn't signed in yet that is available.
You don't have to sign in if you don't want to, but that is an option the city Kalamazoo is prepared a 2025 project plan for upgrades to pump Station 5 and 14.
These projects will improve drinking water quality and ensure continued compliance with drinking water standards.
The project plan is part of the planning documents for the Michigan Department of Environment, Great Lakes and Energy Eagle low interest drinking water state revolving fund loan program.
A public meeting is a regulatory requirement for this project plan, according to Eagle regulations, this public meeting must describe the following four items #1 water quality problems to be addressed by the project, and the alternatives that were considered.
The city operates 13 point of entry stations that utilize groundwater from 90 wells each well and pump station has various treatment technologies to remove pollutants of concern.
Pump Station 5 and 14 have detectable iron and PFAS levels that should be mitigated to protect human health.
Additional water treatment is recommended at station 5 and 14 to remove iron and P5.
Alternatives were reviewed to identify cost effective approach.
It allows the city to maintain reliable drinking water service and meat drinking water, permanent requirements.
The alternatives, which were considered for this project were alternative one pump Station 5, consolidated water treatment plant so that consolidate treatment for both station 5 and 14 at one consolidated plan.
The second alternative considered was a station water treatment plant at 5 and at station 14.
So that's two water treatment plants and then a third alternative which was considered was a do not be an alternative in which no improvements were made.
Our recommendation of these alternatives would be the pump Station 5 and 14 consolidated plan, which provides treatment for both station 5 and 14 at one consolidated treatment plant.
The recommended alternatives, including capital costs and the cost breakdown by product components, the recommended alternative options and capital costs are improvements are described as follows.

The selected alternative one which I discussed was a pump Station 5 and station 14 consolidated with water treatment at one site at Station 5 for a probable cost or as beers, opinion and cost of 51 million, 304,000 and SRF eligible cost of 51 million $304,000.
The project financing and cost to users, including the proposed method of project financing and estimated that retirement and the proposed change in the typical residential customer based on financing the edible portion of these projects through the low interest eagle drinking water state revolving loan fund program.
The estimated total cost of the typical residential customer in the City Council would be approximately 1369 to $1374.00 per course, that's $13.69 or $13.74 per quarter.
If our estimates range between those values, the portion of the project that is not eligible for us, there are funny would be paid from cash on hand and will not impact the quarterly residents.
There is no ineligible amount on this project that fiscal year 2025 drinking water state revolving fund project plan includes 3 projects.
So this includes our Richland, Ross Township Water Main Extension Project, City Council, Zoo led galvanized service replacement project and this project that station 5 and 14 consolidate treatment project for a total cost of 91,304,000.
That's totally core user charge for all three of these projects under this one project plan is estimated at $22.38 per quarter that has that equates to approximately $7.46 per month in users charge increases above where they are currently today.
The anticipated social and environmental impacts associated with the recommended alternative and the measures that will be taking to mitigate adverse effect short term adverse impacts associated with construction activities would be minimal and would be able we would be able to mitigate these impacts in comparison to long term benefits.
So you know, we have very long term benefit to public health and drinking water with this proposed project and it would have some very short term impacts that could be mitigated these short term impacts would include tree removals, some minor traffic disruptions and potential dust and noise from the project itself.
Although work will be done to mitigate those impacts, no long-term negative impacts are anticipated.
No historical, archaeological, or tribal resources will be affected during these projects.
Surface water.
Groundwater quality will not be negatively impacted by the construction of the proposed project.
No floodplains will be impacted.
There may be wetlands along Skippers Lane.
However, a joint permit will be obtained as the design progresses to ensure that no impacts are made to the wetland, or if so, any impacts will be mitigated through the appropriate joint permit as obtained from Eagle.
Additional reviews and their appropriate environmental agency will be contacted during project designed to mitigate the services to any listed species.
Loss of recently recreational area.
Maybe a conservative community.
However, that is does not apply to this project.
There's no loss to recreation area as there are no areas of the project site which are currently open to a recreation.
The City Commission must adopt the project plan prior to the June 1st or prior to June 1st, 2024 project plan submittal deadline date is June 1st, 2024.
Public attendance must be noted, and public comments must be noted for a publicly addressed I.
So given our limited audience that we have at this time, I just don't.
There are no members of the public in the room, and so I we don't have any questions at this time.

Just a reminder that the project plans are available to the city website.
At www.kalamazoocity.org
A copy of the project plan is also available with the city clerk.

And this time I am going to transition into the presentation that we have certainly this meeting is recorded and we'll have a transcript and recording available so that folks may be able to access this in the in the future between now the project plan submittal and when we plan to move forward with the design.
So just have it ended this we've got a brief agenda in front of us today.
We'll talk about the background of this this project, some project descriptions, and justifications.
We'll talk through our exam and alternatives and we'll focus again on costs and debt repayment as well as the impacts and mitigation.
And we'll also have opportunity for public comment if we're joined by any audience member.
So just some broad background.
The city is applying for drinking water, state revolving loan funds and which is a low interest term financing program which will allow the city to fund or finance portion important updates to to water infrastructure.
This is a federal program that is administered at the state level and to be considered for this program, we must submit a project plan.
So that's the activities that we were barred upon.
Now this project plan is available.
We reference this available online and available at the City Clerk's office, and that this public meeting in presentation as part of that project plan.
That project plan will then be submitted to the state, scored, prioritized, based on need.
There's a fixed amount of money available for lending each year, so it's important that the city submit the project plan and that we're competitive against other cities across state of Michigan.
So again, part of the requirement to submit the detailer SRF project plan is that the public can review and comment in the plan.
So that's one of the reasons why we're here tonight.
It did want to note that this DWSRF project plan submittal for fiscal year 25 includes 3 projects in total.
It's the Richland, Ross Township water main extension plan.
The Station 5 and 14 upgrades plan and it's the replacement of blood galvanized water Service plan.
So today we're going to really focus on at Station 5 and 14 consolidation treatment plan.
The projects, including the project plan, were chosen based on the city's asset management plan and Capital Improvement program.
City staff score these projects to find really the top priority projects within our asset management plan and within our capital grouping plan.
So this these projects represent are the most important projects to the city within our capital improvement plan.
Alright, so we've got a table in front of you.
You know, one of the items that we talked about was the importance to, you know, increase water quality improvements to the public and to address water quality problems.
So one of the challenges with Station 5 and Station 14 is local PFAS contamination.
When I say PFAS, I'm referencing PFOA, PFOS, PFFS, XHP F and A.
FHX APFSDS androgenic compounds as well.
Michigan has enacted MCL in August of 2020.
The set and established maximum contaminant levels.

By law, the EPA has just recently announced an update to that so EPA has more stringent, enforceable MCL.
In place and with the more St more stringent EPA MCL's in place, Kalamazoo is an exceedance of PFOS requirement by EPA.
That EPA requirement, under the enforceable MCL, is 4 parts per trillion for PFOS and Station 14, the highest average result is 4.2, so slightly above that.
We also want to know, you see here in the map in front of you, the red triangle provides a general location of station #5.
The Blue triangle is the location of the known part, 201 PFAS contamination site.
So as you look at kind of these two previous slides, you've got an understanding that station 14 is currently in exceedance of the EPA requirement for POS.
If you also see that Station 5 is near no within 1000 feet of a known part tool, one PFAS contamination site.
So with that, certainly we've got both demonstrated facts and future concern for the future water quality, reliability of station 5 and 14.
Well, get some more justification in terms of timing and overall system need.
Station 5 was constructed in 1914, is due for replacement.
We are now in 2024, so that station has been in service for 110 years, certainly due for replacement.
Station 14 was constructed in 1958.
It's also due for replacement again, Station 14 production water exceeds new EPA POF OS requirement by the MCL Station 5.
Again, located within 1000 feet of a known PFAS contamination site, station replacement and treatment are needed Apple sites and you know, we also wanted to note that.
Groundwater supplies that have iron in in Manganese present must be removed prior to PFAS treatment, and that's due to following or failure of the P5 removal technology.
If the iron and manganese is not removed from the process first, you know continuing on the discussion of project justification, Kalamazoo is a system I referenced Kalamazoo public water supply W Assad 03520.
Essentially, that's the Kalamazoo system is the regional system that covers the entire metro area of Kalamazoo, including many of our neighboring townships.
This system was built expanded over the years following a model of resiliency and reliability versus redundancy, meaning that we had many stations that could contribute flow into the system and that any one of those stations could be taken offline and the the system was reliable because the overall redundancy.
However, as we Fast forward through changes in regulatory standards, including Michigan's letting copper rule, PFAS regulations and not only from state of Michigan but now from EPA as well as local level service demands, this is all changed in terms of water quality.
Our ability to control the accuracy and precision across many redundant, often function absolutely stations has now contributed to reduce reliability.
So as we have many stations, we're the water quality has a variability across those stations.
Those stations lack modern treatment techniques.
They also lack, you know, controls and optimization.
And so our ability to control those stations with the precision needed to comply with Michigan Lead and Copper rule as well as Michigan and the EPA.
Criteria for PFAS has become increasingly challenged again, a milestone requirement of administrative consent order with Eagle in 2021 was the study of plans to reduce the points of entry into the system via consolidation plan.
In the statements that I read earlier on, we talked about Kalamazoo with 13 point of entry treatment

stations that is already reduced from where we were a few years ago.
We had started with a 16 stations as recently as 2019.
With those stations were taken offline due to P5 risk within the capture zone of those stations.
So talking about the proposed station consolidation and treatment plan we're looking at, we've described this in the alternatives.
We could have station treatment at 14 and we could have station treatment at 5.
So two independent treatment sites, St both iron, Manganese and PFOS.
At each site independently, however, that was deemed costly and that was also deemed to be not in line with our consolidation plan.
So, but the proposed project would consolidate the raw water from 14, pump it over to Station 5 and then to gather the raw water from both 5 and 14 would be completed at the station 5 site.
So this slide shows you that route from on the left where you see the lake that's near where Station 14 is, and then that would flow to the South, which is, you know, to the to the right.
So south is on the left.
The flow would be to your right, which is to the to the South to go to Station 5 so that red Polygon that's on the right side of the sheet there along E Michigan and skippers that would represent the site for station 5 consolidate treatment where you see that lake there at Spring Valley Lake and you see that rectangle that represents where Station 14 is that North is to the left S is to the right.
So now we're zoomed in here at this, looking at this line, this provides kind of an overview of pictorial image of what the consolidated footprint would look like at Station 5.
You've got Lincoln Ave or E Michigan along the left side of the paper and skippers Lane that runs across the top.
So you also have the cities leave compost site kind of below that.
That's kind of imaged out.
So again, looking through the alternatives, no action was looked at that was not viable.
That would not improve water quality.
That would not address iron, manganese, and PFAS, which we described to be water quality concerns.
We looked optimize existing systems and you know existing water supply system is performing as well as it can.
Additional staffing staff training operational changes are not likely to improve water quality.
We need treatment and the only way to get treatment for PFAS is to build it.
Uh, again, we looked at regionalization.
Kalamazoo Water supply is already regional system, so there wasn't really an opportunity for us to partner with another community to address our or treatment needs.
This is something that needs to be addressed within the Kalamazoo system and again, we evaluated net present worths of all the alternatives to compare the lowest net present value over the 20 year planning period, which is including the project plan.
Many environmental evaluations were considered.
Major environmental impacts are not are not expected to occur from this project needs alternatives and these evaluations are discussed in the alternatives and located the project plan.
Uh, you know, getting into the details of proposed cost at this time, we're estimating the pump station 5 in 14 consolidated treatment upgrades, the cost 51,304,000.
We also summarize the cost of the other projects, including the Richland Ross Water Main extensions, $27 million, Kalamazoo 11, galvanized service replacements, $13 million the total fiscal year 2025 DWR project plan.
This is all the projects is estimated at $91,304,000.
Just going to talk about these projects and where they fit in with our overall debt Service plan, capital improvement project plan.

These projects are included within our long range capital plans.
Their current our current capital program anticipates annual rate increases in the range of 6-9%.
That's just to give us some context of where we are in overall planning.
Certainly we're really need grant award into principal forgiveness for these projects.
That would certainly help reduce the impact to ratepayers.
The actual impact to households would be based on usage and actual impact would be based on you know, where we come in in terms of funding opportunities.
If we are successful with this project plan request and if we are successful in any state, federal grant amounts that may be applied.
So looking at this project and assuming a 20 year loan, 2 1/2% interest rate, the estimated or rate increase would be about $7.94 per RU per month.
And again, that's for those costs are what's estimated for the station, 14 and 5 consolidates treatment.
The actual cost would be based on usage and those other factors you know.
We did also want to reference those other projects as well, Richland, Walk, Richland Township and Ross Township Water main extension.
That would have an estimated per RU per month cost of about $3.39 and the Kalamazoo Lad galvanized service replacement would have an estimated cost of $1.64 per RU per month.
And REU is residential equivalent unit essentially represents the typical household cost.
On a monthly basis, important with this report.
So if we looked at all the fiscal year 2025 projects, we're looking to include the station 5 and 14 consolidation, the Richland Ross Township watering extensions and the Cal City County Zoo led galvanized service replacement.
The estimated cost would be about $12.93 per residential equivalent unit per month.
Based on those factors of a 20 year loan, 2 1/2% interest rate and the we didn't know that the actual impact will household would be based on your usage impacting mitigation, there's a whole bunch of environmental, public health and other areas that we examined from our archaeological and history, geological, cultural, recreational, water quality, air quality, wetlands, coastlands, floodplains.
We also looked at short term things like construction impacts, natural wild scenic rivers and age of Species Priming Inc air cultural land.
So some of these may not apply to this project.
Specifically, when we're talking about Station 5 and 14 consolidation, but every one of these items was looked at, I'm looking at some impacts specific to construction.
We did want to highlight that this project will require tree removals.
Tree removals will be needed for this new facilities at the station 5 footprint that will also be true removals along that force main route that goes from station 14.
Excuse me from that raw water pipeline.
It goes from station 14 to station 5.
Construction also may impact traffic, and it may also impact DOST and other features, but that that will get mitigated through, you know, soil erosion, segmentation control, permits and other best management practices.
So at this point I've concluded the presentation and I will have it open for public comment.
Unfortunately, we don't have anybody in the audience, so at this point we're going to conclude the meeting. --> 0:28:6.740

APPENDIX F: RESOLUTION OF ADOPTION

CITY OF KALAMAZOO

KALAMAZOO CITY COMMISSION

A RESOLUTION ADOPTING A FINAL PROJECT PLAN FOR WATER SYSTEM IMPROVEMENTS AND DESIGNATING AN AUTHORIZED PROJECT REPRESENTATIVE

WHEREAS, the City of Kalamazoo recognizes the need to make improvements to its existing water treatment and distribution system; and

WHEREAS, the City of Kalamazoo authorized Tetra Tech to prepare a Drinking Water State Revolving Fund Project Plan, which recommends the following projects;

- Pump Station 5 and 14 Upgrades

WHEREAS, said Project Plan was presented at a Public Meeting held on Tuesday, April 23, 2024, and all public comments have been considered and addressed;

NOW THEREFORE BE IT RESOLVED, that the City of Kalamazoo formally adopts said Project Plan and agrees to implement the selected alternatives.

BE IT FURTHER RESOLVED, that the City Engineer of the Water Resources Division, a position currently held by James J. Baker, PE, is designated as the authorized representative for all activities with the project referenced above, including the submittal of said Project Plan as the first step in applying to the State of Michigan for a Drinking Water State Revolving Fund Loan to assist in implementation of the selected alternative.

Yeas:

Nays:

Abstain:

Absent:

I certify that the above Resolution was adopted by Kalamazoo City Commission on Monday May 20, 2024.

BY: _____.

Name and Title *(please print or type)*

_____.

Signature Date

APPENDIX G: BASIS OF DESIGN

Water Resources Division
Department of Publics Services
415 Stockbridge Avenue
Kalamazoo, MI 49001

LETTER OF TRANSMITTAL

To:

EGLE
7953 Adobe Road
Kalamazoo, MI 49009

Date: 2/3/2023	Job No. wat0200083
Attention: Nathan Yutzy	
Re: Kalamazoo Water Station 5 Project	

WE ARE SENDING YOU ☒ Attached via email

☐ Shop Drawings ☐ Prints ☒ Plans ☒ Specifications
☐ Copy of Letter ☐ Change Order ☐ Samples ☐

Copies	Date	NO.	Description
1	2/3/2023		Water Main Plans – Civil/Landscape, Process, Architectural
1	2/3/2023		Permit Application & Basis of Design
1	2/3/2023		Specifications – Civil & Treatment Plant

THESE ARE TRANSMITTED as checked below:

☒ For approval	☐ As requested	☐ Approved as submitted	☐ Returned for corrections
☐ For your use	☒ For Review and Comment	☐ Approved as noted	☐

Remarks:

Thank you,
City of Kalamazoo
Water Resources Division

COPY TO:

SIGNED: John Crandall

Department of Public Services
Water Resources Division
415 Stockbridge Avenue
Kalamazoo, MI 49001
Phone: 269.337.8601
Fax: 269.337.8533
www.kalamazoocity.org

February 3, 2023

Nathan Yutzy
EGLE
7953 Adobe Rd
Kalamazoo, MI 49009

Nathan,

Attached are the plans and the PA 399 Permit for construction application for the proposed water main construction for the Kalamazoo Water Station 5 Project.

The City of Kalamazoo will inspect and monitor the installation of the water main and station to ensure that it is installed in full compliance with City standards.

Please review the attached information and, if acceptable, provide the permit for construction at your earliest convenience.

If there are any questions or comments, do not hesitate to contact me directly at 269-337-8055.

Sincerely,

JoAnna Crandall, P.E.
Assistant City Engineer – Water Resources
City of Kalamazoo

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
DRINKING WATER AND ENVIRONMENTAL HEALTH DIVISION

PERMIT APPLICATION FOR WATER SUPPLY SYSTEMS

(CONSTRUCTION - ALTERATION - ADDITION OR IMPROVEMENT) AS DESCRIBED HEREIN

Required under the Authority of 1976 PA 399, as amended (Act 399)

This application becomes an Act 399 Permit only when signed and issued by authorized Michigan Department of Environment, Great Lakes, and Energy (EGLE) staff. See instructions below for completion of this application.

1. **Municipality or Organization, Address and WSSN** that will own or control the water facilities to be constructed. This permit is to be issued to: **City of Kalamazoo** **415 Stockbridge** **Kalamazoo, MI 49001-2896** **WSSN**: **3520**	Permit Stamp Area (EGLE use only)	
2. **Owner's Contact Person** (provide name for questions): Contact: **Anna Crandall, PE** Title: **Assistant City Engineer, Water Resources** Phone: **(269) 337-8055**		
3. **Project Name** (Provide phase number if project is segmented): **Kalamazoo Water Station 5** **wat0200083**	4. **Project Location** (City, Village, Township): **City of Kalamazoo**	5. **County** (location of project): **Kalamazoo**

ISSUED UNDER THE AUTHORITY OF THE DIRECTOR OF
THE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

cc/enc: Mr. Frank Renaldi, P.E., Wightman

Issued by: _____

Reviewed by: _____

☐ **If this box is marked see attached special conditions**.

Instructions: Complete items 1 through 5 above and 6 through 21 on the following pages of this application. Print or type all information except for signatures. Mail completed application, plans and specifications, and any attachments to the EGLE District Office having jurisdiction in the area of the proposed construction.

