LANSING BWL

DWSRF PROJECT PLAN

PREPARED BY:

APRIL 2022

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

2101 Aurelius Road, Suite 2A
Holt, Michigan 48842

HRC Job Number 20220131

Versions:

Draft March 25, 2022 (Submittal to BWL)

Draft April 8, 2022 (Submittal for Public Comment)

Final

Table of Contents

1 Executive Summary 1-1
1.1 Summary 1-1
1.2 Conclusions 1-1
1.3 Recommendations 1-2
2 Project Background 2-1
2.1 Summary of Project Need 2-1
2.2 Study Area Description 2-1
2.3 Population Data 2-6
2.4 Economic Characteristics 2-6
2.5 Cultural and Environmental Settings 2-7
2.6 Existing Water Supply System 2-42
3 Alternative Analysis 3-1
3.1 Alternatives Considered 3-1
3.2 No Action 3-3
3.3 Water Treatment Plant Improvements 3-3
3.4 Operational System Improvements 3-3
3.5 Distribution System Improvements 3-44
3.5 Cost of Alternatives 3-5
3.6 Impacts of Alternatives 3-5
4 Selected Alternatives 4-1
4.1 Proposed Improvements 4-1
4.2 Design Parameters 4-2
4.3 Water Main Installation and Materials 4-2
4.4 Proposed Schedule 4-2
4.5 Cost Estimate 4-3
4.6 User Costs and Cost Sharing 4-3
4.7 Authority to Implement Selected Alternative 4-4
5 Environmental Impacts 5-1
5.1 General 5-1
5.2 Analysis of Impacts 5-2
6 Mitigation 6-1
6.1 Short-Term, Construction Related Mitigation 6-1
6.2 Mitigation of Long-Term Impacts 6-1
6.3 Mitigation of Indirect Impacts 6-1
7 Public Participation 7-1
7.1 General 7-1
7.2 Public Hearing 7-1
7.3 Resolution ..... **Error! Bookmark not defined.**

List of Figures

Figure 2-1. Water System Service Area 2-2
Figure 2-2. BWL Water Distribution System 2-3
Figure 2-3. BWL Zoning Map 2-4
Figure 2-4. Future Land Use Map 2-5
Figure 2-5 Wetlands Map 2-11
Figure 2-6. City of Lansing and Surrounding Area Floodplain Map A 2-12
Figure 2-7. City of Lansing and Surrounding Area Floodplain Map B 2-13
Figure 2-8. City of Lansing and Surrounding Area Floodplain Map C 2-14
Figure 2-9. City of Lansing and Surrounding Area Floodplain Map D 2-15
Figure 2-10. City of Lansing and Surrounding Area Floodplain Map E 2-16
Figure 2-11. City of Lansing and Surrounding Area Floodplain Map F 2-17
Figure 2-12. City of Lansing and Surrounding Area Floodplain Map G 2-18
Figure 2-13. City of Lansing and Surrounding Area Floodplain Map H 2-19
Figure 2-14. City of Lansing and Surrounding Area Floodplain Map I 2-20
Figure 2-15. City of Lansing and Surrounding Area Floodplain Map J 2-21
Figure 2-16. City of Lansing and Surrounding Area Floodplain Map K 2-22
Figure 2-17. City of Lansing and Surrounding Area USGS Topo Map A 2-23
Figure 2-18. City of Lansing and Surrounding Area USGS Topo Map B 2-24
Figure 2-19. City of Lansing and Surrounding Area USGS Topo Map C 2-25
Figure 2-20. City of Lansing and Surrounding Area USGS Topo Map D 2-26
Figure 2-21. City of Lansing and Surrounding Area USGS Topo Map E 2-27
Figure 2-22. City of Lansing and Surrounding Area USGS Topo Map F 2-28
Figure 2-23. City of Lansing and Surrounding Area USGS Topo Map G 2-29
Figure 2-24. City of Lansing and Surrounding Area USGS Topo Map H 2-30
Figure 2-25. City of Lansing and Surrounding Area USGS Topo Map I 2-31
Figure 2-26. City of Lansing and Surrounding Area USGS Topo Map J 2-32
Figure 2-27. City of Lansing and Surrounding Area USGS Topo Map K 2-33
Figure 2-28. City of Lansing and Surrounding Area USGS Topo Map L 2-34
Figure 2-29. City of Lansing and Surrounding Area USGS Topo Map M 2-35
Figure 2-30. City of Lansing and Surrounding Area USGS Topo Map N 2-36
Figure 2-31. City of Lansing and Surrounding Area USGS Topo Map O 2-37
Figure 2-32. City of Lansing and Surrounding Area USGS Topo Map P 2-38
Figure 2-33. City of Lansing and Surrounding Area USGS Topo Map Q 2-39
Figure 2-34. City of Lansing and Surrounding Area USGS Topo Map R 2-40
Figure 2-35. City of Lansing and Surrounding Area USGS Topo Map S 2-41
Figure 2-36. Dye WCP Treatment Process 2-43
Figure 3-1. Project and Improvement Locations Overview 3-2

List of Tables

Table 2-1. Population Projections 2-6
Table 2-2. Study Area Household Income 2-7
Table 2-3. High Serivce Pumping at WCPs 2-44
Table 2-4.Water Storage 2-44
Table 2-5. Water Main Length by Pipe Diameter 2-46
Table 2-6. Water Main Length by Material 2-46

Table 2-7. Distribution System Booster Stations 2-47
Table 3-1. Summary of SRF Projects (by Fiscal Year) 3-5
Table 4-1. Fiscal Year of WTP Projects 4-1
Table 4-2. Fiscal Year of Distribution System Projects 4-1
Table 4-3. Project Plan Task Schedule 4-2
Table 4-4. Residential Water Connections 4-3
Table 4-5. Estimated User Cost Summary by Phase 4-4

List of Appendices

Appendix A: Agency Correspondance
Appendix B: Nationwide Rivers Inventory
Appendix C: Web Soils Survey Results
Appendix D: Michigan Natural Features Inventory Endangered Species
Appendix E: Detailed Cost Estimates
Appendix F: Public Participation Documentation

1 Executive Summary

1.1 Summary

This Project Plan was prepared for the BWL to address Water Conditioning Plant (WCP) and Water Distribution System deficiencies and aging facilities. This Project Plan, as prepared by Hubbell, Roth & Clark, describes the existing condition of various Drinking Water Distribution System components and the BWL's WCPs with alternatives to meet those needs and the most cost-effective alternative.

The Project Plan will be submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in order to qualify for possible Drinking Water State Revolving Fund (DWSRF) loan assistance. While the rates have not been set yet for FY2023, the rates in 2022 is 1.875% for 20-year loans and 2.125% for 30-year loans. The Project Plan has been prepared following the DWSRF Project Plan Preparation Guidance Outline administered by The Office of Drinking Water and Municipal Assistance. These rules call for compliance with the basic Federal Planning Requirements and the National Environmental Policy Act (NEPA). The Project Plan will also serve as the basis for project prioritization and must be submitted to EGLE by July 1, 2022, in order to be considered for funding on the project priority list for the fiscal year 2023. These projects below provide an initial framework for evaluation and assessment.

1.2 Conclusions

The following is a summary of the existing issues identified in the 2021 Water Reliability Study and recommended by the BWL.

- Water Treatment Plant Improvements
  - Dye WCP – Convert Ammonia Systems to Aqueous Forms
    - BWL plans to convert to Aqueous Forms to reduce potential significant safety hazards associated with current plant operations. The equipment is currently at the end of its life cycle and in need of replacement.
  - Dye WCP – Chemical Handling Project – Phase B
    - BWL plans to update the dry chemical handling through three phases. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. This phase includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.
  - Wise Rd WCP – New Chemical Building
    - BWL plans to construct a chemical building adjacent to the storage room to include an additional 2,350-gallon storage tank, a day tank and chemical metering pumps. The storage facility will accommodate full truckload delivery of chemicals on a monthly basis with adequate reserve for 30 days of operation to ensure the water quality of the system.
- Operational System Improvements
  - Elevated Storage – Evaluation and Implementation
    - BWL plans to construct an elevated storage to increase the reliability of the system
  - Well Drilling to replace aged wells

- BWL plans to replace two (2) wells per year to improve the reliability of the system

≡ Distribution System Improvements
- Water Main Replacements (multiple locations throughout BWL jurisdiction)
  - BWL plans to replace significantly aged section of water main (i.e., 100 year old water main)
- Raw Water Main Installation
  - 2,300 linear feet of raw water main to connect Hughes Rd well (drilled in 2020) to existing network

1.3 Recommendations

The BWL should pass a resolution formally adopting the Project Plan and agree to implement the Drinking Water Distribution System and Water Treatment Plant Improvements outlined herein.

The BWL should submit this report to EGLE in order to attempt to qualify for a low-interest loan through the DWSRF Loan Program.

The John F. Dye Water Conditioning Plant is experiencing significant problems with the lime and soda ash systems. This project is one phase of the overall dry chemical handling project which consist of three separate phases. The first phase (Phase A) addresses the severe dust issues associated with chemical delivery. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. The third phase (Phase C) is similar to Phase B, but is associated with the soda ash systems.. The phase the BWL is seeking funding for includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.

2 Project Background

2.1 Summary of Project Need

In an effort to meet various recently revised State requirements, improve system reliability, and address aging infrastructure that has reached its useful life, the BWL is proposing various projects within their Drinking Water Distribution System seeking financial assistance for this work through a low-interest rate loan offered by EGLE. This Project Plan identifies projects that will include improvements to both the water treatment plant and the distribution system on a fiscal year basis.

2.2 Study Area Description

2.2.1 Delineation of Study Area

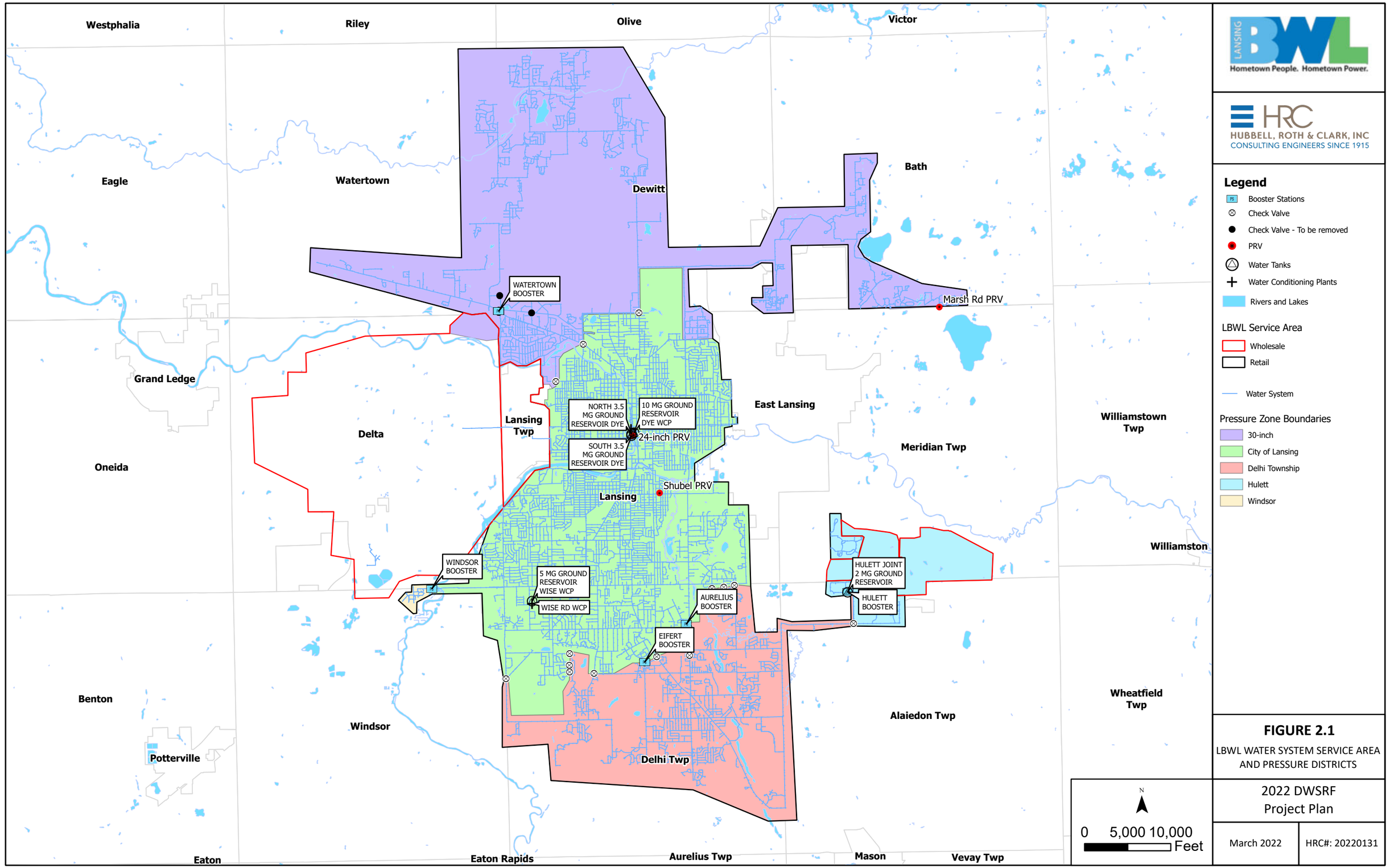
The BWL located in Lansing, Michigan, is a regional system supplying water to the City of Lansing and a large portion of the surrounding community. The study area includes the BWL service area. The water system supplies water for 208,909 retail and wholesale customers. The retail customers include the entire City of Lansing, and portions of Alaiedon Township, Bath Township, City of Dewitt, Delhi Township Dewitt Township, Lansing Township, Watertown Township and Windsor Township. The wholesale customers include Lansing Township West Side water, Delta Township and the East Lansing Meridian Water & Sewer Authority (feed to south side of Merdian Township).

Figure 2-1 illustrates the BWL service area. Figure 2-2 presents the major water system components, including water treatment facilities and booster stations.

2.2.2 Land Use

The existing land use in the study area varies greatly from agriculture, residential to heavy residential and industrial. All of the Townships and Cities have residential located within. The townships all contain some agricultural use. City of Dewitt, East Lansing and Lansing all contain commercial and mixed use. Delta Township, Delhi Township, Windsor Township and City of Lansing also contain industrial areas. The City of Lansing metropolitan area, in which the proposed project is located, is the industrial, commercial, and institutional center for central Michigan. Major existing commercial areas are located along arterial roadways, including Cedar Street, Martin Luther King Jr. Boulevard, Pennsylvania, Washington Avenue, east of Pennsylvania Avenue in southeast Lansing, between I-496 and the Grand River, along Sunset Avenue and North Grand River Avenue, and along the Larch/Cedar Streets corridor from the Grand River north to the corporate limits.

Public and institutional properties are distributed across the City, with a concentration in the core downtown area. Single and multifamily residential properties and parks fill out most of the remaining areas. Future land use and development is generally expected to parallel existing use, while moving toward implementation of Smart Growth principles such as: development of existing communities, mixed land uses, walkable neighborhoods, and preservation of open space. Land use across the study area can be seen in Figure 2-3.



Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- Booster Stations
- Check Valve
- Check Valve - To be removed
- PRV
- Water Tanks
- Water Conditioning Plants
- Rivers and Lakes

LBWL Service Area

- Wholesale
- Retail

- Water System

Pressure Zone Boundaries

- 30-inch
- City of Lansing
- Delhi Township
- Hulett
- Windsor

FIGURE 2.1

LBWL WATER SYSTEM SERVICE AREA AND PRESSURE DISTRICTS

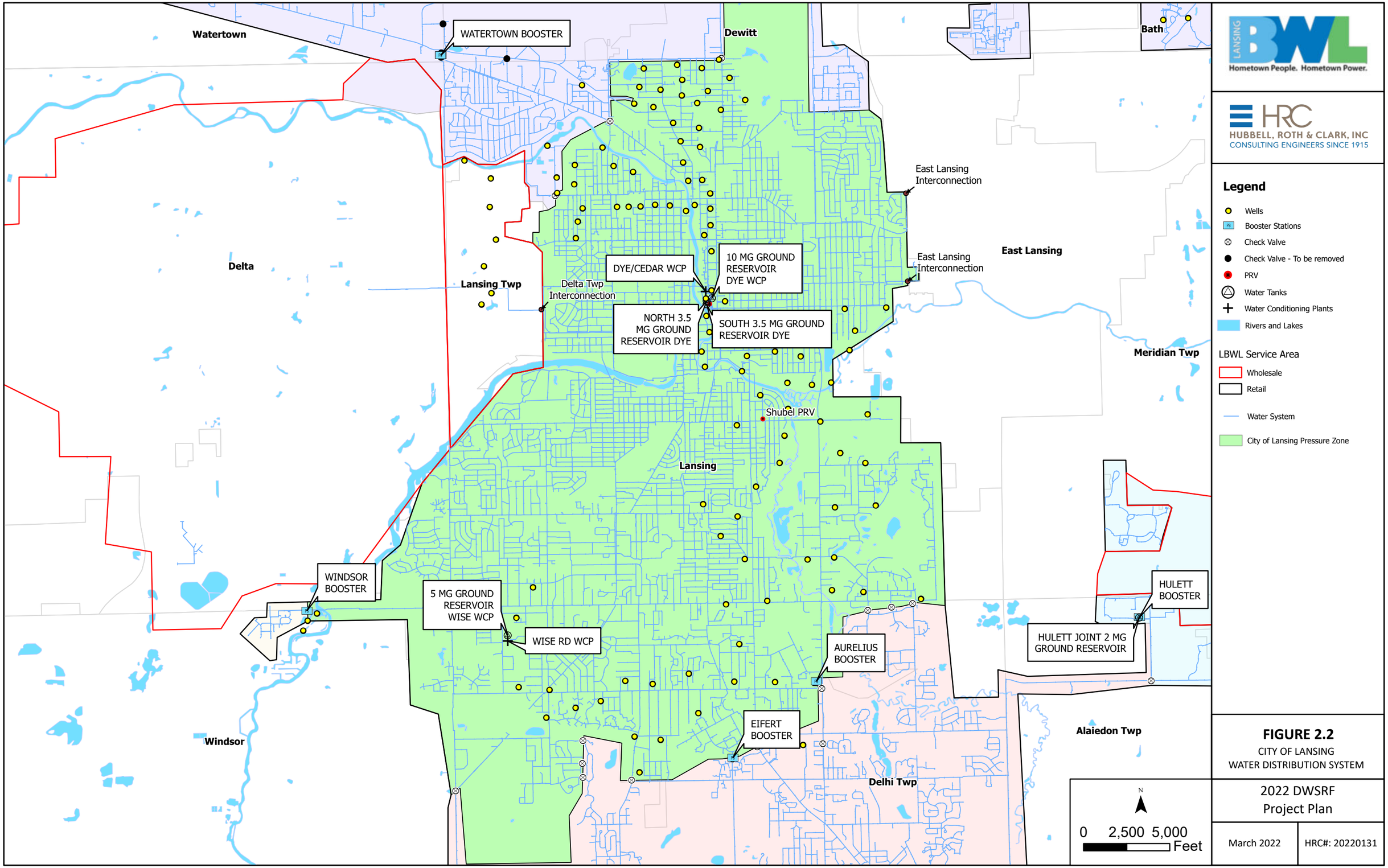
N

0 5,000 10,000 Feet

2022 DWSRF Project Plan

March 2022

HRC#: 20220131



Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- Wells
- Booster Stations
- Check Valve
- Check Valve - To be removed
- PRV
- Water Tanks
- Water Conditioning Plants
- Rivers and Lakes

LBWL Service Area

- Wholesale
- Retail

- Water System
- City of Lansing Pressure Zone

FIGURE 2.2
CITY OF LANSING
WATER DISTRIBUTION SYSTEM

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

Westphalia
Riley
Olive
Victor
Eagle
Watertown
Dewitt
Bath
Grand Ledge
Lansing Twp
East Lansing
Delta
Meridian Twp
Oneida
Lansing
Benton
Windsor
Alaiedon Twp
Wheatfield Twp
Potterville
Delhi Twp
Mason
Ingham Twp

Future Land Use

- RESOURCE PRODUCTION
- CONSERVATION
- RURAL
- SINGLE FAMILY RESIDENTIAL
- SINGLE/TWO FAMILY RESIDENTIAL
- MIXED RESIDENTIAL
- MULTI FAMILY RESIDENTIAL
- MIXED RESIDENTIAL/ NON RURAL
- MOBILE HOME PARK
- NON RETAIL COMMERCIAL
- NEIGHBORHOOD COMMERCIAL
- CENTRAL COMMERCIAL
- GENERAL COMMERCIAL
- INSTITUTIONAL
- CONTAINED/LIGHT INDUSTRIAL
- GENERAL INDUSTRIAL
- NO PLAN
- OVERLAY
- PARKING
- WATER

LBWL Service Area

Map data courtesy of Tri-County Planning from 2012

N

0 5,000 10,000 Feet

FIGURE 2.3
LBWL FUTURE LAND USE MAP

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- LBWL Service Area

USDA NLCD Land Cover 2018

- Unclassified
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Herbaceuous
- Hay/Pasture
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceuous Wetlands

N

0 10,000 Feet

FIGURE 2.4

BWL AREA LAND COVER MAP

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

2.2.3 Water Demands

The existing project areas are comprised of residential, commercial, and industrial properties. The proposed project areas are largely built out, and not much growth is expected.

2.3 Population Data

The City of Lansing's 2010 population, in which the proposed project is located, was reported at 114,297 by the U.S. Census Bureau. This was down approximately 4% from 119,100 recorded in the 2000 census, and down by just over 10% compared to the 127,321 population recorded in the 1990 census. Michigan is projected to gain population at a modest rate of approximately 0.1% per year during the period 2010-2040 (*The Economic and Demographic Outlook for Michigan,* March 2012, Institute for Research on Labor Employment and the Economy, University of Michigan), and Ingham County is expected to slightly exceed Michigan's projected growth rate. The Tri-County Regional Transportation Plan estimates an annual growth rate of 0.4% for the 2010-2040 period. Table 2-2 shows the 2010 census population for all the communities that the BWL services, and projected population over the next, 5, 10 and 20 years. It should be noted that this represents the population of the entire jurisdictional boundary and may not reflect the BWL service territory.

Table 2-1. Population Projections

Unit of Government	Census Population	Census Population	Project Planning Period Calculated Population (5 yr., 10 yr., 20 yr.)		
	2010	2020	2025	2030	2040
Alaiedon Township	2,894	2,910	3,059	3,548	4,325
Bath Township	11,598	13,292	13,970	14,683	17,899
City of Dewitt	4,507	4,776	5,019	5,275	6,431
City of Lansing	114,297	112,644	118,390	124,429	151,679
Delhi Township	25,877	27,710	29,124	30,610	37,314
Dewitt Township	14,321	15,073	15,842	16,650	20,297
Lansing Township	8,126	8,143	8,559	8,996	10,966
Meridian Township	39,688	43,916	46,157	48,512	59,136
Watertown Township	4,836	5,563	5,847	6,145	7,491
Windsor Township	6,838	7,140	7,504	7,378	8,994
Wholesale – Delta Twp	32,408	33,119	34,809	36,585	44,597

2.4 Economic Characteristics

The major industries in the City of Lansing are Government (15,729 people), Education (13,397 people), Healthcare (10,600 people), Manufacturing (9,059 people), and Insurance (5,078 people). The median household income for the City of Lansing was $41,674 in 2019. The median household income is approximately 27.07% lower than the median Michigan household income and 38.28% less than the U.S. median household income. Table 2-3 shows the City of Lansing, City of Dewitt, Ingham County, Eaton County, Delhi Township, Delta Township, Lansing Township, Meridian Township, Watertown Township, and Windsor Township median household income comparison below.

Table 2-2. Study Area Household Income

Municipality	Median Annual Household Income
City of Lansing	$41,674
City of Dewitt	$66,213
Ingham County	$52,872
Eaton County	$64,348
Delhi Township	$66,498
Delta Township	$67,930
Lansing Township	$47,524
Merdian Township	$72,463
Watertown Township	$82,542
Windsor Township	$74,913

*Source: https://www.census.gov/quickfacts/lansingcitymichigan

2.5 Cultural and Environmental Settings

2.5.1 Cultural Setting

The City of Lansing has 1 historical district and 9 historical properties listed under the National Register of Historic Places. The State Historic Preservation Office (SHPO) is to be contacted for proposed work within the affected Historic Districts. The relatively shallow excavations needed to complete the proposed work will be contained within public right-of-way and on private properties. All the proposed work will occur at the same location as existing facilities and lines. Restoration of surface features disturbed by this construction will match existing conditions as much as practicable. Therefore, there is no anticipated permanent impacts on any historical, archeological, geological, cultural, or recreational areas due to this construction. EGLE will be coordinating with the SHPO for final determination of historic properties impacted.

2.5.2 The Natural Environment

Climate

The project area's climate is controlled by its location with respect to major storm tracks that pass through the Midwest and by the influence of Lake Michigan. Lake Michigan tends to moderate and smooth out most climate extremes. Consequently, the city generally experiences warm, mild summers and severe winters. The summer high is around 82 degrees Fahrenheit, and the winter low is around 16 degrees Fahrenheit. Precipitation is distributed through all months of the year. Lake-effect snowfall constitutes a large percentage of the total annual snow accumulation, which averages around 46 inches. Periods of snowfall typically last from November to April, although light snow as late as May or as early as late September sometimes occur. Rain averages around 33 inches annually.

The growing season averages 179 days in length. Average date of the last freezing is May 4; average date of the first freezing temperature is October 5.

Climatological data is collected by the National Oceanic and Atmospheric Administration (NOAA). This project, and the alternatives discussed, will have no impact on the climate of the project.

Air Quality:

Mobile source emissions, mainly from automobiles, are the primary source of outdoor air pollution in this area. No noise pollution problems exist in residential areas, other than from traffic noise from adjacent major roadways. Commercial and business areas experience only normal traffic noise.

Air quality is not anticipated to be an issue for this project, apart from temporary dust and debris from construction and minimal odors from the Cured-in-Place-Pipe curing material. All necessary notifications will be distributed to the public when this occurs and all regulations for this odor will be followed.

Wetlands:

There are no localized wetlands within the existing project footprint where the work is anticipated. For final design, any wetlands that may be impacted would be flagged and the appropriate EGLE and USACE permits will be applied for. However, it is not anticipated to be an issue for this project. Wetland maps are shown in Figure 2-5.

Coastal Zones

There are no coastal zones in the project area.

Floodplains & Surface Waters:

The study area is located in three watersheds including the Red Cedar River Watershed, the Grand River Watershed, and the Looking Glass River Watershed. The Red Cedar River Watershed encompasses 461 square miles, in Livingston and Ingham Counties and flows into the Grand River in Lansing. The Grand River Watershed encompasses 5,572 square miles that flows into Lake Michigan and located in Hillsdale, Jackson, Ingham, Eaton, Clinton, Ionia, Kent, Ottawa, Newago, and Muskegon Counties. The Looking Glass River Watershed encompasses 312 square miles that flows into the Grand River in Portland, primarily in Shiawassee and Clinton Counties, with small areas in Ingham, Ionia, Livingston, and Eaton Counties.

Area groundwater is used as a source of drinking water by the BWL. The water supply for the service area is obtained via 125 existing wells that go to the BWL Water Treatment Plant. There will be no major impacts to the great lake coastal zones, floodplains, and surface waters, however, proper permits will be acquired, and steps will be taken to avoid any damage or permanent disruption which could affect the nearby floodplain. Any work which impacts the floodplain will only be undertaken after first contacting EGLE and obtaining the appropriate permits.

FEMA floodplain maps are shown in Figure 2-6 to Figure 2-27.

Natural or Wild and Scenic Rivers:

The scope of this project is throughout the City of Lansing and surrounding townships and cities. There are no Wild and Scenic Rivers in the project area that will be impacted by the projects. The location of the improvements and construction will be planned to not occur or impact the nearby rivers. See Appendix B for the attached documentation of the Nationwide Rivers Inventory correspondence.

Major Surface Waters

Figure 2.1 presents the overall study area and major surface waters, including the Grand and Red Cedar Rivers, and Sycamore Creek.

Agricultural Resources

There are no prime agricultural resources in areas of proposed work.

National Natural Landmarks:

The Toumey Woodlot is the only registered natural landmark in Ingham County. The site is located outside of the BWL service limits; therefore, no National Natural Landmarks will be affected.

Topography:

The terrain within the City of Lansing and surrounding area is characterized as relatively flat but has low spots near the Grand River. The lowest point at about 805.5 feet above sea level along the Grand River in the City. The highest point is about 890 feet above sea level on the far south side of Lansing near the Northrup Street and Cedar Street intersection.

A set of United States Geological Survey (USGS) topography maps of the city and surrounding townships and cities are shown in Figure 2-28 through Figure 2-35.

Geology:

Three types of bedrock make up the bedrock surface in the City of Lansing and surrounding area, Grand River Formation, Saginaw Formation and Red Beds, which are Meso–Cenozoic continental sedimentary strata that are mainly composed of gravel stone, sandstone, siltstone, mudstone, and shale.

Soils:

According to the USDA Natural Resources Conservation Service Web Soil Survey, the City of Lansing and surrounding area the 4 main soils located within the City are Loamy Sand (65%), Sandy Loam (15%), Clay (5%) and Mucks and Peats (15%). See Appendix C for documentation of the Web Soil Survey results.

As part of the final design process, soil borings will be taken near the proposed work areas to determine if any special construction methods will be needed.

Agricultural Resources:

There is no agricultural land located within the project limits. The project area is within developed and human use land cover; therefore, no agricultural resources will be impacted by the proposed work.

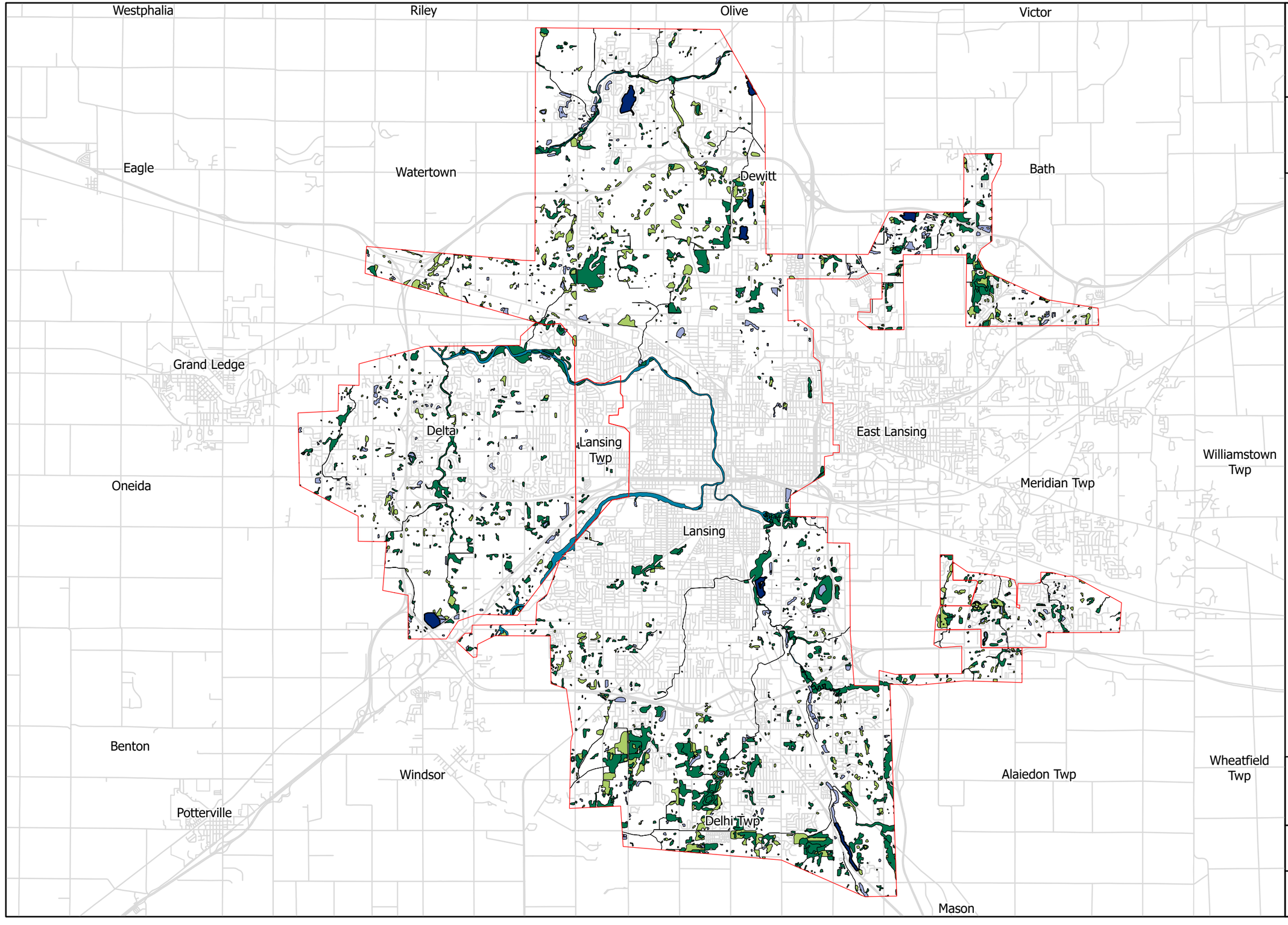
Fauna and Flora

According to the U.S. Fish and Wildlife Service website, the Indiana Bat is the only possible endangered species in the project area. Indiana Bats are found over most of the eastern half of the United States. Almost half of them hibernate in caves in southern Indiana. They hibernate during winter in caves or, occasionally, in abandoned mines. During summer, they roost under the peeling bark of dead and dying trees. Indiana Bats eat a variety of flying insects found along rivers or lakes and in uplands.

The Northern long-eared bat is a possible threatened species in the project area. Northern long-eared bats hibernate in caves and mines. They swarm in surrounding wooded areas in autumn. The bats roost and forage in upland forests during spring and summer.

The proposed project includes sewer and water main work in established road ROWs and developed urban areas. If any tree removal is necessary during construction, it will be completed between November 15 and March 31 to comply with bat restrictions. Consideration will also be taken for migratory birds if nesting areas may be impacted by the project.

A list of all endangered and threatened species generated by the Michigan Natural Features Inventory can be seen in Appendix D.



LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- LBWL Service Area

Wetlands

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

N

0 5,000 10,000 Feet

FIGURE 2.5

WETLANDS MAP

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS2/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242** or visit its website at http://www.ngs.noaa.gov/

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

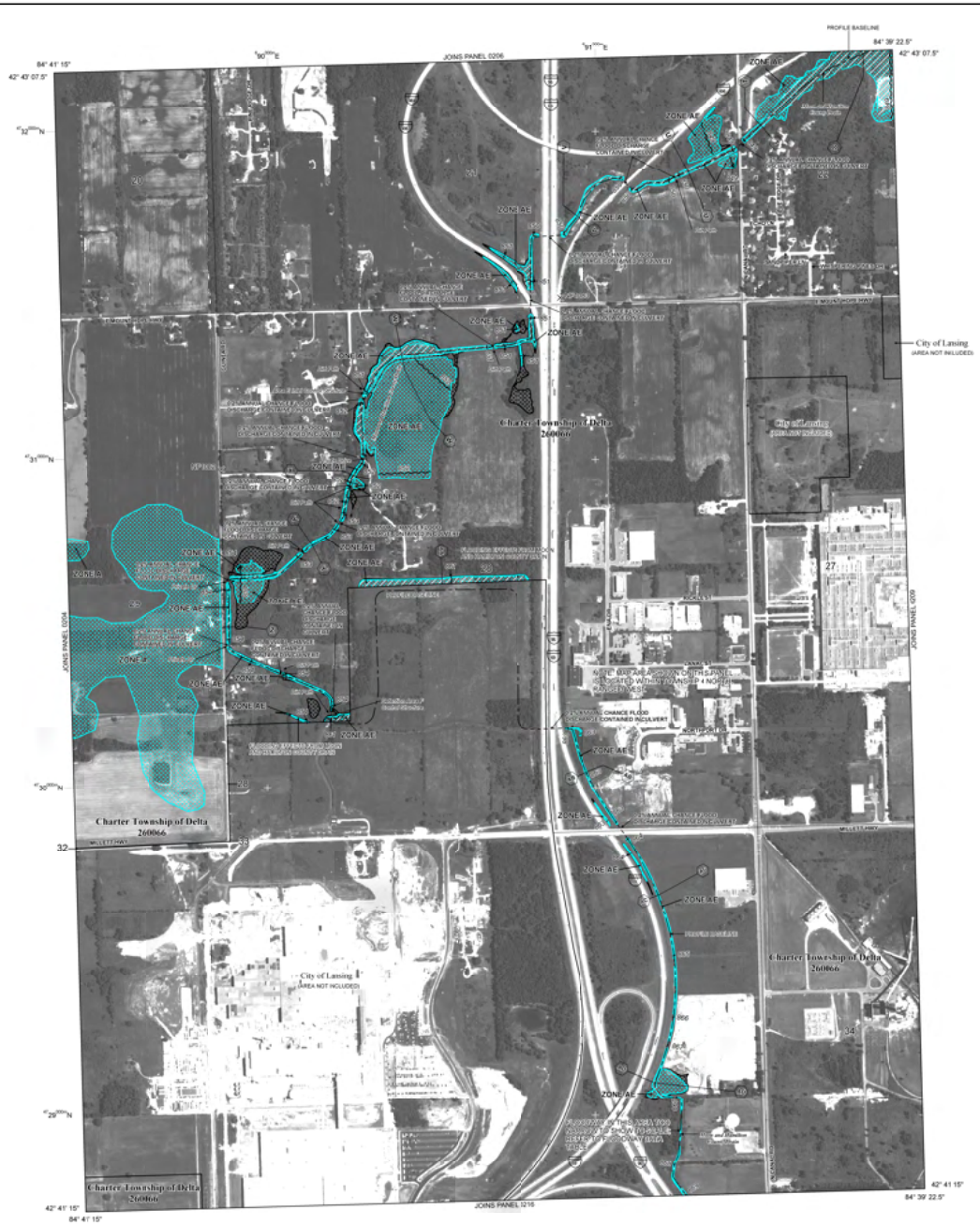
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1- 877- **FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4376000 mN — 1000-meter Universal Transverse Mercator grid values, zone 16
- BM 5513 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0208E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 208 OF 490
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260066	0208	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0208E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.6

FLOODPLAINS MAP

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 75- 3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

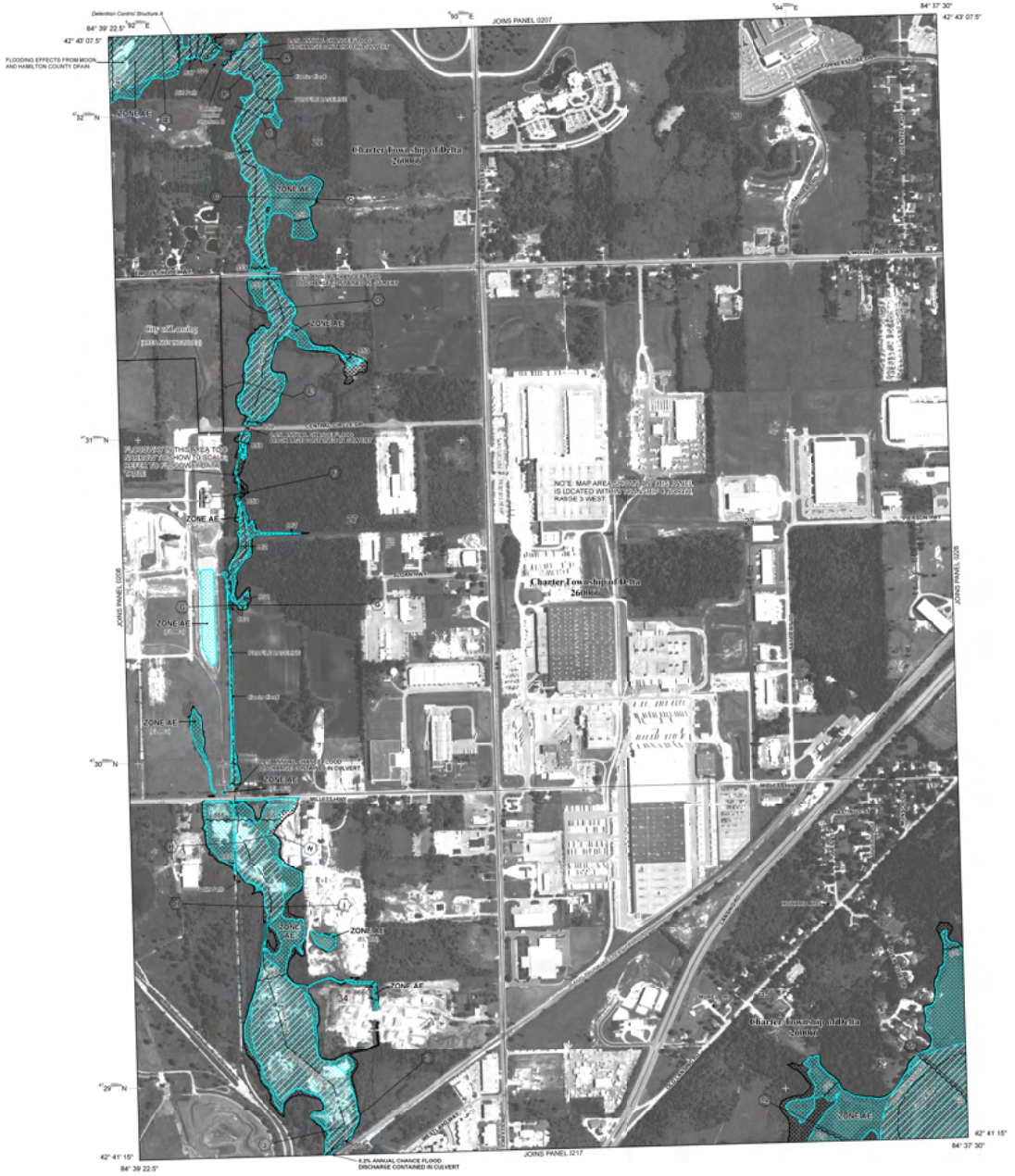
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AR/A, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4851000 mN — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0209E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 209 OF 490

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260096	0209	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0209E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.7

FLOODPLAINS MAP B

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NVNGD/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

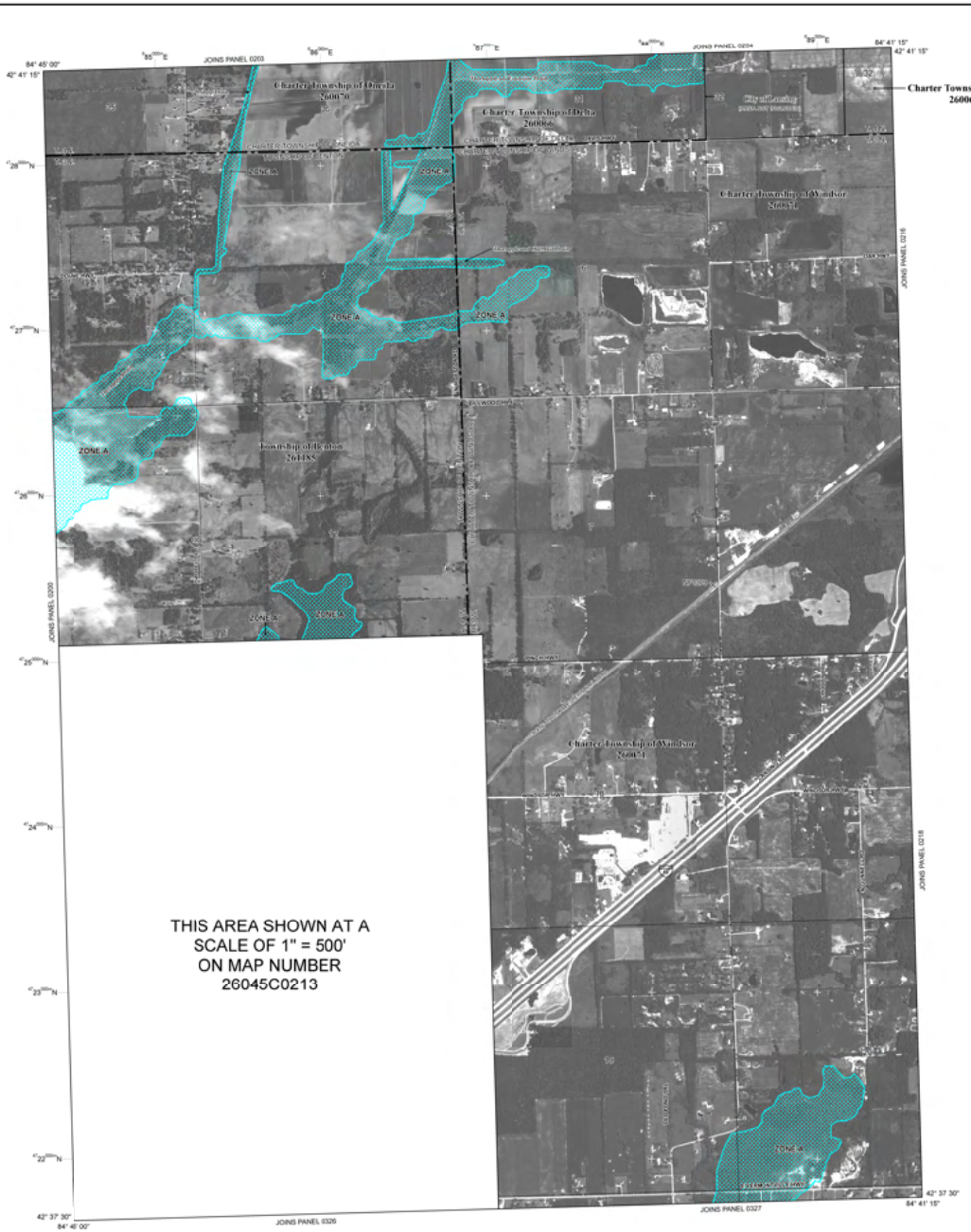
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1- 877- **FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

- OTHER FLOOD AREAS
- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS
- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
- OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
- *Referenced to the North American Vertical Datum of 1988
- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4376000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 0215E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 215 OF 490

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BENTON, TOWNSHIP OF	261185	0215	E
DELTA, CHARTER TOWNSHIP OF	260066	0215	E
ONEIDA, CHARTER TOWNSHIP OF	260070	0215	E
WINDSOR, CHARTER TOWNSHIP OF	260071	0215	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0215E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.8

FLOODPLAINS MAP C

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only onward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Stuu report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Floo Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS8 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGD/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 2091 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of he National Geodetic Survey at **(301) 71l- 3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

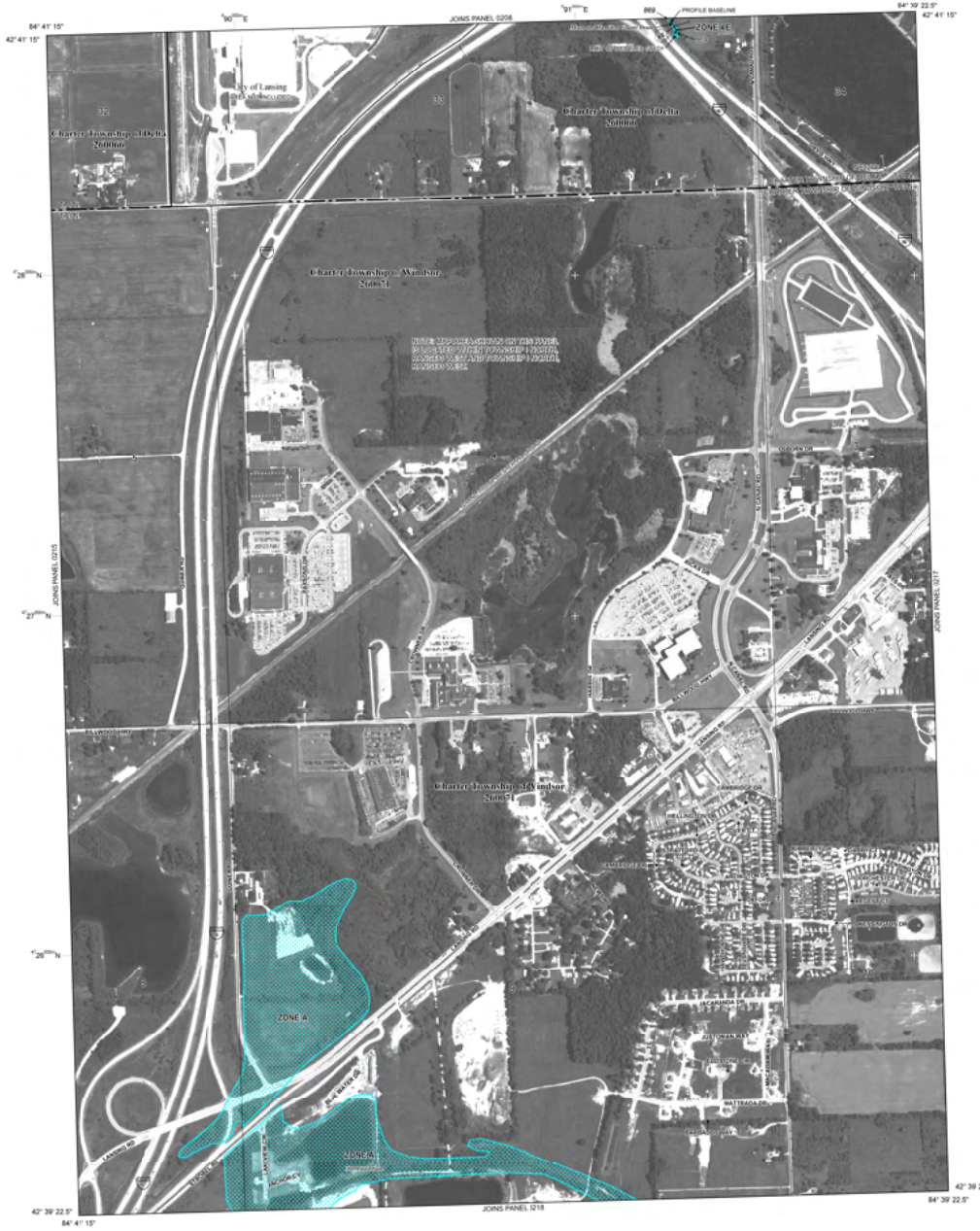
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occured after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA-MAP (1-877-336-2627) for informationon available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Repot, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.mac.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1- 877- **FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/businessnfip/



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1-30, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS
ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS
ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 X — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call theNational Flood Insurance Program at 1-800-638-9620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0216E

FIRM

FLOOD INSURANCE RATE MAP
EATON COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 216 OF 490
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260066	0216	E
WINDSOR, CHARTER TOWNSHIP OF	260071	0216	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0216E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.9

FLOODPLAINS MAP D

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS2/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242** or visit its website at http://www.ngs.noaa.gov/

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

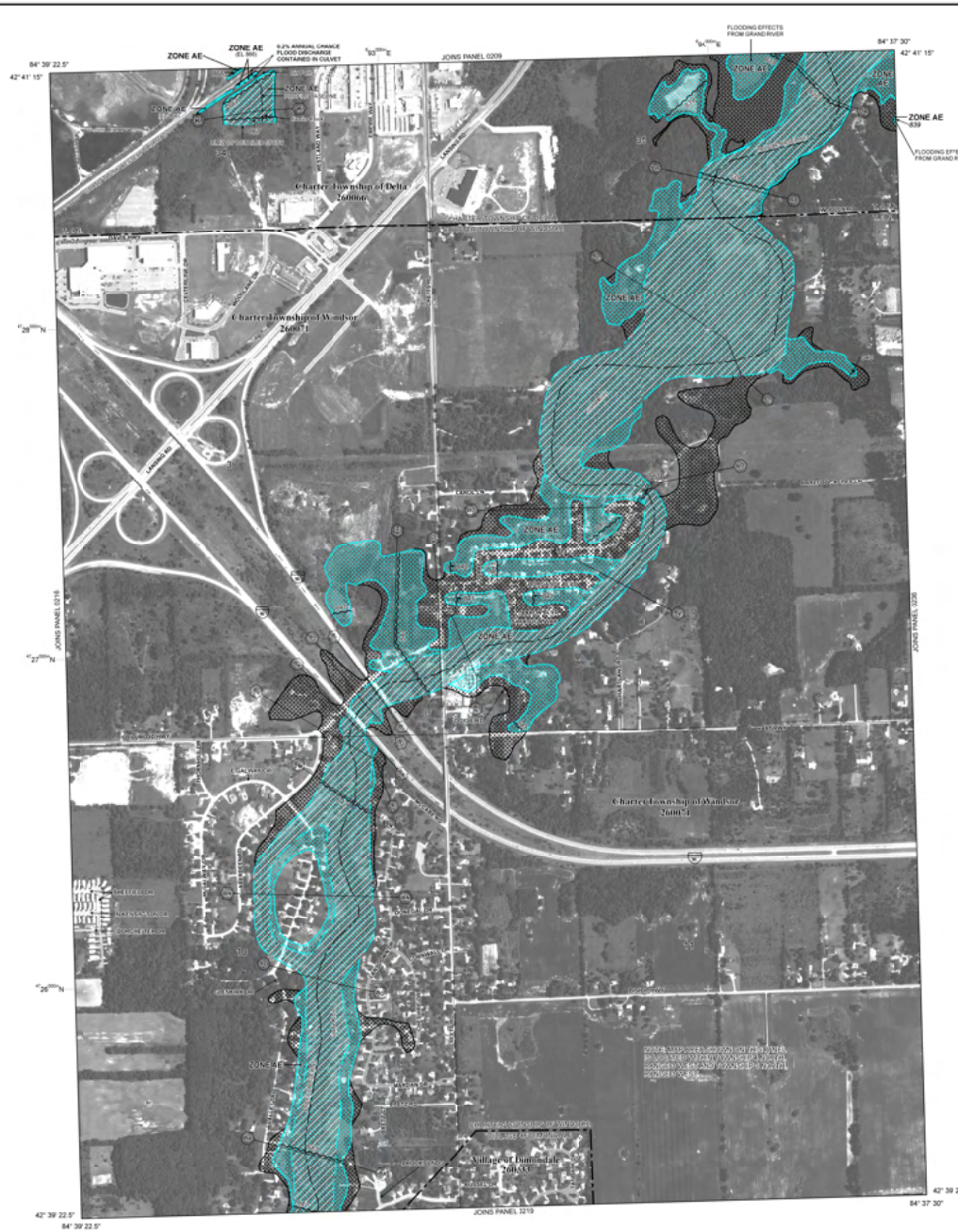
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occured after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1- 877- **FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4927000 N — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0217E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 217 OF 490

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260096	0217	E
DIMONDALE, VILLAGE OF	260333	0217	E
WINDSOR, CHARTER TOWNSHIP OF	260071	0217	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0217E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.10

FLOODPLAINS MAP E

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Floo Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS2/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 7'0- 3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

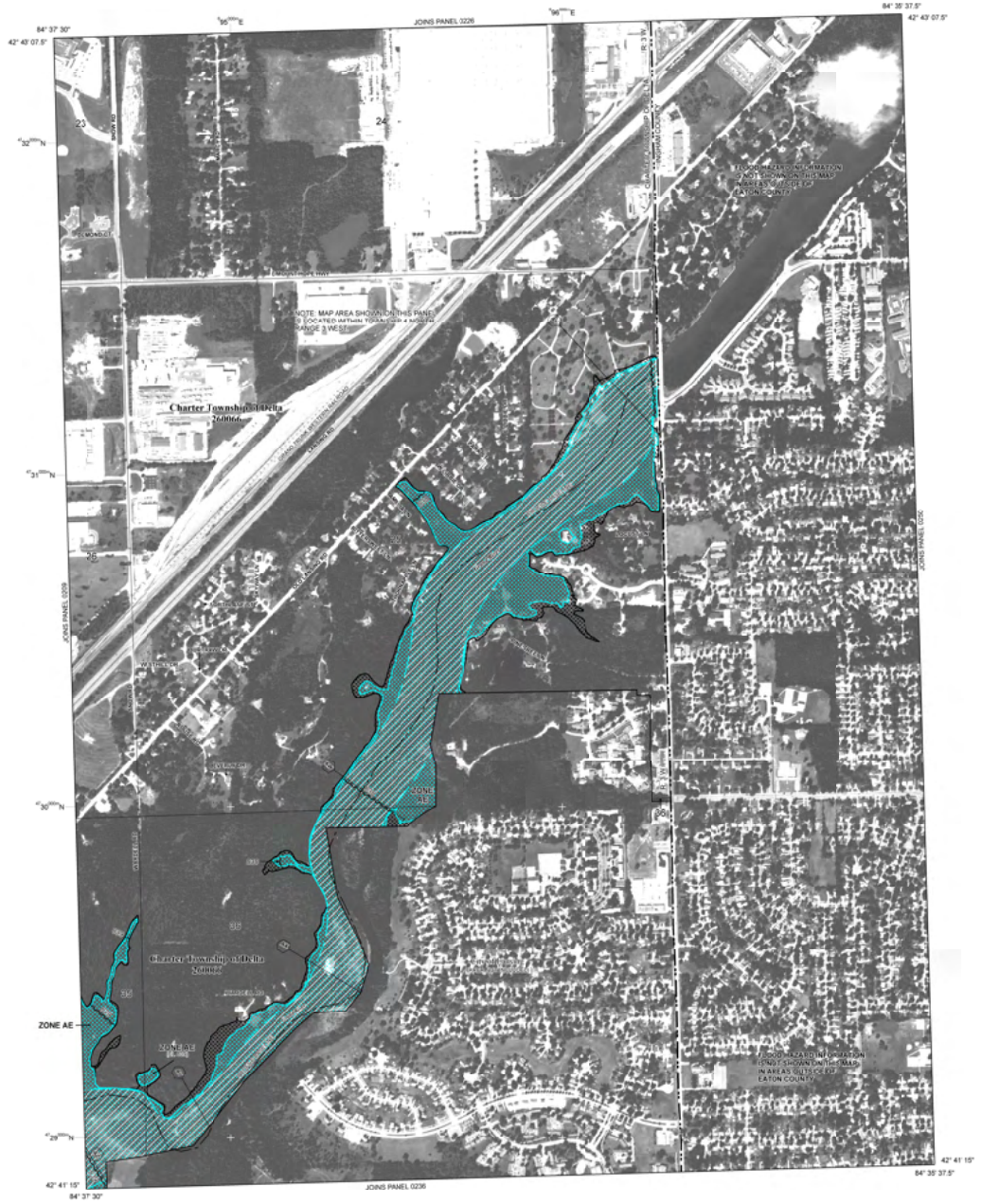
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles n the FIS report. As a result of improved topographic data, he profile baseline, in ome cases, may deviate significantly from the channel centerline or appear outside he Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occured after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the countr showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-80-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions abou this map** or questions concerning the National Flood Insurance Program in general, please call 1- **877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AR/A, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0228E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 228 OF 490

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260066	0228	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0228E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.11

FLOODPLAINS MAP F

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas when **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users areencouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on tis map apply only landward of 0.0' North American Vertical Datum of 1988. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in he Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flooc Insurance Study report for information on flood control structure for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared o structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NINGD/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209' 0-3282
(301)713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 71l- 3242**, or visit its website at http://www.ngs.'noaa.gov/

Base map information shown on this FIRM was derived from U.S. Department of Agriculture (USDA) digital aerial photography produced at a scale of 1:12,000 and dated 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deriate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit ocations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of th panels on which each community is located.

Contact the **FEMA Map Information eXchange** at 1-877-FEMA MAP (1-877-336-2627) for informaonn available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versons of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877 FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AR/A, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4276000 mN — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
November 26, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0236E

FIRM

FLOOD INSURANCE RATE MAP

EATON COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 236 OF 490

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELTA, CHARTER TOWNSHIP OF	260099	0236	E
WINDSOR, CHARTER TOWNSHIP OF	260071	0236	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26045C0236E
EFFECTIVE DATE
NOVEMBER 26, 2010

Federal Emergency Management Agency

Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.12

FLOODPLAINS MAP G

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies the FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.13

FLOODPLAINS MAP H

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4978000 mN — 1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0018D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 18 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CHARTER TOWNSHIP OF	260632	0018	D
LANSING, CITY OF	260090	0018	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0018D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4000000 mN — 1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NORTH
MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0128D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 128 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CHARTER TOWNSHIP OF	260032	0128	D
LANSING, CITY OF	260090	0128	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0128D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.14

FLOODPLAINS MAP I

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.15

FLOODPLAINS MAP J

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4927000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0129D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 129 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CHARTER TOWNSHIP OF	260632	0129	D
LANSING, CITY OF	260081	0129	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0129D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodwa**rs were computed at cross sections and interpolated between cross sections. Th floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 209 0-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

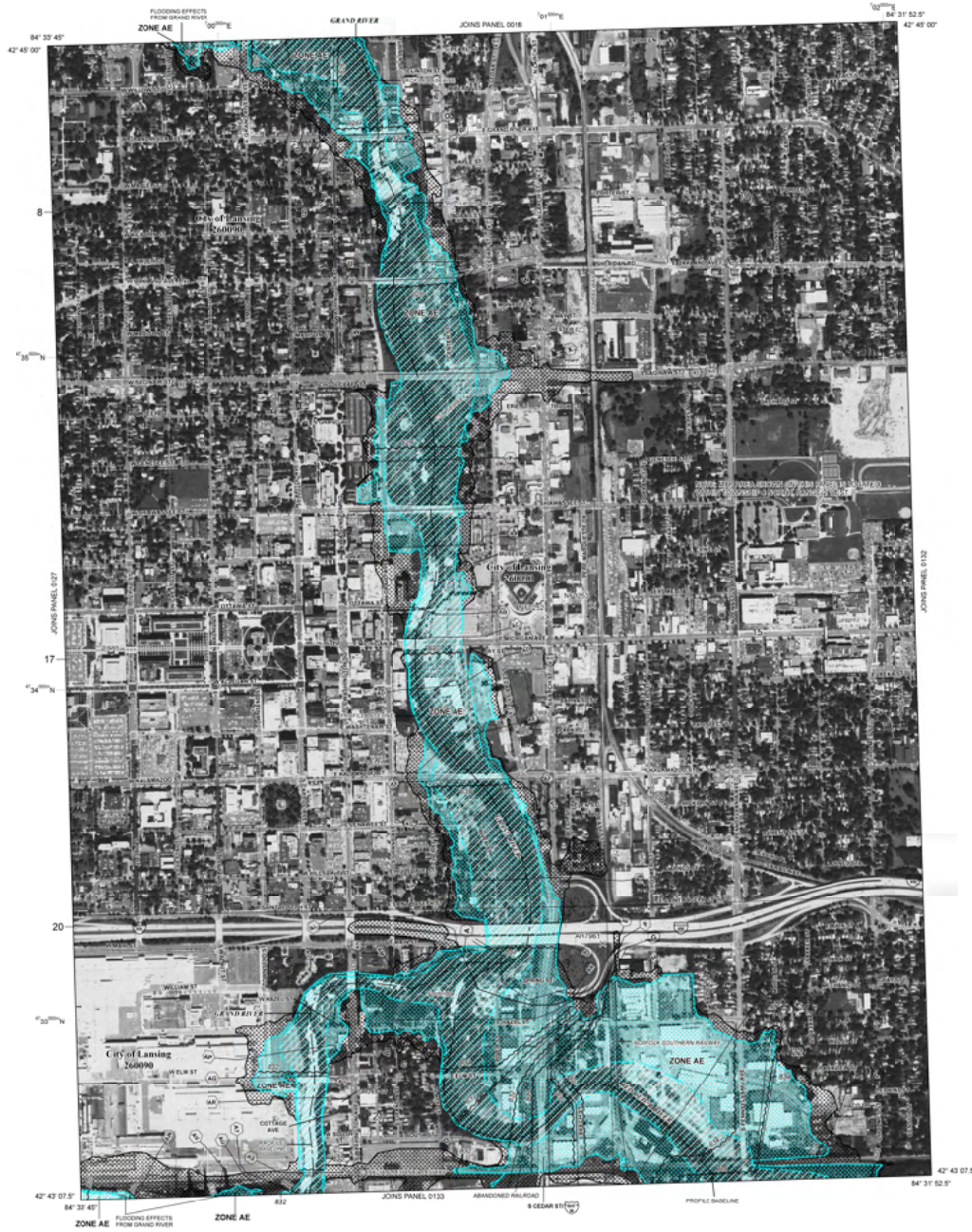
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside he SFHA.