Please Note:

a. This **PERMIT** only authorizes the construction, alteration, addition or improvement of the water system described herein and is issued solely under the authority of 1976 PA 399, as amended.
b. The issuance of this **PERMIT** does not authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other EGLE permits, or approvals from other units of government as may be required by law.
c. This **PERMIT** expires two (2) years after the date of issuance in accordance with R 325.11306, 1976 PA 399, administrative rules, unless construction has been initiated prior to expiration.
d. Noncompliance with the conditions of this permit and the requirements of the Act constitutes a violation of the Act.
e. Applicant must give notice to public utilities in accordance with 1974 PA 53, (MISS DIG), being Section 460.701 to 460.718 of the Michigan Compiled Laws and comply with each of the requirements of that Act.
f. All earth changing activities must be conducted in accordance with the requirements of the Soil Erosion and Sedimentation Control Act, Part 91, 1994 PA 451, as amended (Act 451).
g. All construction activity impacting wetlands must be conducted in accordance with the Wetland Protection Act, Part 303, 1994 PA 451, as amended.
h. Intentionally providing false information in this application constitutes fraud which is punishable by fine and/or imprisonment.
i. Where applicable for water withdrawals, the issuance of this permit indicates compliance with the requirements of Part 327 of Act 451, Great Lakes Preservation Act.

6. **Facilities Description –** In the space below provide a detailed description of the proposed project. Applications without adequate facilities descriptions **will be returned**. SEE EXAMPLES BELOW**.** Use additional sheets if needed.

The design includes the construction of new treatment facilities for existing Water Pump Station No. 5, which will reduce concentrations of iron, manganese, and per- and polyfluoroalkyl substances (PFAS) currently found in the four (4) existing groundwater production wells. The new treatment facilities are to be constructed east of the existing well field site with access from East Michigan Ave. The existing wells will be cleaned, receive new pumps and motors, and then water will be pumped from the wells to a raw water holding tank for oxidation. High service pumps will then bring the raw water into the treatment facility and through greensand and GAC filters. Chemical disinfection and corrosion control strategies are maintained and coordinated with the new treatment systems. The plant effluent will then tie into the existing distribution system. Station 5 is to become base load station.

APPROVED BY:
THE CITY OF KALAMAZOO

DATE: 02/03/2023

DEPARTMENT OF PUBLIC SERVICES
ASSISTANT CITY ENGINEER

EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES	
Water Mains	500 feet of 8-inch water main in First Street from Main Street north to State Street. **OR** 250 feet of 12-inch water main in Clark Road from an existing 8-inch main in Third Avenue north to a hydrant.
Booster Stations	A booster station located at the southwest corner of Third Avenue and Main Street, and equipped with two, 15 Hp pumps each rated 150 gpm @ 200 feet TDH. Station includes backup power and all other equipment as required for proper operation.
Elevated Storage Tank	A 300,000 gallon elevated storage tank located in City Park. The proposed tank shall be spherical, all welded construction and supported on a single pedestal. The tank shall be 150 feet in height, 40 feet in diameter with a normal operating range of 130 – 145 feet. The interior coating system shall be ANSI/NSF Standard 61 approved or equivalent. The tank will be equipped with a cathodic protection system, and includes a tank level control system with telemetry.
Chemical Feed	A positive displacement chemical feed pump, rated at 24 gpd @ 110 psi to apply a chlorine solution for Well No. 1. Chlorine is 12.5% NaOCL, ANSI/NSF Standard 60 approved and will be applied at a rate of 1.0 mg/l of actual chlorine.
Water Supply Well	Well No. 3, a 200 foot deep well with 170 feet of 8-inch casing and 30 feet of 8-inch, 10 slot screen. The well will be equipped with a 20 Hp submersible pump and motor rated 200 gpm @ 225 feet TDH, set at 160 feet below land surface.
Treatment Facilities	A 5 million gpd water treatment plant located at the north end of Second Avenue. The facility will include 6 low service pumps, 2 rapid mix basins, 4 flocculation/sedimentation basins, 8 dual media filters, 3 million gallon water storage reservoir and 6 high service pumps. Also included are chemical feed pumps and related appurtenances for the addition of alum, fluoride, phosphate and chlorine.

General Project Information – Complete all boxes below.

7. Design engineer's name, engineering firm, address, phone number, and email address:
Frank J. Renaldi, PE
Wightman and Associates, Inc.
433 East Ransom Street
Kalamazoo, MI 49007
269-217-4673
frenaldi@gowightman.com

8. Indicate who will provide project construction inspection:
☒Organization listed in Box 1.
☐Engineering firm listed in Box 7.
☐Other - name, address, and phone number listed below.

9. Is a basis of design attached?
☒YES ☐NO

If no, briefly explain why a basis of design is not needed.

10. Are sealed and signed engineering plans attached?
☒YES ☐NO

If no, briefly explain why engineering plans are not needed.

11. Are sealed and signed construction specifications attached?
☒YES ☐NO

If specifications are not attached, they need to be on file at EGLE. The project specifications will be used in conjunction with the City of Kalamazoo Standard Specifications

12. Were Recommended Standards for Water Works, Suggested Practice for Water Works, AWWA guidelines, and the requirements of Act 399 and its administrative rules followed?
☒YES ☐NO

If no, explain which deviations were made and why.

13. Are all coatings, chemical additives and construction materials ANSI/NSF or other adequate 3rd party approved?
☒YES ☐NO

If no, describe what coatings, additives or materials did not meet the applicable standard and why.

14. Are all water system facilities being installed in the public right-of-way or a dedicated utility easement? (For projects not located in the public right-of-way, utility easements must be shown on the plans.)
☒YES ☐NO

If no, explain how access will be obtained.

15. Is the project construction activity within a wetland (as defined by Section 324.30301(d)) of Part 303, 1994 PA 451?
☒YES ☐NO

If yes, a wetland permit must be obtained. – Delineated as a mixed hardwood swamp. Permit application in process.

16. Is the project construction activity within a 100-year floodplain (as defined by R 323.1311(e)) of Part 31, 1994 PA 451, administrative rules?
☐YES ☒NO

If yes, a flood plain permit must be obtained.

17. Is the project construction activity within 500 feet of a lake, reservoir, or stream?
☐YES ☒NO

If yes, a Soil and Erosion Control Permit must be obtained or indicate if the owner listed in box 2 of this application is an Authorized Public Agency (Section 10 of Part 91, 1994 PA 451) ☒Owner is APA.

18. Will the proposed construction activity be part of a project involving the disturbance of five (5) or more acres of land?
☐YES ☒NO – disturbed area is 3.44AC

If YES, is this activity regulated by the National Pollutant Discharge Elimination System (NPDES) storm water regulations?

☐YES: NPDES Authorization to discharge storm water from construction activities must be obtained.

☐NO: Describe why activity is not regulated.

Please call 517-241-8993 with questions regarding the applicability of the storm water regulations.

19. Is the project in or adjacent to a site of suspected or known soil or groundwater contamination?
☐YES ☒NO

If YES, attach a copy of a plan acceptable to EGLE for handling contaminated soils and/or groundwater disturbed during construction. Contact the local EGLE district office for listings of Michigan sites of environmental contamination.

20. IF YOU ARE A CUSTOMER/WHOLESALE/BULK PURCHASER, COMPLETE THE FOLLOWING

1. Name and WSSN of source water supply system (seller): _____

2. Does the water service contract require water producer/seller to review and approve customer/wholesale/bulk purchaser water system construction plans?

☐YES ☐NO

If yes to #2, the producer/seller approval letter must be attached when submitted to EGLE.

21. **Owner's Certification** The owner of the proposed facilities or the owner's authorized representative shall complete the owner's certification. It is anticipated that the owner will either be a governmental agency (city, village, township, county, etc.) or a private owner (individual, company, association, etc.) of a Type I public water supply.

OWNER'S CERTIFICATION

I, JoAnna Crandall (print) (name), acting as the Assistant City Engineer (print) (title/position) for the City of Kalamazoo (print) (entity owning proposed facilities) certify that this project has been reviewed and approved as detailed by the Plans and Specifications submitted under this application, and is in compliance with the requirements of 1976 PA 399, as amended, and its administrative rules.

Signature _____ Date 2/3/2023 Phone 269-337-8055

*Original signature only, no photocopies will be accepted.

Summary of Work:

The design includes the construction of new treatment facilities for existing Water Pump Station No. 5, which will reduce concentrations of iron, manganese, and per- and polyfluoroalkyl substances (PFAS) currently found in the four (4) existing groundwater production wells. The new treatment facilities are to be constructed east of the existing well field site with access from East Michigan Ave. The existing wells will be cleaned, receive new pumps and motors, and then water will be pumped from the wells to a raw water holding tank for oxidation. High service pumps will then bring the raw water into the treatment facility and through greensand and GAC filters. Chemical disinfection and corrosion control strategies are maintained and coordinated with the new treatment systems. The plant effluent will then tie into the existing distribution system. Station 5 is intended to become base load station and is designed to be expandable to include flow from Station 14 in the future. There are provisions in the building design to allow for expansion of the building to the East in the high bay process area to allow for additional filtration to treat future Station 14 water. A space has also been reserved for ion exchange polishing to the west of GAC tanks if it becomes necessary in the future.

Following Sections:

1 Groundwater Characteristics
2 PFAS Sampling Data
3 Well Pumps
4 Groundwater Oxidation
5 Oxidation/Detention Basins
6 High Service Pumps
7 Pre-Filter Oxidation
8 Greensand Pressure Filters
9 GAC Adsorption
10 Backwash Holding Tank
11 Final Disinfection
12 Corrosion Control
13 Fluoridation
14 Workspace Planning

Appendix A - Hydraulic Calculations
Appendix B - Hydraulic Model Analysis
Appendix C - ACT Study

APPROVED BY:
THE CITY OF KALAMAZOO

DATE: 02/03/2023

DEPARTMENT OF PUBLIC SERVICES
ASSISTANT CITY ENGINEER

Analytes	Design Summary Data: Sampling Data Range (mg/l)	Design Value (mg/l)	Primary MCLs (mg/l)	Secondary MCLs (mg/l)
Alkalinity[2]	324-366	340	---	---
Ammonia[2]	<0.1-0.15	<0.1[3]	---	---
Arsenic	0.0027	0.0027	0.010	---
Barium	0.1	0.1	2.0	---
Calcium	*84-125*	*110*	---	---
Chloride	75	75	---	250
Chloroform (TTHM)	0.0084	0.0084	0.080	---
Conductivity[2]	965-1170	1100	---	---
Dissolved Oxygen[2]	1.2-5.1	1.3[4]	---	---
Fluoride	<0.10-0.12	0.12	4.0	2.0
Hardness (as CaCO3)	320	320	---	---
Iron	*<0.01-1.88*	*1.2*[5]	---	0.30
Magnesium	*26-34.8*	*32*	---	---
Manganese	*<0.01-0.478*	*0.35*[6]	---	0.05
Nitrate (as N)	<0.050-3.7	1.1[7]	10	---
Nitrite (as N)	<0.10-.012	0.11	1.0	---
pH[2]	7.11-7.23	7.15	---	6.5-8.5
Potassium	*2.55-4.92*	*3.4*	---	---
Sodium	*31.8-61.3*	*40*	---	---
Sulfate (as SO4)	38.3-48.8	42	---	250

Notes:

[1] *italicized values originally reported as ug/L*

[2] data listed on sheet entitled, "2017 Summer Well Sampling" and does not appear to part of Pace Analytical report

[3] confirm anomaly in November 2017 sampling at PW5-1A.

[4] confirm anomaly in November 2017 sampling at PW5-2A.

[5] wide range in sampling data, design value selected as average of PW5-3A and PW5-4A.

[6] wide range in sampling data, design value selected as average of PW5-1A, 3A and 4A.

[7] PW5-2A appears to be impacted by nitrate. July 2019 composite sample concentration similar to average of individual well sampling in November 2017. Design value selected as average of November 2017 data.

Analytes	November 16, 2017 Sample Data Pace PN: 464627, Sample: 17-320-x PW5-1A (mg/l)	PW5-2A (mg/l)	PW5-3A (mg/l)	PW5-4A (mg/l)
Alkalinity(2)	334	366	336	324
Ammonia(2)	0.15	<0.1	<0.1	<0.1
Arsenic				
Barium				
Calcium	*112*	*125*	*110*	*107*
Chloride				
Chloroform				
Conductivity(2)	965	1170	1105	1055
Dissolved Oxygen(2)	1.4	5.1	1.3	1.2
Fluoride	0.12	<0.10	0.12	<0.10
Hardness (as CaCO3)				
Iron	*0.332*	*<0.01*	*1.34*	*1.88*
Magnesium	*32.1*	*34.8*	*32.2*	*32.0*
Manganese	*0.369*	*<0.01*	*0.478*	*0.204*
Nitrate (as N)	0.61	3.7	<0.050	<0.050
Nitrite (as N)	<0.10	<0.10	0.011	0.012
pH(2)	7.14	7.11	7.13	7.23
Potassium	*2.63*	*2.55*	*3.58*	*4.92*
Sodium	*34.4*	*61.3*	*31.8*	*36.0*
Sulfate (as SO4)	42.6	42.1	48.8	38.3

Analytes	July 02, 2018 Sample Pace PN: 4614380 18-183-TP305 (mg/l)	June 25, 2019 Sample Trace ID: 19F0853-01 19-176-5-B (mg/l)	July 31, 2019 Sample Trace ID: 19G0914-08 TP 305-5 (mg/l)
Alkalinity[(2)]			
Ammonia[(2)]			
Arsenic		0.0027	
Barium		0.10	
Calcium			84
Chloride			75
Chloroform	*0.0084*		
Conductivity[(2)]			
Dissolved Oxygen[(2)]			
Fluoride			0.6
Hardness (as CaCO3)			320
Iron			0.22
Magnesium			26
Manganese			
Nitrate (as N)			0.9
Nitrite (as N)			<0.10
pH[(2)]			
Potassium			
Sodium			35
Sulfate (as SO4)			40

Analytes	Design Summary			
	Sampling Data Range (ng/L, ppt)[1]	Design Value (ng/L, ppt)[1]	Michigan MCLs (ng/L, ppt)[1]	**Treatment Goal** (ng/L, ppt)[1]
Perfluorooctanoic Acid (PFOA)	ND - 4	4	8	ND
Perfluorooctane Sulfonic Acid (PFOS)	ND - 3	3	16	ND
Perfluorononanoic Acid (PFNA)	ND	ND	6	ND
Perfluorohexane Sulfonic Acid (PFHxS)	ND - 5	5	51	ND
Perfluorobutane Sulfonic Acid (PFBS)	2 - 35	35	420	ND
Perfluorohexanoic Acid (PFHxA)	ND - 4	4	400,000	ND
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)[2]	ND	ND	370	ND

Notes:

[1] ng/L = nanograms per Liter, ppt = parts per trillion, (10^{12})

[2] HFPO-DA, a GenX compound

Kalamazoo Environmental is conducting soil analysis and drilling test wells to determine likely source of PFAS and expected plume migration. City to provide results when available.

Low concentrations of PFAS detected at Station 14 also. May combine groundwater treatment at new Station 5 facilities. Station 14 wells reportedly in poor condition with reduced output.

	Station 5 Composite Samples							
	06/15/18	08/15/18	11/13/18	07/11/19	10/17/19	03/23/20	06/17/20	10/21/20
Analytes	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)
PFOA	2	ND	ND	3	ND	ND	ND	2
PFOS	ND	ND	ND	ND	ND	ND	ND	ND
PFNA	ND	ND	ND	ND	ND	ND	ND	ND
PFHxS	ND	3	3	2	ND	ND	4	3
PFBS	4	6	6	14	10	2	13	10
PFHxA	ND	ND	ND	ND	ND	ND	ND	ND
HFPO-DA	---	---	---	---	ND	ND	ND	ND

	Station 5 Individual Well Samples			
	Well 1A	**Well 2A**	**Well 3A**	**Well 4A**
	11/18/2020	11/18/2020	11/18/2020	11/18/2020
Analytes	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)	(ng/L, ppt)
PFOA	ND	4	ND	2
PFOS	ND	3	ND	ND
PFNA	ND	ND	ND	ND
PFHxS	3	5	3	ND
PFBS	16	35	3	8
PFHxA	ND	4	ND	2
HFPO-DA	ND	ND	ND	ND

	Station 14 Composite Samples							
Analytes	10/17/19 (ng/L, ppt)	03/23/20 (ng/L, ppt)	06/17/20 (ng/L, ppt)	09/21/20 (ng/L, ppt)	10/21/20 (ng/L, ppt)	03/24/21 (ng/L, ppt)	06/28/21 (ng/L, ppt)	09/03/21 (ng/L, ppt)
PFOA	2	2	2	2	3	3	2	3
PFOS	4	3	4	5	4	3	4	5
PFNA	ND	ND	ND	ND	ND	ND	ND	ND
PFHxS	4	4	4	4	4	5	3	4
PFBS	5	6	5	6	5	7	5	6
PFHxA	ND	ND	ND	ND	ND	ND	ND	ND
HFPO-DA	ND	ND	ND	ND	ND	ND	ND	ND

	Station 5 Composite Samples 2021							
Analytes	03/18/21 (ng/L, ppt)	06/28/21 (ng/L, ppt)	09/03/21 (ng/L, ppt)	11/01/21 (ng/L, ppt)	- (ng/L, ppt)	- (ng/L, ppt)	- (ng/L, ppt)	- (ng/L, ppt)
PFOA	ND	ND	ND	ND	-	-	-	-
PFOS	ND	ND	ND	ND	-	-	-	-
PFNA	ND	ND	ND	ND	-	-	-	-
PFHxS	3	3	3	3	-	-	-	-
PFBS	8	4	7	3	-	-	-	-
PFHxA	2	ND	ND	ND	-	-	-	-
HFPO-DA	ND	ND	ND	ND	-	-	-	-

Existing Well Construction and Performance:

	Well Construction						Well Maintenance Report				
			Well Casing		Screen			Static	Test	Draw	Specific
	Year	Depth	Outer	Inner	Length	Dia.	Year	Depth	Flow	Down	Capacity
Well #	Drilled	(ft)	(in)	(in)	(ft)	(in)	Tested	(ft)	(gpm)	(ft)	(gpm/ft)
1A	1993	89.5	24	16	30	16	2013	14.9	486	15.5	31.4
2A	1992	86	24	16	26	16	2014	12.9	518	12.8	40.5
3A	1993	95.5	24	16	20	16	2018	11.5	513	20.0	25.7
4A	1993	97	24	16	30	16	2015	16.2	634	10.6	59.8

Soil Characteristics: Unconfined Aquifer:

	Formation Thickness (ft)			
Summary Description*	1A	2A	3A	4A
Topsoil	1	1	1	1
Sandstone w/Clay	17	---	---	---
Unknown Fill	---	---	---	3
Sand, Gravel, Stone, Fine Clay	76	91	96	92
Blue/Gray Clay w/Shale	Boundary Layer			

*see boring logs for details

Preliminary Well Pump Duty Point Estimates:

Assumed WTP Discharge Elevation		781
Approximate Site Elevation		765
Approximate Draw Down Elevation		735
Static Discharge Head (ft)		46
Dynamic Head Estimate, w/ 10% Minor Loss Allowance (ft):		3
Design Flow (gpm)	1400	
Pipe Size, Diameter (in)	12	
Design Velocity, 4 Pumps (fps)	3.97	
Transmission Main (ft)	500	
Hazen-Williams Coefficient, C	120	
Preliminary Duty Point, Four Pumps, Each (gpm, TDH feet):	***350***	***50***

Pump Type:	Vertical Turbine, Multistage
Duty Point Efficiency:	80%
Preliminary W-to-W Horsepower:	6.1
Preliminary Motor Horsepower:	7.5

Existing Well Pumps:

Worthington Vertical Turbine
Bowl Description: 8-inch, 8H48
4-Stage, Impeller Dia. 4 3/4-inch
Design Duty Point: 400 gpm @ 80 feet TDH, 1760 rpm
Original Hydraulic Efficiency: 76%
Installation Date: April 1972
Potential Modifications for Reuse:
Bowl Description: 8-inch, 8H48
2-Stage, Imp. Dia. 5-inch
Design Duty Point: 350 gpm @ 50 feet TDH
Modified Hydraulic Efficiency: 72%

*As discussed with City, no additional pump information available. Likely that existing pumps are to be replaced rather than refurbished.