Corporate limits shown on his map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout o map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program n general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A Cross section line

23 — 23 Transec line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

5000000 mN 1000-meter Universal Transverse Mercator grid values, zone 16

Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0131D

FIRM

FLOOD INSURANCE RATE MAP

INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 131 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CITY OF	260090	0131	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0131D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.16

FLOODPLAINS MAP K

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood-elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

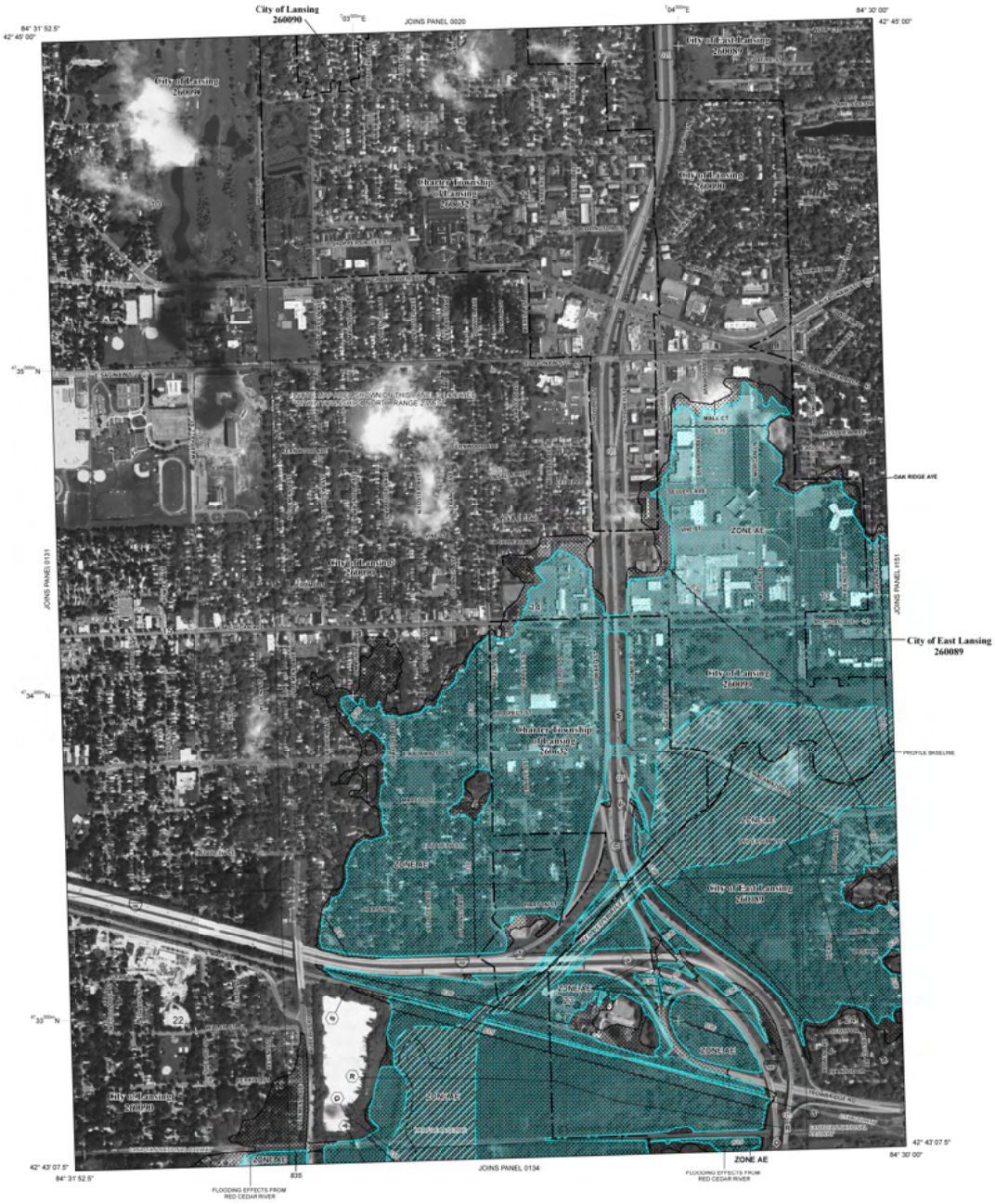
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 16
Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NORTH

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0132D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 132 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EAST LANSING, CITY OF	260089	0132	D
LANSING, CHARTER TOWNSHIP OF	260632	0132	D
LANSING, CITY OF	260090	0132	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0132D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.17

FLOODPLAINS MAP L

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

PANEL 0133D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 133 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CITY OF	260095	0133	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

NATIONAL FLOOD INSURANCE PROGRAM

MAP NUMBER
26065C0133D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.18

FLOODPLAINS MAP M

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

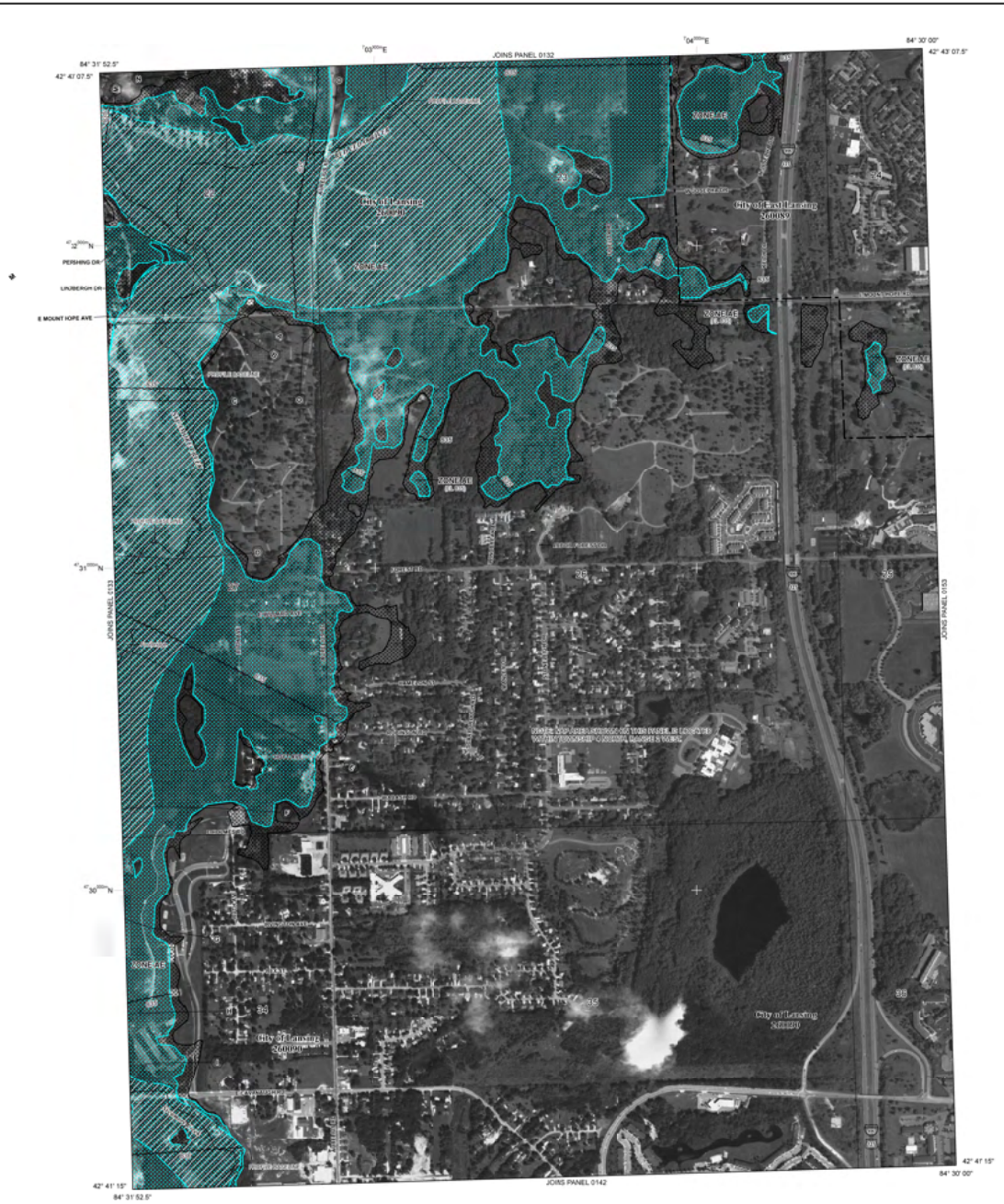
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
5000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0134D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 134 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EAST LANSING, CITY OF	260095	0134	D
LANSING, CITY OF	260081	0134	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0134D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.19

FLOODPLAINS MAP N

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 16
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0136D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 136 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260095	0136	D
LANSING, CITY OF	260099	0136	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0136D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.20

FLOODPLAINS MAP O

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.21

FLOODPLAINS MAP P

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4982000 N — 1000-meter Universal Transverse Mercator grid values, zone 16
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0137D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 137 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260095	0137	D
LANSING, CITY OF	260090	0137	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0137D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies the FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4982000 N — 1000-meter Universal Transverse Mercator grid values, zone 16
- 5000 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0138D

FIRM

FLOOD INSURANCE RATE MAP

INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 138 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260093	0138	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0138D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.22

FLOODPLAINS MAP Q

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

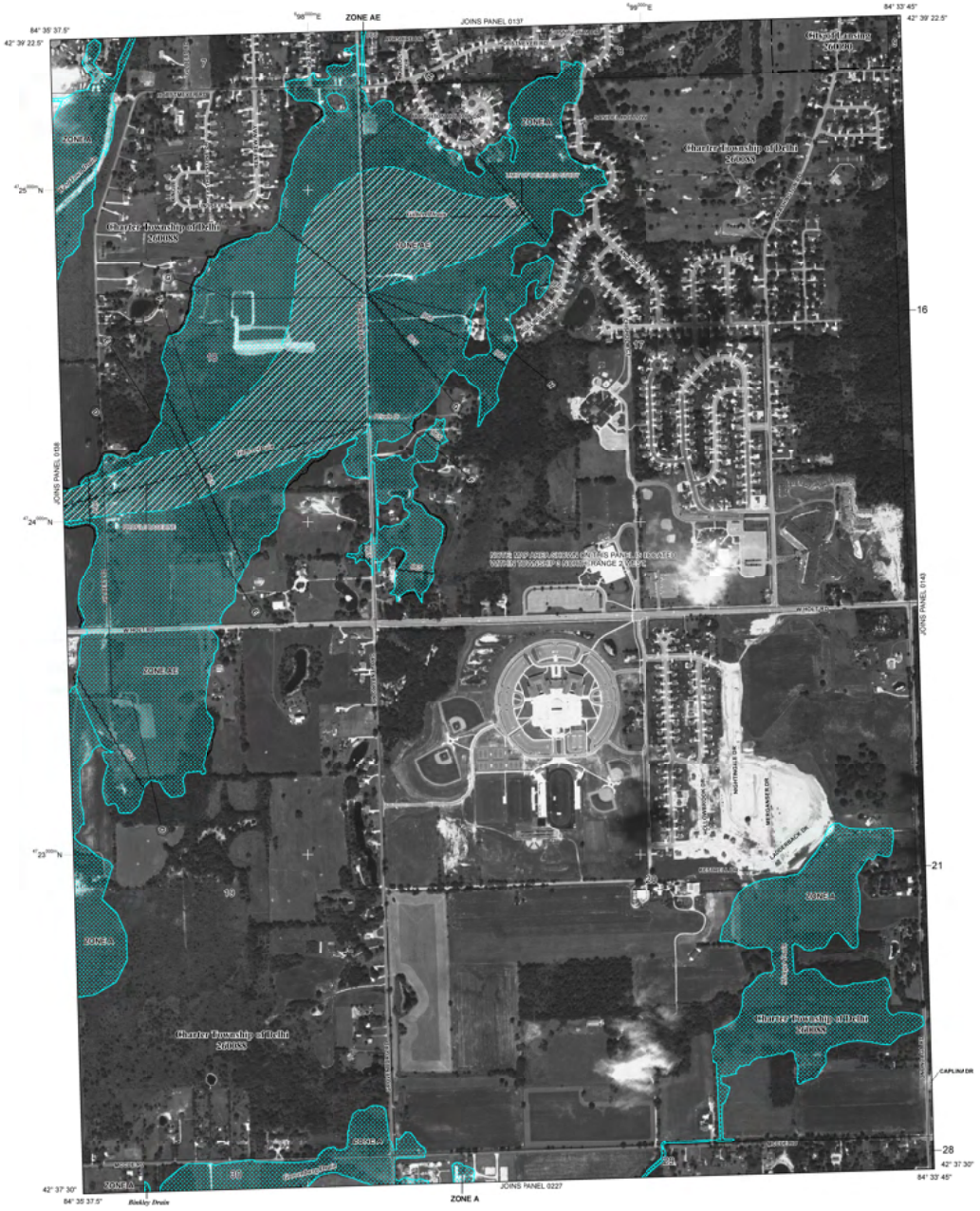
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4000000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

PANEL 0139D

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 139 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260093	0139	D
LANSING, CITY OF	260090	0139	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0139D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.23

FLOODPLAINS MAP R

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 16
5351810 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0141D

FIRM
FLOOD INSURANCE RATE MAP
INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 141 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, CITY OF	260095	0141	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for this subject community.

MAP NUMBER
26065C0141D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.24

FLOODPLAINS MAP S

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

Hometown People. Hometown Power.

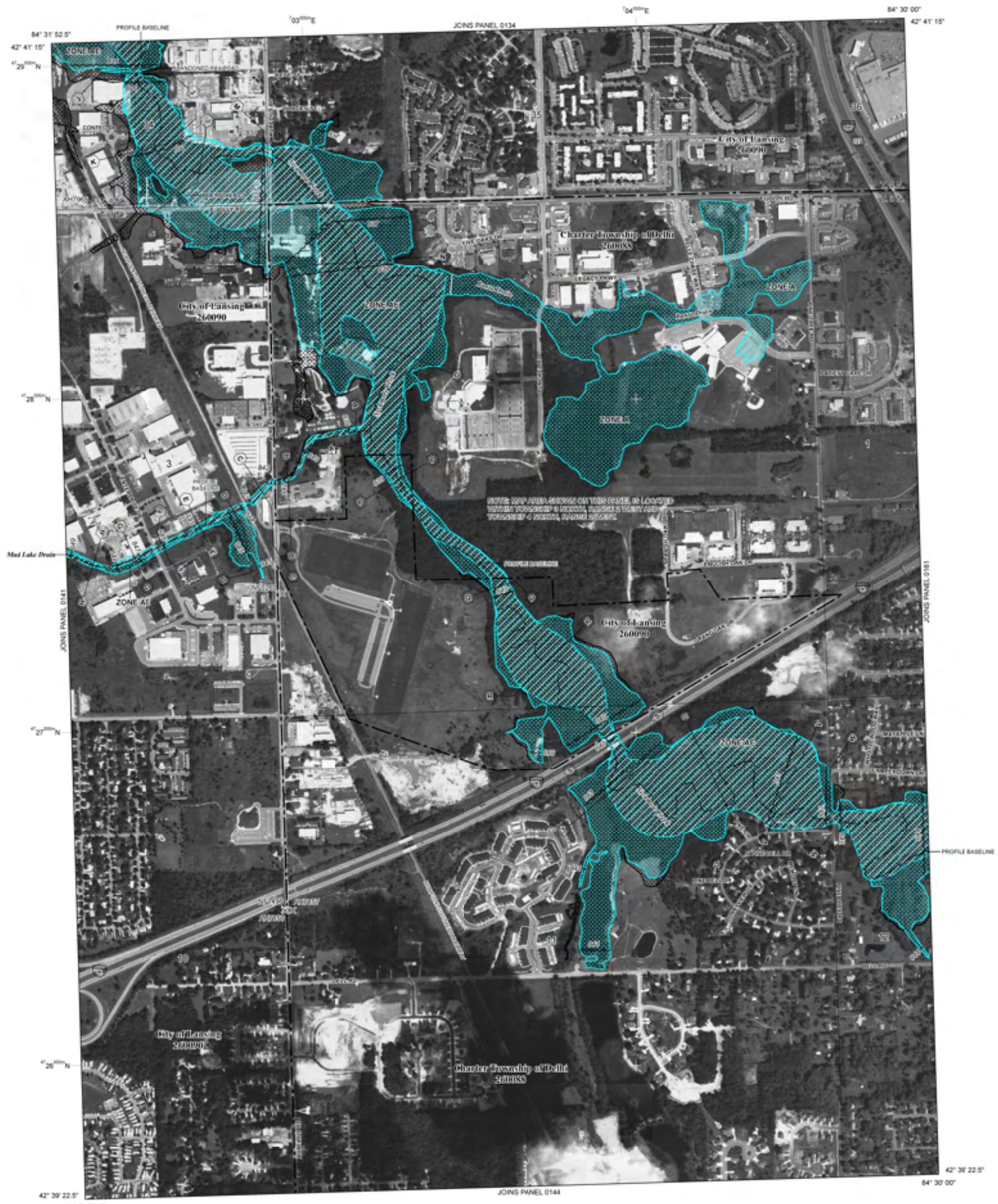
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.25

FLOODPLAINS MAP T

2022 DWSRF Project Plan

March 2022 | HRC#: 20220131



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
~~~ 513 ~~~ Base Flood Elevation line and value; elevation in feet*
(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)—(A) Cross section line
(23)- - - -(23) Transect line
45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 16
DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
•M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0142D

FIRM

FLOOD INSURANCE RATE MAP

INGHAM COUNTY, MICHIGAN
(ALL JURISDICTIONS)

PANEL 142 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260088	0142	D
LANSING, CITY OF	260090	0142	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0142D

EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency
~~~

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

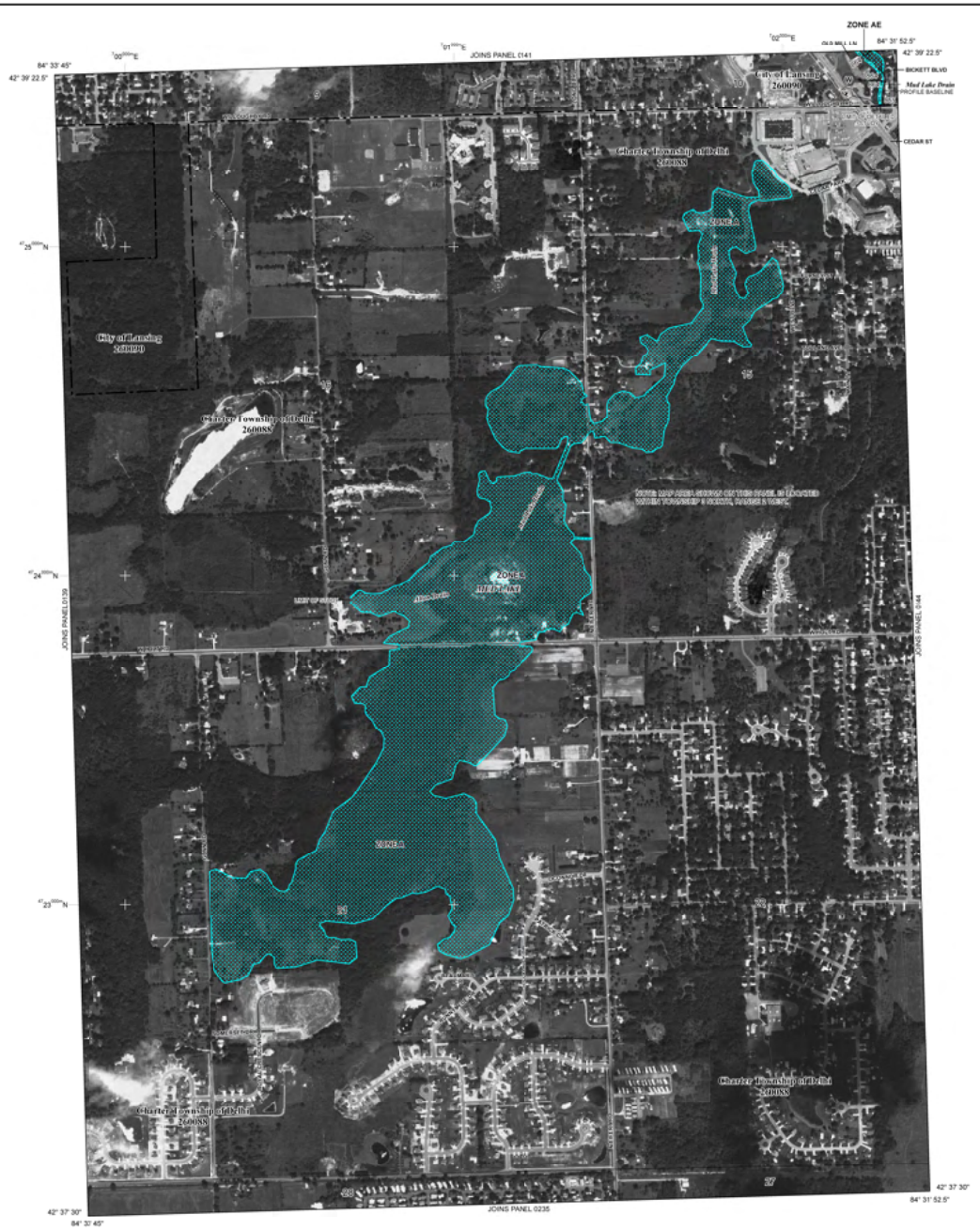
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** — No Base Flood Elevations determined.
- **ZONE AE** — Base Flood Elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 5000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NORTH

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

PANEL 0143D

FIRM

FLOOD INSURANCE RATE MAP

INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 143 OF 425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260088	0143	D
LANSING, CITY OF	260090	0143	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

NATIONAL FLOOD INSURANCE PROGRAM

MAP NUMBER
26065C0143D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.26

FLOODPLAINS MAP U

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program at a scale of 1:12,000 from imagery dated July 7, 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, I, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** — No Base Flood Elevations determined.
- **ZONE AE** — Base Flood Elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** — Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4927000 m N — 1000-meter Universal Transverse Mercator grid values, zone 16
- 5000 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NORTH

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0144D

FIRM

FLOOD INSURANCE RATE MAP

INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)

PANEL 144 OF 425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DELHI, CHARTER TOWNSHIP OF	260088	0144	D
LANSING, CITY OF	260091	0144	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
26065C0144D
EFFECTIVE DATE
AUGUST 16, 2011

Federal Emergency Management Agency

LANSING BWL
Hometown People. Hometown Power.

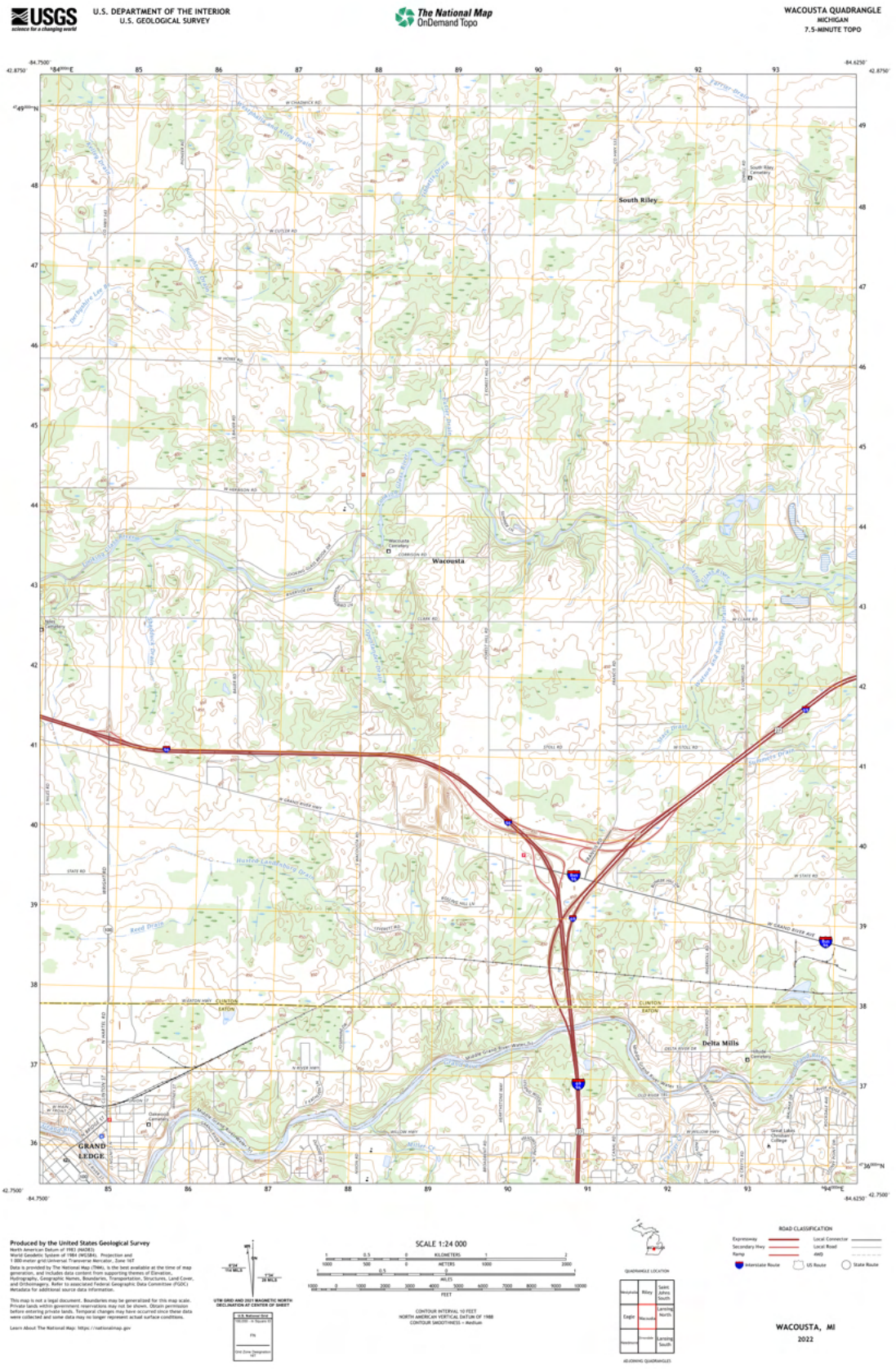
HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.27

FLOODPLAINS MAP V

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131



HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

LANSING BWL
Hometown People. Hometown Power.

FIGURE 2.28
LBWL SERVICE AREA
USGS TOPO MAP A

2022 DWSRF
Project Plan

March 2022

HRC#: 20220131

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

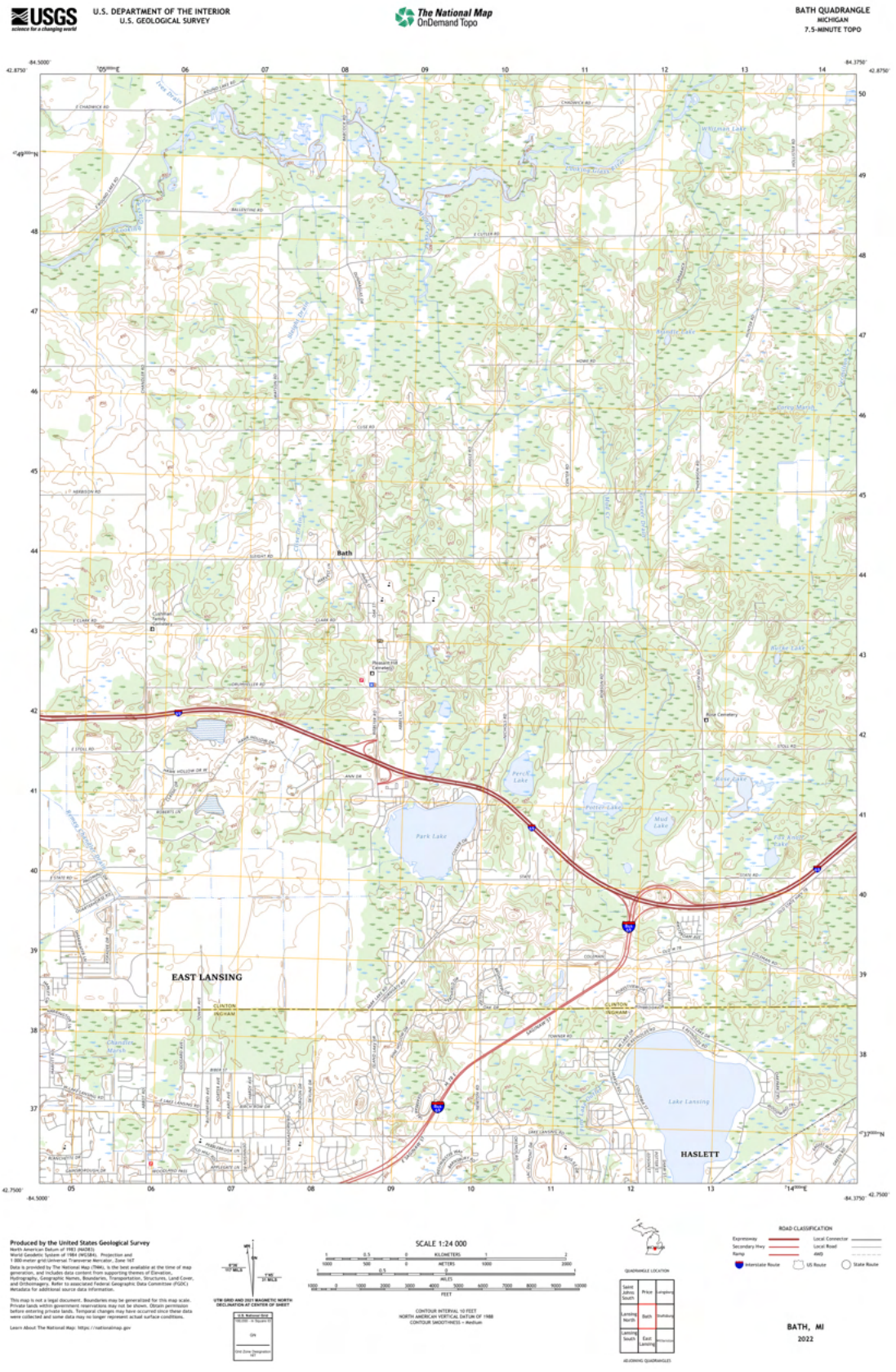
LANSING BWL
Hometown People. Hometown Power.

FIGURE 2.29
LBWL SERVICE AREA
USGS TOPO MAP B

2022 DWSRF
Project Plan

March 2022

HRC#: 20220131



HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

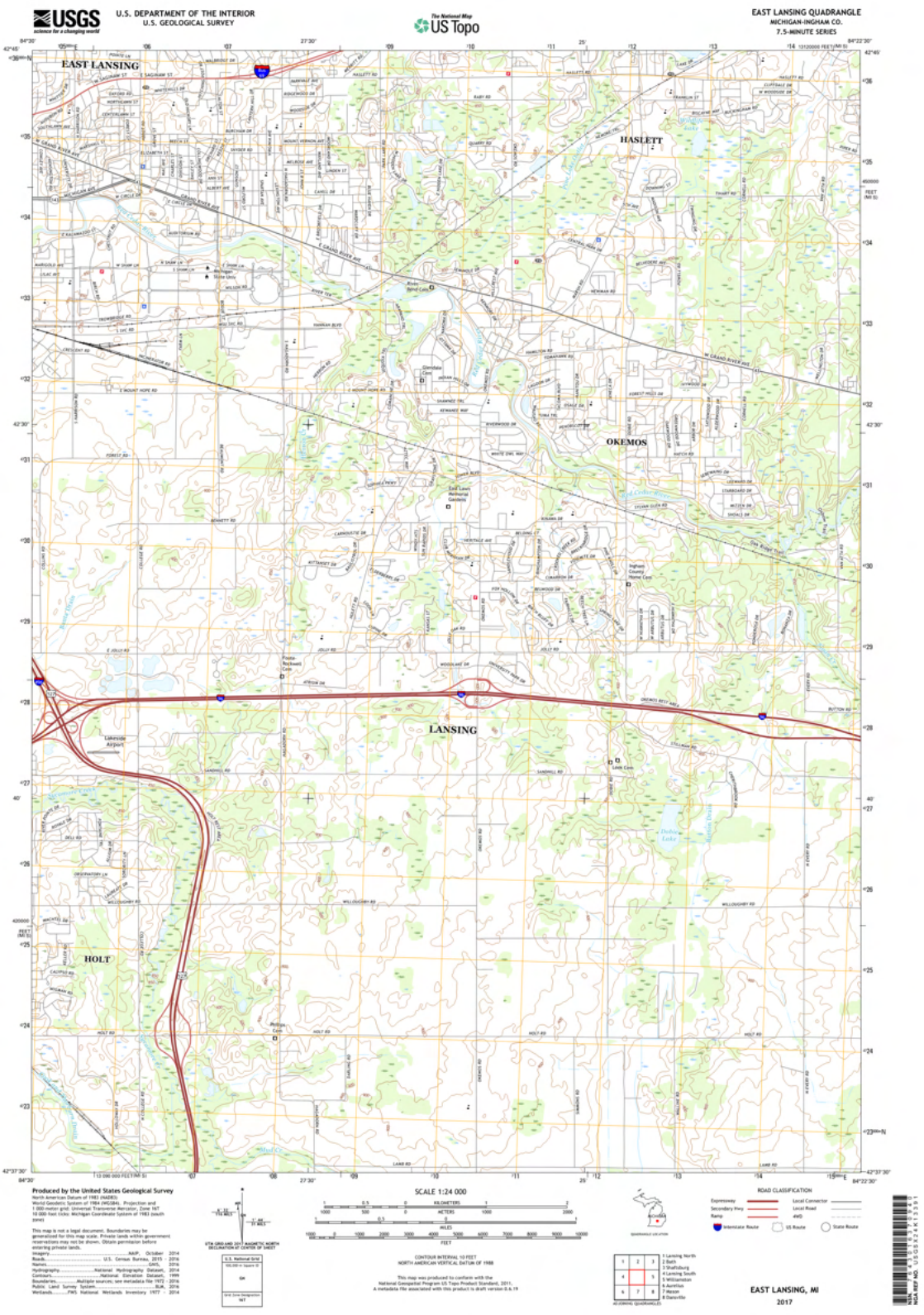
Hometown People. Hometown Power.

FIGURE 2.30
LBWL SERVICE AREA
USGS TOPO MAP C

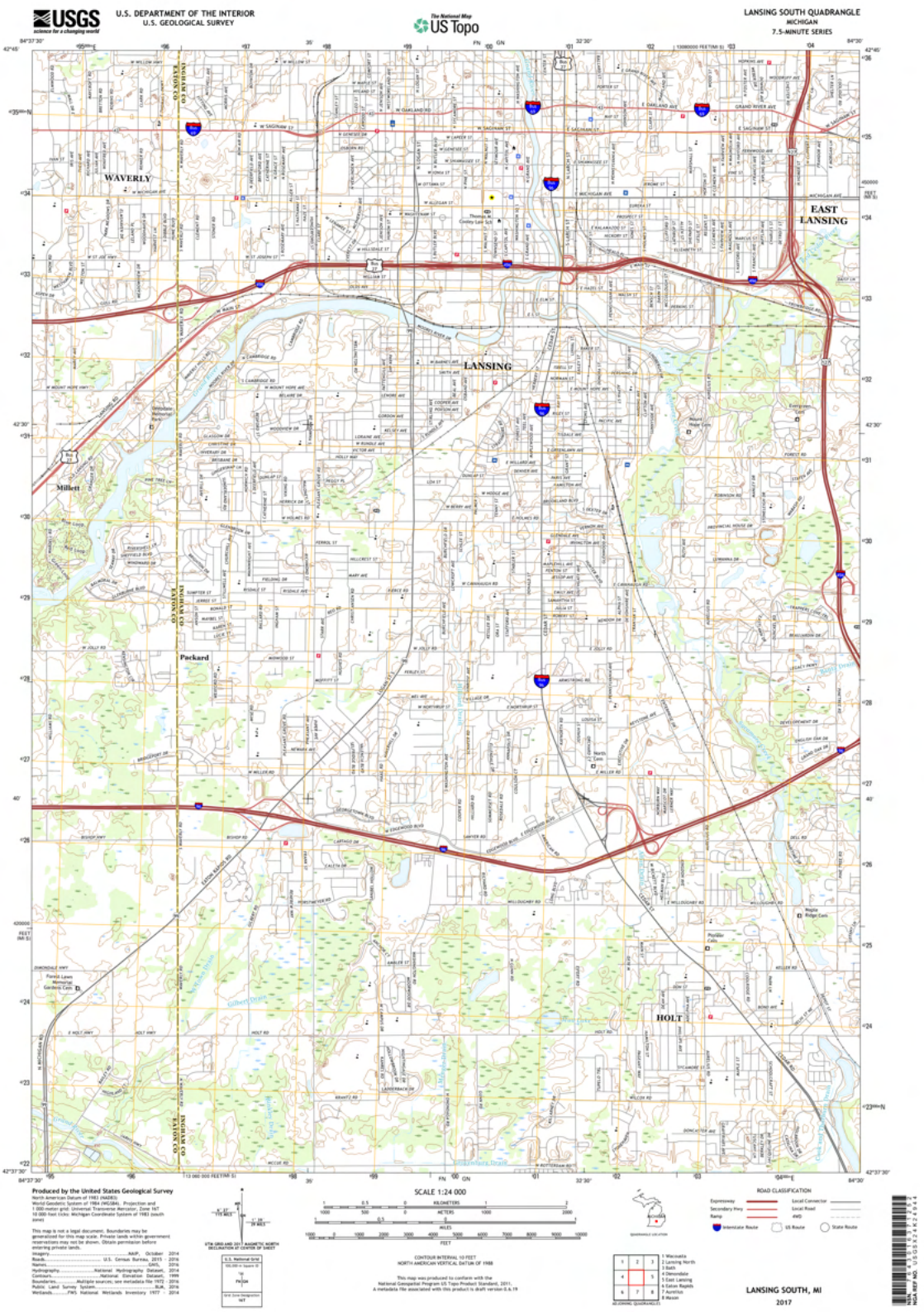
2022 DWSRF
Project Plan

March 2022

HRC#: 20220131



HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915 LANSING BWL Hometown People. Hometown Power.	**FIGURE 2.31** LBWL SERVICE AREA USGS TOPO MAP D	2022 DWSRF Project Plan March 2022 | HRC#: 20220131



HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

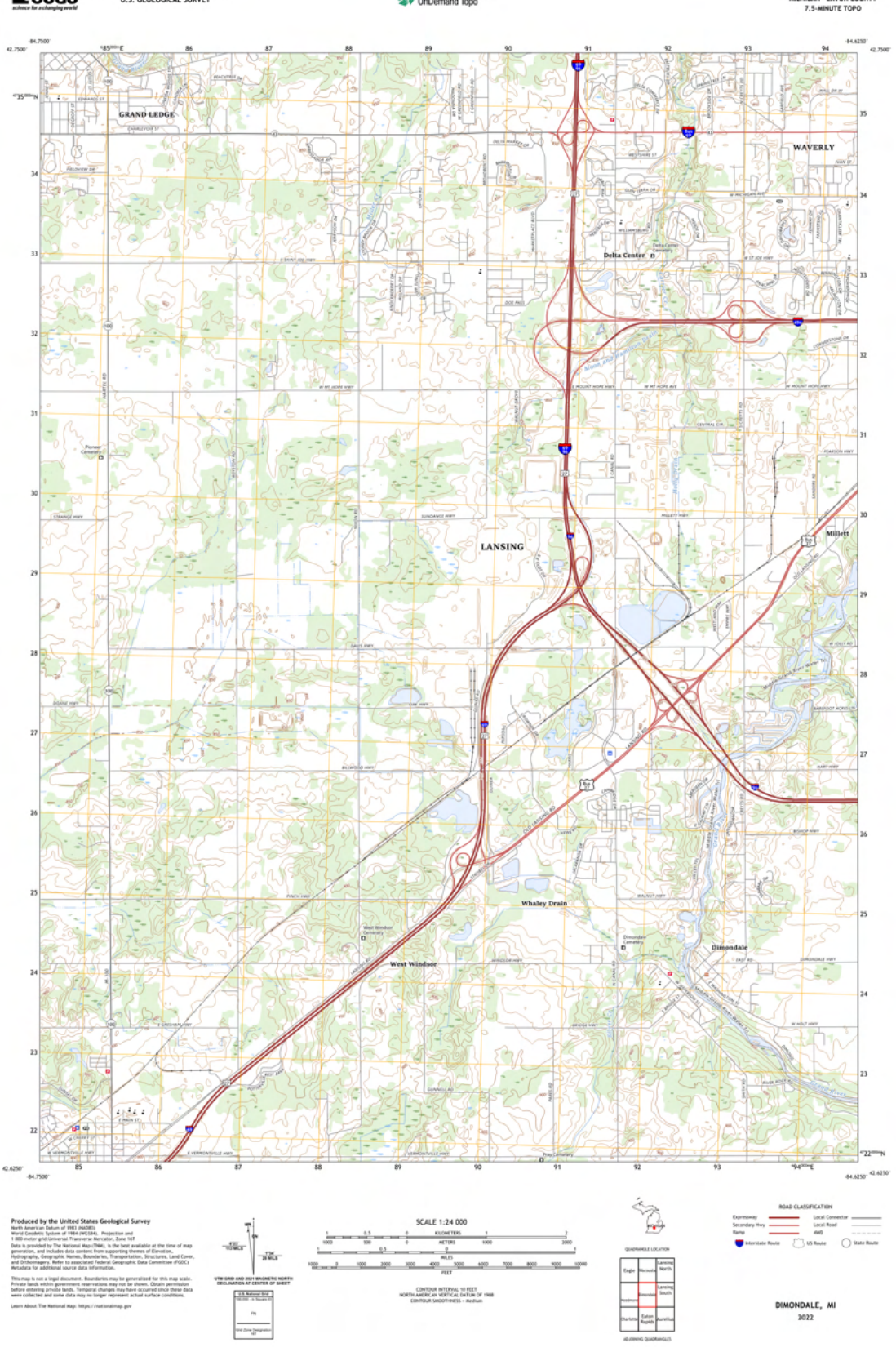
Hometown People. Hometown Power.