Replacement Well Pumps:

Vertical Turbine
Design Duty Point: 350 gpm @ 50.1 feet TDH
Hydroflo Pumps
Model 11LL, 1-stage, 1800 rpm, 7.5 hp
Hydraulic Efficiency: 75.1%

Considerations:

1 Based on scanned well and pump records, appears that pumps are ~50 years old.
2 Condition of existing well pumps, columns, shafting, and motors unknown.
3 Replacement pumps could increase hydraulic efficiency by 10% or more.
4 Pumps and motors will be replaced and "condos" built at each wellhead.
5 Power supply will be from the treatment plant and will be backed up with generator power.

Chlorine Demand and Dosage Calculations:

	November 2017 Sample Analytics			
	PW5-1A (ug/l)	PW5-2A (ug/l)	PW5-3A (ug/l)	PW5-4A (ug/l)
Analysis				
Iron[(1)]	332	*1200*	1340	1880
Manganese[(1)]	369	*350*	478	204
Ammonia	0.15	<0.1	<0.1	<0.1
pH	7.14	7.11	7.13	7.23
Alkalinity	334	366	336	324
Dissolved Oxygen[(1)]	1.4	5.1	1.3	1.2
Conductivity	965	1170	1105	1055

[(1)] PW5-2A appears impacted by elevated Dissolved Oxygen, design value selected as average of PW5-1A, 3A and 4A.

Stoichiometric Chlorine Oxidation Rates		
Iron(II)	0.64	(mg CL_2 / mg Fe(II))
Manganese(II)	1.29	(mg CL_2 / mg Mn(II))

Design Chlorine Oxidation Rates		
Design Multiplier	2.00	
Iron(II)	1.28	(mg CL_2 / mg Fe(II))
Manganese(II)	2.58	(mg CL_2 / mg Mn(II))

Design Flow Rates (gpm):	350	350	350	350
Daily Hours of Operation:	24	24	24	24
Daily Flow (mgd):	0.50	0.50	0.50	0.50

Design Chlorine Demand	(ppd)	(ppd)	(ppd)	(ppd)
Iron	1.79	6.46	7.21	10.12
Manganese	4.00	3.80	5.19	2.21
Totals, per Well	5.79	10.26	12.40	12.33

Total, Design Demand **41** **(ppd)**

Total, Eq. Chlorine Dosage **2.4** **(mg/l)**

Preferred Chlorinator System:

Superior Water Solutions, Gas Chlorinator Series CL-16

Ejector nozzle sized to feed up to 50 ppd.

Water supply pressure: 55 psi @ 3.4 gpm.

Scrubber:

Purafil Dry Scrubber

Model FOC5

Chlorine Residual Analyzer:

Free chlorine residual analyzer for groundwater oxidation Chlorinator control.

Oxidation Aging/Detention Basins:

Primary Purposes:

1 Provide extended detention time for complete oxidation of dissolved iron and manganese in groundwater supply prior to pressure filtration.

2 Enhanced process and pump controls:

a High Service Pumps controlled/paced on water level in Detention Basin.

General Notes:

1 Oxidation of iron and manganese is to be provided by chlorine.

2 Pressure filters are designed with detention volume above the media.

3 Chlorination does not require additional detention when manganese mineral media or manganese coated media (I.e., "Greensand") is used for filtration.

Conceptual Sizing:

Detention (min.)	Volume (gal.)	SWD (ft.)	Footprint (sf.)	Width (ft.)	Length (ft.)
30	42,000	10	561	20	30
60	84,000	10	1,123	30	40

Detention Tank:

Volume: 50,000 gallons (Rounded for roughly 30 min detention time).

Diameter: 24'

Height: 16'

Concrete foundation as a base.

City of Kalamazoo, Michigan
Water Station 5 Reconstruction
Preliminary Basis of Design
6 High Service Pumps

Design Flow Rate:

Hydraulic Capacity for Water Pump Station 5:				1,400	gpm
Firm Capacity Criteria:					
High Service Pumps:	**2**	**each**	**@**	**1,400**	**gpm**
	1	**each**	**@**	**700**	**gpm**

Design Future Flow Rate when Combined with Station 14:

Future Hydraulic Capacity for Water Pump Station:				2,800	gpm
Firm Capacity Criteria:					
High Service Pumps:	**2**	**each**	**@**	**2,800**	**gpm**
	1	**each**	**@**	**1,400**	**gpm**
	1	**each**	**@**	**700**	**gpm**

Pump Selection (see Appendix A for Hydraulic Calculations and Appendix B for Hydraulic Model Analysis):

700 GPM Pump: Aurora Model 411 - Horizontal, single-stage, split-case pump.

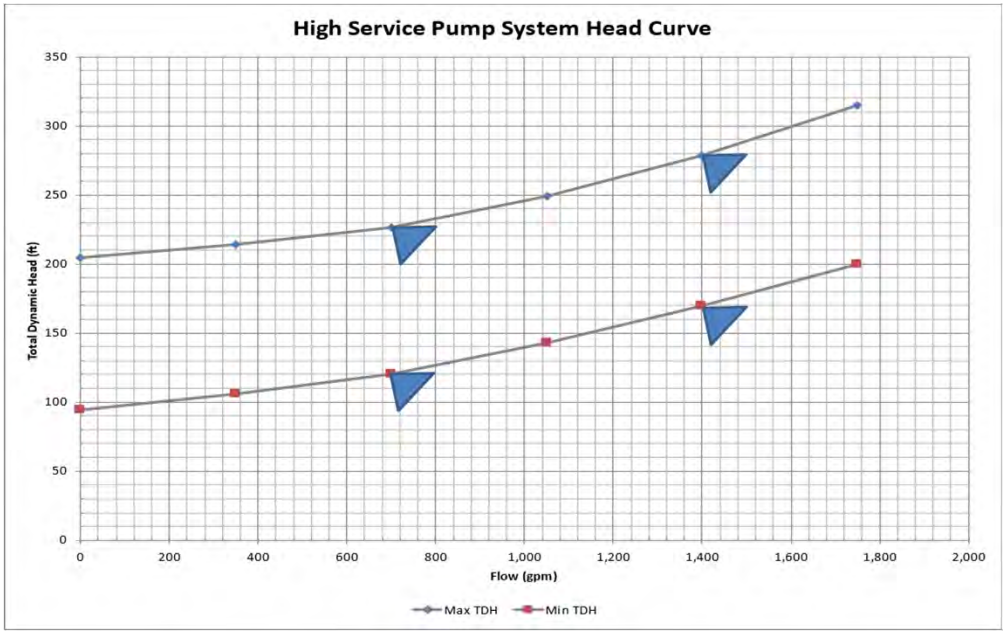
Design Duty Point: 700 gpm @ 223.3 ft TDH

3550 rpm, 75 hp

1400 GPM Pump: Aurora Model 411 - Horizontal, single-stage, split-case pump.

Design Duty Point: 1400 gpm @ 274.7 ft TDH

3550 rpm, 150 hp



Additional Design Considerations:

1 Water Hammer Mitigation/Protection:
   a Variable Frequency Drives
   b Pressure Relief Valve

2 Potential Future Increase in Hydraulic Design Capacity (to 2,800 gpm)

Purpose:

Greensand filters require "oxidizing conditions" within the filters to effectively reduce and capture remaining soluble iron and manganese on filter media. Operations will need to minimize chlorine residuals from Detention Basin and Greensand Pressure Filters to reduce adsorption capacity impacts on GAC. Therefore, "tweaking" of chlorine residual prior to the Greensand Pressure Filters will enhance process control and operation flexibility.

Conceptual Design Conditions:

1 Chlorine Analyzer measuring free chlorine for Pre-Filter Chlorinator control.

2 Pre-Filter Chlorinator, designed for independent operation and control.

3 Chlorine Demand Estimate:

a	**Dosage:**	**0.5**	**mg/l**	(design range 0.0 to 0.5 mg/l)
b	Flow:	1,400	gpm	
c	Demand:	8	ppd	

4 Chlorine Future Demand Estimate:

a	**Dosage:**	**0.5**	**mg/l**	(design range 0.0 to 0.5 mg/l)
b	Flow:	2,800	gpm	
c	Demand:	17	ppd	

5 Booster pump for chlorine injection (sized to satisfy current and future demand):
Design Duty Point: 36 GPM @ 280 ft TDH.

6 Ejector nozzle sized to feed up to 50 ppd.
Backpressure at injection point: 120 psi.
Water supply pressure: 212 psi @ 8.1 gpm.

Purpose:

Greensand filters exist to remove Iron and Manganese to below secondary MCLs and to eliminate the potential for fouling of the GAC filters by Iron and Manganese.

Design Criteria:

Design Based on Ten State Standards

For Iron/Manganese Removal by Manganese Coated Media Filtration:

a. Provisions should be made to apply the chlorine as far ahead of the filter as practical and to a point immediately before the filter.
b. Aeration is used prior to the pre-filter chlorine oxidation point to reduce the amount of the chemical oxidant needed.
c. An anthracite media cap of at least 6 inches shall be provided over manganese coated media.
d. Normal filtration rate is 3gpm/sf.
e. With air washing provided, normal backwash rate shall be less than 8 gpm/sf.

Backwash Rates and Volumes

Using finished water (post GAC) for backwash to address PFAS concerns.

Design Backwash Rate and Volume per 10 State Standards:

With Combination Air/Water Backwash Process:

Diameter Options:	12	ft
Filtration Area, Ea.:	113.2	sf
Number of Filters:	4	units
Backwash Rate, Ea.:	5	gpm/sf
Backwash Duration:	15	min.
Waste Volume, Ea.:	8500	gal.
Waste Volume, Total:	34000	gal.
Design Backwash Flow Rate:	**566.1**	**gpm**
Design Waste Volume/Backwash Cycle:	**34000**	**gallons**

Purpose:

Following removal of Iron and Manganese in the greensand filters, the GAC filters will remove PFAS substances from the water to levels below Michigan drinking water MCLs for PFAS.

Per- and Polyfluoroalkyl Substances (PFAS) Reduction:

PFAS has been the primary focus of this proposed Water Station 5 Reconstruction project since mid-2019. A draft Summary Report subtitled "Letters of Interest from Equipment Manufacturers and System Suppliers, Proposed Pilot Study for PFAS Reduction at Water Supply Station No. 5" was prepared November 12, 2019 and provided detailed background on treatment options. PFAS regulation and treatment has evolved rapidly over the past 2+ years, including Michigan establishing Drinking Water Maximum Contaminant Levels (MCLs) for PFAS, which went into effect in August 2020. See previous documents for evaluations of PFAS treatment alternatives.

Based on evaluations, Granular Activated Carbon (GAC) adsorption was selected as the preferred treatment technology for PFAS reduction at Water Station 5.

Calgon Carbon Corporation has extensive experience with PFAS Adsorption and has provided numerous GAC systems for treatment of PFAS-impacted groundwater systems. As the frontrunner in this emerging market, Calgon has provided invaluable technical support and guidance in developing this proposed treatment system.

Calgon's Accelerated Column Test (ACT) analysis confirmed original opinions that short-chain PFAS compounds (PFBS, more specifically) would have the lowest adsorption capacity and would likely exceed the City's performance standard of Non-Detect (ND) after approximately 310 days of full-scale operation at full hydraulic design capacity.

Calgon's current proposal includes two (2) "skids," with lead and lag reactors in each train. A total of four (4) 12-foot diameter reactors is proposed.

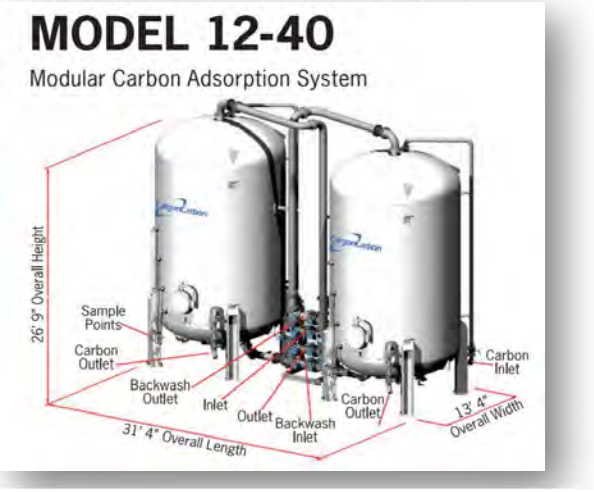
System Configuration:

Dimensional sketch for the proposed Model 12-40 GAC Adsorption System:

<u>Backwash Volume:</u>

960.5 gpm @ 75F

45000 gallon per vessel



Pilot Study:

ACT Study: Removal of Per- and Polyfluoroalkyl Substances and TOC from Potable Drinking Water Using F400 Granular Activated Carbon. (See Appendix C at the end of this document).

Special Considerations:

In a June 8, 2021 email from Dan Iorio, Senior Technical Sale Representative for Calgon Carbon, it was noted that "systems could be 45+ weeks out from PO issuance to shipment" due to raw material shortages and delivery delays.

It is the City's intent that Calgon Carbon will be fully responsible and accepts liability for receiving PFAS-impacted materials. City notes that Calgon Carbon advertises that their regeneration process "destroys" PFAS substances. The City's potential liability for PFAS discharge to atmosphere if PFAS is not fully destroyed shall be minimized by Calgon Carbon.

Summary:

Greensand filter air/water BW requires 5 gpm/sf, (566 gpm) for 10 minutes, then 5 minutes of 15 gpm/sf (1695 gpm) water only.

The GAC filter BW requires about 8.5 gpm/sf @ 55 °F, or 961 gpm.
Calgon BW for 4 bed volumes @ 10,000 gal/bed volume, or 40,000 gal.

The BW holding tank volume could be reduced if we assume the discharge will always be open and allows up to 600 gpm discharge to the sanitary sewer (some head/depth in the holding tank is needed to produce 600 gpm).

The backwash discharge rate to the sanitary sewer has been limited to 600gpm maximum by the City of Kalamazoo Wastewater Division. Assuming 600 gpm discharge from the tank at all times, the tank would need to hold the difference between the 1000 gpm BW rate, and 600 gpm discharge rate for the duration of the BW, or (40,000 gal/1000 gpm) 40 minutes. 400 gpm x 40 minutes = 16,000 gallons.

The tank has been designed to hold 20,000 gallons to provide some safety buffer.

Purpose:

Final disinfection and residual for distribution system. Majority of iron and manganese should be removed through the oxidation and greensand pressure filtration system. In addition to PFAS, the GAC adsorption system will also reduce total organic carbon (TOC) concentrations. Chlorine demand in the finished water prior to final disinfection should be minimal.

Conceptual Design Conditions:

1 Inline Chlorine Analyzer measuring total chlorine for Final Disinfection Chlorinator control.

2 Final Disinfection Chlorinator, designed for independent operation and control.

3 Chlorine Demand Estimate:

a	**Dosage:**	**2 mg/l**	(design range 1.0 to 2 mg/l)
b	Flow:	1,400 gpm	
c	Demand:	34 ppd	

4 Chlorine FUTURE Demand Estimate:

a	**Dosage:**	**2 mg/l**	(design range 1.0 to 2 mg/l)
b	Flow:	2,800 gpm	
c	Demand:	67 ppd	

5 Ejector nozzle sized to feed up to 100 ppd.
Backpressure at injection point: 120 psi.
Water supply pressure: 215 psi @ 27.2 gpm.

Corrosion Control Strategy:

City is conducting a corrosion control study and intends to change to CARUS 8700 for corrosion control. Calculations on this page are for CARUS 8700.

Based on demand calculations for selected product, there will be bulk storage w/ day

Chemical Feed Calculations

1 According to the EPA, orthophosphate treatment for controlling lead and copper should target residual concentrations of 1.0 to 3.0 mg/L as PO4 at the tap.

2 Orthophosphate Demand Estimate:

a	**Dosage:**	**5.5**	**mg/l PO4**	(Design range 1-5.5 mg/L)
b	Flow:	1,400	gpm	
c	Usage:	384	ppd PO4	
	Usage:	33	gpd PO4	

3 Day Tank 30 Hour Storage Volume = 41 gallons

Bulk Tank 30 Day Storage Volume = 994 gallons

4 Orthophosphate Future Demand Estimate:

a	**Dosage:**	**5.5**	**mg/l PO4**
b	Flow:	2,800	gpm
c	Usage:	768	ppd PO4
	Usage:	66	gpd PO4

5 Day Tank 30 Hour Storage Volume = 83 gallons

Bulk Tank 30 Day Storage Volume = 1989 gallons

6 Transfer Pump for Liquid Chemical Feed Systems
Lutz-Jesco Centran Mag Drive Transfer Pump Model 5.05
3450 rpm, 1/2 hp, 5 gpm
With a back-pressure valve.

7 Metering Pump for Liquid Chemical Feed Systems
Grundfos Digital Diaphragm Dosing Pump Model DDA 12-10
Feed Rate Range: 12 ml/h - 3.17 gph

Fluoridation:

Individual well sample data from November 16, 2017 indicate Fluoride concentrations range from <0.10 to 0.12 mg/l, and would support supplemental fluoridation.

Chemical Feed Calculations

1 Hydrofluorosilicic Acid, H2SiF6

a	Concentration:	23%	Hydrofluorosilicic Acid
b	Available Fluoride Ion:	0.79	
	$Temp_{avg:}$	14	°C
	Background F:	0.1	mg/L F

2 Dosage: 0.99 mg/L F

Based on Average maximum daily air temperature

3 Hydrofuorosilicic Acid Demand Estimate:

a	**Dosage:**	**0.99**	**mg/L Fluoride**	
b	Flow:	1,400	gpm	
c	Usage:	91.04	ppd	Hydrofluorosilicic Acid
	Usage:	10.90	gpd	Hydrofluorosilicic Acid

4 Day Tank 30 Hour Volume = 13.63 gallons

Bulk 30 Day Storage Volume = 327.08 gallons

5 Hydrofluorosilicic Acid Future Demand Estimate:

a	**Dosage:**	**0.99**	**mg/L Fluoride**	
b	Flow:	2800	gpm	
c	Usage:	182.08	ppd	Hydrofluorosilicic Acid
	Usage:	21.81	gpd	Hydrofluorosilicic Acid

6 Day Tank 30 Hour Volume = 27.26 gallons

Bulk 30 Day Storage Volume = 654.17 gallons

1 General

1.1 Existing facilities are to be retained and refurbished for continued use as noted.

1.2 New facilities are to be constructed for iron and manganese removal,

1.3 PFAS reduction, and for associated operation and administrative functions.

2 Existing Water Station 5 Facilities

Well No. 1A	Retain. Well cleaning and testing.
Well No. 2A	Retain. Well cleaning and testing.
Well No. 3A	Retain. Well cleaning and testing.
Well No. 4A	Retain. Well cleaning and testing.
Pump House	Retain. Repurpose and upgrade as Well Pump Control Building.
	Demo booster pumps and revise piping, new flow meter.
	Upgrade electrical feed to pumps.

After cleaning and testing, all wells will receive new pumps, motors, and enclosures.

Power Supply will be routed from treatment plant for all wells with backup generator.

Chemical Building	Demolish. Chemical feed systems will be in new building.
Booster Building	Historical building. Turn into water equipment storage.

APPENDIX A

Hydraulic Calculations

WIGHTMAN

ARCHITECTURE | ENGINEEERING
ENVIRONMENTAL | SURVEYING | GIS
INTERIOR DESIGN | LANDSCAPE ARCHITECTURE
PLANNING | REALITY CAPTURE

Blue = User Input

City of Kalamazoo
Water Station 5

Date 11/17/2021 Author B. Sabin

Design Point	**1400 gpm**	**274.7 ft**	118.9 psi

	Synthetic	Max TDH (ft)	Min TDH (ft)
	0	200.8	90.5
Water Elevations	350	206.5	98.0
Detention tank **789.5 ft**	700	212.3	105.5
	1050	225.8	119.6
	1400	243.3	134.5
C Factor **130**	1750	266.0	151.1

Calgon: O&M Manual, Sect 1 - Backwashing/backflushing is usually required whe
Tonka: 10/26/2021 Tonka recommends using a max headloss of 15 psi through t
WesTech: 10/25/2021 For pressure filters, no “curve” so to say, but the design star

Flow (gpm)	Friction Head (ft)	Max TDH	Min TDH
0	0.0	**200.8**	**90.5**
350	4.3	**210.8**	**102.3**
700	11.0	**223.3**	**116.5**
1050	20.0	**245.8**	**139.7**
1400	31.4	**274.7**	**165.9**
1750	45.2	311.2	196.3
2100	61.2		
2450	79.6		
2800	100.2		
3150	123.1		
3500	148.3		
3850	175.8		
4200	205.6		
4550	237.6		
4900	271.9		
5250	308.5		
5600	347.3		
5950	388.4		
6300	431.7		
6650	477.3		
7000	525.2		

Pipe Velocity at Design Point	
Pipe Dia (in)	Velocity at design point (fps)
3	63.58
4	35.76
6	15.90
8	8.94
10	5.72
12	3.97
16	2.24
18	1.77
24	0.99
30	0.64
36	0.44

Prein&Newhof memo 9/22/2021

Dist. System (gpm)	Max TDH (ft)	Min TDH (ft)
0	969.5	880.0
350	975.3	887.5
700	981.0	895.0
1000	992.0	907.0
1050	994.5	909.1
1400	1012.0	924.0
1750	1034.8	940.6
1800	1038.0	943.0

Pipe Section 1 **Detention tank to H.S. pump 3** Flow Modifier *gpm or value*

Nominal Diameter **12** inches Add 0
Pipe Type **Ductile Iron**
Actual Diameter 12.4 inches
Length **118** ft
C 130
K 3.71

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	0.9	0.04	0.0	0.09
700	700	1.9	0.13	0.2	0.33
1050	1050	2.8	0.28	0.4	0.73
1400	1400	3.7	0.48	0.8	1.28
1750	1750	4.7	0.72	1.2	1.97
2100	2100	5.6	1.01	1.8	2.81
2450	2450	6.5	1.35	2.4	3.79
2800	2800	7.4	1.73	3.2	4.92
3150	3150	8.4	2.15	4.0	6.19
3500	3500	9.3	2.61	5.0	7.59
3850	3850	10.2	3.11	6.0	9.14
4200	4200	11.2	3.65	7.2	10.83
4550	4550	12.1	4.24	8.4	12.66
4900	4900	13.0	4.86	9.8	14.63
5250	5250	14.0	5.52	11.2	16.74
5600	5600	14.9	6.22	12.8	18.99
5950	5950	15.8	6.96	14.4	21.37
6300	6300	16.7	7.74	16.2	23.89
6650	6650	17.7	8.55	18.0	26.55
7000	7000	18.6	9.40	19.9	29.35

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	1	0.78	0.78
Pipe Exit	0	1.00	0.00
Valves (gate)	1	0.10	0.10
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	3	0.39	1.17
45 Deg. Bends	1	0.21	0.21
Tee (branch)	1	0.78	0.78
Tee (flow thru)	2	0.26	0.52
Valves (check)	0	1.30	0.00
6"x12" reducer-pump suction	1	0.15	0.15
			3.71

Pipe Section 2 Pump #3 suction to discharge header Flow Modifier *gpm or value*

Nominal Diameter	6	inches	Divide	2
Pipe Type	Ductile Iron			
Actual Diameter	6.22	inches		
Length	17.5	ft		
C	130			
K	2.29			

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	175	1.8	0.04	0.1	0.17
700	350	3.7	0.16	0.5	0.64
1050	525	5.5	0.33	1.1	1.43
1400	700	7.4	0.57	1.9	2.51
1750	875	9.2	0.85	3.0	3.89
2100	1050	11.1	1.20	4.4	5.57
2450	1225	12.9	1.59	6.0	7.55
2800	1400	14.8	2.04	7.8	9.82
3150	1575	16.6	2.53	9.8	12.38
3500	1750	18.5	3.08	12.2	15.23
3850	1925	20.3	3.67	14.7	18.38
4200	2100	22.2	4.31	17.5	21.82
4550	2275	24.0	5.00	20.5	25.54
4900	2450	25.9	5.74	23.8	29.56
5250	2625	27.7	6.52	27.3	33.87
5600	2800	29.6	7.34	31.1	38.46
5950	2975	31.4	8.22	35.1	43.34
6300	3150	33.3	9.13	39.4	48.51
6650	3325	35.1	10.09	43.9	53.97
7000	3500	37.0	11.10	48.6	59.72

Minor Losses, 6":

Fittings:	Number	K value	K Sum
Pipe Entrance (flare)	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	2	0.12	0.24
Valves (ball)	0	0.05	0.00
Valves (butterfly)	0	0.68	0.00
Valves (plug)	0	0.83	0.00
90 Deg. Bends	1	0.45	0.45
45 Deg. Bends	0	0.24	0.00
Tee (branch)	0	0.90	0.00
Tee (flow thru)	0	0.3	0.00
Valves (check)	1	1.50	1.50
4" x 6" increaser	1	0.10	0.10
			2.29

Pipe Section 3 Pumps to Greensand filter #4 Flow Modifier *gpm or value*

Nominal Diameter	12	inches	Add	0
Pipe Type	Ductile Iron			
Actual Diameter	12.4	inches		
Length	83.25	ft		
C	130			
K	3.37			

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	0.9	0.03	0.0	0.07
700	700	1.9	0.09	0.2	0.27
1050	1050	2.8	0.20	0.4	0.61
1400	1400	3.7	0.34	0.7	1.06
1750	1750	4.7	0.51	1.1	1.64
2100	2100	5.6	0.72	1.6	2.35
2450	2450	6.5	0.95	2.2	3.17
2800	2800	7.4	1.22	2.9	4.12
3150	3150	8.4	1.51	3.7	5.18
3500	3500	9.3	1.84	4.5	6.37
3850	3850	10.2	2.19	5.5	7.68
4200	4200	11.2	2.58	6.5	9.10
4550	4550	12.1	2.99	7.7	10.64
4900	4900	13.0	3.43	8.9	12.31
5250	5250	14.0	3.90	10.2	14.09
5600	5600	14.9	4.39	11.6	15.99
5950	5950	15.8	4.91	13.1	18.00
6300	6300	16.7	5.46	14.7	20.13
6650	6650	17.7	6.03	16.4	22.38
7000	7000	18.6	6.63	18.1	24.75

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	1	0.10	0.10
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	2	0.39	0.78
45 Deg. Bends	0	0.21	0.00
Tee (branch)	2	0.78	1.56
Tee (flow thru)	3	0.26	0.78
Valves (check)	0	1.30	0.00
12" x 6" reducer (branch flow tee)	1	0.15	0.15
			3.37

Pipe Section 4 Filter #4 inlet to effluent inc. media

Nominal Diameter	8	inches	Flow Modifier: Divide	*gpm or value*: 4
Pipe Type	Ductile Iron			
Actual Diameter	8.33	inches		
Length	6.5	ft		
C	130			
K	3.22			

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)	Clean Greensand Bed Headloss (ft)
0	0	0.0	0.00	0.0	0.00	0.00
350	87.5	0.5	0.00	0.0	0.43	0.42
700	175	1.0	0.00	0.1	0.90	0.84
1050	262.5	1.5	0.01	0.1	1.40	1.27
1400	350	2.1	0.01	0.2	1.93	1.70
1750	437.5	2.6	0.02	0.3	2.49	2.14
2100	525	3.1	0.03	0.5	3.08	2.58
2450	612.5	3.6	0.04	0.7	3.71	3.02
2800	700	4.1	0.05	0.9	4.37	3.46
3150	787.5	4.6	0.06	1.1	5.05	3.92
3500	875	5.2	0.08	1.3	5.77	4.37
3850	962.5	5.7	0.09	1.6	6.53	4.83
4200	1050	6.2	0.11	1.9	7.31	5.29
4550	1137.5	6.7	0.12	2.2	8.13	5.76
4900	1225	7.2	0.14	2.6	8.97	6.23
5250	1312.5	7.7	0.16	3.0	9.85	6.70
5600	1400	8.2	0.18	3.4	10.76	7.18
5950	1487.5	8.8	0.20	3.8	11.70	7.66
6300	1575	9.3	0.23	4.3	12.68	8.14
6650	1662.5	9.8	0.25	4.8	13.68	8.63
7000	1750	10.3	0.28	5.3	14.72	9.13

Minor Losses, 6":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.11	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	2	0.63	1.26
Valves (plug)	0	0.89	0.00
90 Deg. Bends	0	0.42	0.00
45 Deg. Bends	0	0.22	0.00
Tee (branch)	2	0.84	1.68
Tee (flow thru)	1	0.28	0.28
Valves (check)	0	1.40	0.00
12" x 6" icreaser (branch flow tee)	1	0.00	0.00
		15	3.22

Pipe Section 5 Filter #4 to #3 effluent

Nominal Diameter	12	inches	Flow Modifier: Divide	*gpm or value*: 4
Pipe Type	Ductile Iron			
Actual Diameter	12.4	inches		
Length	15	ft		
C	130			
K	0.26			

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	87.5	0.2	0.00	0.0	0.00
700	175	0.5	0.00	0.0	0.00
1050	262.5	0.7	0.00	0.0	0.00
1400	350	0.9	0.00	0.0	0.01
1750	437.5	1.2	0.01	0.0	0.01
2100	525	1.4	0.01	0.0	0.02
2450	612.5	1.6	0.01	0.0	0.02
2800	700	1.9	0.02	0.0	0.03
3150	787.5	2.1	0.02	0.0	0.04
3500	875	2.3	0.03	0.0	0.05
3850	962.5	2.6	0.03	0.0	0.06
4200	1050	2.8	0.04	0.0	0.07
4550	1137.5	3.0	0.04	0.0	0.08
4900	1225	3.3	0.05	0.0	0.09
5250	1312.5	3.5	0.05	0.0	0.10
5600	1400	3.7	0.06	0.1	0.12
5950	1487.5	4.0	0.07	0.1	0.13
6300	1575	4.2	0.08	0.1	0.15
6650	1662.5	4.4	0.08	0.1	0.16
7000	1750	4.7	0.09	0.1	0.18

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	0	0.21	0.00
Tee (branch)	0	0.78	0.00
Tee (flow thru)	1	0.26	0.26
Valves (check)	0	1.30	0.00
Misc.	0	0.00	0.00
			0.26

Pipe Section 6 Filter #3 to #2 effluent

Nominal Diameter	12	inches	
Pipe Type	Ductile Iron		
Actual Diameter	12.4	inches	
Length	15	ft	
C	130		
K	0.36		

Flow Modifier: Divide — *gpm or value*: 2

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	175	0.5	0.00	0.0	0.00
700	350	0.9	0.00	0.0	0.01
1050	525	1.4	0.01	0.0	0.02
1400	700	1.9	0.02	0.0	0.04
1750	875	2.3	0.03	0.0	0.06
2100	1050	2.8	0.04	0.0	0.08
2450	1225	3.3	0.05	0.1	0.11
2800	1400	3.7	0.06	0.1	0.14
3150	1575	4.2	0.08	0.1	0.17
3500	1750	4.7	0.09	0.1	0.21
3850	1925	5.1	0.11	0.1	0.26
4200	2100	5.6	0.13	0.2	0.30
4550	2275	6.0	0.15	0.2	0.35
4900	2450	6.5	0.17	0.2	0.41
5250	2625	7.0	0.19	0.3	0.47
5600	2800	7.4	0.22	0.3	0.53
5950	2975	7.9	0.25	0.3	0.60
6300	3150	8.4	0.27	0.4	0.66
6650	3325	8.8	0.30	0.4	0.74
7000	3500	9.3	0.33	0.5	0.82

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	1	0.10	0.10
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	0	0.21	0.00
Tee (branch)	0	0.78	0.00
Tee (flow thru)	1	0.26	0.26
Valves (check)	0	1.30	0.00
Misc.	0	0.00	0.00
			0.36

Pipe Section 7 Filter #2 to #1 effluent

Nominal Diameter	12	inches	
Pipe Type	Ductile Iron		
Actual Diameter	12.4	inches	
Length	15	ft	
C	130		
K	0.26		

Flow Modifier: Multiply — *gpm or value*: 0.75

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	262.5	0.7	0.00	0.0	0.00
700	525	1.4	0.01	0.0	0.02
1050	787.5	2.1	0.02	0.0	0.04
1400	1050	2.8	0.04	0.0	0.07
1750	1312.5	3.5	0.05	0.0	0.10
2100	1575	4.2	0.08	0.1	0.15
2450	1837.5	4.9	0.10	0.1	0.20
2800	2100	5.6	0.13	0.1	0.25
3150	2362.5	6.3	0.16	0.2	0.32
3500	2625	7.0	0.19	0.2	0.39
3850	2887.5	7.7	0.23	0.2	0.47
4200	3150	8.4	0.27	0.3	0.56
4550	3412.5	9.1	0.32	0.3	0.65
4900	3675	9.8	0.36	0.4	0.75
5250	3937.5	10.5	0.41	0.4	0.85
5600	4200	11.2	0.46	0.5	0.97
5950	4462.5	11.9	0.52	0.6	1.09
6300	4725	12.6	0.58	0.6	1.21
6650	4987.5	13.3	0.64	0.7	1.35
7000	5250	14.0	0.70	0.8	1.49

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	0	0.21	0.00
Tee (branch)	0	0.78	0.00
Tee (flow thru)	1	0.26	0.26
Valves (check)	0	1.30	0.00
Misc.	0	0.00	0.00
			0.26

Pipe Section 8 Greensand to GAC #1 Flow Modifier *gpm or value*
Nominal Diameter **12** inches Add 0
Pipe Type **Ductile Iron**
Actual Diameter 12.4 inches
Length **80** ft
C 130
K 1.82

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	0.9	0.02	0.0	0.05
700	700	1.9	0.09	0.1	0.19
1050	1050	2.8	0.19	0.2	0.41
1400	1400	3.7	0.32	0.4	0.72
1750	1750	4.7	0.49	0.6	1.10
2100	2100	5.6	0.69	0.9	1.57
2450	2450	6.5	0.91	1.2	2.11
2800	2800	7.4	1.17	1.6	2.74
3150	3150	8.4	1.45	2.0	3.44
3500	3500	9.3	1.77	2.4	4.21
3850	3850	10.2	2.11	3.0	5.07
4200	4200	11.2	2.48	3.5	6.00
4550	4550	12.1	2.87	4.1	7.01
4900	4900	13.0	3.29	4.8	8.09
5250	5250	14.0	3.74	5.5	9.25
5600	5600	14.9	4.22	6.3	10.48
5950	5950	15.8	4.72	7.1	11.79
6300	6300	16.7	5.24	7.9	13.17
6650	6650	17.7	5.80	8.8	14.63
7000	7000	18.6	6.37	9.8	16.16

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	4	0.39	1.56
45 Deg. Bends	0	0.21	0.00
Tee (branch)	0	0.78	0.00
Tee (flow thru)	1	0.26	0.26
Valves (check)	0	1.30	0.00
Misc.	0	0	0.00
			1.82

Pipe Section 9 GAC #1 to GAC #2 influent Flow Modifier *gpm or value*
Nominal Diameter **8** inches Divide 2
Pipe Type **Ductile Iron**
Actual Diameter 8.33 inches
Length **51.83** ft
C 130
K 1.27

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	175	1.0	0.03	0.0	0.05
700	350	2.1	0.11	0.1	0.20
1050	525	3.1	0.24	0.2	0.43
1400	700	4.1	0.40	0.3	0.74
1750	875	5.2	0.61	0.5	1.13
2100	1050	6.2	0.86	0.8	1.61
2450	1225	7.2	1.14	1.0	2.16
2800	1400	8.2	1.46	1.3	2.80
3150	1575	9.3	1.81	1.7	3.51
3500	1750	10.3	2.20	2.1	4.30
3850	1925	11.3	2.63	2.5	5.16
4200	2100	12.4	3.08	3.0	6.10
4550	2275	13.4	3.58	3.5	7.12
4900	2450	14.4	4.10	4.1	8.21
5250	2625	15.5	4.66	4.7	9.38
5600	2800	16.5	5.25	5.4	10.62
5950	2975	17.5	5.88	6.1	11.93
6300	3150	18.6	6.53	6.8	13.32
6650	3325	19.6	7.22	7.6	14.78
7000	3500	20.6	7.94	8.4	16.32

Minor Losses, 8":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.11	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.63	0.00
Valves (plug)	0	0.89	0.00
90 Deg. Bends	3	0.42	1.26
45 Deg. Bends	0	0.22	0.00
Tee (branch)	0	0.84	0.00
Tee (flow thru)	0	0.28	0.00
Valves (check)	0	1.40	0.00
12" x 8" reducer	1	0.01	0.01
			1.27

Pipe Section 10 16" x 12" reducer to existing 12" main on Flow Modifier *gpm or value*

Nominal Diameter **12** inches Divide 2

Pipe Type **Ductile Iron**

Actual Diameter 12.4 inches

Length **35.75** ft

C 130

K 1.09

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	175	0.5	0.00	0.0	0.01
700	350	0.9	0.01	0.0	0.03
1050	525	1.4	0.02	0.0	0.06
1400	700	1.9	0.04	0.1	0.10
1750	875	2.3	0.06	0.1	0.15
2100	1050	2.8	0.09	0.1	0.22
2450	1225	3.3	0.11	0.2	0.29
2800	1400	3.7	0.15	0.2	0.38
3150	1575	4.2	0.18	0.3	0.48
3500	1750	4.7	0.22	0.4	0.59
3850	1925	5.1	0.26	0.4	0.70
4200	2100	5.6	0.31	0.5	0.83
4550	2275	6.0	0.36	0.6	0.98
4900	2450	6.5	0.41	0.7	1.13
5250	2625	7.0	0.46	0.8	1.29
5600	2800	7.4	0.52	0.9	1.46
5950	2975	7.9	0.58	1.1	1.64
6300	3150	8.4	0.65	1.2	1.84
6650	3325	8.8	0.72	1.3	2.04
7000	3500	9.3	0.79	1.5	2.26