FIGURE 2.32
LBWL SERVICE AREA
USGS TOPO MAP E

2022 DWSRF
Project Plan

March 2022

HRC#: 20220131



HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

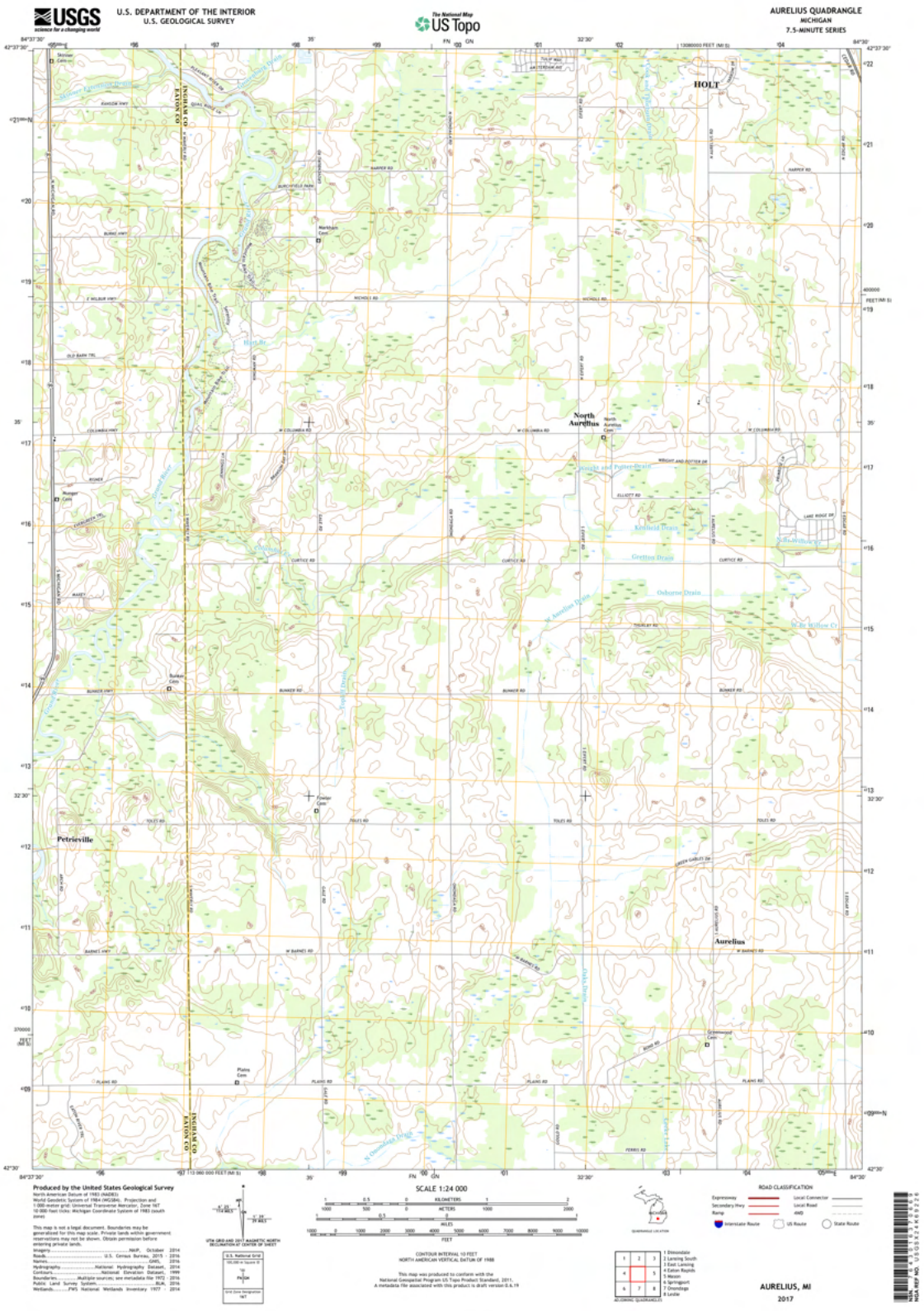
LANSING BWL
Hometown People. Hometown Power.

FIGURE 2.33
LBWL SERVICE AREA
USGS TOPO MAP F

2022 DWSRF
Project Plan

March 2022

HRC#: 20220131



HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

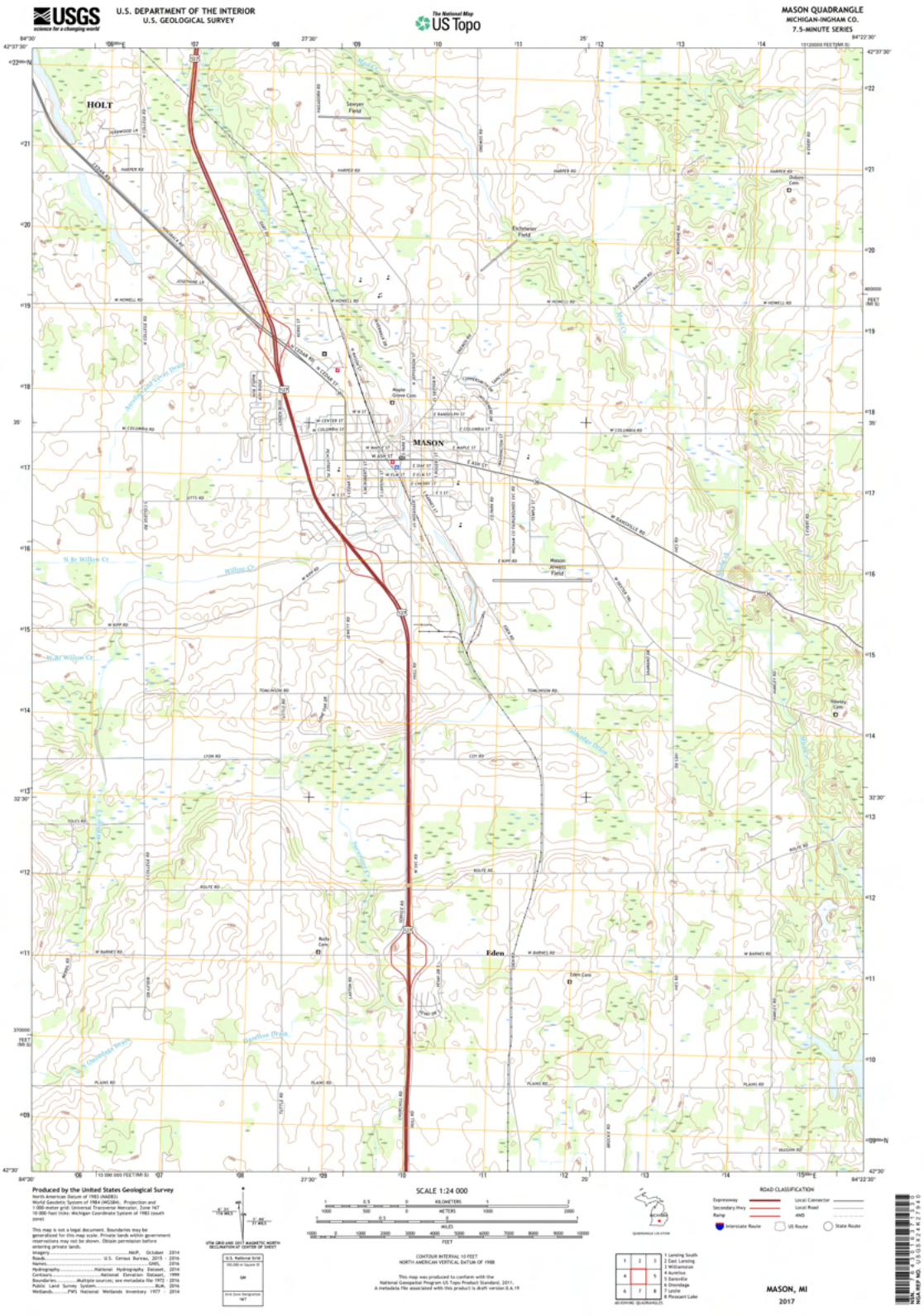
LANSING BWL
Hometown People. Hometown Power.

FIGURE 2.34
LBWL SERVICE AREA
USGS TOPO MAP G

2022 DWSRF
Project Plan

March 2022

HRC#: 20220131



HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915 LANSING BWL Hometown People. Hometown Power.	**FIGURE 2.35** LBWL SERVICE AREA USGS TOPO MAP H	2022 DWSRF Project Plan March 2022 | HRC#: 20220131

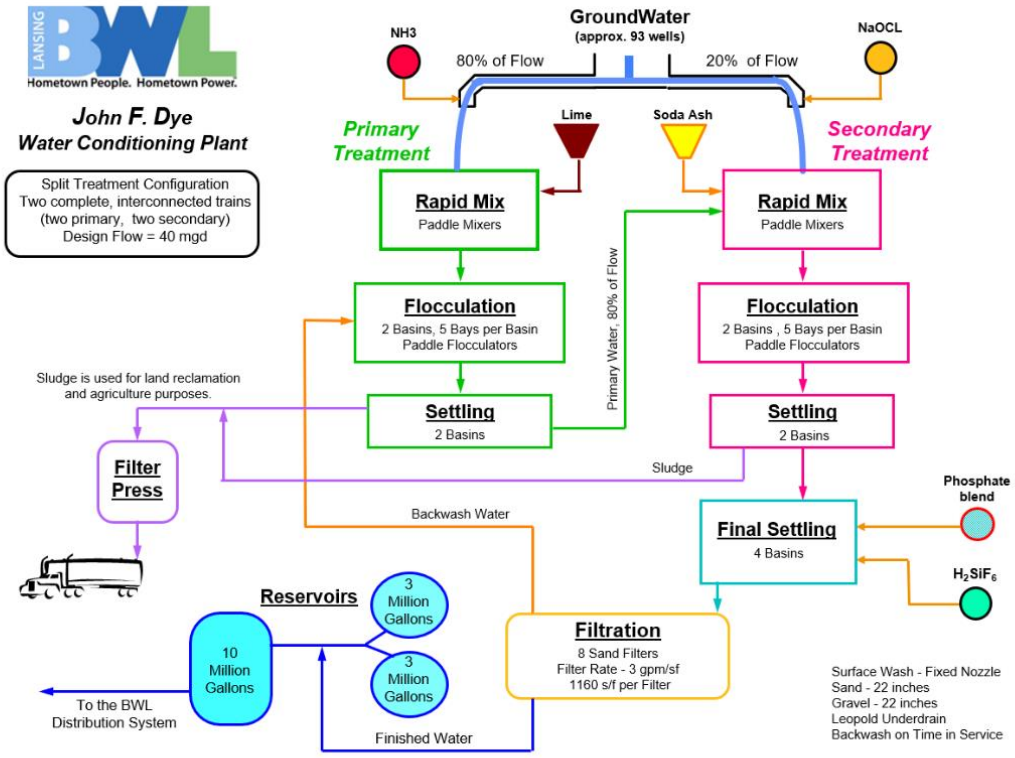
2.6 Existing Water Supply System

2.6.1 Water Supply and Conditioning

The BWL water supply utilizes groundwater from the Saginaw Aquifer, delivered in varying amounts by deep rock wells located throughout the greater Lansing area. BWL has 122 wells that are either in active or out of service status, with 7 of those wells owned by Lansing Township West Side Water. Wells that are out of service are for routine maintenance or reduced water usage during the winter. All wells are connected by a system of raw water transmission mains to either the Dye Water Conditioning Plant (WCP) or the Wise Road WCP.

The Dye WCP was built in 1939 with a rated capacity of 30 million gallons per day (MGD). In 1949, the plant was expanded to 40 MGD, due to an increase in demand. Current treatment consists of two-stage split treatment softening, granular media filtration, and chloramine disinfection. Approximately 80% of the incoming groundwater undergoes excess lime treatment at a pH above 11 in the primary treatment basins to precipitate calcium and magnesium hardness as calcium carbonate (CaCO3) and magnesium hydroxide (Mg (OH)2), respectively. The primary treatment train is comprised of two rapid mix basins, two flocculation basins (five bays each, each containing paddle flocculators), and two settling basins. Ammonia is added to the primary basin influent line, and lime is added at the primary rapids mix stage. After water is passed through rapid mix, it flows into the flocculation basins where, through the five bays, flocs form and grow in size as they progress towards the settling basins. In the settling basins, these flocs settle out and get transferred to the sludge thickening system and the clean water overflows to secondary treatment. Settled water from the primary basins is blended with untreated groundwater (approximately 20% of the incoming flow) prior to entering the secondary treatment basins to reduce the pH of the blended water and to maintain a pH of approximately 9.5 in the finished water leaving the plant. This reduced pH also promotes precipitation of excess lime as CaCO3 within the secondary settling basins. Sodium hypochlorite and fluoride are added to the secondary basin influent line, and soda ash is added at the rapid mix stage of the secondary train. The effluent from the secondary basins flows to final settling prior to the sand filters. A polyphosphate/orthophosphate chemical blend is added to the final settling basins as a scale inhibitor in the filters and a corrosion inhibitor in the distribution system. The backwash pump supplies water to clean the filters. The filter effluent flow is transmitted to one of three finished water reservoirs, which supply flow to the high-service pumping stations. This facility has two high-service pumping stations, Dye High Lift and Cedar Pumping Station, which operate simultaneously and pump water to the distribution system. Dye High Lift contains three high service pumps (and one filter backwash pump), and Cedar contains four high service pumps (Pump 1 is directly wired to the generator and Pump 4 is not operable). The residual backwash water is sent to the cistern and then reintroduced at the head of the plant. Sludge from the thickener underflow is processed through a filter press and hauled off-site for land application and/or reclamation, while the residual water is conveyed to the head of the primary basins. The schematic on the following page shows the treatment process through the Dye WCP.

Figure 2-36. Dye WCP Treatment Process



The Wise WCP was constructed in 1966 in the southern portion of Lansing, Michigan. It has a design capacity of 10 MGD. Current treatment consists of two-stage split treatment softening, granular media filtration, and chloramine disinfection. The general treatment processes are the same as the Dye WCP, but on a smaller scale. This plant generally receives water from 21 wells dedicated to this plant, and BWL can send water to Wise from an additional 23 wells by opening or closing valves on the raw water transmission line, depending on demand. Just as at Dye, the raw water is split 80% primary and 20% secondary in which each train consists of two rapid mix basins, two flocculation basins, and two settling basins. The remainder of the process mimics that at Dye, ending at four sand filters and finished water piped to a reservoir on site. The high service pumping station contains four pumps, which pump water to the distribution system. The Wise WCP does not contain any solids processing equipment; the solids are pumped nearly seven miles to the Dye WCP for processing.

Climate change has multiple potential impacts on water quality and water quantity. Therefore, it is important to consider and plan for these impacts. In the Great Lakes region, there has been an increase in storm intensity which has led to increased runoff from farms and cities, and flooding, which leads to more pollutants entering waterways and groundwater. In addition, there is more stress on the aquifer from fluctuating temperatures. Other items that can be affected are excessive frost penetration, resulting in water main breaks, pressure loss and associated coliform outbreaks. There is an increase in demands to prevent freezing services, and 1920s era water main tends to not meet current depth of bury standards that would prevent mains and services from freezing. The BWL has completed and certified completion of the Risk and Resilience Assessment, as well as the Emergency Response Plan, which was an all hazards approach evaluating risk to the system from malevolent

acts and natural hazards. Natural hazards include items such as power outage (from things such as an ice storm or other), flood, tornado, earthquakes, and pandemics.

2.6.1.1 High Service Pumping

The BWL has high service pumping at both of its WCPs and owns and operates 5 booster stations. The high service pumps are listed below in the table:

Table 2-3. High Service Pumping at WCPs

	Year Installed	Pump Number	Capacity (MGD)
Dye High Lift	1995	Pump 1	20.0
	1995	Pump 2	20.0
	1995	Pump 3	10.0
Cedar St	1952	Pump 1 – Emergency Use	20.0
	1984	Pump 2	12.5
	1953	Pump 3	18.0
	1953	Pump 4 (Out of Service)	15.0
Wise Rd	1966	Pump 1	5.0
	1966	Pump 2	5.0
	1966	Pump 3	10.0
	1966	Pump 4	10.0

2.6.2 Storage Facilities

Storage at the BWL is in ground level reservoirs at Dye Water and Wise Road Conditioning Plants and at the Hulett Booster Pump Station. The BWL has five (5) storage tanks within the water system with a total storage capacity of 24 MG. Three of the storage tanks are located at the Dye WCP, one storage tank is located at the Wise Road WCP, and one storage tank is located adjacent to the Hulett Pumping Station. All three storage tanks at the Dye WCP are hydraulically interconnected and each tank is capable of being isolated from the other two as necessary for maintenance.

Table 2-4.Water Storage

Location Description	Volume
Dye/Cedar North 3.5	3.5 MG
Dye/Cedar South 3.5	3.5 MG
Dye/Cedar East 10.0	10.0 MG
Wise WCP	5.0 MG
Hulett	2.0 MG
Total	**24.0 MG**

2.6.3 Water Distribution Piping

The BWL owns and operates the raw water mains, finished water mains, and water services to the outlet side of the water meter including all appurtenances that make up the distribution system such as booster pumping stations, water valves, hydrants, curb stops and boxes, etc. The system comprises of 52 miles of raw water main, 275 raw water main valves, 808 miles of finished water main, and 828 miles of water services.

The condition of water mains is currently being assessed based on the following criteria:

- Pipe Age
- Number of main breaks, main breaks per 100 miles per year by pipe "category" and by pipe segment
- C factor, hydraulic deficiencies
- Available fire flow based on zoned land use
- Water quality related parameters

Pipe age can be indicator for several criteria listed above. For example, aging unlined cast iron pipe will typically contribute to lower C factors, resulting in greater pumping energy used, increased maintenance and flushing, reduced fire flow, and faster degradation of chlorine residuals, increasing the likelihood of coliform bacteria outbreaks and nitrification. Excessive tuberculation of unlined cast iron pipe in the distribution system promotes bio-growth that in turn reduces chlorine residual. The reduction in chlorine frees up ammonia, creating food for nitrite oxidizing bacteria causing nitrification issues. Nitrification can reduce pH and alkalinity, decreasing the effectiveness of the corrosion control. As bio-growth increases, chemical dosages must be increased to achieve the same disinfection and corrosion control results. Eventually, the deteriorating main could impair disinfection and corrosion goals to the point that treatment technique requirements are not met, and water quality standard violations occur. By replacing older unlined cast iron pipe, BWL helps ensure that disinfection and corrosion control chemical costs are lowered, and public health protection remains intact. Unlined cast iron pipe was primarily used as the material of choice in the BWL water system until the late 1950s to early 1960s. Approximately 35.2% of the system is currently cast iron pipe material.

Main breaks are another driver for assessing the condition of the water system. The BWL spatially tracks main breaks within a database and analyzes patterns to better understand how pipes are performing. Main break data is ultimately input into a GIS based system and this data feeds into the capital improvement planning process as one of the criteria for likelihood of failure. Over the years, the BWL has recognized main break related patterns based on installation era and pipe material. The BWL currently analyzes main break related data based on the following categories, in addition to by pipe segment:

- "Landel" System – a community water system the BWL acquired, which is also unlined cast iron pipe
- Cast iron pipes installed after 1945
- Cast iron pipes installed prior to 1945
- Ductile iron pipe

The "Landel" system, in terms of main breaks, has a higher likelihood of failing than any other category. This followed by post-1945 installed cast iron pipe, pre-1945 installed cast iron pipe, and ductile iron. Ductile iron pipe has the least likelihood of failure of any pipe material in the BWL system.

The BWL has a capital improvement plan in place to replace aging infrastructure. The BWL has already replaced lead service lines. Additionally, the BWL coordinates with the City of Lansing and other jurisdictions to team up on projects that are mutually beneficial, saving on restoration costs and optimizing capital dollars.

The tables below show an overview of the age, material, and size of finished water mains within the BWL water distribution system.

Table 2-5. Water Main Length by Pipe Diameter

Type	Diameter (inch)	Length (miles)	Percentage
Finished Water Main	< = 6-inch	343.30	42.5%
	8-inch	215.05	26.6%
	10-inch	11.15	1.4%
	12-inch	143.94	17.8%
	14-inch	4.48	0.6%
	16-inch	68.80	8.5%
	18-inch	1.13	0.1%
	20-inch	2.24	0.3%
	24-inch	5.14	0.6%
	30-inch	12.50	1.5%
	36-inch	0.04	0.0%
	42-inch	0.11	0.0%
	60-inch	0.00	0.0%
	72-inch	0.07	0.0%
Total Finished WM		**807.95**	**100.00%**

Table 2-6. Water Main Length by Material

Material	Percent of Total	Length (Miles)
Cast Iron	35.2%	284.7
Ductile Iron	61.8%	499.4
Other	1.4%	11.4
Unclassified	1.5%	12.4
Grand Total	100.0%	808.0

2.6.4 Booster Stations

The BWL operates five major booster stations, the Windsor Booster Station, Watertown Booster Station, Hulett Booster Station, Eifert Booster Station, and Aurelius Road Booster Station.

Table 2-7. Distribution System Booster Stations

Location	Year Installed	Pump Number	Pump Install Year	Capacity (MGD)
Aurelius	1993	Pump 1	1993	6.3
Eifert	1973	Pump 1	1973	6.3
Windsor	2003	Pump 1 – Fire Pump	2003	2.8
	2003	Pump 2 – Fire Pump	2003	2.8
	2003	Pump 3	2003	0.2
	2003	Pump 4	2003	0.2
Hulett	2000	Pump 1	2000	2.5
	2000	Pump 2	2000	2.5
	2000	Pump 3	2000	2.5
	2000	Pump 4	2000	1.3
	2000	Pump 5	2000	0.6
	2000	Pump 6	2000	0.6
Watertown (Out of Service)		Pump 1		5.0
		Pump 2 (impeller removed)		0.0

2.7 *Summary of Project Need*

The BWL is proposing to replace aging water main, valves, fire hydrants and appurtenances located within two of the City of Lansing's Combined Sewer Separation Areas. The City of Lansing is under Administrative Consent Order (ACO) for their sewer system and Wastewater Treatment Plant to separate their system and reduce sanitary sewer overflows (SSOs). ACO-05153 was entered in on December 19, 2019. The BWL works with the City of Lansing on the City's Combined Sewer Overflow (CSO) program to coordinate the replacement of the aging water main while the streets and sidewalks are under construction as part of the CSO work to help reduce costs for both organizations. Many of these water main pipes are the oldest in the BWL's system and have severe tuberculation – the formation of small mounds of corrosion produces on the inside of the pipe - that impact water quality and hydraulic performance. Main breaks in this era of pipe are generally 7 times more likely to occur than ductile iron pipe (newer era pipe).

The BWL also works to replace water main located outside of CSO areas for similar reasons. The BWL is currently targeting the replacement of a poor performing water main system that was acquired in the 1940s, that consists of unlined cast iron pipe. These pipes are typically 40 times more likely to break than that of new pipe and approximately 6 times more likely to break than the average pipe within the BWL system. These areas are also known to have severe tuberculation resulting in water quality and hydraulic performance issues mentioned above.

The BWL uses a chloramination process for disinfection at two water treatment plants (Dye and Wise Road). The plants currently use 150-pound cylinders of anhydrous ammonia gas in conjunction with chlorine to form chloramines as part of the disinfection process. An Ammonia Alternative Study was completed by Fishbeck in April 2016 for the BWL. This study recommends the conversion of the plant from anhydrous ammonia to ammonium hydroxide. The project includes construction of two (2) new 3,100 gallon FRP bulk storage tanks, new tank fill and vapor return lines and the storage area would be enclosed to isolate it from the rest of the plant. Additionally, a new chemical storage/feed room would be constructed adjacent to the storage room and would include an additional 2,350 gallon storage tank, a day tank and chemical metering pumps.

The BWL currently does not have any elevated water storage within its system. This proves to be a risk to the system as they rely on back up generators and pumps to supply pressure during a power outage. If the system currently in place were to fail, the water distribution system will lose pressure within minutes and the BWL would not be able to supply water to their customers. Over the past two years, the BWL has experienced several instances where the pumps have been impacted by a loss of power or voltage changes that triggered the emergency generator and emergency pump to startup and maintain pressures in the system. . These events result in pressure fluctuations over a short period of time within the system which increases the likelihood of causing main breaks putting customers at risk of lost service.

Within the BWL system, there are 122 active wells that are used as source water. Of these 125 active wells, approximately 75% off them are over 50 years old and 32% of the wells are over 70 years old. In addition, the vast majority of the aged wells are associated with the Dye Water Treatment Plant which is the primary treatment facility for the Board. The aging infrastructure that is critical to the water distribution of the area relies on these point sources. According to the BWL 2017 Asset Management Plan the probability of failure of an individual well is high based on the age of the wells. If multiple wells were to fail due to structural conditions resulting from age, this could cause a significant impact to the BWL's ability to supply water to their customers.

The John F. Dye Water Conditioning Plant is experiencing significant problems with the lime and soda ash systems. This project is one phase of the overall dry chemical handling project which consist of three separate phases. The first phase (Phase A) addresses the severe dust issues associated with chemical delivery. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. The third phase (Phase C) is similar to Phase B, but is associated with the soda ash systems. The phase the BWL is seeking funding for includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.

Based on a feasibility study completed in 2019, the BWL drilled a new well in 2021 on Hughes Road, south of Jolly Road. This well has the potential to produce 350 to 400 gpm. The purpose of this project is to connect the newly drilled well to the raw water piping network so the well can feed water to the water conditioning plant.

All of the above-described projects will improve the reliability of the system.

2.7.1 Compliance with Drinking Water Standards

No court or enforcement orders, or written enforcement actions have been issued to the BWL regarding the water system.

2.7.2 Drinking Water Quality Problems

The BWL has recognized patterns with unlisted cast iron pipes contributing to chlorine degradation over a much shorter period of time than cement lined ductile iron pipe. This can ultimately lead to additional water quality related problems in the distribution system such as nitrification and increased likelihood of coliform outbreaks. The BWL is addressing these issues through proactive water main replacement.

Delta Township, a wholesale customer of the BWL, performed a Level 1 Assessment due to excessive positive total coliform samples in 2018. Implementation of this project plan and replacement of unlined cast iron pipes (i.e., Aging infrastructure) will ultimately improve water quality in the distribution system. There are no other known water quality concerns.

2.7.3 Projected Needs for the Next 20 Years

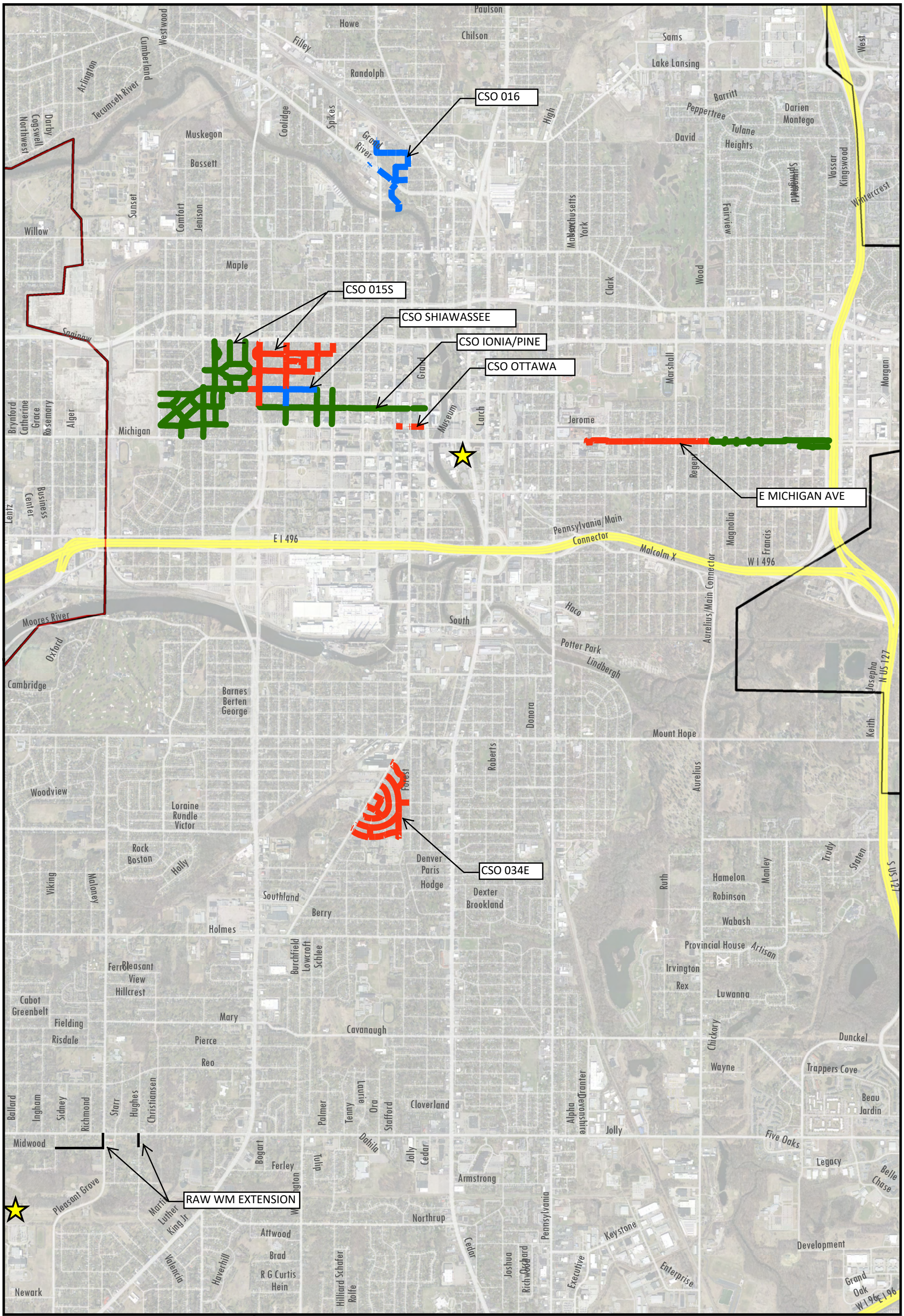
Over the next 20 years, the BWL is planning to ramp up water main replacement to address aging infrastructure within the distribution system. Below is a summary of the needs over the 20 years related to water main replacement.

- There are currently 60 miles of water main in service that is over 100 years old in need of replacement.
- There will be an additional 60 miles of water main that will reach end of useful life over the next 20 years.
- The BWL has 50 miles of "Landel" pipes (a system that fails 7 times more frequently than the average pipe in the system) that is in need of replacement.
- The total of these three is 170 miles of pipe that needs to be replaced over the next 20 years. This is approximately 8.5 miles per year. By applying for DWSRF funding, the BWL is hoping they can ramp up water main replacement more quickly, since current rates cannot support this footage of replacement.