Minor Losses, 12":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	1	0.10	0.10
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.08	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	1	0.21	0.21
Tee (branch)	1	0.78	0.78
Tee (flow thru)	0	0.26	0.00
Valves (check)	0	1.30	0.00
Misc.	0	0.00	0.00
			1.09

Pipe Section 11 GAC #2 influent, GAC media, effluent Flow Modifier *gpm or value*

Nominal Diameter **8** inches Divide 2

Pipe Type **Ductile Iron**

Actual Diameter 8.33 inches

Length **101** ft

C 130

K 40.00

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)	Bed Headloss each
0	0	0.0	0.00	0.0	0.00	0.00
350	175	1.0	0.06	0.7	3.35	1.31
700	350	2.1	0.22	2.6	8.14	2.64
1050	525	3.1	0.46	5.9	14.37	3.98
1400	700	4.1	0.79	10.6	22.03	5.34
1750	875	5.2	1.19	16.5	31.12	6.71
2100	1050	6.2	1.67	23.8	41.63	8.10
2450	1225	7.2	2.22	32.3	53.57	9.50
2800	1400	8.2	2.84	42.2	66.93	10.92
3150	1575	9.3	3.53	53.5	81.70	12.36
3500	1750	10.3	4.29	66.0	97.90	13.81
3850	1925	11.3	5.12	79.9	115.52	15.27
4200	2100	12.4	6.01	95.0	134.55	16.75
4550	2275	13.4	6.97	111.5	155.00	18.24
4900	2450	14.4	7.99	129.4	176.86	19.75
5250	2625	15.5	9.08	148.5	200.14	21.28
5600	2800	16.5	10.23	169.0	224.83	22.82
5950	2975	17.5	11.45	190.7	250.93	24.37
6300	3150	18.6	12.73	213.8	278.45	25.94
6650	3325	19.6	14.06	238.3	307.38	27.53
7000	3500	20.6	15.46	264.0	337.72	29.13

Minor Losses, 8":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.11	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.63	0.00
Valves (plug)	0	0.89	0.00
90 Deg. Bends	0	0.42	0.00
45 Deg. Bends	0	0.22	0.00
Tee (branch)	0	0.84	0.00
Tee (flow thru)	0	0.28	0.00
Basket strainer/fittings/pipe	2	20.00	40.00
misc	0	0	0.00
			40.00

Pipe Section 12 Finished water GAC #2 to GAC #1 Flow Modifier *gpm or value*

Nominal Diameter **16** inches Multiply 0.5

Pipe Type **Ductile Iron**

Actual Diameter 16.54 inches

Length **36** ft

C 130

K 1.04

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	175	0.3	0.00	0.0	0.00
700	350	0.5	0.00	0.0	0.01
1050	525	0.8	0.01	0.0	0.02
1400	700	1.0	0.01	0.0	0.03
1750	875	1.3	0.02	0.0	0.04
2100	1050	1.6	0.02	0.0	0.06
2450	1225	1.8	0.03	0.1	0.08
2800	1400	2.1	0.04	0.1	0.11
3150	1575	2.4	0.04	0.1	0.13
3500	1750	2.6	0.05	0.1	0.16
3850	1925	2.9	0.06	0.1	0.20
4200	2100	3.1	0.08	0.2	0.24
4550	2275	3.4	0.09	0.2	0.27
4900	2450	3.7	0.10	0.2	0.32
5250	2625	3.9	0.12	0.2	0.36
5600	2800	4.2	0.13	0.3	0.41
5950	2975	4.4	0.14	0.3	0.46
6300	3150	4.7	0.16	0.4	0.52
6650	3325	5.0	0.18	0.4	0.58
7000	3500	5.2	0.20	0.4	0.64

Minor Losses, 16":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.10	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	0	0.21	0.00
Tee (branch)	1	0.78	0.78
Tee (flow thru)	1	0.26	0.26
Valves (check)	0	1.30	0.00
Misc.	0	0	0.00
			1.04

Pipe Section 13 GAC #1 to flow meter Flow Modifier *gpm or value*

Nominal Diameter **16** inches Add 0

Pipe Type **Ductile Iron**

Actual Diameter 16.54 inches

Length **26** ft

C 130

K 0.19

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	0.5	0.00	0.0	0.00
700	700	1.0	0.01	0.0	0.01
1050	1050	1.6	0.02	0.0	0.02
1400	1400	2.1	0.03	0.0	0.04
1750	1750	2.6	0.04	0.0	0.06
2100	2100	3.1	0.05	0.0	0.08
2450	2450	3.7	0.07	0.0	0.11
2800	2800	4.2	0.09	0.1	0.15
3150	3150	4.7	0.12	0.1	0.18
3500	3500	5.2	0.14	0.1	0.22
3850	3850	5.8	0.17	0.1	0.27
4200	4200	6.3	0.20	0.1	0.31
4550	4550	6.8	0.23	0.1	0.37
4900	4900	7.3	0.26	0.2	0.42
5250	5250	7.8	0.30	0.2	0.48
5600	5600	8.4	0.34	0.2	0.54
5950	5950	8.9	0.38	0.2	0.61
6300	6300	9.4	0.42	0.3	0.68
6650	6650	9.9	0.46	0.3	0.76
7000	7000	10.5	0.51	0.3	0.83

Minor Losses, 16":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.10	0.00
90 Deg. Bends	0	0.39	0.00
45 Deg. Bends	0	0.21	0.00
Tee (branch)	0	0.78	0.00
Tee (flow thru)	0	0.26	0.00
Valves (check)	0	1.30	0.00
16"x8" reducer	1	0.19	0.19
			0.19

Pipe Section 14 Flow meter Flow Modifier *gpm or value*
Nominal Diameter **8** inches Add 0
Pipe Type **Ductile Iron**
Actual Diameter 8.33 inches
Length **0** ft
C 130
K 0.30

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	2.1	0.00	0.0	0.02
700	700	4.1	0.00	0.1	0.08
1050	1050	6.2	0.00	0.2	0.18
1400	1400	8.2	0.00	0.3	0.32
1750	1750	10.3	0.00	0.5	0.50
2100	2100	12.4	0.00	0.7	0.71
2450	2450	14.4	0.00	1.0	0.97
2800	2800	16.5	0.00	1.3	1.27
3150	3150	18.6	0.00	1.6	1.60
3500	3500	20.6	0.00	2.0	1.98
3850	3850	22.7	0.00	2.4	2.40
4200	4200	24.7	0.00	2.9	2.85
4550	4550	26.8	0.00	3.3	3.35
4900	4900	28.9	0.00	3.9	3.88
5250	5250	30.9	0.00	4.5	4.46
5600	5600	33.0	0.00	5.1	5.07
5950	5950	35.0	0.00	5.7	5.72
6300	6300	37.1	0.00	6.4	6.42
6650	6650	39.2	0.00	7.1	7.15
7000	7000	41.2	0.00	7.9	7.92

Minor Losses, 8":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.11	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.63	0.00
Valves (plug)	0	0.89	0.00
90 Deg. Bends	0	0.42	0.00
45 Deg. Bends	0	0.22	0.00
Tee (branch)	0	0.84	0.00
Tee (flow thru)	1	0.28	0.28
Valves (check)	0	1.40	0.00
8"x16" expansion	1	0.02	0.02
			0.30

Pipe Section 15 Building to Michigan St. Flow Modifier *gpm or value*
Nominal Diameter **16** inches Add 0
Pipe Type **Ductile Iron**
Actual Diameter 16.54 inches
Length **475** ft
C 130
K 1.77

Flow (gpm)	Flow (gpm, w/ mod)	Velocity (fps)	Friction Loss (ft)	Fitting Loss (ft)	Total Head Loss (ft)
0	0	0.0	0.00	0.0	0.00
350	350	0.5	0.04	0.0	0.04
700	700	1.0	0.13	0.0	0.16
1050	1050	1.6	0.28	0.1	0.35
1400	1400	2.1	0.47	0.1	0.59
1750	1750	2.6	0.72	0.2	0.90
2100	2100	3.1	1.00	0.3	1.27
2450	2450	3.7	1.34	0.4	1.70
2800	2800	4.2	1.71	0.5	2.19
3150	3150	4.7	2.13	0.6	2.74
3500	3500	5.2	2.58	0.8	3.34
3850	3850	5.8	3.08	0.9	3.99
4200	4200	6.3	3.62	1.1	4.70
4550	4550	6.8	4.20	1.3	5.47
4900	4900	7.3	4.82	1.5	6.29
5250	5250	7.8	5.47	1.7	7.16
5600	5600	8.4	6.17	1.9	8.09
5950	5950	8.9	6.90	2.2	9.07
6300	6300	9.4	7.67	2.4	10.10
6650	6650	9.9	8.47	2.7	11.19
7000	7000	10.5	9.32	3.0	12.32

Minor Losses, 16":

Fittings:	Number	K value	K Sum
Pipe Entrance	0	0.78	0.00
Pipe Exit	0	1.00	0.00
Valves (gate)	0	0.10	0.00
Valves (ball)	0	0.04	0.00
Valves (butterfly)	0	0.35	0.00
Valves (plug)	0	1.10	0.00
90 Deg. Bends	2	0.39	0.78
45 Deg. Bends	2	0.21	0.42
Tee (branch)	0	0.78	0.00
Tee (flow thru)	2	0.26	0.52
Valves (check)	0	1.30	0.00
16" x 12" reducer	1	0.05	0.05
			1.77

APPENDIX B

Hydraulic Model Analysis

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

Memorandum

Date:	September 22, 2021
To:	Anna Crandall
Company:	City of Kalamazoo Water Resources Division
From:	Julie Feria
Project #:	2180076
Re:	PS 5 Rebuild Hydraulic Model Analysis

Pump Station (PS) 5 is being rebuilt in the Intermediate Pressure District. To inform the design of the station rebuild, the hydraulic model of the City of Kalamazoo Water System was used to simulate the needed total dynamic head (TDH) of the pump station and to simulate the impact of different PS 5 flow rates on cycling of the Mt. Olivet and Parchment elevated tanks.

Assumptions

1. Stations 10 and 23 were assumed to be closed for all scenarios, isolating the Intermediate Pressure District and the City of Parchment from the rest of the water system.
2. PS 14 was assumed to be closed for some scenarios and was assumed to be utilized as a peaking station for other scenarios. The eventual goal is to provide treatment for water from both PS 14 and PS 5 at the current PS 5 site.
3. Average day and maximum demands for the Intermediate Pressure District and the City of Parchment were taken from the 2017 Water System Reliability Study.
    a. Average Day Demand: 1,260 gpm
    b. Maximum Day Demand: 2,800 gpm
4. Tank trend graphs are based on a simulated diurnal curve, with an hourly peaking factor of 1.7 times the average day or maximum day demand.

Analysis with PS 14 as a Peaking Station

If the design flow rate of PS 5 is unable to meet projected demands, PS 14 will need to be utilized as a peaking station, turning on when the Mt. Olivet Tank level drops below 70% full. The model was used to simulate the following flow rates at PS 5 with PS 14 as a peaking station: 700 gpm, 1,000 gpm, and 1,400 gpm. Table 1 show the modeled discharge head elevation at PS 5 for each flow rate, to be used in selecting the design TDH. Figures 1A and 1B illustrate simulated tank levels for each flow rate for average day and maximum day demands, respectively.

See Basis of Design Hydraulic Calculations (Appendix A).

Table 1. Modeled Discharge Elevation Range with PS 14 as a Peaking Station

Scenario	PS 5 Flow Rate (gpm)	Modeled Discharge Head Elevation (ft)
Maximum TDH	700	981
Minimum TDH	700	895
Maximum TDH	1,000	992
Minimum TDH	1,000	907
Maximum TDH	1,400	1,012
Minimum TDH	1,400	924
Maximum TDH	1,800	1,038
Minimum TDH	1,800	943

Notes:
1. Maximum TDH scenario assumes system demand is zero, and tanks are 95% full.
2. Minimum TDH scenario assumes peak hour system demand with tanks at 60% full.
3. PS 14 assumed to be off for TDH calculation scenarios.
4. The PS 5 pump elevation is approximately 762 feet.
5. Discharge head elevation does not include station losses.

Proposed Oxidation tank FF = 774.5 with water level maintained at 15' via use of VFDs on High Service Pumps for a pumping level of 789.5 in the tank.

The modeled discharge head elevations for PS 5 flow rates of 1,000 gpm and 1,400 gpm result in discharge pressures over 100 psi. A significant cause of head loss is the lack of transmission between PS 5 and the Mt. Olivet Tank. The 8-inch main on Mt. Olivet Road in particular results in high head loss at high flow rates. Transmission improvements are recommended to prevent high pressures if the flow rate of PS 5 is increased from existing conditions.

As shown in Figure 1A, PS 14 does not turn on as often when PS 5 is operating at 1,400 gpm, resulting in tank levels remaining low throughout the day. This could be addressed with a higher "pump on" elevation setting for PS 14. Even with PS 14 as a peaking station, the simulated flow rates of 700 gpm and 1,000 gpm at PS 5 are not sufficient to keep tank levels up during maximum day demands. Figure 1B shows that PS 5 at 1,400 gpm results in the Mt. Olivet Tank level dropping to 957.5 feet. A flow rate of 1,800 gpm is needed to keep the Mt. Olivet Tank low level at 959 feet, under simulated demand patterns.

Analysis with PS 14 Closed (PS 5 only Supply Location)

Since PS 14 is currently master planned to be piped to PS 5 for treatment, the model was also used to look at flow rates greater than 1,400 gpm at PS 5. Due to the need for more transmission between PS 5 and the Mt. Olivet Tank to reduce discharge pressures, future transmission routes of 12-inch main and 16-inch main between PS 5 and the Mt. Olivet Tank were also simulated.

Table 2 provides the modeled discharge head elevation for PS 5 at flow rates of 2,800 gpm and 3,800 gpm for existing water main, a future 12-inch transmission route, and a future 16-inch transmission route. The 3,800 gpm flow rate was selected due to its ability to maintain the Mt. Olivet Tank at 60% full during maximum day demands. Discharge head elevations show that

transmission improvements are necessary at these higher flow rates to maintain pressures below 150 psi at the PS 5 discharge.

Figure 2 shows tank trending for PS 5 at 2,800 gpm under average day demand conditions. Figure 3 illustrates trending for PS 5 at 2,800 gpm under existing maximum day demand conditions with transmission improvements, and Figure 4 shows trending for PS 5 at 3,800 gpm under existing and projected maximum day demand conditions with transmission improvements.

Table 2. Modeled Discharge Elevation Range with PS 5 as the Only Station

Scenario	Transmission Alternative	PS 5 Flow Rate (gpm)	Modeled Discharge Head Elevation (ft)
Maximum TDH	Existing Water Main	2,800	1,124
Minimum TDH	Existing Water Main	2,800	990
Maximum TDH	Existing Water Main	3,800	1,241
Minimum TDH	Existing Water Main	3,800	1,049
Maximum TDH	12” Transmission	2,800	1,032
Minimum TDH	12” Transmission	2,800	970
Maximum TDH	12” Transmission	3,800	1,080
Minimum TDH	12” Transmission	3,800	994
Maximum TDH	16” Transmission	2,800	994
Minimum TDH	16” Transmission	2,800	964
Maximum TDH	16” Transmission	3,800	1,012
Minimum TDH	16” Transmission	3,800	973

Notes:
1. Maximum TDH scenario assumes system demand is zero, and tanks are 95% full.
2. Minimum TDH scenario assumes peak hour system demand with tanks at 60% full.
3. The PS 5 pump elevation is approximately 762 feet.
4. Discharge head elevation does not include station losses.
5. The transmission route was modeled as the most direct route between PS 5 and the Mt. Olivet Tank.

Conclusion

According to the existing hydraulic model, to maintain tank levels at 70% full for average day demands and 60% full for maximum day demands, PS 5 must be able to provide approximately 1,800 gpm if PS 14 will be maintained as a separate peaking station. PS 5 must be able to provide approximately 3,800 gpm when PS 14 is piped to PS 5 for treatment. Calibration of the model to current tank trending and demand patterns would give more confidence in selecting a specific flow rate for design. Transmission improvements between PS 5 and the Mt. Olivet Tank are recommended to keep discharge pressures at PS 5 within an acceptable range, especially if PS 5 is the only supply location.

Figure 1A: Simulated Tank Levels with PS 14 as Peaking Station (Average Day Demand)

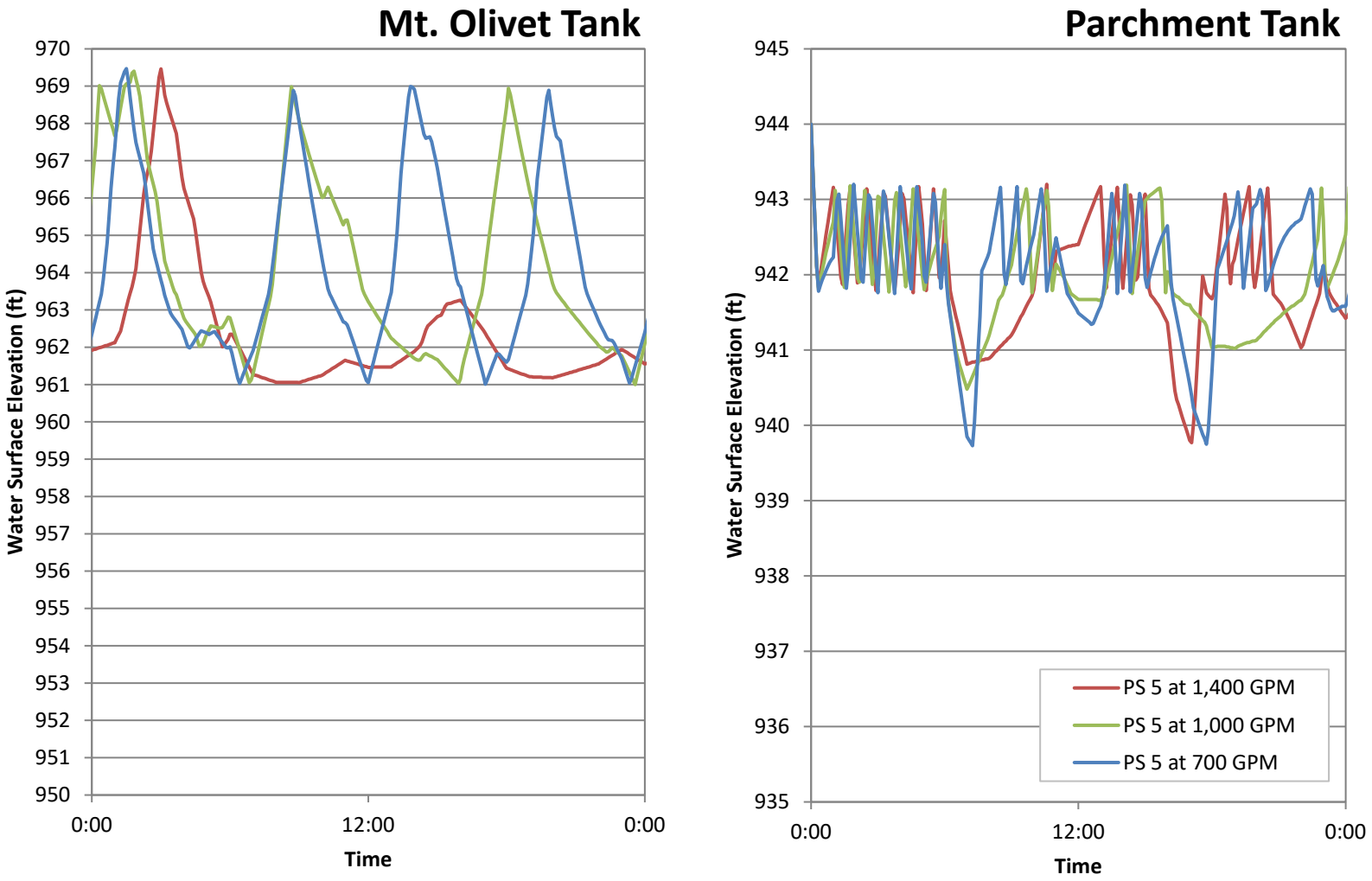


Figure 1B: Simulated Tank Levels with PS 14 as Peaking Station (Maximum Day Demand)

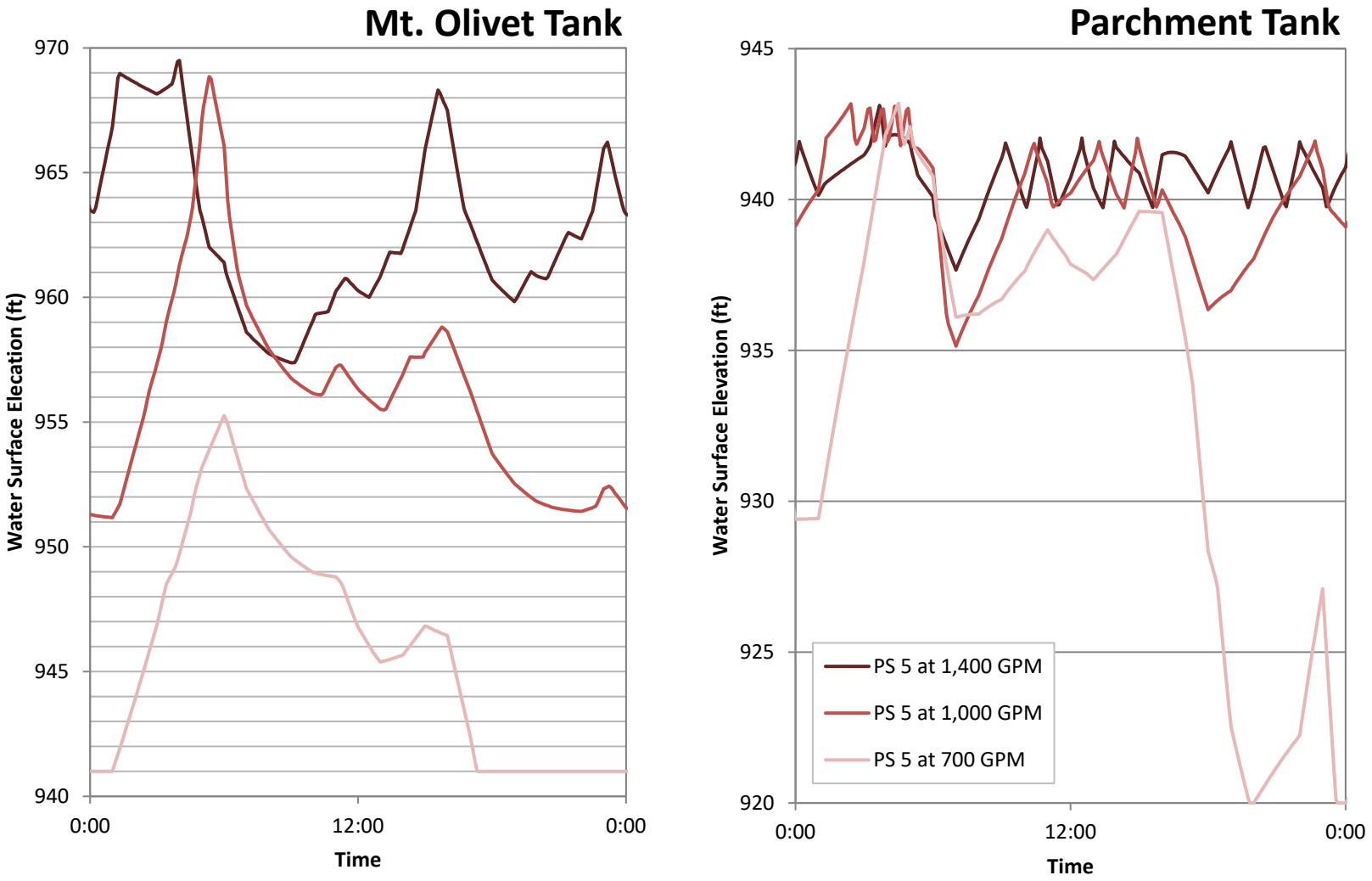


Figure 2: Simulated Tank Levels with PS 5 at 2,800 gpm (Average Day Demand)

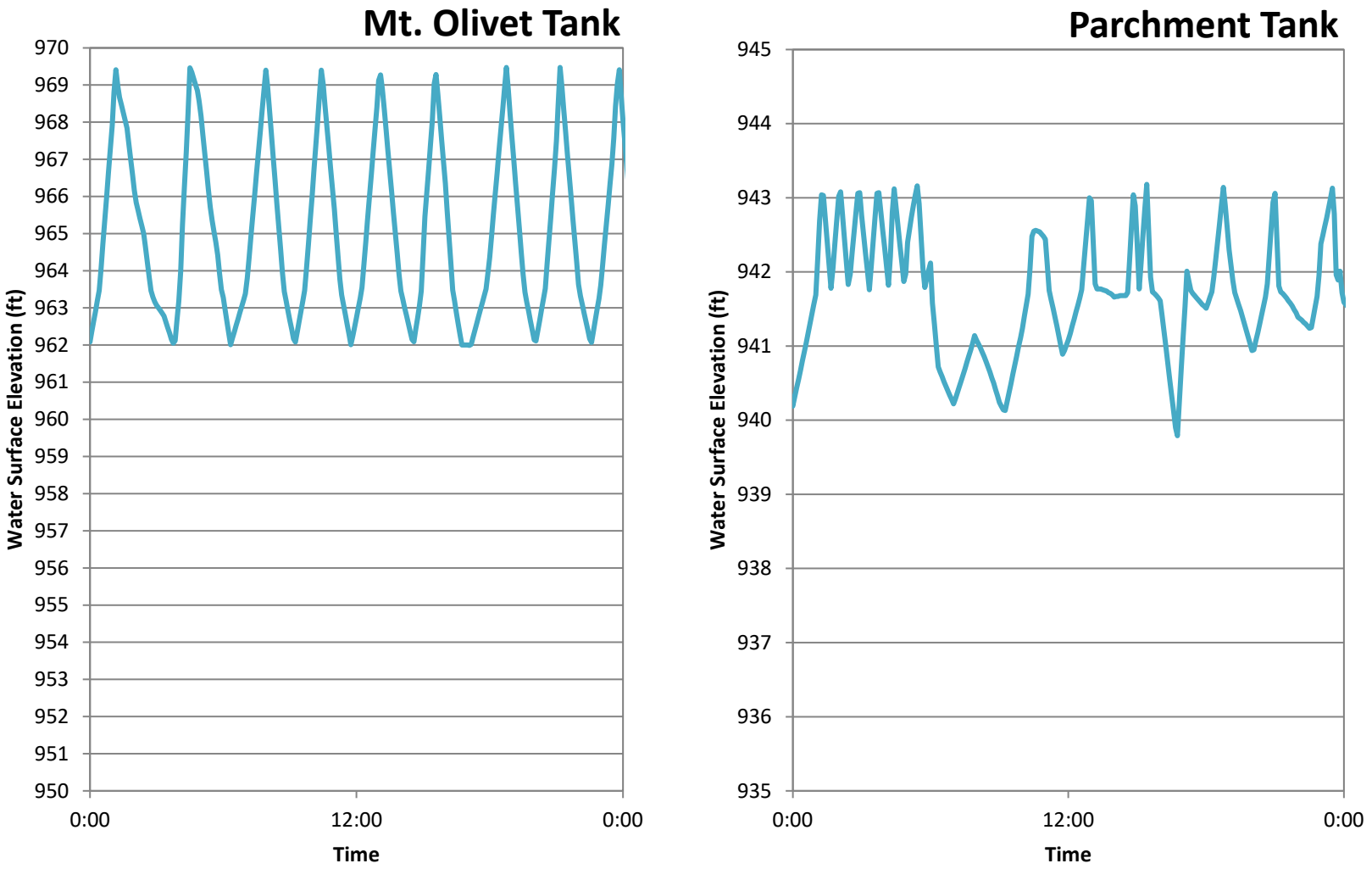


Figure 3: Simulated Tank Levels with PS 5 at 2,800 gpm with Transmission Improvements (Existing Maximum Day Demand)

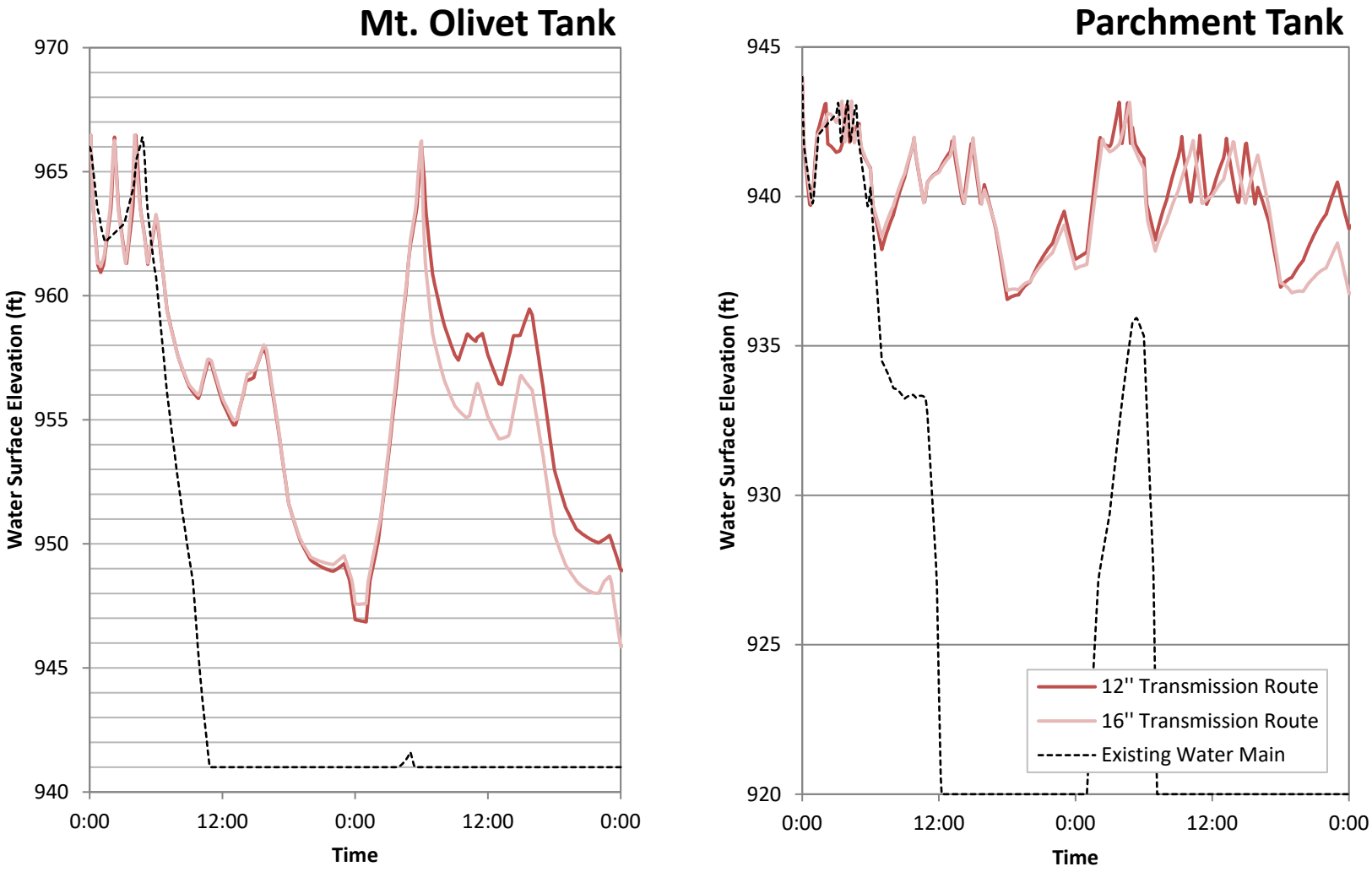
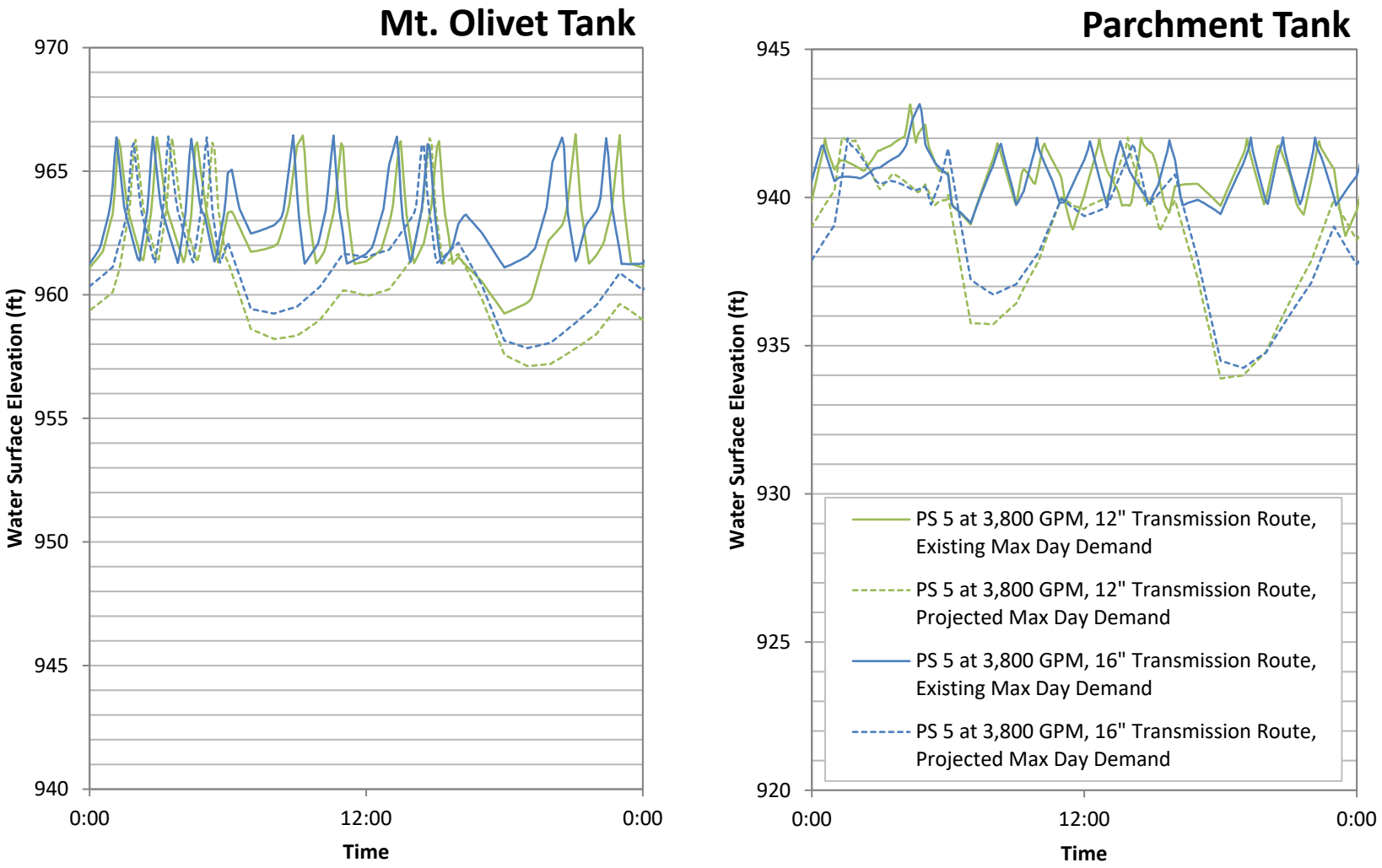


Figure 4: Simulated Tank Levels with PS 5 at 3,800 gpm with Transmission Improvements (Existing and Projected Maximum Day Demand)



APPENDIX C

ACT Study

CONFIDENTIAL

Calgon Carbon Corporation

Pittsburgh, PA

Technical Service Report No. 20200454

ACT Study: Removal of Per- and Polyfluoroalkyl Substances and TOC from Potable Drinking Water Using F400 Granular Activated Carbon

Prepared For:

Kalamazoo, MI - Water Treatment Plant

Author: Adam Creveling

Adam Creveling

Date: May 1, 2020

cc: J. Gray
A. Lynn
R. DiStefano
R. Klingbeil
S. Briczinski Kalamazoo ACT20200454 SB20209

INTRODUCTION

Calgon Carbon Corporation, hereinafter CCC, conducted an Accelerated Column Test (ACT) at the request of the Kalamazoo Water Treatment Plant to determine the performance of Filtrasorb 400 (F400) granular activated carbon (GAC) for the removal of total organic carbon (TOC) and Per- and Polyfluoroalkyl Substances (PFAS) from drinking water sourced from the treatment plant. The ACT simulated a M12-40 system with a flow rate of 700 gpm operating for two years.

Filtrasorb F400 is a 12x40 mesh granular activated carbon with a 1000 Iodine number that is commonly used in municipal water applications. F400 is manufactured from select grades of bituminous coal through CCC's reagglomeration process.

Due to their useful properties, such as oil and water repellency, PFAS have been used in a variety of manufacturing processes since the mid-20th century. Some PFAS are problematic because of their stability and persistence in the environment, mobility, and bioaccumulative nature. Pefluoroalkyl substances, where every carbon atom in the chain is saturated with fluorine atoms, are generally separated into two main categories: perfluoroalkyl sulfonates and perfluoroalkyl carboxylates, of which PFOS and PFOA are respective examples. The EPA Health Advisory Exposure Limit for combined perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) is 70 ng/L (ppt) in treated water. In addition, the Michigan PFAS Action Response Team Science Advisory Work Group (MPART SAWG) provided the health-based values (HBV) listed in Table 1. These are being used as a starting point for the rulemaking process, as Michigan works toward draft Maximum Contaminant Levels for PFAS.