3 Alternative Analysis

3.1 Alternatives Considered

Each project was assessed to follow one of the following alternate classifications. Each upgrade or rehabilitative method was chosen on a technical basis and cost comparisons are presented for each alternative analysis, where applicable. Figure 3-1 shows the overall locations of these projects in Lansing Board of Water & Light jurisdiction.



Water Main CIP - CY2023 to CY2025

N

0 2,250 4,500 Feet

Legend

2023, Contractor

2024, Contractor

2025, Contractor

BWL Retail

BWL Wholesale

INTERSTATES

3.2 No Action

The "No-Action" alternative is not an option as it fails to meet the requirements of the Michigan Safe Drinking Water Act (MI-SDWA) and the mission and goals of the Lansing Board of Water & Light to provide safe and clean water to its customers.

3.3 Water Treatment Plant Improvements

3.3.1 Dye WCP – Convert Ammonia Systems to Aqueous Forms

The Lansing Board of Water and Light (BWL) uses a chloramination process for disinfection at two water treatment plants (Dye and Wise Road). The plants currently use 150-pound cylinders of anhydrous ammonia gas in conjunction with chlorine to form chloramines as part of the disinfection process. An Ammonia Alternative Study was completed by Fishbeck in April 2016 for the BWL. This study recommends the conversion of the plant from anhydrous ammonia to ammonium hydroxide. The project includes construction of two (2) new 3,100 gallon FRP bulk storage tanks, new tank fill and vapor return lines and the storage area would be enclosed to isolate it from the rest of the plant. Additionally, a new chemical storage/feed room would be constructed adjacent to the storage room and would include an additional 2,350 gallon storage tank, a day tank and chemical metering pumps.

There is no practical alternative to accomplish the same outcome to reduce significant safety hazards associated with the current WCP operations.

3.3.2 Dye Chemical Handling – Phase B

The John F. Dye Water Conditioning Plant is experiencing significant problems with the lime and soda ash systems. This project is one phase of the overall dry chemical handling project which consist of three separate phases. The first phase (Phase A) addresses the severe dust issues associated with chemical delivery. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. The third phase (Phase C) is similar to Phase B, but is associated with the soda ash systems. The phase the BWL is seeking funding for includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.

There is no practical alternative to accomplish the same outcome to address significant issues that are occurring with the lime system. This will improve reliability and control of these systems and improve severe dust issues associated with chemical deliveries that expose employees to safety risks.

3.3.3 Wise Rd – Chemical Building

A new chemical/storage building would be constructed adjacent to the storage room at Wise Rd WCP and would include an additional 2,350-gallon storage tank, a day tank and chemical metering pumps. This additional storage facility will allow full truckload delivery of chemicals on a monthly basis with adequate reserve for 30 days of operation.

There is no practical alternative to accomplish the same outcome to provide additional storage and isolate the chemicals from the rest of the plant and provide a 30 day reserve for the system.

3.4 Operational System Improvements

3.4.1 Elevated Storage

This includes the construction of an elevated storage facility, as the BWL system currently does not have one. The elevated storage facility would be strategically located to best support the system and hold 2-3 million gallons. This storage would allow the BWL to have enough water pressure to provide water to their customers for approximately two hours after a power outage allowing the BWL a cushion of time to trouble shoot any mechanical and electrical issues or for the restoration of the permanent power to the area.

There is no practical alternative to accomplish the same outcome as the system currently does not have an elevated storage facility. If the system currently in place were to fail, the water distribution system will lose pressure within minutes and the BWL would not be able to supply water to their customers. Over the past two years, the BWL has experienced eight (8) instances where the pumps have been impacted by a loss of power or voltage changes to the pumps.

3.4.2 Well Drilling to Replace Aged Wells

This includes the construction of two (2) wells per years to replace aging infrastructure within the system and improve the reliability. Given the large number of aged wells within the system, slowing abandoning the oldest wells and replacing with new wells increase the longevity of the system. The location of the two (2) wells to be replaced in 2023 are adjacent to existing wells that are the oldest within the inventory.

There is no practical alternative to accomplish the same outcome as the system is drastically aging and wells need to be replaced to ensure the system has an adequate source water.

3.5 Distribution System Improvements

3.5.1 Water Main Construction

The BWL works with the City of Lansing on the City's Combined Sewer Overflow (CSO) program to coordinate the replacement of the aging water main while the streets and sidewalks are under construction as part of the CSO work to help reduce costs for both organizations. Many of these water main pipes are the oldest in the BWL's system and have severe tuberculation – the formation of small mounds of corrosion produced on the inside of the pipe - that impact water quality and hydraulic performance. Main breaks in this era of pipe are generally 7 times more likely to occur than ductile iron pipe (newer era pipe).

The BWL also works to replace water main located outside of CSO areas for similar reasons. The BWL is currently targeting the replacement of a poor performing water main system that was acquired in the 1940s, that consists of unlined cast iron pipe. These pipes are typically 40 times more likely to break than that of new pipe and approximately 6 times more likely to break than the average pipe within the BWL system. These areas are also known to have severe tuberculation resulting in water quality and hydraulic performance issues mentioned above.

There is no practical alternative to accomplish the same outcome. Replacing and upsizing the above-mentioned distribution mains advances the proper resolution of the pressure and reliability problems throughout the distribution system.

3.6 Cost of Alternatives

The costs of the improvements detailed previously are shown in Table 3-1 by Fiscal Year.

Table 3-1. Summary of SRF Projects (by Fiscal Year)

Projects	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Water Treatment Plant					
Dye – Convert Ammonia Systems to Aqueous Forms	$2,055,000				
Dye Dry Chemical Handling	$3,533,803				
Wise Rd – Chemical Building					$1,358,000
Operations System					
Elevated Storage	$100,000	$9,306,000			
Well Drilling to replace aged wells	$712,856	$712,856	$712,856	$712,856	$712,856
Distribution System					
Water Main Replacement	$12,423,950	$11,339,000	$2,489,400		
Total FY Project Cost	**$18,725,609**	**$21,457,856**	**$3,202,256**	**$712,856**	**$2,070,856**
Total Projects Cost	**$46,169,433**				

3.7 Impacts of Alternatives

The recommended alternatives include improvements listed in the above projects which are a mixture of work at the Water Treatment Plant (WTP) and Distribution System. The long and short-term impacts of the alternatives are described in Section 5.

4 Selected Alternatives

4.1 Proposed Improvements

4.1.1 Proposed Water Treatment Plant Improvements

The following projects noted in Table 4-1 are the proposed WTP improvements under this Project Plan.

Table 4-1. Fiscal Year of WTP Projects

Project	Fiscal Year
Dye – Convert Ammonia System to Aqueous Form	2023
Elevated Storage Evaluation and Implementation	2023-2024
Well Drilling to replace aged wells	2023-2027
Wise Chemical Building	2027

The design period of each project phase is estimated start in the year prior to the project fiscal year. The projects would be advertised and bid upon receipt of all the necessary permits. The general schedule would follow the consecutive phases, and specific, dates would be adjusted to meet the DWSRF Financing and Milestone Schedules adopted for each year of the project.

4.1.2 Proposed Distribution System Improvements

The following projects noted in Table 4-2 are the proposed distribution system improvements under this Project Plan.

Table 4-2. Fiscal Year of Distribution System Projects

Project	Fiscal Year
034E	2023
Ottawa	2023
015S	2024-2025
Ionia/Pine	2024
Shiawassee	2025
016	2025
E Michigan Ave	2023-2024
Raw Water Main Extension	2023

The BWL works with the City of Lansing on the City's Combined Sewer Overflow (CSO) program to coordinate the replacement of the aging water mains while the streets and sidewalks are under construction as part of the CSO work to help reduce costs for both organizations. The water main replacement projects are designed and constructed as individual projects or combined into one phase of projects for each fiscal year. The BWL has approximately 10% non-revenue water in its system. Most of the older cast iron mains are over 80 to 100 years old. Many of these main pipes are the oldest in the BWL's system and have severe tuberculation – the formation of small mounds of corrosion produced on the inside of the pipe – that impact the water quality and hydraulic performance. These older pipes contribute to the risk of water reliability concerns and water mains breaks which can compromise system water quality. Areas of low flow due to smaller pipe size and reduced friction factors associated with older pipe can cause safety concerns from reduced fire flows. Implementing the water main replacements recommended in the 2021 Water System Reliability Study will address the reliability, quality, and safety concerns.

4.2 Design Parameters

The proposed WTP improvements listed in Table 4-1 will be installed to meet the Michigan Safe Drinking Water Act 399 requirements as well as the BWL's design standards and Recommended Standards for WaterWorks (Ten States Standards).

The proposed distribution system improvements listed in Table 4-2 will be installed to meet the Act 399 requirements and the Lansing Board of Water and Light design standards for water distribution system.

4.3 Water Main Installation and Materials

The installation methods for the water main replacement projects will primarily be completed using open cut methods. The site conditions may dictate other methods of replacement to accommodate the public and environment and construction efficiencies. Open-cut methods will be implemented to coordinate with street paving activities. Horizontal directional drilling (HDD) may be used in applications with the appropriate clearances to underground utilities is provided and where there are limited service connections, tees, bends and other fittings along a particular length of main.

New water mains will be AWWA C151 ductile iron pipe, Thickness Class 52 or Pressure Class 350 in accordance the BWL's standards. If used, pipe installed by HDD methods would be AWWA C906 HDPE with a minimum DR11 wall thickness.

4.4 Proposed Schedule

Table 4-3 below shows the completed Project Plan submittal task dates.

Table 4-3. Project Plan Task Schedule

Project Plan Task	Scheduled Date
Draft Project Plan to EGLE	April 8, 2022
Public Hearing Notice	April 8, 2022
Formal Public Hearing	May 9, 2022

Board of Water and Light Board Resolution of Adoption of Plan	May 24, 2022
Submit Final Project Plan to EGLE	June 1, 2022

4.5 Cost Estimate

The estimated total project cost for the proposed SRF projects is $46,169,433.25. Detailed cost estimates for the distribution system improvements and WTP improvements are both shown in Appendix E. The estimated project costs do not incorporate any potential principal forgiveness the projects may be eligible for.

4.6 User Costs and Cost Sharing

The BWL Water Conditioning Plants provide residential connections to BWL residents including City of Lansing, City of Dewitt, City of East Lansing, Delhi Township, Delta Township, Dewitt Township, Bath Township, Alaiedon Township, Lansing Township, Merdian Township, Watertown Township, and Windsor Township. Table 4-4 denotes the number of residential connections for each that make up the total of 50,463 residential water connections.

Table 4-4. Water Connections

Community	Residential Water Connections	Commercial Water Connections	Industrial Water Connections	Total
Alaiedon Township	4	22	0	26
Bath Township	1,041	106	0	1,147
City of East Lansing	20	90	0	110
Dewitt Township	2,143	415	0	2,558
City of Lansing	36,968	5,530	78	42,576
City of Dewitt	899	93	0	992
Delhi Township	7,446	786	9	8,241
Delta Township	78	74	4	156
Lansing Township	1,282	273	0	1,555
Meridian Township	4	23	0	27
Watertown Township	559	119	4	682
Windsor Township	19	0	0	19
Grand Total	**50,463**	**7,531**	**95**	**58,089**

The estimated costs for all proposed projects and fiscal years are presented below. User charges are developed based on cost of service studies to recover the operations, maintenance, depreciation, and interest expenses that benefit the water utility's customers.

Table 4-5 presents a summary of the estimated user costs by Fiscal year which were developed based on the estimated capital costs for the proposed project costs over the next five fiscal years. Project costs are typically allocated between fixed and variable charges, with most of the cost assumed fixed on a customer's bill. For simplicity in this bill impact analysis, it is assumed the incremental cost of these projects will be an incremental fixed charge on the bill. For reference, the average monthly residential user in the BWL system consumers 5 CCF per month. 1 CCF is 100 cubic feet of water or 748 gallons.

Table 4-5. Estimated User Cost Summary by Phase

Descriptions	FY2023	FY2024	FY2025	FY2026	FY2027	Total
Total Phase Project Cost	$18,825,609	$21,357,856	$3,202,256	$712,856	$2,070,856	**$46,169,433**
Interest Rate	1.875%	1.875%	1.875%	1.875%	1.875%	
Term (years)	20	20	20	20	20	
No. of Residential Connections*	58,089	58,089	58,089	58,089	58,089	
Total Annual Debt Repayment	$1,137,471	$1,290,473	$3,202,256	$712,856	$2,070,856	**$2,789,625**
Total Monthly Cost for Project per REU	$0.36	$0.53	$0.06	$0.01	$0.04	**$1.00**
Total Cost of Loan	$22,749,423	$25,809,465	$3,869,701	$861,436	$2,502,484	**$55,792,509**
Interest Paid	$2,844,728	$3,988,734	$645,515	$148,580	$431,628	**$9,623,076**

**Notes:*
1. Assumes interest rate of 1.8750%, pricing in 2022.
2. No. of Residential Connections is based on Residential Equivalent Units (REUs) of 145,839 assuming 123 gpd per REU.

4.7 Authority to Implement Selected Alternative

Implementation of the proposed project assumes that the project will be financed by a low-interest loan from the SRF program. The Lansing Board of Water & Light has the necessary legal, institutional, financial, and managerial resources available to ensure the construction, operation, and maintenance of the proposed facilities.

Most of the water main replacements will occur in the local jurisdiction's road right-of-way but portions of the proposed project will occur in the road right-of-way under the jurisdiction of the Michigan Department of Transportation (MDOT). MDOT jurisdiction includes I-496(BUS) and during the construction plan development the necessary MDOT permits will be acquired.

5 Environmental Impacts

5.1 General

The anticipated environmental impacts resulting from the construction of the selected plan include beneficial & adverse, short term & long term, and irreversible impacts. The following is a discussion of the environmental impacts of the selected plan.

5.1.1 Beneficial and Adverse Impacts

The two (2) WCPs are the BWL drinking water conditioning facilities. The WCPs provide drinking water to all commercial and domestic (residential) residents. Drinking water to homes and businesses is conveyed from the WCP after being treated from the BWL's raw water supply from existing wells that access the Saginaw Aquifer. Without the diligent work of WCP employees to operate and maintain the facilities, the clean water would not be distributed throughout the BWL's jurisdiction.

Construction activities associated with the proposed WCP improvements and Drinking Water Distribution System improvements will take place on the existing facilities. Construction and equipment manufacturing related jobs would be generated, and local contractors would have an equal opportunity to bid on the construction contracts.

The environmental impacts for each alternative are expected to be minimal to none. All elements of improvement efforts in this project aim to have the least impact possible on the community and environment. No long-lasting impacts are expected for any alternative. Implementation of the Project Plan would create temporary disruption due to required construction. This includes noise and dust generated by the work and possible erosion of soils from open excavation. The assessment of alternate solutions and sites for the proposed project included identification of any important resources of either historic or environmental value which are protected by law and should be avoided.

No registered contamination sites were found within the WCP projects using the EGLE site contamination online mapper tool.

5.1.2 Short-Term and Long-Term Impacts

The short-term adverse impacts associated with construction activities would be minimal, and mitigatable, in comparison to the resulting long-term beneficial impacts. Impacts from the Drinking Water Distribution System and WCP improvements include temporary site disturbance, temporary damage to surface vegetation, and temporary water shut-off for residents. All restoration required post-replacement should return the impacted area to existing conditions. No long-term negative impacts are anticipated.

The long-term positive impacts include upgrading failing infrastructure, improved efficiency at the plant, and the ability to continue providing adequate clean water throughout the BWL jurisdiction. These impacts also include improved processing at the plant and reduced wear on the plant equipment.

5.1.3 Irreversible Impacts

The investment in non-recoverable resources committed to the Project Plan would be traded off for the improved performance of the facilities during the life of the system. The commitment of resources includes public capital, energy, labor, and unsalvageable materials. These non-recoverable resources would be foregone for the provision of the proposed improvements.

Construction accidents associated with this project may cause irreversible bodily injuries or death. Accidents may also cause damage to or destruction of equipment and other resources.

5.2 Analysis of Impacts

5.2.1 Direct Impacts

Local Air Quality

There will be minimal direct impacts on local air quality during the construction phases of these projects. Any effects on air quality will be due to dust and emissions from construction equipment.

Archeological, Historical, or Cultural Resources

There are no impacts on archaeological, tribal, historical, or cultural resources due to this project. However, the appropriate affiliates will be contacted and informed about the project upon any changes in conditions.

Impacts Upon the Existing or Future Quality of Local Groundwater and Surface Waters

Construction will occur at the WCP site as well as throughout the Drinking Water Distribution System. No impact will be made to Grand River, Red Cedar River, or Looking Glass River and surrounding waterways, but appropriate measures will be taken during construction to avoid impact to these neighboring bodies of water. All necessary permits will be obtained before the proposed activities. There are no impacts anticipated to the local groundwater.

Impacts Upon Sensitive Features

Since the work is expected to take place within the existing Drinking Water Distribution System and WCP facilities, the construction will take place outside of the designated floodplain, wetland areas, or other sensitive areas. Any work that takes place within floodplain limits, proper mitigation measures, and permits will be obtained before the proposed activities.

Impacts Upon People and The Local Economy

Short-term impacts on people will occur during the construction phase. Increased construction traffic will occur in the localized area of the WCPs. The BWL jurisdiction water users will experience beneficial long-term impacts due to the level of service to which they expect to be maintained by these improvements.

The local economy will be stimulated for contractors and suppliers of the materials, labor, and equipment necessary to construct the project.

Operational Impacts

The proposed projects will improve the operation efficiency of the WCP and lower future operation and maintenance (O&M) costs for the Drinking Water Distribution System.

5.2.1 Indirect Impacts

Changes in Rate, Density, Or Type of Residential, Commercial, or Industrial Development and the Associated Transportation Changes

No changes are anticipated to the above.

Changes in Land Use

No changes are anticipated to the above. All improvements to the WCP and the Drinking Water Distribution System will be completed on the existing WCP site and existing system facilities.

Changes in Air or Water Quality Due to Facilitated Development

There will be no changes to air quality due to development.

Changes to The Natural Setting or Sensitive Features Resulting from Secondary Growth

There should be no changes to the natural setting or sensitive features resulting from secondary growth.

Impacts on Cultural, Human, Social and Economic Resources

No changes are anticipated to the above.

Impacts of Area Aesthetics

All the proposed WCP work will be completed on the existing site which is largely isolated from public view and the Drinking Water Distribution System will be completed on existing structures which are mainly underground.

Resource Consumption Over the Useful Life of the Treatment Works, Especially the Generation of Solid Wastes

No changes are anticipated to the above.

5.2.1 Cumulative Impacts

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.

Water Quality Impacts from Direct Discharges and Non-Point Sources

There should not be any impacts to the above as a result of this project.

Indirect Impacts from Development

There should not be development as a result of this project.

The Impacts from Multiple Public Works Projects Occurring in the Same Vicinity

There will only be short-term traffic impacts during the construction phase of this project and proper traffic control measures will be followed.

6 Mitigation

6.1 Short-Term, Construction Related Mitigation

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

The soil erosion impact would be mitigated through the contractor's required compliance with a program for control of soil erosion and sedimentation as specified in Part 91 of Michigan Act 451, P.A. of 1994. The use of soil erosion and sedimentation controls (i.e., straw bales, sedimentation basins, catch basin inserts, silt fencing, etc.) will protect the Grand River, Red Cedar River, and Looking Glass River.

Careful considerations will be taken during the construction planning process to ensure that the plant remains in service while the improvements are underway. Construction equipment will be maintained in good condition to decrease noise. All access roads will be swept as necessary to avoid tracking sediment onto public roads.

6.2 Mitigation of Long-Term Impacts

General construction activities will prohibit the disposal of soils in wetlands, floodplains, or other sensitive areas. Catch basins will be protected where earth-changing activities will take place.

6.3 Mitigation of Indirect Impacts

The current trend in the Lansing Board of Water & Light's jurisdiction is that the land use is largely dominated by commercial and residential properties. According to the Lansing Board of Water & Light's master planning for land use, this will not change. Considering that a vast majority of the residents within BWL jurisdiction are connected to the water system, a substantial increase in flow is not expected from within the BWL jurisdiction.

The Lansing Board of Water & Light's Master Plan and ordinances can also be found on their websites.

7 Public Participation

7.1 General

The Project Plan will be advertised in the local newspaper before April 8, 2022 (refer to Appendix G for all public participation documentation.) A copy of the Project Plan will be placed at the following location for review:

- Lansing Board of Water & Light – 1201 S. Washington Ave., Lansing, MI 48910
- Online at the Lansing Board of Water & Light's Website

A formal public hearing will be held on May 9, 2022, to review the work associated with the proposed Project Plan. The hearing will review the information presented in the Project Plan, including estimated user costs and to receive comments and views of interested persons. Copies of correspondence related to agency notifications, as well as other relevant correspondence, will also be included in Appendix G.

7.2 Public Hearing

Appendix G will include a transcribed copy of the public hearing, commission members attendance list, the Project Plan resolution, comments received and answered, and a photocopy of the slides presented at the hearing.

APPENDIX A: AGENCY CORRESPONDANCE

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824
SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360
PHONE: 248-454-6300
WEBSITE: hrcengr.com

March 11, 2022

MDOT Bureau of Aeronautics
2700 Port Lansing Road
Lansing, MI 48906-2160

Attn: Mr. Steve Houtteman, Aeronautics Environmental Specialist

Re: Impact Review
Drinking Water Improvements Project
Lansing Board of Water & Light
City of Lansing, Michigan

HRC Job No. 20220131

Dear Mr. Houtteman:

The Lansing Board of Water & Light is submitting a Project Plan to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for acceptance into the Drinking Water State Revolving Fund (DWSRF) Loan Program. The Project Plan requires a review to determine any potential impacts on airspace and airports in the vicinity of the project.

On behalf of the Lansing Board of Water & Light, we are requesting information regarding the impacts of the above referenced proposed project upon Federal Aviation Administration (FAA) regulations and the Michigan Tall Structure Act (1950 PA 327). The project construction will involve the following:

- Improvements to the distribution systems including:
  - Replacement of aging water mains
  - Well Drilling to replace aging wells
- Addressing limitations at the water conditioning plant including:
  - Converting Ammonia Systems to Aqueous Form
  - Elevated Storage Evaluation and Implementation

The BWL's raw water supply is from 125 wells that are used to extract water from the Saginaw Aquifer, 7 of which are owned by Lansing Township. Water is conveyed from the wells through raw water transmission mains to one of the two conditioning plants. The total capacity of all the wells is 67.56 million gallons per day (MGD). Treatment is provided by two (2) Water Conditioning Plants (WCP), the John Dye WCP and Wise Road WCP, that provide 40 MGD and 10 MGD respectively located in the City of Lansing. The WCPs are equipped with four rapid mix basins, four flocculation basins, and four settling basins, and twelve sand filters, finished water storage, and seven high service pumps (finished water). The service area location of the WCPs is provided in the attached figures.

The proposed project site covers mostly urban areas with construction taking place at existing facilities. Excavations will be used throughout the site to help with the rehabilitation of existing facilities. Since the proposed project involves improvements to existing facilities, no impacts are expected from the proposed project upon any airspace and airports. Since construction will occur within 5-miles of a licensed airport, we are requesting on behalf of the Lansing Board of Water & Light, a review to confirm that the above referenced project will not cause an impact to any airspace or airports in the project vicinity.

We request, on behalf of the Lansing Board of Water & Light, your concurrence with this determination. We appreciate

your review and would be grateful for a response by Monday, April 4, 2022 so that we may meet program deadlines.

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

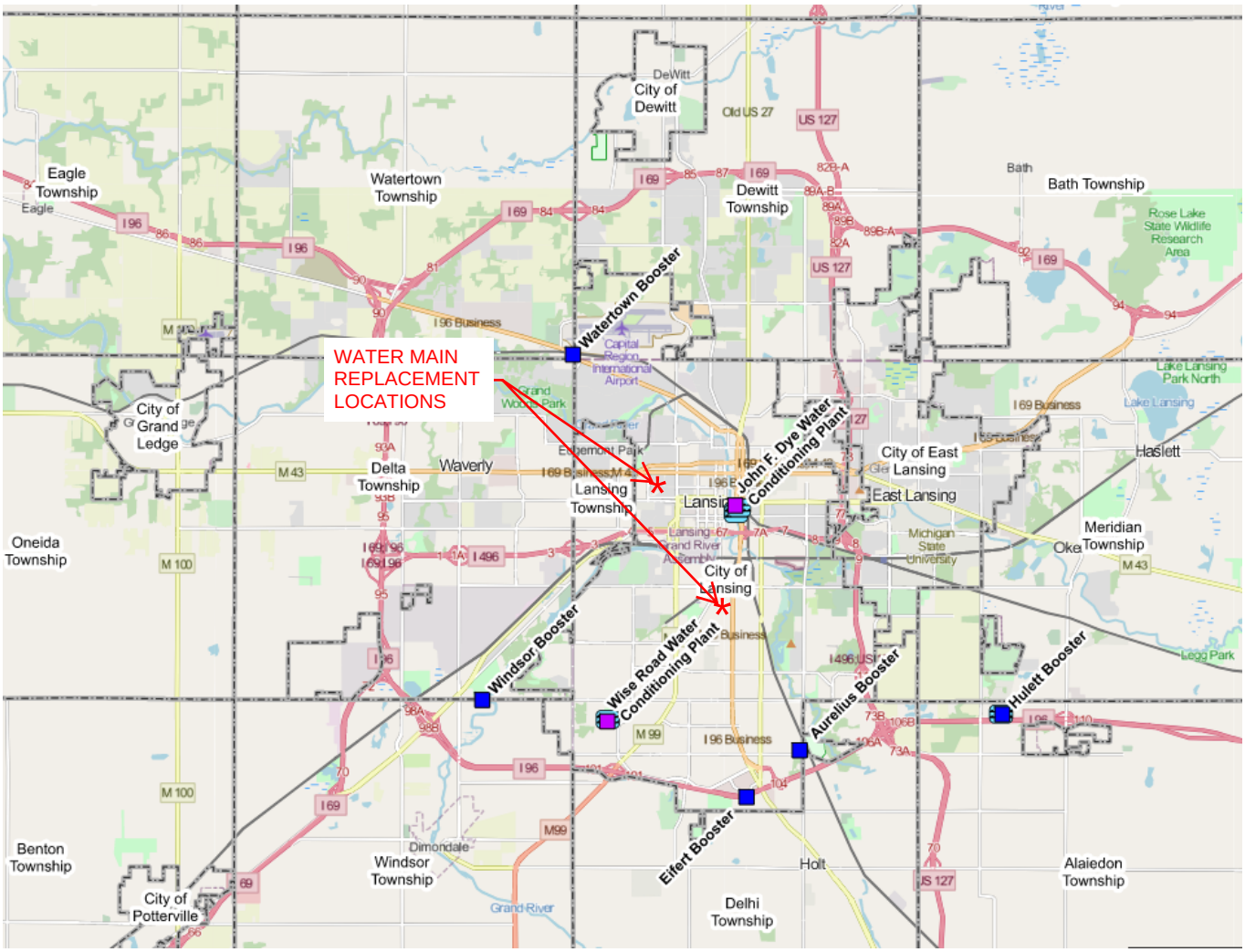
HUBBELL, ROTH & CLARK, INC.

Brittany R. Covault

Brittany R. Covault, E.I.T.
Graduate Engineer II

Attachments
Project Location Map

N



LANSING BWL	Job No. 20220131	LBWL DWSRF PROJECT PLAN IMPROVEMENTS (NOT TO SCALE)	SHEET NO. 1
HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915	Date March 2022		

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

STREET: 2101 Aurelius Road
Suite 2A
Holt, MI 48842
PHONE: 517-694-7760
WEBSITE: hrcengr.com

March 11, 2022

Michigan Department of Environment, Great Lakes, and Energy (EGLE)
Lansing District Office
525 W. Allegan St.
P.O. Box 30242
Lansing, MI 48909-7742

Re: Regional Environmental Planning Review
Drinking Water Improvements Program
Lansing Board of Water & Light
City of Lansing, Michigan

HRC Job No. 20220131

To Whom it May Concern:

The Lansing Board of Water & Light (BWL) is submitting a Project Plan to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for acceptance into the Drinking Water State Revolving Fund (DWSRF) Loan Program. The Project plan requires a review to determine any potential impacts on land-water interfaces, including Inland Lakes and Streams, Floodplains, Wetlands, Great Lakes Shorelands, Navigable Waters and Army Corps of Engineers (ACE) Regulated Activities.

On behalf of the Lansing Board Water & Light, we are requesting information regarding the impacts of the above referenced proposed project upon the previously detailed land-water interfaces in the vicinity of the project. The project work will involve the following:

- Improvements to the distribution systems including:
  - Replacement of aging water mains
  - Well Drilling to replace aging wells
- Addressing limitations at the water conditioning plant including:
  - Converting Ammonia Systems to Aqueous Form
  - Elevated Storage Evaluation and Implementation

The BWL's raw water supply is from 125 wells that are used to extract water from the Saginaw Aquifer, 7 of which are owned by Lansing Township. Water is conveyed from the wells through raw water transmission mains to one of the two conditioning plants. The total capacity of all the wells is 67.56 million gallons per day (MGD). Treatment is provided by two (2) Water Conditioning Plants (WCP), the John Dye WCP and Wise Road WCP, that provide 40 MGD and 10 MGD respectively located in the City of Lansing. The WCPs are equipped with four rapid mix basins, four flocculation basins, and four settling basins, and twelve sand filters, finished water storage, and seven high service pumps (finished water). The service area location of the WCPs is provided in the attached figures.

The proposed project plan site encompasses pre-existing water mains beneath paved roadways or along bridges. In addition to this, construction will take place within the existing water treatment plant.

Based on the attached FEMA Floodplain Maps, it can be concluded that no construction is expected to be within floodplains. All proper permits and precautions will be implemented during this construction. On behalf of the Lansing Board of Water

& Light, we are requesting a review to confirm that the above referenced project will not cause any long-term impacts to any floodplains in the project vicinity.

The proposed project locations are mainly within previously attained easements. Since the work will be primarily within existing structures in these easements, no impacts to any existing wetland areas are expected. However, if project work is required within an existing wetland, necessary mitigation measures will be undertaken to protect the wetlands influenced by the project. On behalf of the Lansing Board of Water & Light, we are requesting a review to confirm that the above referenced project will not cause an impact to any wetlands in the project vicinity.

Since the proposed project involves improvements to existing facilities, no impacts are expected from the proposed project upon Great Lakes Shorelands, Navigable Waters or ACE Regulated Activities. On behalf of the Lansing Board of Water & Light, we are requesting a review to confirm that the above referenced project will not cause an impact to any Great Lakes Shorelands, Navigable Waters or ACE Regulated Activities.

If not already obtained, the appropriate joint permit applications will be completed, and the necessary permits obtained prior to any construction activities in this project area.

We request, on behalf of the Lansing Board of Water & Light, your concurrence with this determination. We appreciate your review and would be grateful for a response as soon as possible so that we may meet program deadlines. If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

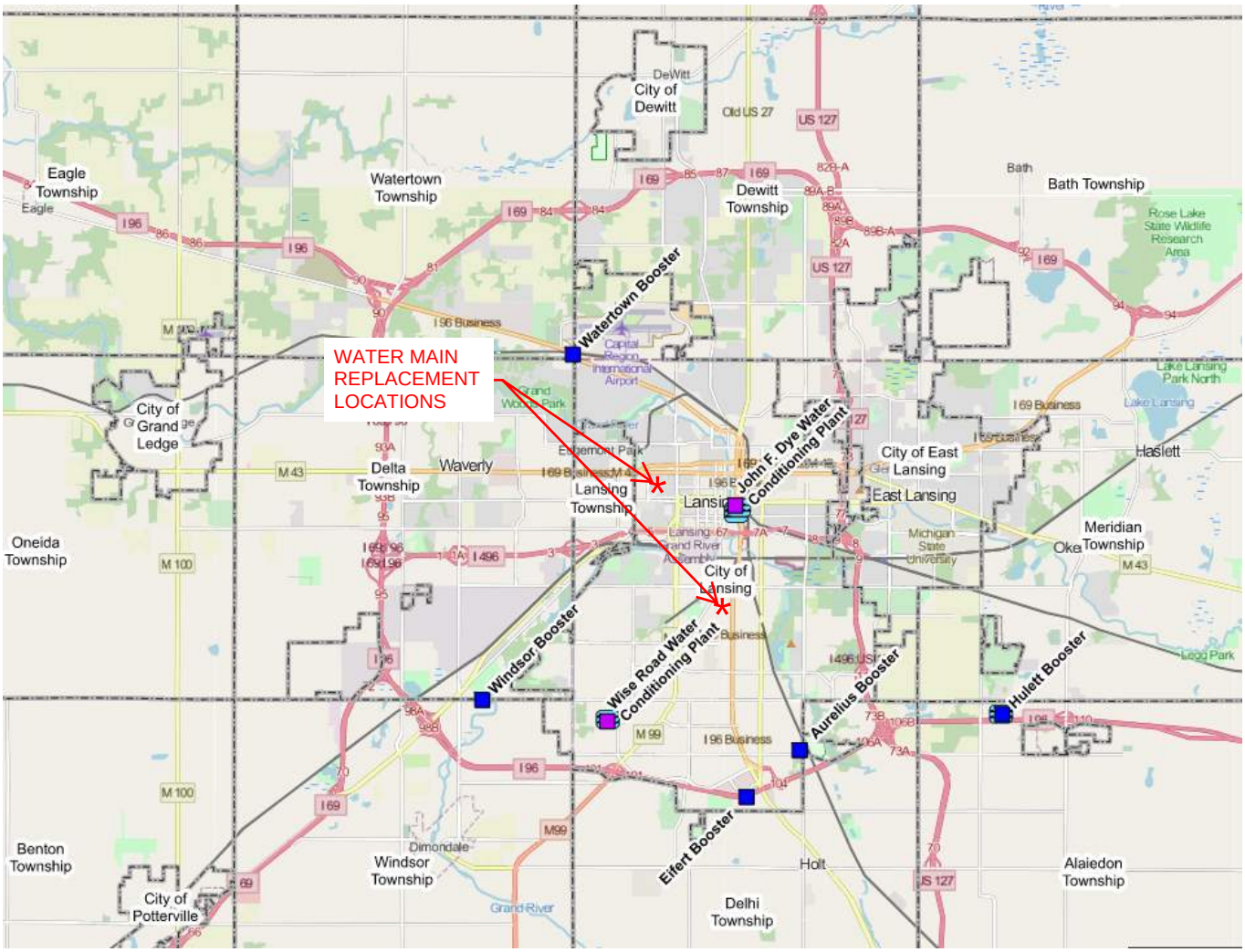
HUBBELL, ROTH & CLARK, INC.

Brittany R. Covault

Brittany R. Covault, E.I.T.
Graduate Engineer II

Attachment
Project Location Map
Recommended Improvements
FEMA Floodplain

N



LANSING BWL	Job No. 20220131	LBWL DWSRF PROJECT PLAN IMPROVEMENTS (NOT TO SCALE)	SHEET NO. 1
HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915	Date March 2022		

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

Memorandum

To: Bethel Skinker
David Worthington

From: Todd Sneathen
Kelly Ferencz

Date: March 17, 2022

Subject: Lansing Board of Water and Light — HRC Job No. 20220131
DWSRF Preliminary Scoring Project Summary

The Lansing Board of Water & Light plans to include the following projects in their submittal of 2022 Project Plan associated with the Drinking Water State Revolving Fund (DWSRF) Application.

Dye Plant – Convert Gas Ammonia Systems to Aqueous Form

Background: The Lansing Board of Water and Light (BWL) uses a chloramination process for disinfection at two water treatment plants (Dye and Wise Road). The plants currently use 150-pound cylinders of anhydrous ammonia gas in conjunction with chlorine to form chloramines as part of the disinfection process. An Ammonia Alternative Study was completed by Fishbeck in April 2016 for the BWL. This study recommends the conversion of the plant from anhydrous ammonia to ammonium hydroxide. The project includes construction of two (2) new 3,100 gallon FRP bulk storage tanks, new tank fill and vapor return lines and the storage area would be enclosed to isolate it from the rest of the plant. Additionally, a new chemical storage/feed room would be constructed adjacent to the storage room and would include an additional 2,350 gallon storage tank, a day tank and chemical metering pumps.

Improvements/Upgrades: The improvements recommended in the Fishbeck Study are needed due to the age of the existing equipment, much of the existing equipment is at the end of its life cycle and in need of replacement, as well as to address operational issues and reduce potential significant safety hazards associated with the current plant operations. Utilizing a gaseous form of ammonia in anhydrous ammonia can pose significant safety concerns. Additionally, the storage facilities will allow full truckload delivery of chemicals on a monthly basis with adequate reserve for 30 days of operation.

Elevated Storage

Background: The Lansing Board of Water and Light (BWL) currently does not have any elevated water storage within its system. This proves to be a risk to the system as they rely on backup generators and pumps to supply pressure during a power outage. If the system currently in place were to fail, the water distribution system will lose pressure within minutes and the BWL would not be able to supply water to their customers. Over the past two years, the BWL has experienced several instances where the pumps have been impacted by a loss of power or voltage changes that triggered the emergency generator and emergency pump to startup and maintain pressures in the system. . These events result in pressure fluctuations over a short period of time within the system which increases the likelihood of causing main breaks putting customers at risk of lost service.

Improvements/Upgrades: The proposed elevated storage tank dramatically increases the reliability of the BWL system. The elevated storage would be located strategically to best support the system and is proposed to hold between 2-3 million gallons. This storage volume would allow the BWL to provide water to customers at adequate pressures for approximately two hours in case the backup generator or emergency pump had any issues during an unplanned power outage or any other issue at the plant that may result in the inability to deliver water out of the plant. This would provide the BWL extra time to trouble shoot any mechanical and electrical issues or for the restoration of the permanent power to the area compared to having no elevated storage.

Well Drilling to Replace Aged Wells

Background Within the BWL system, there are 122 active wells that are used as source water. Of these 125 active wells, approximately 75% off them are over 50 years old and 32% of the wells are over 70 years old. In addition, the vast majority of the aged wells are associated with the Dye Water Treatment Plant which is the primary treatment facility for the Board. The aging infrastructure that is critical to the water distribution of the area relies on these point sources. According to the BWL 2017 Asset Management Plan the probability of failure of an individual well is high based on the age of the wells. If multiple wells were to fail due to structural conditions resulting from age, this could cause a significant impact to the BWL's ability to supply water to their customers.

Improvements/Upgrades: The BWL plans to replace two (2) wells per year to improve the reliability of the system. Given the large number of aged wells, slowly abandoning the oldest wells and replacing with new wells increases the longevity of the system. The location of the first two wells to be replaced in 2023 are adjacent to existing wells and will be off-set wells. These will be from some of the oldest wells in the inventory.

Dry Chemical Handling Project – Phase B

Background The John F. Dye Water Conditioning Plant is experiencing significant problems with the lime and soda ash systems. This project is one phase of the overall dry chemical handling project which consist of three separate phases. The first phase (Phase A) addresses the severe dust issues associated with chemical delivery. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. The third phase (Phase C) is similar to Phase B, but is associated with the soda ash systems.. The phase the BWL is seeking funding for includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.

Improvements/Upgrades:

The BWL plans to upgrade the dry chemical handling system to address significant issues that are occurring with the lime and soda ash systems. This will improve reliability and control of these systems and improve severe dust issues associated with chemical deliveries that expose employees to safety risks.

Watermain Replacement

Background: The BWL works with the City of Lansing on the City's Combined Sewer Overflow (CSO) program to coordinate the replacement of the aging water main while the streets and sidewalks are under construction as part of the CSO work to help reduce costs for both organizations. Many of these water main pipes are the oldest in the BWL's system and have severe tuberculation – the formation of small mounds of corrosion produces on the inside of the pipe - that impact water quality and hydraulic performance. These impacts result in a reduction in chlorine levels, increase in suspended solids, discolored water, nitrification, excess ammonia and high levels of iron. Main breaks in this era of pipe are generally 7 times more likely to occur than ductile iron pipe (newer era pipe).

The BWL also works to replace water main located outside of CSO areas for similar reasons. The BWL is currently targeting the replacement of a poor performing water main system that was acquired in the 1940s, that consists of unlined cast iron pipe. These pipes are typically 40 times more likely to break than that of new pipe and approximately 6 times more likely to break than the average pipe within the BWL system. These areas are also known to have severe tuberculation resulting in water quality and hydraulic performance issues mentioned above.

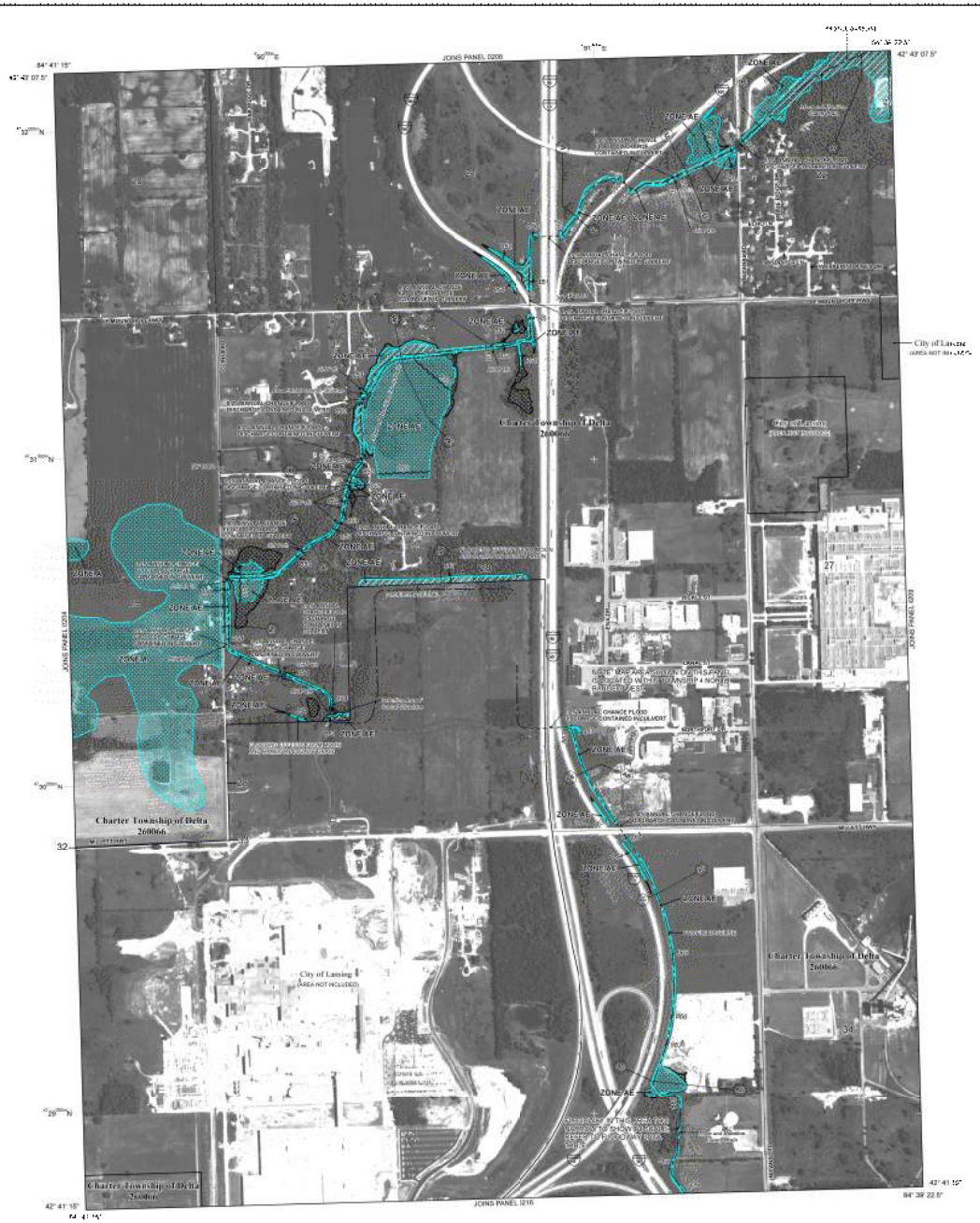
Improvements/Upgrades: The BWL plans to replace the significantly aged sections of water main (i.e. 100 year old sections along Michigan Avenue and areas within CSO boundaries) as well as areas outside of CSO that has experienced main breaks at a rate of 40 times more than ductile iron and 6 times more than the average pipe within the BWL system. The amount of planned watermain replacement in conjunction with the City of Lansing's CSO work is approximately half of the planned watermain. The replacements will improve the reliability of the system to the areas of the network that are currently experiencing significant breaks as well improve the quality of the water delivered to the customers.

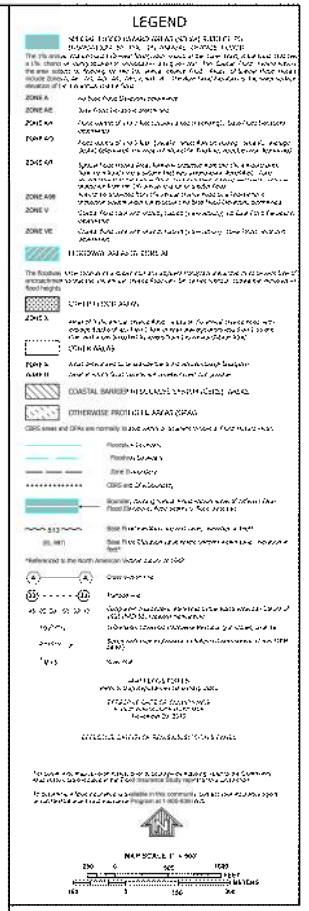
Raw Watermain Installation

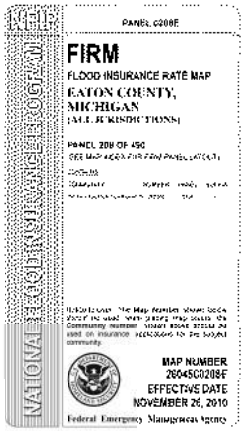
Background: Based on a feasibility study completed in 2019, the BWL drilled a new well in 2022 on Hughes Road, south of Jolly Road. This well has the potential to produce 350 to 400 gpm. The purpose of this project is to connect the newly drilled well to the raw water piping network so the well can feed water to the water conditioning plant.

Improvements/Upgrades: This project includes the construction of approximately 2,300 of raw watermain to connect this new well to existing network. By connecting this newly drilled well into the overall network, the BWL will be improving reliability of providing water.

NOTES TO USERS







Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

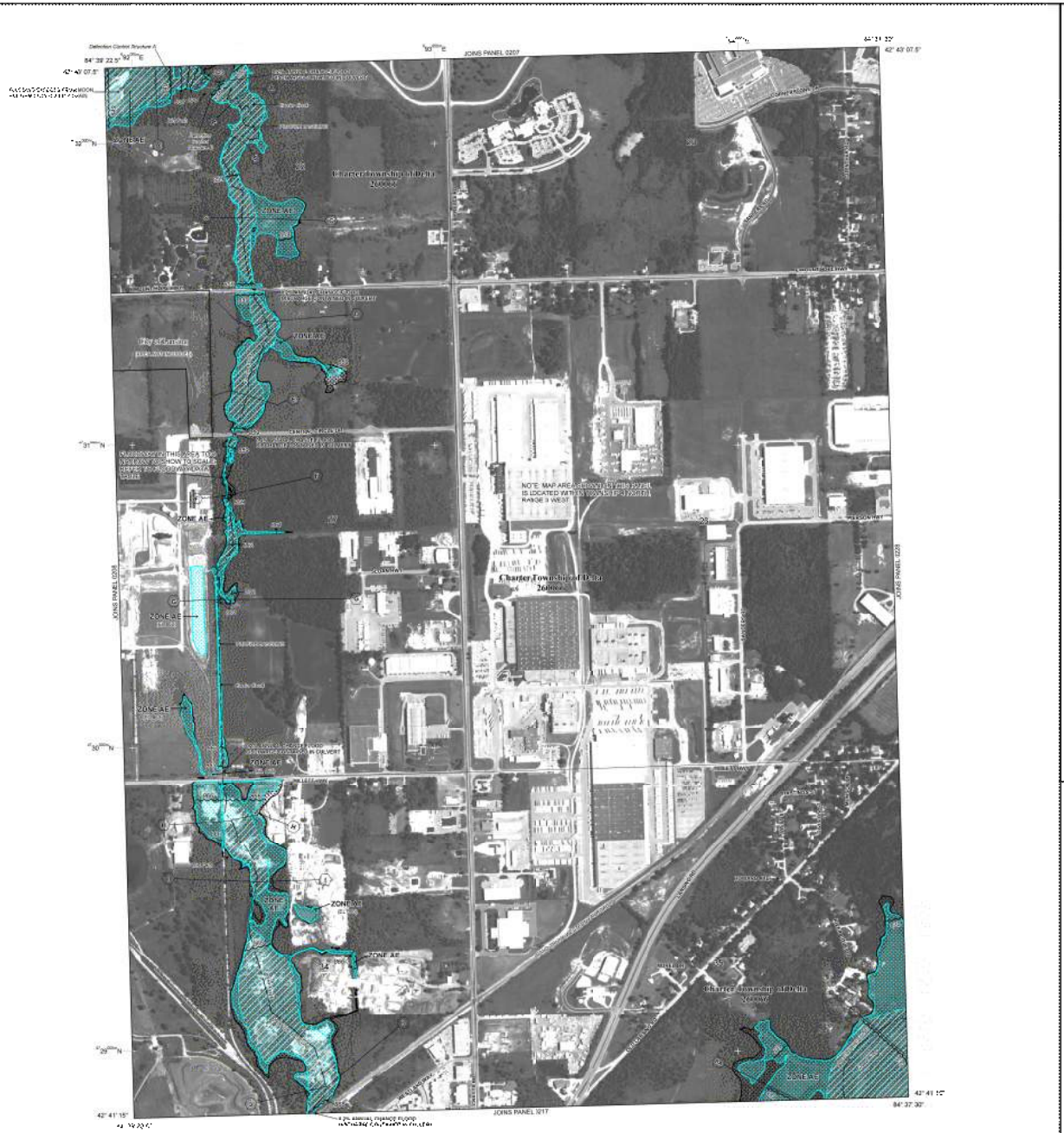
FIGURE 2.6

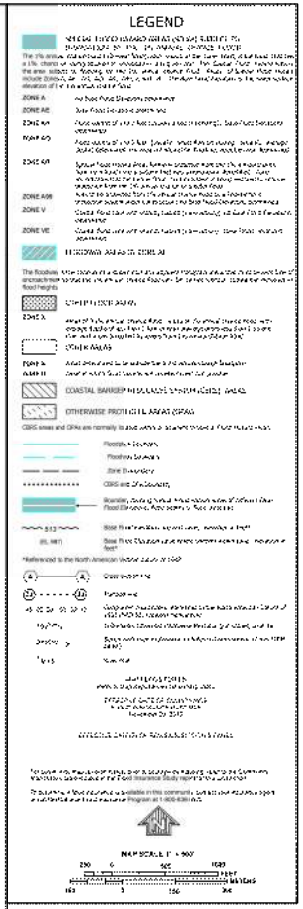
FLOODPLAINS MAP

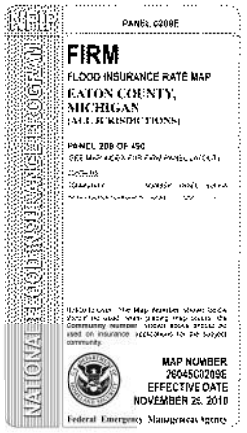
2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS







LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

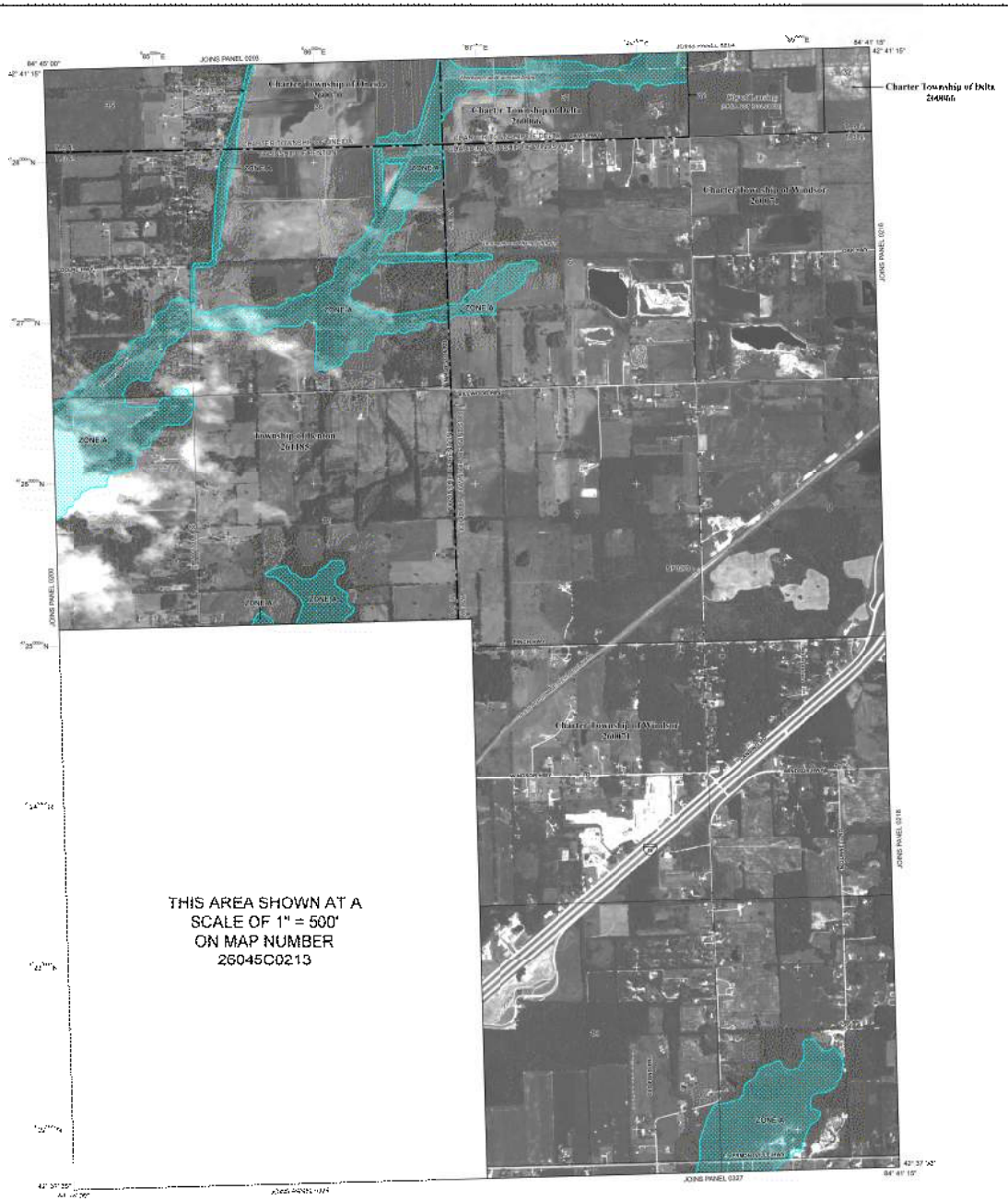
FIGURE 2.7

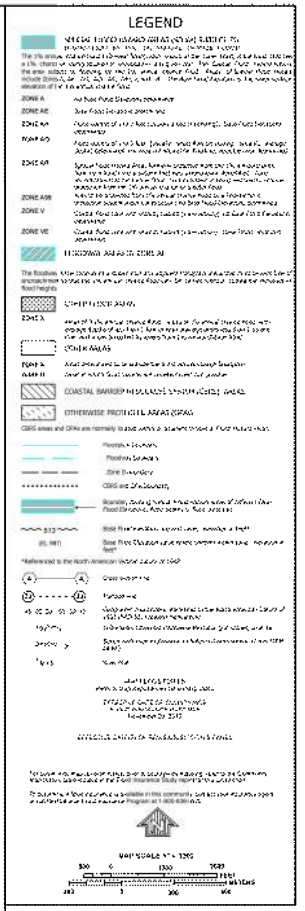
FLOODPLAINS MAP B

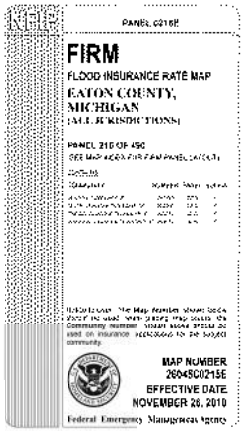
2022 DWSRF Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS







LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

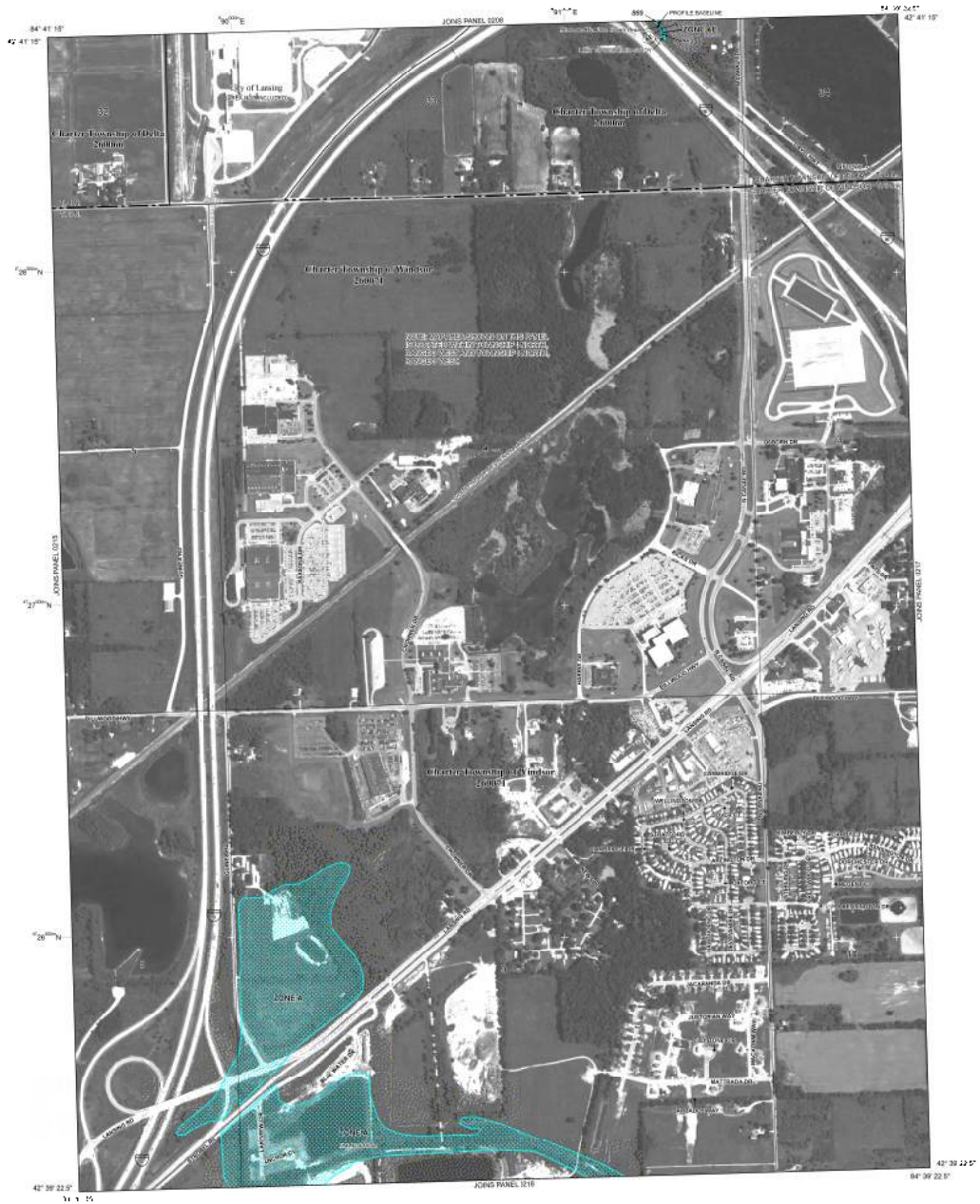
FIGURE 2.8

FLOODPLAINS MAP C

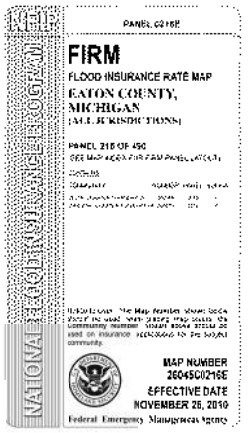
2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS



LEGEND



Hometown People. Hometown Power.

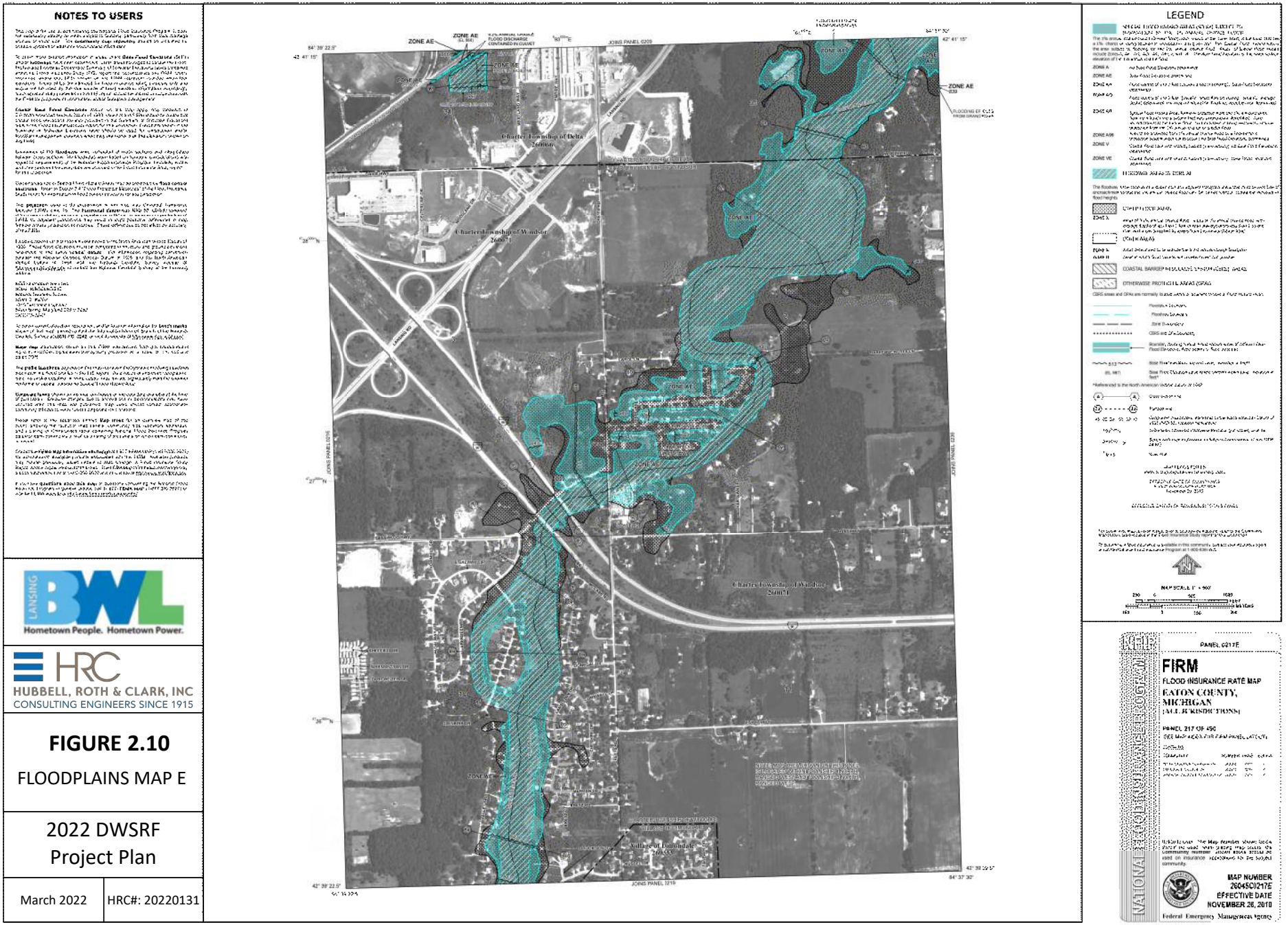
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.9

FLOODPLAINS MAP D

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131



Hometown People. Hometown Power.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

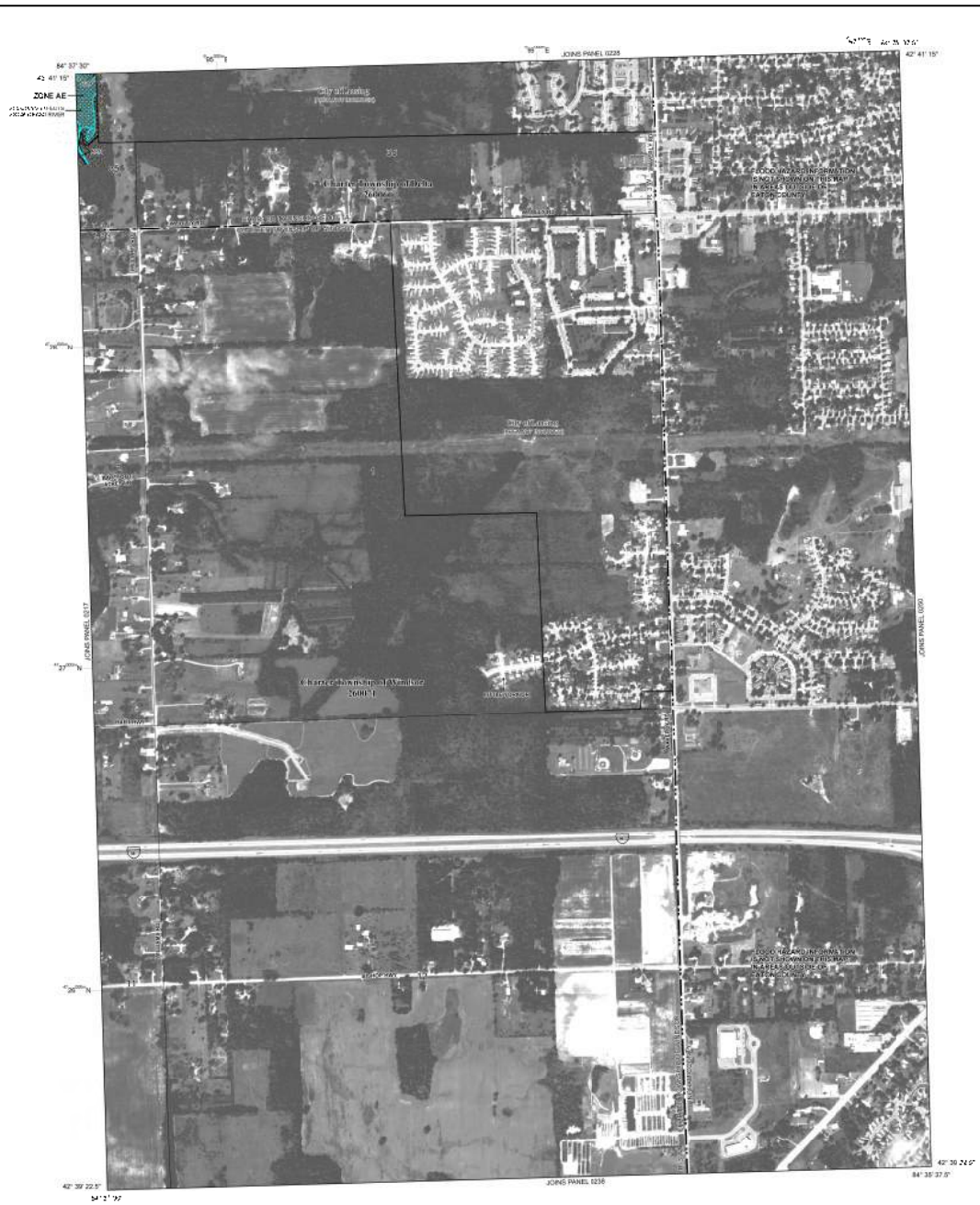
FIGURE 2.10

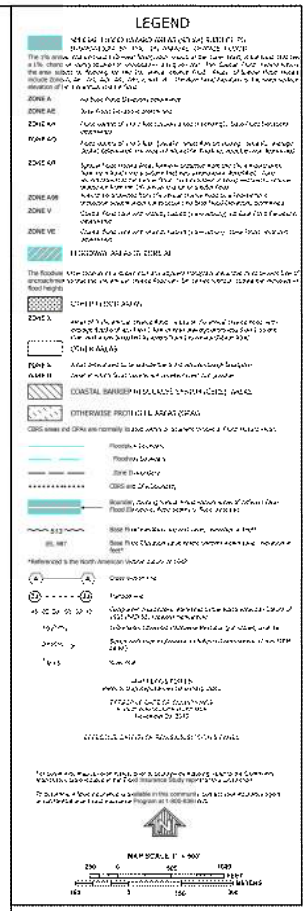
FLOODPLAINS MAP E

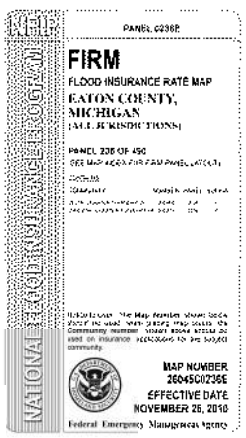
2022 DWSRF Project Plan

March 2022 | HRC#: 20220131

NOTES TO USERS







LANSING BWL
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

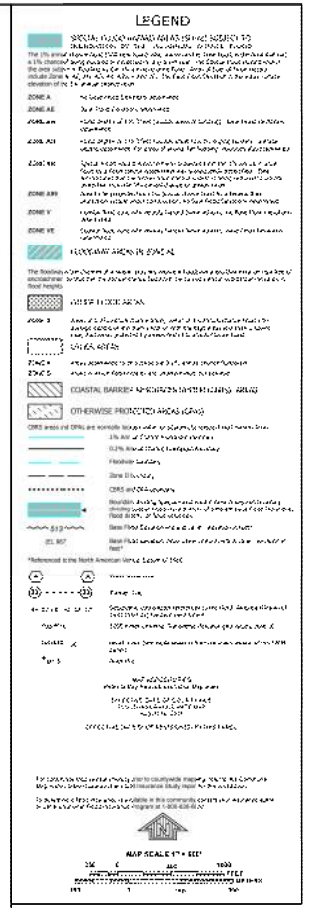
FIGURE 2.12

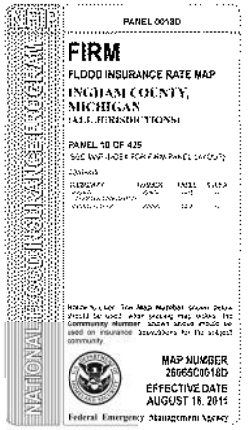
FLOODPLAINS MAP G

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

NOTES TO USERS





BWL LANSING
Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

FIGURE 2.13

FLOODPLAINS MAP H

2022 DWSRF
Project Plan

March 2022	HRC#: 20220131

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

STREET: 1925 Breton Road SE
Suite 100
Grand Rapids, MI 49506
PHONE: 616-454-4286
WEBSITE: hrcengr.com

March 11, 2022

Tri-County Regional Planning Commission
3135 Pine Tree Road #2C
Lansing, MI 48911

Re: Regional Environmental Planning Review
Drinking Water Improvements Project
Lansing Board of Water & Light
City of Lansing, MI

HRC Job No. 20220131

To Whom It May Concern:

The Lansing Board of Water & Light (BWL) is submitting a Project Plan to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for acceptance into the Drinking Water State Revolving Fund (DWSRF) Loan Program. The Project Plan requires a review to determine any potential impacts on any local development plans, area wide waste treatment management plans and/or regional water quality management plans.