Table 1. HBVs for PFAS in Michigan

PFAS Name		Potable water HBV
Perfluorononanoic acid	PFNA	6 ppt
Perfluorooctanoic acid	PFOA	8 ppt
Perfluorooctanesulfonic acid	PFOS	16 ppt
Perfluorohexanesulfonic acid	PFHxS	51 ppt
Hexafluoropropylene oxide dimer	GenX	370 ppt
Perfluorobutanesulfonic acid	PFBS	420 ppt
Perfluorohexanoic acid	PFHxA	400,000 ppt

SUMMARY and CONCLUSIONS

The ACT was conducted using virgin F400 activated carbon to determine the effective bed life for the removal of the target PFAS compounds, PFBS, PFHxS, PFOA, and PFOS spiked in the water. The column test was designed to simulate treatment through a 12-ft. GAC adsorption vessel containing 40,000 lbs. of GAC (Model 12-40), operating at 700 gpm and providing 12.1

minutes of Empty Bed Contact Time (EBCT) based on apparent density (AD) packing; 14.0 minutes after back-washing and bed expansion. The feed water was spiked with an additional 25 ppt PFBS, 25 ppt PFHxS, 25 ppt PFOA, and 25 ppt PFOS to ensure breakthrough would be achieved for most compounds during the study. Complete simulation details are shown in Table 3. At completion, the ACT simulated 770 days of operation and 776 million gallons of water treated.

PFAS and TOC breakthrough curves are shown in Figure 1 and raw data is shown in Table 2. PFOS is not shown because breakthrough was never detected in the effluent.

The following conclusions may be drawn from the test results:

- The TOC in the feed was measured to be 0.92 ppm. After spiking, the PFAS concentrations were PFBS (26.3 ppt), PFHxS (21.3 ppt), PFOA (22.3 ppt), and PFOS (24.3 ppt).
- PFAS compounds were successfully removed by F400 GAC. PFOS in the effluent remained below the limit of detection of ~1.8 ppt for the entire duration of the ACT. PFOA was detected after 474 simulated days (478 million gallons treated) and approached the HBV of 8 ppt by the end of the 770-day simulation (Figure 1). PFHxS was detected in the effluent after 529 simulated days (533 million gallons treated) and PFBS was detected after 309 days (311 million gallons treated). The mass transfer zone (MTZ) for PFOA occupies 53% of the adsorber (7.3 minutes), and the MTZ for PFBS occupies 42% of the adsorber (5.9 minutes).
- Carbon change out at 474 days (478 million gallons treated) based on PFOA effluent detection corresponds to a Carbon Usage Rate (CUR) of 0.083 lb. GAC / 1000 gallons treated, and carbon change out at 770 days corresponds to a CUR of 0.051 lb. GAC / 1000 gallons treated based on the average feed PFOA concentration of 22.3 ppt.

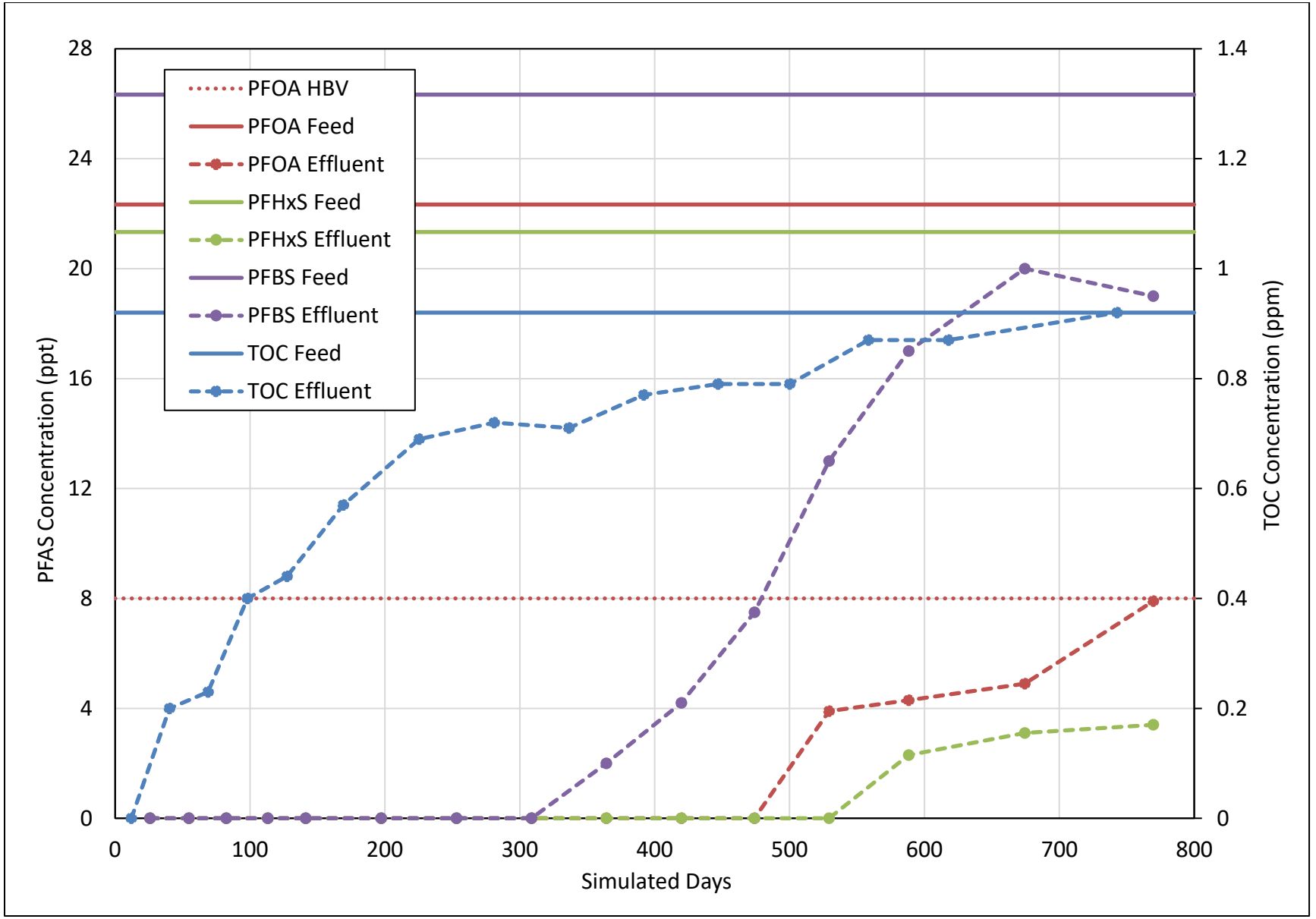


Figure 1. PFAS Concentration vs Simulated Days

Table 2. Raw data

Sample	Date & Time Collected	Simulated Days of Operation	Simulated Gallons Treated (x1,000,000)	Bed Volumes Treated	TOC (ppm)	Perfluorobutanesulfonic acid (ppt)	Perfluorohexanesulfonic acid (ppt)	Perfluorohexanoic acid (ppt)	Perfluorooctanesulfonamide (ppt)	Perfluorooctanesulfonic acid (ppt)	Perfluorooctanoic acid (ppt)	Perfluoropentanoic acid (ppt)
						PFBS	PFHxS	PFHxA	PFOSA	PFOS	PFOA	PFPnA
Feed 1	2/5/2020	--	--	--	0.87	29	21	1.9	14	22	21	2.0
Feed 2	2/6/2020	--	--	--	0.97	--	--	--	--	--	--	--
Feed 3	3/6/2020	--	--	--	0.88	27	23	2.1	<1.8	22	24	<1.8
Feed 4	3/31/2020	--	--	--	0.96	23	20	<1.8	2.2	29	22	<1.8
3	2/6/20 8:00	12.1	12.2	1,424	<0.1	--	--	--	--	--	--	--
4	2/7/20 8:00	25.9	26.1	3,064	--	<1.9	<1.9	<2.6	6.3	<1.9	<1.9	<1.9
5	2/8/20 8:00	40.2	40.5	4,838	0.20	--	--	--	--	--	--	--
6	2/9/20 8:00	54.6	55.0	6,612	--	<1.8	<1.8	<1.8	7.0	<1.8	<1.8	<1.8
7	2/10/20 8:00	68.9	69.5	8,386	0.23	--	--	--	--	--	--	--
8	2/11/20 8:00	82.4	83.0	9,941	--	<1.9	<1.9	<1.9	4.2	<1.9	<1.9	<1.9
9	2/12/20 8:00	98.1	98.9	12,079	0.40	--	--	--	--	--	--	--
10	2/13/20 8:00	113	114	14,014	--	<1.7	<1.7	<1.7	2.1	<1.7	<1.7	<1.7
11	2/14/20 8:00	127	128	15,762	0.44	--	--	--	--	--	--	--
12	2/15/20 8:00	141	142	17,433	--	<1.8	<1.8	<1.8	3.8	<1.8	<1.8	<1.8
13	2/17/20 8:00	169	171	20,776	0.57	--	--	--	--	--	--	--
14	2/19/20 8:00	197	199	24,152	--	<1.8	<1.8	<1.8	3.4	<1.8	<1.8	<1.8
15	2/21/20 8:00	225	227	27,548	0.69	--	--	--	--	--	--	--

Sample	Date & Time Collected	Simulated Days of Operation	Simulated Gallons Treated (x1,000,000)	Bed Volumes Treated	TOC (ppm)	Perfluorobutanesulfonic acid (ppt)	Perfluorohexanesulfonic acid (ppt)	Perfluorohexanoic acid (ppt)	Perfluorooctanesulfonamide (ppt)	Perfluorooctanesulfonic acid (ppt)	Perfluorooctanoic acid (ppt)	Perfluoropentanoic acid (ppt)
						PFBS	PFHxS	PFHxA	PFOSA	PFOS	PFOA	PFPnA
16	2/23/20 8:00	253	255	30,887	--	<1.8	<1.8	<1.8	3.1	<1.8	<1.8	<1.8
17	2/25/20 8:00	281	283	34,227	0.72	--	--	--	--	--	--	--
18	2/27/20 8:00	309	311	37,533	--	<1.8	<1.8	<1.8	4.0	<1.8	<1.8	<1.8
19	2/29/20 8:00	336	339	40,839	0.71	--	--	--	--	--	--	--
20	3/2/20 8:00	364	367	44,145	--	2.0	<1.9	<1.9	3.0	<1.9	<1.9	<1.9
21	3/4/20 8:00	392	395	47,462	0.77	--	--	--	--	--	--	--
22	3/6/20 8:00	420	423	50,798	--	4.2	<1.8	<1.8	6.2	<1.8	<1.8	1.9
23	3/8/20 8:00	447	451	53,968	0.79	--	--	--	--	--	--	--
24	3/10/20 8:00	474	478	57,139	--	7.5	<1.9	<1.9	3.0	<1.9	<1.9	2.1
25	3/12/20 8:00	500	504	60,043	0.79	--	--	--	--	--	--	--
26	3/14/20 8:00	529	533	63,710	--	13	<1.8	<1.8	2.4	<1.8	3.9	2.4
27	3/16/20 8:00	558	563	67,377	0.87	--	--	--	--	--	--	--
28	3/18/20 8:00	588	593	71,207	--	17	2.3	1.9	3	<1.8	4.3	2.3
29	3/20/20 8:00	618	623	74,989	0.87	--	--	--	--	--	--	--
31	3/24/20 8:00	674	680	81,865	--	20	3.1	<1.9	4.1	<1.9	4.9	2.1
33	3/29/20 8:00	743	749	89,907	0.92	--	--	--	--	--	--	--
34	3/31/20 8:00	770	776	93,008	--	19	3.4	<2.0	<2.0	<2.0	7.9	<2.0

Table 3. ACT design parameters

Parameter	Full-Scale Adsorber	ACT
ACT Scale Factor	--	14.1
Carbon Mesh Size	12x40	100x325
Mean Particle Diameter	1.11 mm	0.10 mm
*Carbon A.D.	0.577 g/mL	0.567 g/mL
Adsorber I.D.	12 ft	0.46 cm
Weight of Carbon in Adsorber	40,000 lbs.	2.00 g
Flow Rate	700 gpm	4.2 mL/min
EBCT	13.96 min	50 sec
Operation Time	770 days	55 days
Volume of Water Treated	776 million gallons	87 gallons

*****Full-scale uses the average AD for F400, ACT uses the specific AD of the carbon

EXPERIMENTAL

ACT Design

The ACT simulated a 12-ft. adsorber containing 40,000 lbs. of F400 12x40, operating at 700 gpm, and providing 14 minutes of EBCT after backwashing. See Table 2 for design parameters used in the simulation. The ACT ran for 770 simulated days (776 million gallons treated). A description of the ACT is shown in Appendix A.

ACT Carbon Preparation

A current production sample of virgin F400 GAC was systematically re-sized to 100x325 mesh for use in the ACT. The test carbon was dried at 105° C for 16 hours and allowed to cool in a desiccator. Prior to the introduction of the challenge water, the column was pre-wetted with deionized water for approximately 16 hours.

ACT Influent Preparation

CCC received two 55-gallon plastic drums on January 31, 2020. The feed was spiked with an additional 25 ppt of each of the following compounds: PFBS, PFHxS, PFOA, and PFOS. A total of 87 gallons was consumed throughout the course of the ACT.

ACT Sampling

Samples were collected once per day via an automated sample collector. The effluent was collected into 8-oz plastic bottles. The TOC samples were collected manually into 40 mL vials from the 8-oz bottles.

The flow rate of the ACT was closely monitored throughout the study. Composite samples of each ACT effluent, minus discrete samples for testing, were collected at least three times per week. From these data, average flow rates were calculated, and the flow rate was adjusted as necessary.

Analytical

TOC samples were analyzed in CCC's analytical laboratory using SM 5310B Total Organic Carbon, High Temperature Combustion. PFAS samples were analyzed by Eurofins Lancaster Laboratories using EPA 537 Version 1.1 Modified.

Appendix A: Accelerated Column Test Protocol

The Accelerated Column Test (ACT) procedure uses a miniature carbon-filled column to rapidly simulate the adsorption breakthrough curve that would be obtained by treating an aqueous stream in a large adsorption system. This technique, developed by Calgon Carbon Corporation's Research and Development, has been shown to accurately simulate the carbon treatment of a wide range of waters and wastewaters under various conditions.

The principle advantage of the ACT procedure compared to the one-inch diameter column adsorption test is its increased speed. Typically, an ACT can be completed in 1/20th to 1/10th of the time required for a one-inch diameter study. The basic description of the ACT system is defined in the article, "High Pressure Technique for Rapid Screening of Activated Carbons for Use in Potable Water." [1]

Scale factors for sizing the full-scale adsorbers from the ACT data are developed by a proprietary method based on the chemistry of adsorption on activated carbon. To predict the volume breakthrough curve for the full-scale adsorber, the ACT results must be multiplied by the volume scale factor determined for each carbon type. The time breakthrough curve for the full-scale adsorber can be calculated by either of two methods. First, one can divide the predicted volumes calculated above by the flow rate of the full-scale system. Second, one can multiply the run time by the scale factor determined for each carbon type.

[1] Rosene, M.R., R. T. Deithorn, J. R. Lutchko, and N.J. Wagner, "High Pressure Technique for Rapid Screening of Activated Carbon for Use in Potable Water," Activated Carbon Adsorption of Organics from the Aqueous Phase, Vol. 1. I. H. Suffet and M. J. McGuire, editors, Ann Arbor Science, Ann Arbor, MI Chapter 15 (1980)

Appendix B: Sales Spec Sheet

SALES SPECIFICATION SHEET

FILTRASORB 400

Granular Activated Carbon

Test	Specification Min	Specification Max	Calgon Carbon Test Method
IODINE NUMBER, mg/g	1000	-	TM-4,ASTM D4607
MOISTURE (AS PACKAGED), wt%	-	2	TM-1,ASTM D2867
ABRASION NUMBER	75	-	TM-9,AWWA B604
EFFECTIVE SIZE, mm	0.55	0.75	TM-8,ASTM D2862
UNIFORMITY COEFFICIENT	-	1.9	TM-8,ASTM D2862
FCC - WATER EXTRACTABLE, wt%	-	4	TM-43,FCC
12 US MESH [1.70 mm], wt%	-	5	TM-8,ASTM D2862
< 40 US MESH [0.425 mm] (PAN), wt%	-	4	TM-8,ASTM D2862

Typical Properties:

This product complies with ANSI/AWWA B604 (2012) – Granular Activated Carbon.

This product complies with the requirements for activated carbon as defined by the Food Chemicals Codex (FCC) (Latest Edition) published by the U.S. Pharmacopeia.

This product is produced under supervision of the Islamic Food and Nutrition Council of America (IFANCA).

This product is prepared under the supervision of the Kashruth Division of the Orthodox Union and is Kosher.

Only products bearing the NSF Mark are Certified to NSF/ANSI/CAN 61 - Drinking Water System Components - Health Effects standard. Certified Products will bear the NSF Mark on packing or documentation shipped with the product.

Calgon Carbon Corporation's activated carbon products are continuously being improved and changes may have taken place since this publication went to press. 12030-10/09/2018

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Drinking Water State Revolving Fund Project
Chapter 3 – Richland/Ross Townships Water Main Extension

Chapter 3 Contents

Figures

Appendices

1 INTRODUCTION

In Richland Township in the M-89 corridor, there is a facility identified as 34th Street Production Plated Plastics Company. That facility was closed in 1991 but the site had contamination from heavy metals and chlorinated volatile organic compounds. The site has an active groundwater extraction/treatment system and in 2018, PFAS was discovered in the system.

Groundwater flow from the site extends southward and southeastward into both Richland and Ross Townships. Groundwater sampling by the State of Michigan has revealed exceedances of current Michigan PFAS criteria in both townships. Additionally, both Chromium 6 and Nickel continue to migrate from the site into the townships. The primary project goal is to provide a permanent, long-term solution to contamination free drinking water source for the local residents and businesses.

2 BACKGROUND

2.1 Study and Service Area

The extent of the project area is illustrated in Figure 1 and is labelled as Phase 1. This area is proposed for fiscal year 2025. The area is bounded on the east by N 37th Street and N 36th Street, and by E D Avenue and E CD Avenue connecting them. The northern boundary is the intersection of E C Avenue and West Gull Lake Drive. The project extends west and south to tie into the existing water main on E C Avenue, N 35th Street, E D Avenue, M-89, and E DE Avenue. It also includes the neighborhoods along Lake Vista Drive, Delmar, Littlefield, Sherbrook, and Merrimac Street. No water main currently exists in the project area. The area is currently composed of 260 developed properties supplied with private wells. A comprehensive review of the current and future needs and development within the project area can be found in the latest City of Kalamazoo Water Reliability Study.

The project area crosses potential water withdrawal site WSSN 2013239 for 0.15 miles on N 37th St and E D Ave. The proposed water main will have no effects on this potential water withdrawal site.

2.2 Population

Based on the assumptions of the Water Model Analysis Memo dated September 5, 2023 included in Appendix G, the current population of the project area is approximated to be 650 people.

Based on the 2022 Kalamazoo Water Reliability Study, Richland Township is expected to increase population by approximately 11.6% by the year 2042. Therefore, it is estimated that the population in the new service area will increase to approximately 729 people in 2045.

2.3 Existing Environmental Evaluation

2.3.1 Cultural and Historic Resources

2.3.1.1 THPO We have contacted all of the local Tribal Organizations who have confirmed there are no known cultural resources which may be impacted within the project areas. Copies of these correspondences are included in Appendix A.

2.3.1.2 SHPO The proposed projects will not impact existing structures in work areas. Therefore, no historic or archaeological sites will be impacted by the construction of the proposed project. A historical and environmental evaluation was performed by Orbis Environmental Consulting who is a State of Michigan approved consultant for this work. Their report of no impact is included in Appendix B.

2.3.2 Air Quality

There are no project activities which will affect air quality.

2.3.3 Wetlands

There is no project work proposed in wetland areas as can be seen in Figure 2.

2.3.4 Great Lakes Shorelands, Coastal Zones, and Coastal Management Areas

There is no project work which will affect great lakes shorelands, coastal zones, or coastal management areas.