On behalf of the Lansing Board of Water & Light, we are requesting information regarding the impacts of the above referenced proposed project upon any local development plans, area wide waste treatment management plans and/or regional water quality management plans in the vicinity of the project. The project work will involve the following:

- Improvements to the distribution systems including:
  - Replacement of aging water mains
  - Well Drilling to replace aging wells
- Addressing limitations at the water conditioning plant including:
  - Converting Ammonia Systems to Aqueous Form
  - Elevated Storage Evaluation and Implementation

The BWL's raw water supply is from 125 wells that are used to extract water from the Saginaw Aquifer, 7 of which are owned by Lansing Township. Water is conveyed from the wells through raw water transmission mains to one of the two conditioning plants. The total capacity of all the wells is 67.56 million gallons per day (MGD). Treatment is provided by two (2) Water Conditioning Plants (WCP), the John Dye WCP and Wise Road WCP, that provide 40 MGD and 10 MGD respectively located in the City of Lansing. The WCPs are equipped with four rapid mix basins, four flocculation basins, and four settling basins, and twelve sand filters, finished water storage, and seven high service pumps (finished water). The service area location of the WCPs is provided in the attached figures.

All population figures and projections referenced in the project plan were collected from the United States Census Bureau.

We request, on behalf of the Lansing Board of Water & Light, notification if an alternative source for the population data is recommended.

Since the proposed project involves improvements to existing facilities and properties, no impacts are expected from the proposed project upon local development plans, area wide waste treatment management plans and/or regional water quality management plans. On behalf of the Lansing Board of Water & Light, we are requesting a review to confirm that the above

referenced project will not cause an impact to any local development plans, area wide waste treatment management plans and/or regional water quality management plans.

We request, on behalf of the Lansing Board of Water & Light, your concurrence with this determination. We appreciate your review and would be grateful for a response as soon as possible so that we may meet program deadlines. If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

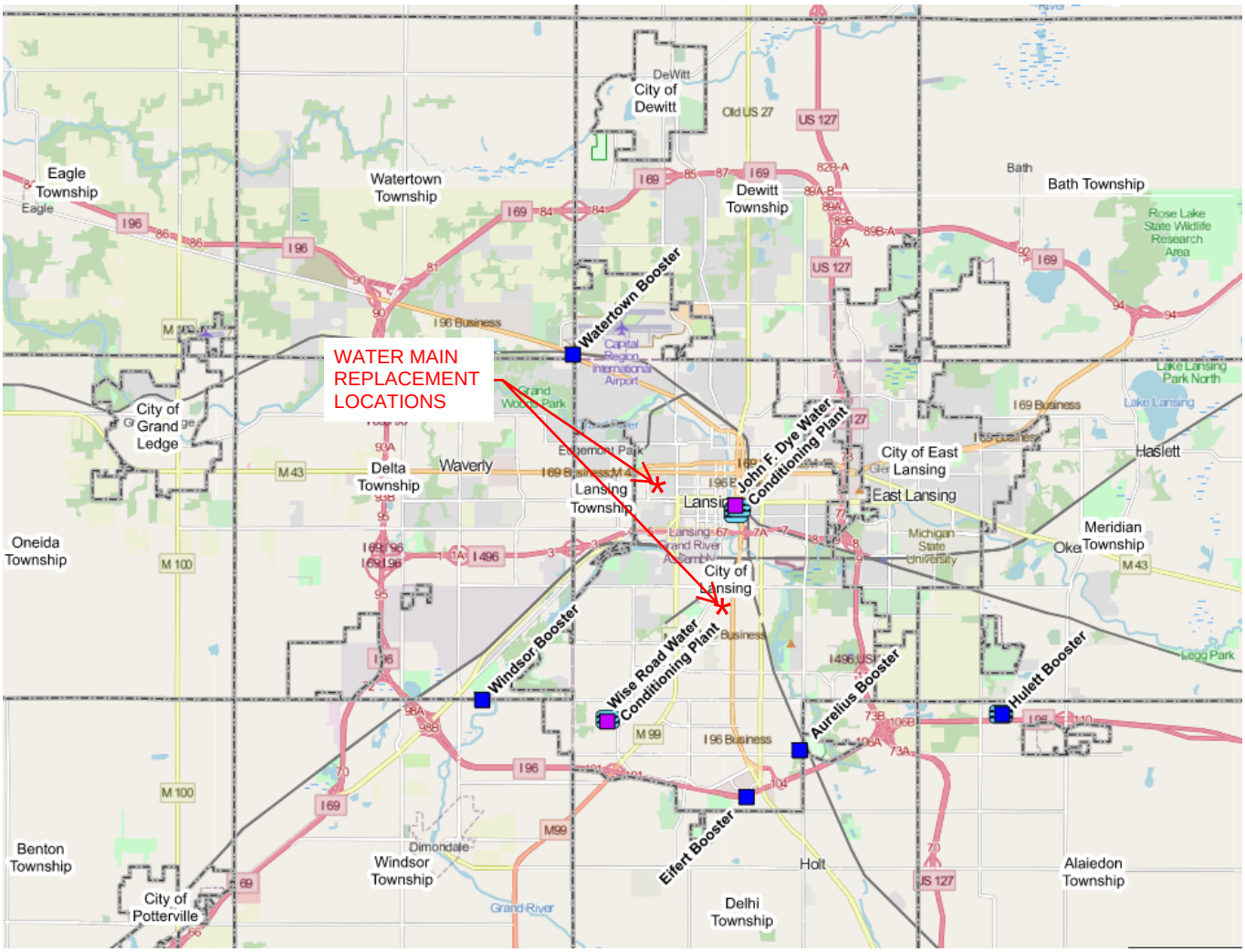
HUBBELL, ROTH & CLARK, INC.

Brittany R. Covault

Brittany R. Covault, E.I.T.
Graduate Engineer II

Attachment
Project Location Map
Recommended/Proposed Improvements Memo

N



LANSING BWL	Job No. 20220131	LBWL DWSRF PROJECT PLAN IMPROVEMENTS (NOT TO SCALE)	SHEET NO. 1
HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915	Date March 2022		

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

Memorandum

To: Bethel Skinker
David Worthington

From: Todd Sneathen
Kelly Ferencz

Date: March 17, 2022

Subject: Lansing Board of Water and Light — HRC Job No. 20220131
DWSRF Preliminary Scoring Project Summary

The Lansing Board of Water & Light plans to include the following projects in their submittal of 2022 Project Plan associated with the Drinking Water State Revolving Fund (DWSRF) Application.

Dye Plant – Convert Gas Ammonia Systems to Aqueous Form

Background: The Lansing Board of Water and Light (BWL) uses a chloramination process for disinfection at two water treatment plants (Dye and Wise Road). The plants currently use 150-pound cylinders of anhydrous ammonia gas in conjunction with chlorine to form chloramines as part of the disinfection process. An Ammonia Alternative Study was completed by Fishbeck in April 2016 for the BWL. This study recommends the conversion of the plant from anhydrous ammonia to ammonium hydroxide. The project includes construction of two (2) new 3,100 gallon FRP bulk storage tanks, new tank fill and vapor return lines and the storage area would be enclosed to isolate it from the rest of the plant. Additionally, a new chemical storage/feed room would be constructed adjacent to the storage room and would include an additional 2,350 gallon storage tank, a day tank and chemical metering pumps.

Improvements/Upgrades: The improvements recommended in the Fishbeck Study are needed due to the age of the existing equipment, much of the existing equipment is at the end of its life cycle and in need of replacement, as well as to address operational issues and reduce potential significant safety hazards associated with the current plant operations. Utilizing a gaseous form of ammonia in anhydrous ammonia can pose significant safety concerns. Additionally, the storage facilities will allow full truckload delivery of chemicals on a monthly basis with adequate reserve for 30 days of operation.

Elevated Storage

Background: The Lansing Board of Water and Light (BWL) currently does not have any elevated water storage within its system. This proves to be a risk to the system as they rely on backup generators and pumps to supply pressure during a power outage. If the system currently in place were to fail, the water distribution system will lose pressure within minutes and the BWL would not be able to supply water to their customers. Over the past two years, the BWL has experienced several instances where the pumps have been impacted by a loss of power or voltage changes that triggered the emergency generator and emergency pump to startup and maintain pressures in the system. . These events result in pressure fluctuations over a short period of time within the system which increases the likelihood of causing main breaks putting customers at risk of lost service.

Improvements/Upgrades: The proposed elevated storage tank dramatically increases the reliability of the BWL system. The elevated storage would be located strategically to best support the system and is proposed to hold between 2-3 million gallons. This storage volume would allow the BWL to provide water to customers at adequate pressures for approximately two hours in case the backup generator or emergency pump had any issues during an unplanned power outage or any other issue at the plant that may result in the inability to deliver water out of the plant. This would provide the BWL extra time to trouble shoot any mechanical and electrical issues or for the restoration of the permanent power to the area compared to having no elevated storage.

Well Drilling to Replace Aged Wells

Background Within the BWL system, there are 122 active wells that are used as source water. Of these 125 active wells, approximately 75% off them are over 50 years old and 32% of the wells are over 70 years old. In addition, the vast majority of the aged wells are associated with the Dye Water Treatment Plant which is the primary treatment facility for the Board. The aging infrastructure that is critical to the water distribution of the area relies on these point sources. According to the BWL 2017 Asset Management Plan the probability of failure of an individual well is high based on the age of the wells. If multiple wells were to fail due to structural conditions resulting from age, this could cause a significant impact to the BWL's ability to supply water to their customers.

Improvements/Upgrades: The BWL plans to replace two (2) wells per year to improve the reliability of the system. Given the large number of aged wells, slowly abandoning the oldest wells and replacing with new wells increases the longevity of the system. The location of the first two wells to be replaced in 2023 are adjacent to existing wells and will be off-set wells. These will be from some of the oldest wells in the inventory.

Dry Chemical Handling Project – Phase B

Background The John F. Dye Water Conditioning Plant is experiencing significant problems with the lime and soda ash systems. This project is one phase of the overall dry chemical handling project which consist of three separate phases. The first phase (Phase A) addresses the severe dust issues associated with chemical delivery. The second phase (Phase B) addresses the lime chemical issues primarily the delivery and slaking equipment. The third phase (Phase C) is similar to Phase B, but is associated with the soda ash systems.. The phase the BWL is seeking funding for includes tasks such as lime bin slide gates, lime bin 9" screw feeders, lime screw feeder discharge chute, lime slaking equipment and controls, demo of existing chemical feed equipment, and miscellaneous electrical improvements.

Improvements/Upgrades:

The BWL plans to upgrade the dry chemical handling system to address significant issues that are occurring with the lime and soda ash systems. This will improve reliability and control of these systems and improve severe dust issues associated with chemical deliveries that expose employees to safety risks.

Watermain Replacement

Background: The BWL works with the City of Lansing on the City's Combined Sewer Overflow (CSO) program to coordinate the replacement of the aging water main while the streets and sidewalks are under construction as part of the CSO work to help reduce costs for both organizations. Many of these water main pipes are the oldest in the BWL's system and have severe tuberculation – the formation of small mounds of corrosion produces on the inside of the pipe - that impact water quality and hydraulic performance. These impacts result in a reduction in chlorine levels, increase in suspended solids, discolored water, nitrification, excess ammonia and high levels of iron. Main breaks in this era of pipe are generally 7 times more likely to occur than ductile iron pipe (newer era pipe).

The BWL also works to replace water main located outside of CSO areas for similar reasons. The BWL is currently targeting the replacement of a poor performing water main system that was acquired in the 1940s, that consists of unlined cast iron pipe. These pipes are typically 40 times more likely to break than that of new pipe and approximately 6 times more likely to break than the average pipe within the BWL system. These areas are also known to have severe tuberculation resulting in water quality and hydraulic performance issues mentioned above.

Improvements/Upgrades: The BWL plans to replace the significantly aged sections of water main (i.e. 100 year old sections along Michigan Avenue and areas within CSO boundaries) as well as areas outside of CSO that has experienced main breaks at a rate of 40 times more than ductile iron and 6 times more than the average pipe within the BWL system. The amount of planned watermain replacement in conjunction with the City of Lansing's CSO work is approximately half of the planned watermain. The replacements will improve the reliability of the system to the areas of the network that are currently experiencing significant breaks as well improve the quality of the water delivered to the customers.

Raw Watermain Installation

Background: Based on a feasibility study completed in 2019, the BWL drilled a new well in 2022 on Hughes Road, south of Jolly Road. This well has the potential to produce 350 to 400 gpm. The purpose of this project is to connect the newly drilled well to the raw water piping network so the well can feed water to the water conditioning plant.

Improvements/Upgrades: This project includes the construction of approximately 2,300 of raw watermain to connect this new well to existing network. By connecting this newly drilled well into the overall network, the BWL will be improving reliability of providing water.

TRI-COUNTY
regional planning commission

April 4, 2022

Brittany R. Covault, E.I.T.
Graduate Engineer II
Hubbell, Roth & Clark, Inc
1925 Breton Road SE, Suite 100
Grand Rapids, MI 49506

Dear Ms. Covault:

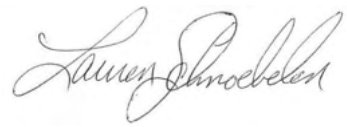
Thank you for reaching out regarding the Lansing Board of Water & Light's project plan for the Drinking Water State Revolving Fund Loan Program. We have reviewed the plan and the requests laid out within your letter. Below are our responses to the listed inquires:

- Regarding the inquiry for all population figures, population projection references, and median annual household income in the Project Plan, we suggest incorporating the 2020 census data to the best of your abilities for the purposes of this project(s).

- We have reviewed and concur that the referenced project(s) will not cause an impact to any local development plans, area wide waste treatment management plans, and/or regional water quality management plans.

Should you have additional questions, please do not hesitate to reach out.

Sincerely,



Lauren Schnoebelen
Environmental Sustainability Planner

WWW.MITCRPC.ORG
3135 PINE TREE RD | SUITE 2C | LANSING, MI 48911
P: (517) 393-0342 | F: (517) 393-4424

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824
SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360
PHONE: 248-454-6300
WEBSITE: hrcengr.com

March 11, 2022

Natural River Administrator
DNR Fisheries Division
PO Box 30446
Lansing, MI 48909-7946

Re: Wild and Scenic Rivers Review
Drinking Water Improvements Program
Lansing Board of Water & Light
City of Lansing, Michigan

HRC Job No. 20220131

To Whom it May Concern:

The Lansing Board of Water & Light is submitting a Project Plan to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for acceptance into the Drinking Water State Revolving Fund (DWSRF) Loan Program. The Project Plan requires a review to determine any potential impacts on state or federally-designated wild, scenic, or natural rivers or tributaries in the vicinity of the project.

On behalf of the Lansing Board of Water & Light, we are requesting information regarding the impacts of the above referenced proposed project upon protected state or federally-designated wild, scenic, or natural rivers or tributaries. The project work will involve the following:

- Improvements to the distribution systems including:
  - Replacement of aging water mains
  - Well Drilling to replace aging wells
- Addressing limitations at the water conditioning plant including:
  - Converting Ammonia Systems to Aqueous Form
  - Elevated Storage Evaluation and Implementation

The BWL's raw water supply is from 125 wells that are used to extract water from the Saginaw Aquifer, 7 of which are owned by Lansing Township. Water is conveyed from the wells through raw water transmission mains to one of the two conditioning plants. The total capacity of all the wells is 67.56 million gallons per day (MGD). Treatment is provided by two (2) Water Conditioning Plants (WCP), the John Dye WCP and Wise Road WCP, that provide 40 MGD and 10 MGD respectively located in the City of Lansing. The WCPs are equipped with four rapid mix basins, four flocculation basins, and four settling basins, and twelve sand filters, finished water storage, and seven high service pumps (finished water). The service area location of the WCPs is provided in the attached figures.

The proposed project site covers mostly urban areas with construction taking place at existing facilities. Excavations will be used throughout the site to help with the rehabilitation of existing facilities. The location of these improvements and construction will not occur or impact the any nearby Lakes and/or Rivers. The Wild and Scenic Rivers Inventory in Michigan and the National Park Service National Rivers Inventory maps are attached.

On behalf of the Lansing Board of Water & Light, we are requesting a review to confirm that the above referenced project will not cause an impact to any state or federally designated wild, scenic, or natural rivers or tributaries.

We request, on behalf of the Lansing Board of Water & Light, your concurrence with this determination. We appreciate

your review and would be grateful for a response by Monday, April 4, 2022 so that we may meet program deadlines.

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

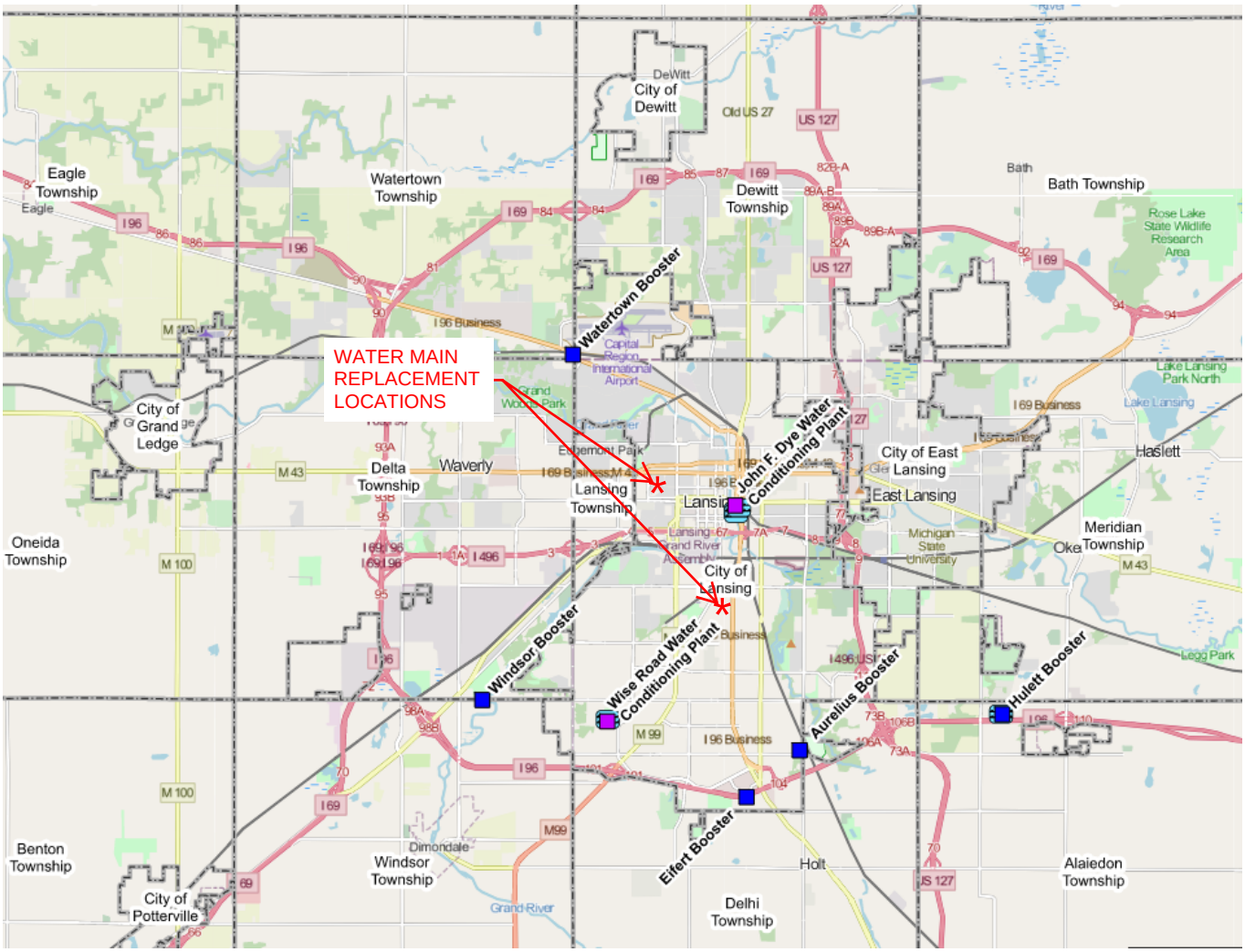
HUBBELL, ROTH & CLARK, INC.

Brittany R. Covault

Brittany R. Covault, E.I.T.
Graduate Engineer II

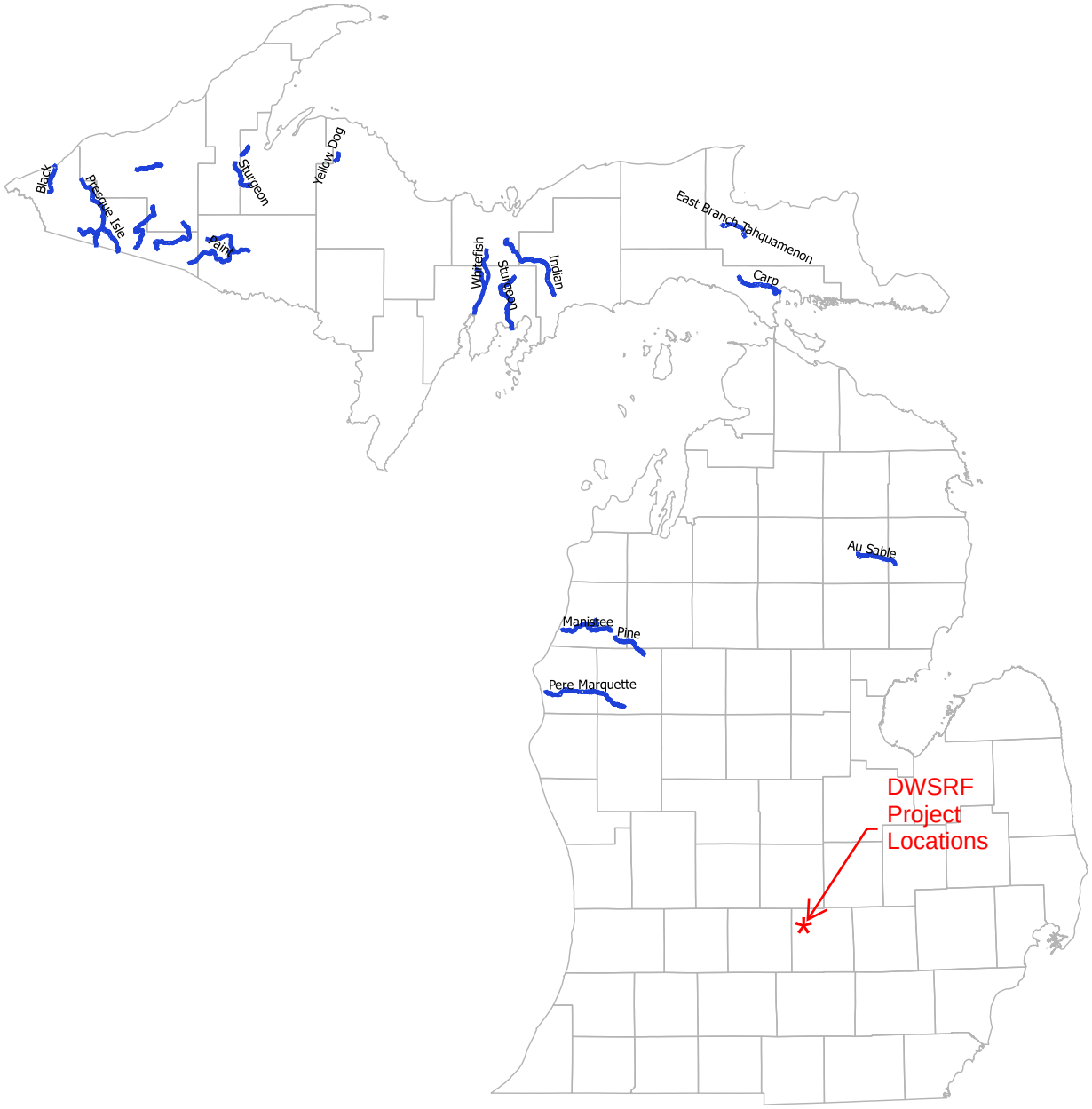
Attachments
Project Location Map
Michigan Wild & Scenic River Map
National Rivers Inventory Map

N



LANSING BWL	Job No. 20220131	LBWL DWSRF PROJECT PLAN IMPROVEMENTS (NOT TO SCALE)	SHEET NO. 1
HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915	Date March 2022		

Michigan Wild and Scenic Rivers



Legend

National Wild and Scenic Rivers System

Source: National Wild and Scenic Rivers System Website (https://www.rivers.gov/mapping-gis.php).

MSHDA
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY

4/2018

Nationwide Rivers Inventory

This is a listing of more than 3,200 free-flowing river segments in the U.S. that are believed to possess one or more "outstandingly remarkable" values.

National Park Service
U.S. Department of the Interior

N

0 10,560 Feet

APPENDIX B
FIGURE 1
NATIONWIDE RIVERS INVENTORY MAP

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

APPENDIX B: NATIONWIDE RIVERS INVENTORY

Nationwide Rivers Inventory

This is a listing of more than 3,200 free-flowing river segments in the U.S. that are believed to possess one or more "outstandingly remarkable" values.

National Park Service
U.S. Department of the Interior

N

0 10,560 Feet

APPENDIX B
FIGURE 1
NATIONWIDE RIVERS INVENTORY MAP

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131

APPENDIX C: WEB SOILS SURVEY RESULTS

Hometown People. Hometown Power.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

LBWL Service Area

Soils

- Indiana and Ohio Till Plain
- Southern Michigan and Northern Indiana Drift Plain

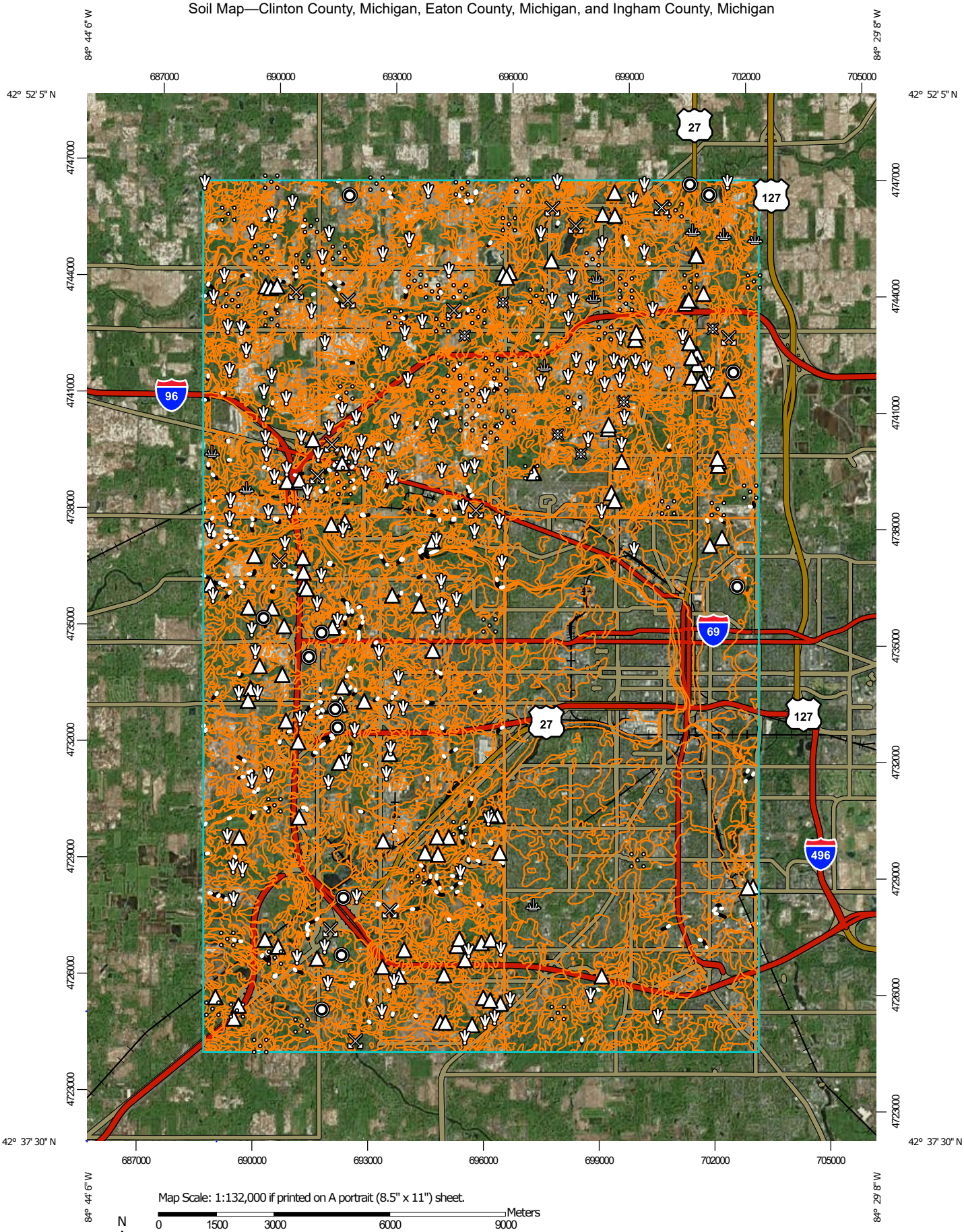
N

0 6,000 12,000 Feet

APPENDIX C
FIGURE 1
WEB SOIL SURVEY RESULTS

2022 DWSRF
Project Plan

March 2022 | HRC#: 20220131



Map Scale: 1:132,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 1500 3000 6000 9000

Feet
0 5000 10000 20000 30000

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: Clinton County, Michigan
Survey Area Data: Version 18, Aug 31, 2021

Soil Survey Area: Eaton County, Michigan
Survey Area Data: Version 18, Sep 2, 2021

Soil Survey Area: Ingham County, Michigan
Survey Area Data: Version 19, Sep 2, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 1, 2011—Aug 11, 2020