2.3.5 Floodplains

There are no floodplains within the project area, as can be seen in Figure 3.

2.3.6 Natural or Wild and Scenic Rivers

There is no project work which will affect these areas.

2.3.7 Major Surface Waters

In Ross Township, Gull Creek will be crossed at three locations at E DE Avenue, M-89, and E D Avenue as can be seen in Figure 1. At each of these locations, horizontal directional drilling methods are proposed to be used to avoid impacting the waterways. In Richland Township, a stream will be crossed on East DE Avenue approximately 4,000 feet west of N 37th Street. Although this stream may be crossed using open trench methods, no permanent changes will be made to the stream. EGLE permitting will be obtained for the construction of all stream crossings.

There is no project work which will affect Gull Lake or other major bodies of water.

2.3.8 Topography

There are no proposed topographical changes in the project.

2.3.9 Geology

There are no proposed changes to local geology nor is any dewatering anticipated.

It is not anticipated that contamination will affect the construction of the proposed project as all work will be within existing utility corridors. Corridors have been reviewed and no contamination is expected to be encountered.

2.3.10 Soil Types

Based on the USDA Web Soil Survey, local soils consist primarily of sandy loams and clay loams. No import of material or export of native material is anticipated.

2.3.11 Agricultural Resources

All of the proposed water main will be placed within existing road right-of-way and will not impact any adjacent farmlands.

2.3.12 Fauna and Flora

The proposed project work will be within the existing road right-of-way and will not impact fauna or flora within the project areas. Although the habitats of the Indiana bat (endangered) and the Northern long-eared bat (threatened) have the potential to be encountered as they typically roost under bark or in crevices in trees, if tree removal or trimming is required, it will be performed between October 15 and March 31 to prevent disruption of roosting bats.

The typical habitats of the Eastern Massasauga Rattlesnake (threatened) and the Whooping Crane (experimental population, non-essential) include stream beds, which are near our project area. The current plan is to utilize horizontal directional drilling methods to avoid impacts to existing streams. The clearance report through the National Fish and Wildlife Service is included in Appendix C.

2.4 Existing System

There are 260 developed properties within the project area which are supplied with water from private wells. There is currently no public water supply available to these properties.

The City of Kalamazoo currently provides municipal water to Richland Township through a water service agreement. The City of Kalamazoo and Ross Township are establishing a water service agreement in anticipation of this extension project.

Appendix G contains the report summarizing the modeling results of adding the existing Richland/Ross system to the Kalamazoo system. Based on the modeling, the existing system can support both current and future demand in the proposed project area.

The City of Kalamazoo system is supplied by several well fields n various locations throughout the system. The entire system has approximately 73,440 Residential Equivalent Units currently served. A full summary and analysis of the Kalamazoo water system is available in the latest Water Reliability Study.

2.5 Need for the Project

2.5.1 Standards Compliance and Reliability

Several State of Michigan monitoring wells have detected unacceptable levels of PFAS in Richland and Ross Townships within the project area, as can be seen in Figure 4.

The water main installation will effectively address water safety concerns for the 260 properties and approximated 650 residents. The City of Kalamazoo water system is currently in compliance with all drinking water standards and has the capacity to serve the affected area.

2.5.2 Orders of Enforcement Action

Currently the City of Kalamazoo is under an enforcement action to complete system-wide corrosion control optimization.

2.5.3 Drinking Water Quality Problems

The City of Kalamazoo water system is currently not providing water to the affected area. There are currently 260 private wells in the project area which are impacted by the PFAS to varying degrees. The proposed project is designed to provide water free of PFAS to the Richland and Ross Township residents in the affected areas.

2.6 Projected Future Needs

The project area is not currently fully developed. Based on current zoning/land use maps, and land use may change in future years. Appendix G contains the report summarizing the modeling results of adding the existing Richland/Ross system to the Kalamazoo system. Based on the modeling, the existing system can support both current and future demand in the proposed project area.

3 NEW WATER SUPPLY WELL PROCEDURES

No new wells are proposed.

4 ANALYSIS OF ALTERNATIVES

4.1 No Action

This alternative is not acceptable to any of the communities as it does not address the immediate health concern or provide any other long-term solution.

4.2 Optimum Performance of the Existing System

There are no current or foreseen operational issues with the existing water system which would prevent/hinder the proposed water main extensions into Richland and Ross Townships.

4.3 Regionalization – Extension of the City of Kalamazoo Water System

The City of Kalamazoo is the regional water provider and will continue to be in the future. No other regional alternatives exist. The City of Kalamazoo water system is immediately adjacent to

the area of Richland/Ross Townships affected by the PFAS contamination. The new water main is proposed to tie into the existing water mains on E C Avenue, N 35th Street, E D Avenue, M-89, and E DE Avenue. No other routes will effectively reach the properties proposed for new water main. The Kalamazoo system has the capacity to meet all the demands in the Richland/Ross Townships area proposed to be served by the system extension. The City of Kalamazoo currently provides municipal water to Richland Township through a water service agreement. The City of Kalamazoo and Ross Township are establishing a water service agreement in anticipation of this extension project.

4.4 Monetary Evaluation

Although there are no alternatives to the proposed water main extension, a present worth analysis for the water main is provided in Figure 6.

4.5 Environmental Evaluation

4.5.1 Cultural and Historic Resources

4.5.1.1 THPO: We have contacted all of the local Tribal Organizations who have confirmed there are no known cultural resources which may be impacted within the project areas. Copies of these correspondences are included in Appendix A.

4.5.1.2 SHPO: The proposed projects may have impact if there exists previously undisturbed soils within the road right-of-way in several areas. `A historical and environmental evaluation was performed by Orbis Environmental Consulting who is a State of Michigan approved consultant for this work. Their report of potential impact is included in Appendix B. They have recommended a supplemental survey of several specific sites, after which a final determination of effect will be made.

4.5.2 Air Quality

There are no project activities which will affect air quality.

4.5.3 Wetlands

There is no project work proposed in wetland areas as can be seen in Figure 2.

4.5.4 Great Lakes Shorelands, Coastal Zones, and Coastal Management Areas

There is no project work which will affect great lakes shorelands, coastal zones, or coastal management areas.

4.5.5 Floodplains

There are no floodplains within the project area, as can be seen in Figure 3.

4.5.6 Natural or Wild and Scenic Rivers

There is no project work which will affect these areas.

4.5.7 Major Surface Waters

In Ross Township, Gull Creek will be crossed at three locations at E DE Avenue, M-89, and E D Avenue as can be seen in Figure 1. At each of these locations, horizontal directional drilling methods are proposed to be used to avoid impacting the waterways. In Richland Township, a stream will be crossed on East DE Avenue approximately 4,000 feet west of N 37th Street. Although this stream may be crossed using open trench methods, no permanent changes will be made to the stream. EGLE permitting will be obtained for the construction of all stream crossings.

There is no project work which will affect Gull Lake or other major bodies of water.

4.5.8 Topography

There are no proposed topographical changes in the project.

4.5.9 Geology

There are no proposed changes to local geology nor is any dewatering anticipated.

It is not anticipated that contamination will affect the construction of the proposed project as all work will be within existing utility corridors. Corridors have been reviewed and no contamination is expected to be encountered. An environmental corridor review memorandum is included in Appendix H.

4.5.10 Soil Types

Based on the USDA Web Soil Survey, local soils consist primarily of sandy loams and clay loams. No import of material or export of native material is anticipated.

4.5.11 Agricultural Resources

All of the proposed water main will be placed within existing road right-of-way and will not impact any adjacent farmlands.

4.5.12 Fauna and Flora

The proposed project work will be within the existing road right-of-way and will not impact fauna or flora within the project areas. Although the habitats of the Indiana bat (endangered) and the Northern long-eared bat (threatened) have the potential to be encountered as they typically roost under bark or in crevices in trees, if tree removal or trimming is required, it will be performed between October 15 and March 31 to prevent disruption of roosting bats.

The typical habitats of the Eastern Massasauga Rattlesnake (threatened) and the Whooping Crane (experimental population, non-essential) include stream beds, which are near our project area. The current plan is to utilize horizontal directional drilling methods to avoid impacts to existing streams. The clearance report through the National Fish and Wildlife Service is included in Appendix C.

4.5.13 Anticipated Mitigation Requirements and Costs

As there are no anticipated detrimental Environmental impacts due to the project, there are no mitigation measures required and therefore no associated costs.

4.5.14 Technical Considerations

4.5.14.1 Pressure and Flow Capacity

Appendix G contains the report summarizing the modeling results of adding the existing Richland/Ross system to the Kalamazoo system. Based on the modeling, the existing system can meet current and future maximum day demand along with the desired fire flow in the project area.

4.5.15 New/Increased Water Withdrawals

No new or increased water withdrawals, above existing permit limits, are proposed for this project.

5 SELECTED ALTERNATIVE

5.1 Water Main Installation

5.1.1 Design Parameters

The routing and sizing of the proposed water main extensions were based on several factors:

- Potential new customers along the proposed water main extension route were divided into two categories: Current and Buildout. Existing homes and businesses along the proposed water main extension were incorporated into the model as current demands (260 REU) and were modeled as existing demands in the proposed scenarios. Houses were counted as 1 Residential Equivalence Unit (REU), and other structures were assigned an estimated REU based on size and function.
- Vacant parcels adjacent to the proposed water main extension were counted as future buildout customers. The zoning category for each parcel and the minimum lot size in the zoning ordinance for Richland and Ross Townships was used to estimate an REU per acre for each vacant parcel. Zoning categories predicted a higher customer demand than Future Land Use categories, and therefore were used for estimating future buildout demands (approximately 1,300 REU). For the buildout demand scenarios, the existing Kalamazoo distribution system was modeled using the 20-year projected demands from the 2022 Water System Reliability Study.
- Future phases of potential extensions were examined to provide additional service to other areas of Richland and Ross Townships. This generated the need for water main sizing that facilitated transmission capacity for an expanded future service district.
- Fire flows for both current and future service area.

5.1.2 Useful Life

5.1.3 Materials

Water Services – Current City of Kalamazoo Building Code adopts the use of the Michigan Building Code and Michigan Residential Code. These codes allow for the use of multiple water service materials on the private property side of water services. Because the City of Kalamazoo is responsible for water services from the water main up to, and including, the water meter, all water services installed will be Type K copper as is required of services in the City of Kalamazoo water system. These services are expected to have a useful life of 75 years.

Water Mains – The current City of Kalamazoo Standards for Construction require the use of minimum Class 52 Ductile Iron pipe, materials, and fittings in accordance with ANSI/AWWA Standards. The water mains are expected to have a useful life of 100 years.

5.1.4 Water and Energy Efficiency

Water meters will be placed at all current user connections and are required for all future connections. Billed water volumes are compared to production water volumes to quantify unmetered water losses. Leaks and meter repairs are identified and maintenance activities directed to mitigate the losses.

5.1.5 Schedule for Design and Construction

Design for all of the proposed work will begin immediately after funding is secured. It is anticipated that all of the proposed work will be designed in 2025 and begin construction in 2026. Multiple contractors will be required, and multiple project segments will be constructed concurrently.

The table below is a schedule for the proposed water distribution system improvement project. It would be funded under the fourth quarter of fiscal year 2025.

DWRF Project (4rd Quarter 2025)
Proposed Project Schedule

Milestone	Date
Hold Public Meeting	April 2024
Submit Final Project Plan to EGLE	June 2024
Receive Funding Determination	September 2024

User Charge System Approved	January 2025
Plans and Specifications Approved	May 2025
Bid Advertisement	May 2025
Receive Construction Bids	June 2025
EGLE Order of Approval	August 2025
Begin Construction	April 2026
Construction Completed	October 2027

5.1.6 Cost Summary

Appendix D contains a detailed cost estimate for the proposed water system installation. The estimated $45,960,000 dollar project costs for FY 2025 includes both construction costs and construction administration/inspection costs.

The entire three area project plan of the proposed lead service replacements, station upgrades, and watermain extensions is estimated to cost $110,264,000. If the entire project plan is DWRF loan funded with an estimated 2.5 % interest rate for a 20 year period, the expected annual debt service for the proposed project based on the DWRF loan criteria will be approximately $7,039,600 per year.

The city typically bases its cost allocations on a Residential Equivalent Unit (REU). One REU is the designation given to a single-family residential household which has an average water use of approximately 210 gallons per day and a water meter size of 1-inch. For businesses or industries with larger meters, the number of Residential Equivalent Units is calculated based on the meter size serving that entity. The larger the meter, the larger the number of equivalent units assigned to that meter. The assigned REU is directly proportional to the larger meter's capacity as compared to the capacity of a residential meter.

With the current number of 73,440 REU in the entire water system, the potential debt service and added O&M cost associated with the improvements, there will be a usage cost increase of approximately $106.00 per year per REU.

5.1.7 Implementability

There are no physical, legal, or managerial issues which will prevent or affect the implementation of the proposed water main installation.

6 ENVIRONMENTAL AND PUBLIC HEALTH IMPACTS

6.1 Direct Impacts

6.1.1 Social Impact/Economic Impact

The proposed projects will have a positive impact on the economics of the project area. Properties with wells affected by PFAS have been recommended to not utilize the water for drinking, food preparation/canning, teeth brushing, or any other task that could result in ingestion. Given the multiple impacts of PFAS on humans and other organisms, there is an atmosphere of fear which reduced the current quality of life in the area and is potentially affecting property values. The proposed installation of water main and connection to a reliable, safe potable water supply will significantly reduce or eliminate the current social and economic impacts of the PFAS contamination.

6.1.2 Construction Impacts

6.1.2.1 Construction Methods

With the exception of waterway crossings, water main will be installed using open cut trenching. The width of the trenches will vary based on the depth of the trench, but all open cut work must be contained within the right-of-way, including the trench width. Water services will be connected using directional drill technology.

6.1.2.2 Natural and Man-Made Features

The water main and services will be installed underground, and thus their presence will not affect species or environments on the ground surface.

6.1.2.3 Historical/Archaeological

6.1.2.3.1 THPO We have contacted all of the local Tribal Organizations who have confirmed there are no known cultural resources which may be impacted within the project areas. Copies of these correspondences are included in Appendix A.

6.1.2.3.2 SHPO The proposed projects will not impact existing structures in work areas. Therefore, no historic or archaeological sites will be impacted by the construction of the proposed project. A historical and environmental evaluation was

performed by Orbis Environmental Consulting who is a State of Michigan approved consultant for this work. Their report of no impact is included in Appendix B.

6.1.2.4 Water Quality

The proposed project will replace the PFAS contaminated well water sources and will provide local residents with potable municipal drinking water which meets all current public drinking water standards.

6.1.2.5 Endangered Species

The proposed project work will be within the existing road right-of-way and will not impact fauna or flora within the project areas. Although the habitats of the Indiana bat (endangered) and the Northern long-eared bat (threatened) have the potential to be encountered as they typically roost under bark or in crevices in trees, if tree removal or trimming is required, it will be performed between October 15 and March 31 to prevent disruption of roosting bats.

The typical habitats of the Eastern Massasauga Rattlesnake (threatened) and the Whooping Crane (experimental population, non-essential) include stream beds, which are near our project area. The current plan is to utilize horizontal directional drilling methods to avoid impacts to existing streams. The clearance report through the National Fish and Wildlife Service is included in Appendix C.

6.1.2.6 Agricultural Land

All of the proposed water main will be placed within existing road right-of-way and will not impact any adjacent farmlands.

6.1.2.7 Groundwater Impacts

No dewatering is proposed for this project.

6.1.2.8 Traffic Impacts

The proposed project is within road rights-of-way where streets and driveways will be impacted. All components of the project will be coordinated carefully with residences and businesses in the area, and construction methods will be selected to minimize disruptions.

Standard traffic and safety control devices such as barricades and lighted barrels will be in place to warn and protect residents during construction activities.

6.1.2.9 Air Quality

All of the projects are installing underground water infrastructure. Therefore, the projects will not negatively impact the air quality in the affected areas.

6.1.2.10 Wetlands

There is no project work proposed in wetland areas as can be seen in Figure 2.

6.1.2.11 Great Lakes Shorelands, Coastal Zones, and Coastal Management Areas

There is no project work which will affect great lakes shorelands, coastal zones, or coastal management areas.

6.1.2.12 Floodplains

There are no floodplains within the project area, as can be seen in Figure 3.

6.1.2.13 Natural or Wild and Scenic Rivers

We reviewed the State of Michigan Department of Natural Resources data and found that no designated wild, scenic or natural rivers or tributaries exist within the study area.

6.1.2.14 Dust and Noise

Dust control methods such as water and/or brine will be used to keep dust to a minimum. All public roadways will be swept regularly and maintained to assure residents access to the area. Construction equipment will be maintained in good condition to decrease noise.

6.2 Indirect Impacts

No long-term impacts to the environment are anticipated. No changes in the environment are proposed for this project.

6.3 Cumulative impacts

Once construction is completed, there are no anticipated permanent, detrimental impacts to the environment or the community.

7 MITIGATION

7.1 Short Term Construction Related Mitigation

Standard procedures used in the construction industry will be included in the construction contract documents to mitigate construction activities.

7.1.1 Traffic Disruption

The proposed project is within road rights-of-way where streets and driveways will be impacted. All components of the project will be coordinated carefully with residences and businesses in the area, and construction methods will be selected to minimize disruptions.

Standard traffic and safety control devices such as barricades and lighted barrels will be in place to warn and protect residents during construction activities.

7.1.2 Dust and Noise

Dust control methods such as water and/or brine will be used to keep dust to a minimum. All public roadways will be swept regularly and maintained to assure residents access to the area. Construction equipment will be maintained in good condition to decrease noise.

7.1.3 Soil Erosion

Soil erosion and sedimentation control measures such as straw bales, sedimentation basins, and silt fence, will be part of the construction activities to prevent soil release and protect streams, wetlands, and existing storm water system.

7.1.4 Potential Loss of Wildlife / Habitat

Given the potential for tree removal within the road right-of-way, tree removal can be limited to the time periods between October 1 and March 31, in order to protect young bats that are not able to fly. If tree cutting is performed outside of this season, surveys of the trees will be performed in order to determine whether they are roost trees for the endangered Indiana bat or the threatened Northern long-eared bat. No other habitat impacts are anticipated.

8 PUBLIC PARTICIPATION

As noted in the Project Need section, the proposed project work is in response to discovered PFAS contamination. The scope of the proposed project is based on the current testing data available and the public input received to date.

8.1 Public Meetings

A public meeting was held on The meeting will be held on Monday, April 15, 2024 at 6 p.m. EST at Gracespring Bible Church located at 8643 Gull Rd, Richland, MI 49083.

A Notice of Public meeting was published on MLive prior to the Public Meeting and was posted on the websites for City of Kalamazoo, Richland Township, and Ross Township. Physical posters were also put up at the offices of both Townships. A copy of the notice and proof of advertisement are included in Appendix E. The Project Planning Document was posted on the city's website. The city received no comments or questions during the public advertisement period.

A presentation was given by the project consultant and City staff during which a description of the DWSRF program and general comments on the Project Planning Document were presented. It was noted that the Project Planning Document contained cost estimates for projects and potential impacts. The Public Meeting summary is provided in Appendix E.

8.2 Adoption of Project Planning Document

On Monday, May 20, 2024, the City of Kalamazoo City Commission passed a resolution adopting the Project Planning Document. A copy of the signed resolution is provided in Appendix F.