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
Ad	Adrian muck, 0 to 1 percent slopes	214.5	0.3%
BdA	Blount loam, 0 to 2 percent slopes	1.9	0.0%
Bh	Borrow land	201.6	0.3%
BnB	Boyer sandy loam, 0 to 6 percent slopes	1,312.2	1.6%
BnC	Boyer sandy loam, 6 to 12 percent slopes	348.5	0.4%
BoB	Boyer complex, 0 to 6 percent slopes	306.9	0.4%
BoC	Boyer complex, 6 to 12 percent slopes	98.4	0.1%
BoD	Boyer complex, 12 to 18 percent slopes	84.9	0.1%
BoE	Boyer complex, 18 to 25 percent slopes	91.5	0.1%
CbB	Capac-Marlette loams, 1 to 6 percent slopes	3,849.4	4.8%
Ce	Ceresco fine sandy loam	3.2	0.0%
Ch	Cohoctah loam	111.8	0.1%
Co	Colwood loam	690.3	0.9%
Cr	Corunna sandy loam	87.4	0.1%
CvraaB	Conover loam, 0 to 4 percent slopes	5,372.3	6.7%
Ed	Edwards muck, 0 to 1 percent slopes	44.5	0.1%
Gf	Gilford sandy loam, 0 to 2 percent slopes, gravelly subsoil	208.5	0.3%
Gr	Granby loamy sand, 0 to 2 percent slopes	27.7	0.0%
Ho	Houghton muck, 0 to 1 percent slopes	1,436.6	1.8%
KbA	Kibbie loam, 0 to 3 percent slopes	301.6	0.4%
LaB	Lapeer sandy loam, 2 to 6 percent slopes	84.5	0.1%
MaB	Marlette loam, 2 to 6 percent slopes	5,186.5	6.5%
MaC	Filer loam, 6 to 12 percent slopes	2,262.2	2.8%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
MaD	Filer loam, 12 to 18 percent slopes	234.8	0.3%
MaE	Filer loam, 18 to 35 percent slopes	69.8	0.1%
MbC3	Marlette clay loam, 6 to 12 percent slopes, severely eroded	64.0	0.1%
MbD3	Marlette clay loam, 12 to 18 percent slopes, severely eroded	207.7	0.3%
MdA	Matherton loam, 0 to 3 percent slopes	207.2	0.3%
MeA	Metamora-Capac sandy loams, 0 to 4 percent slopes	249.5	0.3%
MhB	Metea loamy sand, 2 to 6 percent slopes	11.3	0.0%
OaB	Oakville fine sand, 0 to 6 percent slopes	13.2	0.0%
OsB	Oshtemo sandy loam, 2 to 6 percent slopes	73.8	0.1%
OtA	Owosso sandy loam, 0 to 2 percent slopes	105.7	0.1%
OwB	Owosso-Marlette sandy loams, 2 to 6 percent slopes	652.7	0.8%
OwC	Owosso-Marlette sandy loams, 6 to 12 percent slopes	178.1	0.2%
Pa	Palms muck, 0 to 1 percent slopes	381.6	0.5%
Pg	Pits, gravel	221.4	0.3%
Pr	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	1,263.3	1.6%
Sb	Sebewa loam, 0 to 2 percent slopes	315.4	0.4%
SeA	Selfridge loamy sand, till plain, 0 to 4 percent slopes	24.4	0.0%
Sg	Sewage lagoons	2.4	0.0%
Sh	Shoals loam	8.2	0.0%
Sl	Sanitary landfill	328.4	0.4%
Sm	Sims silty clay loam	14.6	0.0%
SnB	Sisson fine sandy loam, 2 to 6 percent slopes	269.9	0.3%
So	Sloan loam	573.0	0.7%
SpB	Spinks loamy sand, 0 to 6 percent slopes	450.2	0.6%
SpC	Spinks loamy sand, 6 to 12 percent slopes	77.3	0.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ThA	Thetford loamy sand, 0 to 3 percent slopes	17.2	0.0%
UdB	Udorthents, loamy, 0 to 8 percent slopes	1,143.9	1.4%
W	Water	348.1	0.4%
Wa	Wallkill loam	51.2	0.1%
WbA	Wasepi sandy loam, 0 to 3 percent slopes	492.0	0.6%
Wd	Washtenaw loam	494.0	0.6%
Subtotals for Soil Survey Area		**30,871.0**	**38.6%**
Totals for Area of Interest		**80,018.3**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ad	Adrian muck, 0 to 1 percent slopes	108.5	0.1%
Aq	Aquents and Histosols, ponded	19.2	0.0%
Bh	Borrow land	427.4	0.5%
BnB	Boyer loamy sand, 0 to 6 percent slopes	213.9	0.3%
BnC	Boyer loamy sand, 6 to 12 percent slopes	69.4	0.1%
BoB	Boyer sandy loam, 0 to 6 percent slopes	141.1	0.2%
BoC	Boyer sandy loam, 6 to 12 percent slopes	71.4	0.1%
BpD	Boyer-Spinks loamy sands, 12 to 18 percent slopes	34.1	0.0%
BrA	Brady-Bronson sandy loams, 0 to 3 percent slopes	341.5	0.4%
CbB	Capac-Marlette loams, 1 to 6 percent slopes	2,500.9	3.1%
Ch	Cohoctah fine sandy loam, frequently flooded	131.0	0.2%
Co	Colwood loam	811.1	1.0%
Cp	Colwood loam, depressional	37.4	0.0%
CvraaB	Conover loam, 0 to 4 percent slopes	5,106.3	6.4%
Ed	Edwards muck, 0 to 1 percent slopes	65.8	0.1%
Gf	Gilford sandy loam, 0 to 2 percent slopes, gravelly subsoil	223.2	0.3%
HaB	Hillsdale sandy loam, 2 to 6 percent slopes	68.3	0.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HaC	Hillsdale sandy loam, 6 to 12 percent slopes	97.8	0.1%
Ho	Houghton muck, 0 to 1 percent slopes	555.0	0.7%
KbA	Kibbie fine sandy loam, 0 to 3 percent slopes	309.9	0.4%
Le	Lenawee silty clay loam, depressional	55.3	0.1%
MaB	Marlette loam, 2 to 6 percent slopes	5,692.6	7.1%
MaC	Filer loam, 6 to 12 percent slopes	1,364.6	1.7%
MaD	Filer loam, 12 to 18 percent slopes	299.9	0.4%
MaE	Filer loam, 18 to 35 percent slopes	175.4	0.2%
MbC3	Marlette clay loam, 6 to 12 percent slopes, severely eroded	38.0	0.0%
MdA	Matherton loam, 0 to 3 percent slopes	33.9	0.0%
MeA	Metamora-Capac sandy loams, 0 to 4 percent slopes	500.3	0.6%
OwB	Owosso-Marlette sandy loams, 1 to 6 percent slopes	1,414.1	1.8%
OwC	Owosso-Marlette sandy loams, 6 to 12 percent slopes	442.2	0.6%
OwD	Owosso-Marlette sandy loams, 12 to 18 percent slopes	143.3	0.2%
Pa	Palms muck, 0 to 1 percent slopes	326.9	0.4%
Pg	Pits, gravel	85.3	0.1%
Pr	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	2,241.7	2.8%
Sb	Sebewa loam, 0 to 2 percent slopes	110.9	0.1%
Sh	Shoals-Sloan loams	682.0	0.9%
SpB	Spinks loamy sand, 0 to 6 percent slopes	209.6	0.3%
SpC	Spinks loamy sand, 6 to 12 percent slopes	103.2	0.1%
StB	Spinks-Metea loamy sands, 0 to 6 percent slopes	154.4	0.2%
StC	Spinks-Metea loamy sands, 6 to 12 percent slopes	14.8	0.0%
TuA	Tuscola fine sandy loam, 0 to 4 percent slopes	90.0	0.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
UdB	Udorthents, nearly level and undulating	346.1	0.4%
W	Water	690.6	0.9%
WaA	Wasepi sandy loam, 0 to 3 percent slopes	116.5	0.1%
Subtotals for Soil Survey Area		**26,664.8**	**33.3%**
Totals for Area of Interest		**80,018.3**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ad	Adrian muck, 0 to 1 percent slopes	116.8	0.1%
AnA	Aubbeenaubbee-Capac sandy loams, 0 to 3 percent slopes	105.6	0.1%
Bo	Boots muck	15.4	0.0%
BrB	Boyer sandy loam, 0 to 6 percent slopes	0.4	0.0%
BsD	Boyer-Spinks loamy sands, 12 to 18 percent slopes	10.8	0.0%
BsE	Boyer-Spinks loamy sands, 18 to 30 percent slopes	9.9	0.0%
ByA	Brady sandy loam, 0 to 3 percent slopes	72.0	0.1%
Ce	Ceresco fine sandy loam	21.8	0.0%
Ch	Cohoctah silt loam	344.6	0.4%
Co	Colwood-Brookston loams	655.7	0.8%
CvraaB	Conover loam, 0 to 4 percent slopes	943.7	1.2%
Ed	Edwards muck, 0 to 1 percent slopes	1.3	0.0%
Gf	Gilford sandy loam, 0 to 2 percent slopes, gravelly subsoil	185.7	0.2%
Gr	Granby loamy fine sand, 0 to 2 percent slopes	87.4	0.1%
Hn	Houghton muck, 0 to 1 percent slopes	292.2	0.4%
Ka	Keowns very fine sandy loam	19.2	0.0%
KbA	Kibbie loam, 0 to 3 percent slopes	97.9	0.1%
Ln	Lenawee silty clay loam	8.9	0.0%
MaB	Marlette fine sandy loam, 2 to 6 percent slopes	135.7	0.2%
MaC	Filer fine sandy loam, Saginaw Lobe, 6 to 12 percent slopes	48.6	0.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
MeD2	Marlette loam, 12 to 18 percent slopes, eroded	19.5	0.0%
MtB	Metea loamy sand, 2 to 6 percent slopes	72.2	0.1%
Na	Napoleon muck	15.2	0.0%
OsB	Oshtemo sandy loam, 0 to 6 percent slopes	3.1	0.0%
OtB	Oshtemo-Spinks loamy sands, 0 to 6 percent slopes	46.3	0.1%
OtC	Oshtemo-Spinks loamy sands, 6 to 12 percent slopes	9.1	0.0%
OwB	Owosso-Marlette sandy loams, 2 to 6 percent slopes	242.6	0.3%
OwC	Owosso-Marlette sandy loams, 6 to 12 percent slopes	14.5	0.0%
Pa	Palms muck, 0 to 1 percent slopes	105.0	0.1%
Pt	Pits	49.7	0.1%
RdB	Riddles-Hillsdale sandy loams, 2 to 6 percent slopes	21.4	0.0%
RdC	Riddles-Hillsdale sandy loams, 6 to 12 percent slopes	13.1	0.0%
Sl	Sanitary landfill	56.0	0.1%
SnB	Sisson fine sandy loam, 2 to 6 percent slopes	13.0	0.0%
SnC	Sisson fine sandy loam, 6 to 12 percent slopes	0.1	0.0%
SpB	Spinks loamy sand, 0 to 6 percent slopes	125.1	0.2%
SpC	Spinks loamy sand, 6 to 12 percent slopes	100.2	0.1%
ThA	Thetford loamy sand, 0 to 3 percent slopes	20.4	0.0%
Ud	Udorthents and Udipsamments	366.5	0.5%
UeB	Urban land-Boyer-Spinks complex, 0 to 10 percent slopes	850.6	1.1%
UpA	Urban land-Capac-Colwood complex, 0 to 4 percent slopes	6,057.7	7.6%
UtB	Urban land-Marlette complex, 2 to 12 percent slopes	10,100.0	12.6%
Uu	Urban land-Fluvaquents complex	618.6	0.8%
W	Water	380.5	0.5%
Subtotals for Soil Survey Area		**22,473.7**	**28.1%**
Totals for Area of Interest		**80,018.3**	**100.0%**

APPENDIX D: MICHIGAN NATURAL FEATURES INVENTORY ENDANGERED SPECIES

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
http://www.fws.gov/midwest/EastLansing/

In Reply Refer To: March 03, 2022
Project Code: 2022-0015429
Project Name: LBWL DWSRF

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/midwest/EastLansing/te/pdf/MIFO_IPAC_instructions_v1_Jan2021.pdf. 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: http://www.fws.gov/midwest/endangered/section7/s7process/index.html. 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/midwest/eagle/permits/index.html 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/birds/policies-and-regulations/administrative-orders/executive-orders.php.

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: 2022-0015429
Event Code: None
Project Name: LBWL DWSRF
Project Type: Distribution Line - Maintenance/Modification - Below Ground
Project Description: This project would provide several improvements for the existing Water Treatment Plans and distribution system including water main replacement (outdated), converting the ammonia system to aqueous form, updates to the Wise Road WCP chemical building, elevated storage, and well drilling.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.7474135,-84.58971573450552,14z

Counties: Clinton , Eaton , and Ingham counties, 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.

---

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. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5949 General project design guidelines: https://ipac.ecosphere.fws.gov/project/RB4LPB726FB2DN4RYND2T7XRYQ/documents/generated/5663.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/RB4LPB726FB2DN4RYND2T7XRYQ/documents/generated/5664.pdf	Threatened

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*	Threatened

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/RB4LPB726FB2DN4RYND2T7XRYQ/documents/generated/5280.pdf

Clams

NAME	STATUS
Snuffbox Mussel *Epioblasma triquetra*	Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/4135

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus*	Candidate

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/9743

Flowering Plants

NAME	STATUS
Eastern Prairie Fringed Orchid *Platanthera leucophaea*	Threatened

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/601

Critical habitats

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

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.

---

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. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31

NAME	BREEDING SEASON
Black Tern *Chlidonias niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
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
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
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
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
Ruddy Turnstone *Arenaria interpres morinella* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
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.

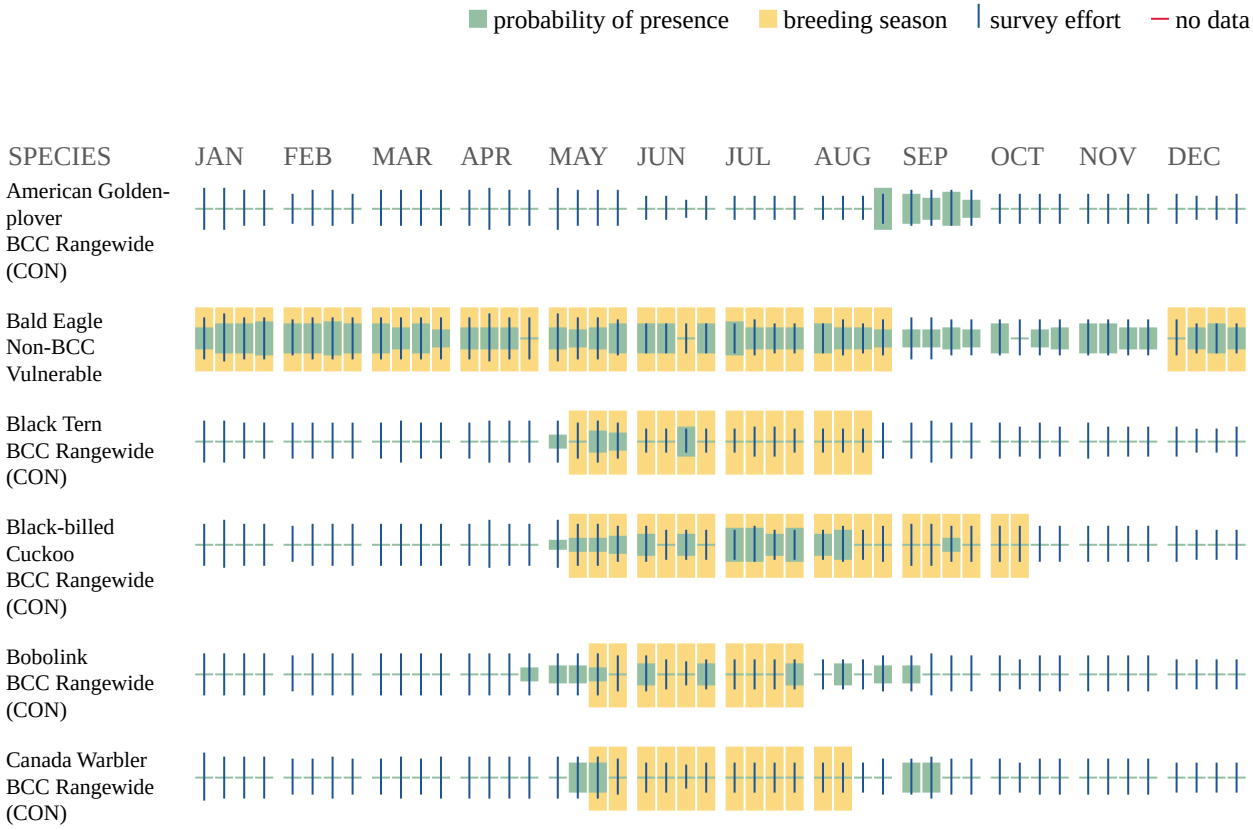
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

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 http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.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 migratory birds potentially occurring 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 AKN Phenology 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, migrating or present year-round in my project 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 refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. 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.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

IPaC User Contact Information

Agency:	Lansing city (Clinton County, MI; Eaton County, MI; Ingham County, MI)
Name:	Brittany Covault
Address:	2101 Aurelius Road
Address Line 2:	Suite 2A
City:	Holt
State:	MI
Zip:	48842
Email	bcovault@hrcengr.com
Phone:	5172921936

APPENDIX E: DETAILED COST ESTIMATES

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Subarea 034E
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/CSO

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 10,000.00	$ 10,000.00
2	Mobilization, Max 5%	1	LSUM	$ 94,597.75	$ 94,597.75
3	Curb and Gutter, Rem	820	Ft	$ 10.00	$ 8,200.00
4	Pavt, Rem	7,840	Syd	$ 10.00	$ 78,400.00
5	Erosion Control	1	LSUM	$ 15,000.00	$ 15,000.00
6	Subbase, CIP	2,620	Cyd	$ 20.00	$ 52,400.00
7	Aggregate Base, 8 inch	7,840	Syd	$ 12.00	$ 94,080.00
8	HMA, LVSP	1,785	Ton	$ 125.00	$ 223,125.00
9	Curb and Gutter, Conc, Det F4, Modified	820	Ft	$ 25.00	$ 20,500.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
13	Water Main, Connect to Existing	11	Ea	$ 750.00	$ 8,250.00
14	Water Main, DI, 8 inch, Tr Det G, Modified	7,050	Ft	$ 120.00	$ 846,000.00
15	Gate Valve and Box, 8 inch, Modified	20	Ea	$ 2,500.00	$ 50,000.00
16	Hydrant Assembly	8	Ea	$ 5,000.00	$ 40,000.00
17	Water Service	203	Ea	$ 2,000.00	$ 406,000.00

Estimated Construction Cost: $ 1,986,552.75

Engineering, Legal, and Admin. (25%): $ 496,638.19

Contingency (20%): $ 397,310.55

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 2,880,501.49

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Subarea 034E
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option without CSO

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 10,000.00	$ 10,000.00
2	Mobilization, Max 5%	1	LSUM	$ 94,518.75	$ 94,518.75
3	Curb and Gutter, Rem	820	Ft	$ 10.00	$ 8,200.00
4	Pavt, Rem	7,840	Syd	$ 10.00	$ 78,400.00
5	Erosion Control	1	LSUM	$ 15,000.00	$ 15,000.00
6	Subbase, CIP	2,620	Cyd	$ 20.00	$ 52,400.00
7	Aggregate Base, 8 inch	7,840	Syd	$ 12.00	$ 94,080.00
8	HMA, LVSP	4,365	Ton	$ 125.00	$ 545,625.00
9	Cold Milling HMA Surface	10,835	Syd	$ 2.00	$ 21,670.00
10	Curb and Gutter, Conc, Det F4, Modified	820	Ft	$ 25.00	$ 20,500.00
11	Pavement Markings	1	LSUM	$ 10,000.00	$ 10,000.00
12	Traffic Control	1	LSUM	$ 40,000.00	$ 40,000.00
13	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
14	Water Main, Connect to Existing	11	Ea	$ 750.00	$ 8,250.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	7,050	Ft	$ 125.00	$ 881,250.00
16	Gate Valve and Box, 8 inch, Modified	20	Ea	$ 2,500.00	$ 50,000.00
17	Hydrant Assembly	8	Ea	$ 5,000.00	$ 40,000.00
18	Water Service	203	Ea	$ 2,500.00	$ 507,500.00

Estimated Construction Cost: $ 2,492,393.75

Engineering, Legal, and Admin. (25%): $ 623,098.44

Contingency (20%): $ 498,478.75

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 3,613,970.94

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Subarea 034E
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill Option

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 10,000.00	$ 10,000.00
2	Mobilization, Max 5%	1	LSUM	$ 141,618.25	$ 141,618.25
3	Curb and Gutter, Rem	820	Ft	$ 10.00	$ 8,200.00
4	Pavt, Rem	370	Syd	$ 10.00	$ 3,700.00
5	Erosion Control	1	LSUM	$ 15,000.00	$ 15,000.00
6	Subbase, CIP	20	Cyd	$ 20.00	$ 400.00
7	Aggregate Base, 8 inch	370	Syd	$ 12.00	$ 4,440.00
8	HMA, LVSP	75	Ton	$ 125.00	$ 9,375.00
9	Curb and Gutter, Conc, Det F4, Modified	820	Ft	$ 25.00	$ 20,500.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
13	Water Main, Connect to Existing	11	Ea	$ 750.00	$ 8,250.00
14	Water Main, DI, 8 inch, Tr Det G, Modified	7,050	Ft	$ 300.00	$ 2,115,000.00
15	Gate Valve and Box, 8 inch, Modified	20	Ea	$ 2,500.00	$ 50,000.00
16	Hydrant Assembly	8	Ea	$ 5,000.00	$ 40,000.00
17	Water Service	203	Ea	$ 2,500.00	$ 507,500.00

Estimated Construction Cost: $ 2,973,983.25

Engineering, Legal, and Admin. (25%): $ 743,495.81

Contingency (20%): $ 594,796.65

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 4,312,275.71

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Subarea 015S
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/CSO

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 403,827.50	$ 403,827.50
3	Curb and Gutter, Rem	2,850	Ft	$ 10.00	$ 28,500.00
4	Pavt, Rem	33,000	Syd	$ 10.00	$ 330,000.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	11,000	Cyd	$ 20.00	$ 220,000.00
7	Aggregate Base, 8 inch	33,000	Syd	$ 12.00	$ 396,000.00
8	HMA, LVSP	8,270	Ton	$ 125.00	$ 1,033,750.00
9	Curb and Gutter, Conc, Det F4, Modified	2,850	Ft	$ 25.00	$ 71,250.00
10	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
11	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
12	Lawn Restoration	1	LSUM	$ 80,000.00	$ 80,000.00
13	Water Main, Connect to Existing	23	Ea	$ 750.00	$ 17,250.00
14	Water Main, DI, 8 inch, Tr Det G, Modified	29,690	Ft	$ 120.00	$ 3,562,800.00
15	Water Main, DI, 16 inch, Tr Det G, Modified	1,670	Ea	$ 150.00	$ 250,500.00
16	Gate Valve and Box, 8 inch, Modified	105	Ea	$ 2,500.00	$ 262,500.00
17	Gate Valve and Box, 16 inch, Modified	5	Ea	$ 4,000.00	$ 20,000.00
18	Hydrant Assembly	35	Ea	$ 5,000.00	$ 175,000.00
19	Water Service	712	Ea	$ 2,000.00	$ 1,424,000.00

Estimated Construction Cost: $ 8,480,377.50

Engineering, Legal, and Admin. (25%): $ 2,120,094.38

Contingency (20%): $ 1,696,075.50

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 12,296,547.38

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO Subarea 015S
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option without CSO

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 540,265.75	$ 540,265.75
3	Curb and Gutter, Rem	2,850	Ft	$ 10.00	$ 28,500.00
4	Pavt, Rem	33,000	Syd	$ 10.00	$ 330,000.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	11,000	Cyd	$ 20.00	$ 220,000.00
7	Aggregate Base, 8 inch	33,000	Syd	$ 12.00	$ 396,000.00
8	HMA, LVSP	24,065	Ton	$ 125.00	$ 3,008,125.00
9	Cold Milling HMA Surface	58,220	Syd	$ 2.00	$ 116,440.00
10	Curb and Gutter, Conc, Det F4, Modified	2,850	Ft	$ 25.00	$ 71,250.00
11	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
12	Traffic Control	1	LSUM	$ 150,000.00	$ 150,000.00
13	Lawn Restoration	1	LSUM	$ 80,000.00	$ 80,000.00
14	Water Main, Connect to Existing	23	Ea	$ 750.00	$ 17,250.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	29,690	Ft	$ 125.00	$ 3,711,250.00
16	Water Main, DI, 16 inch, Tr Det G, Modified	1,670	Ft	$ 200.00	$ 334,000.00
17	Gate Valve and Box, 8 inch, Modified	105	Ea	$ 2,500.00	$ 262,500.00
18	Gate Valve and Box, 16 inch, Modified	5	Ea	$ 4,000.00	$ 20,000.00
19	Hydrant Assembly	35	Ea	$ 5,000.00	$ 175,000.00
20	Water Service	712	Ea	$ 2,500.00	$ 1,780,000.00

Estimated Construction Cost: $ 11,345,580.75

Engineering, Legal, and Admin. (25%): $ 2,836,395.19
Contingency (20%): $ 2,269,116.15

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 16,451,092.09

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Subarea 015S
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill Option

DATE: March 10, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 630,896.00	$ 630,896.00
3	Curb and Gutter, Rem	2,850	Ft	$ 10.00	$ 28,500.00
4	Pavt, Rem	1,235	Syd	$ 10.00	$ 12,350.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	50	Cyd	$ 20.00	$ 1,000.00
7	Aggregate Base, 8 inch	1,235	Syd	$ 12.00	$ 14,820.00
8	HMA, LVSP	330	Ton	$ 125.00	$ 41,250.00
9	Curb and Gutter, Conc, Det F4, Modified	2,850	Ft	$ 25.00	$ 71,250.00
10	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
11	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
12	Lawn Restoration	1	LSUM	$ 80,000.00	$ 80,000.00
13	Water Main, Connect to Existing	23	Ea	$ 750.00	$ 17,250.00
14	Water Main, DI, 8 inch, Tr Det G, Modified	29,690	Ft	$ 300.00	$ 8,907,000.00
15	Water Main, DI, 16 inch, Tr Det G, Modified	1,670	Ft	$ 600.00	$ 1,002,000.00
16	Gate Valve and Box, 8 inch, Modified	105	Ea	$ 2,500.00	$ 262,500.00
17	Gate Valve and Box, 16 inch, Modified	5	Ea	$ 4,000.00	$ 20,000.00
18	Hydrant Assembly	35	Ea	$ 5,000.00	$ 175,000.00
19	Water Service	712	Ea	$ 2,500.00	$ 1,780,000.00

Estimated Construction Cost: $ 13,248,816.00

Engineering, Legal, and Admin. (25%): $ 3,312,204.00
Contingency (20%): $ 2,649,763.20

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 19,210,783.20

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO E Ionia St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 102,671.60	$ 102,671.60
3	Curb and Gutter, Rem	3,220	Ft	$ 10.00	$ 32,200.00
4	Pavt, Rem	10,111	Syd	$ 10.00	$ 101,110.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	2,250	Cyd	$ 20.00	$ 45,000.00
7	Aggregate Base, 8 inch	10,111	Syd	$ 12.00	$ 121,332.00
8	HMA, LVSP	2,230	Ton	$ 125.00	$ 278,750.00
9	Curb and Gutter, Conc, Det F4, Modified	3,220	Ft	$ 25.00	$ 80,500.00
10	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
11	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
12	Lawn Restoration	1	LSUM	$ 50,000.00	$ 50,000.00
13	Water Main, DI, 4 inch, Tr Det G, Modified	20	Ft	$ 90.00	$ 1,800.00
14	Water Main, DI, 6 inch, Tr Det G, Modified	40	Ft	$ 96.00	$ 3,840.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	2,380	Ft	$ 120.00	$ 285,600.00
16	Water Main, DI, 16 inch, Tr Det G, Modified	4,000	Ea	$ 150.00	$ 600,000.00
17	Gate Valve and Box, 4 inch, Modified	1	Ea	$ 1,800.00	$ 1,800.00
18	Gate Valve and Box, 6 inch, Modified	2	Ea	$ 2,000.00	$ 4,000.00
19	Gate Valve and Box, 8 inch, Modified	1	Ea	$ 2,500.00	$ 2,500.00
20	Gate Valve and Box, 16 inch, Modified	7	Ea	$ 4,000.00	$ 28,000.00
21	Live Tap, 8 inch by 8 inch	15	Ea	$ 5,000.00	$ 75,000.00
22	Live Tap, 8 inch by 12 inch	2	Ea	$ 6,000.00	$ 12,000.00
23	Hydrant Assembly	5	Ea	$ 5,000.00	$ 25,000.00
24	Water Service	50	Ea	$ 2,000.00	$ 100,000.00

Estimated Construction Cost: $ 2,156,103.60

Engineering, Legal, and Admin. (25%): $ 539,025.90
Contingency (20%): $ 431,220.72

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 3,126,350.22

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO E Ionia St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/out CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 108,302.50	$ 108,302.50
3	Curb and Gutter, Rem	1,625	Ft	$ 10.00	$ 16,250.00
4	Pavt, Rem	10,250	Syd	$ 10.00	$ 102,500.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	2,250	Cyd	$ 20.00	$ 45,000.00
7	Aggregate Base, 8 inch	10,250	Syd	$ 12.00	$ 123,000.00
8	HMA, LVSP	3,343	Ton	$ 125.00	$ 417,875.00
9	Cold Milling HMA Surface	10,250	Syd	$ 2.00	$ 20,500.00
9	Curb and Gutter, Conc, Det F4, Modified	1,625	Ft	$ 25.00	$ 40,625.00
10	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
11	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
12	Lawn Restoration	1	LSUM	$ 50,000.00	$ 50,000.00
13	Water Main, DI, 4 inch, Tr Det G, Modified	20	Ft	$ 90.00	$ 1,800.00
14	Water Main, DI, 6 inch, Tr Det G, Modified	100	Ft	$ 96.00	$ 9,600.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	2,380	Ft	$ 120.00	$ 285,600.00
16	Water Main, DI, 16 inch, Tr Det G, Modified	4,000	Ea	$ 150.00	$ 600,000.00
17	Gate Valve and Box, 4 inch, Modified	1	Ea	$ 1,800.00	$ 1,800.00
18	Gate Valve and Box, 6 inch, Modified	2	Ea	$ 2,000.00	$ 4,000.00
19	Gate Valve and Box, 8 inch, Modified	1	Ea	$ 2,500.00	$ 2,500.00
20	Gate Valve and Box, 16 inch, Modified	7	Ea	$ 4,000.00	$ 28,000.00
21	Live Tap, 8 inch by 8 inch	15	Ea	$ 5,000.00	$ 75,000.00
22	Live Tap, 8 inch by 12 inch	2	Ea	$ 6,000.00	$ 12,000.00
23	Hydrant Assembly	5	Ea	$ 5,000.00	$ 25,000.00
24	Water Service	50	Ea	$ 2,000.00	$ 100,000.00

Estimated Construction Cost: $ 2,274,352.50

Engineering, Legal, and Admin. (25%): $ 568,588.13
Contingency (20%): $ 454,870.50

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 3,297,811.13

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO E Ionia St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 160,189.85	$ 160,189.85
3	Curb and Gutter, Rem	1,625	Ft	$ 10.00	$ 16,250.00
4	Pavt, Rem	506	Syd	$ 10.00	$ 5,060.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	112	Cyd	$ 20.00	$ 2,240.00
7	Aggregate Base, 8 inch	506	Syd	$ 12.00	$ 6,072.00
8	HMA, LVSP	112	Ton	$ 125.00	$ 14,000.00
9	Curb and Gutter, Conc, Det F4, Modified	1,625	Ft	$ 25.00	$ 40,625.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
13	Water Main, Connect to Existing	23	Ea	$ 750.00	$ 17,250.00
14	Water Main, DI, 4 inch, Tr Det G, Modified	20	Ft	$ 100.00	$ 2,000.00
15	Water Main, DI, 6 inch, Tr Det G, Modified	40	Ft	$ 200.00	$ 8,000.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	2,380	Ft	$ 300.00	$ 714,000.00
17	Water Main, DI, 16 inch, Tr Det G, Modified	4,000	Ea	$ 500.00	$ 2,000,000.00
18	Gate Valve and Box, 4 inch, Modified	1	Ea	$ 1,800.00	$ 1,800.00
19	Gate Valve and Box, 6 inch, Modified	2	Ea	$ 2,000.00	$ 4,000.00
20	Gate Valve and Box, 8 inch, Modified	1	Ea	$ 2,500.00	$ 2,500.00
21	Gate Valve and Box, 16 inch, Modified	7	Ea	$ 4,000.00	$ 28,000.00
22	Live Tap, 8 inch by 8 inch	15	Ea	$ 5,000.00	$ 75,000.00
23	Live Tap, 8 inch by 12 inch	2	Ea	$ 6,000.00	$ 12,000.00
24	Hydrant Assembly	6	Ea	$ 5,000.00	$ 30,000.00
25	Water Service	50	Ea	$ 2,000.00	$ 100,000.00
				Estimated Construction Cost:	$ 3,363,986.85
				Engineering, Legal, and Admin. (25%):	$ 840,996.71
				Contingency (20%):	$ 672,797.37
				TOTAL OPINION OF PROBABLE CONSTRUCTION COST =	**$ 4,877,780.93**

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: Raw Water Main Extension - Hughes Rd
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 25,219.50	$ 25,219.50
3	Pavt, Rem	2,200	Syd	$ 10.00	$ 22,000.00
4	Erosion Control	1	LSUM	$ 30,000.00	$ 30,000.00
5	Subbase, CIP	112	Cyd	$ 20.00	$ 2,240.00
6	Aggregate Base, 8 inch	2,200	Syd	$ 12.00	$ 26,400.00
7	HMA, LVSP	500	Ton	$ 140.00	$ 70,000.00
8	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
9	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
10	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
11	Water Main, Connect to Existing	1	Ea	$ 750.00	$ 750.00
12	Water Main, DI, 8 inch, Tr Det G, Modified	2,400	Ft	$ 120.00	$ 288,000.00

Estimated Construction Cost: $ 529,609.50

Engineering, Legal, and Admin. (25%): $ 132,402.38
Contingency (20%): $ 105,921.90

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 767,933.78

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO Michigan Ave
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/out CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 145,033.75	$ 145,033.75
3	Curb and Gutter, Rem	200	Ft	$ 10.00	$ 2,000.00
4	Pavt, Rem	14,080	Syd	$ 10.00	$ 140,800.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	3,126	Cyd	$ 20.00	$ 62,520.00
7	Aggregate Base, 8 inch	14,080	Syd	$ 12.00	$ 168,960.00
8	HMA, LVSP	4,647	Ton	$ 125.00	$ 580,875.00
9	Curb and Gutter, Conc, Det F4, Modified	200	Ft	$ 25.00	$ 5,000.00
9	Cold Milling HMA Surface	14,080	Syd	$ 2.00	$ 28,160.00
11	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
12	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
13	Lawn Restoration	1	LSUM	$ 50,000.00	$ 50,000.00
14	Water Main, DI, 6 inch, Tr Det G, Modified	35	Ft	$ 96.00	$ 3,360.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	2,000	Ft	$ 120.00	$ 240,000.00
16	Water Main, DI, 16 inch, Tr Det G, Modified	6,700	Ea	$ 150.00	$ 1,005,000.00
17	Gate Valve and Box, 16 inch, Modified	11	Ea	$ 4,000.00	$ 44,000.00
18	Live Tap, 8 inch by 8 inch	27	Ea	$ 5,000.00	$ 135,000.00
19	Hydrant Assembly	16	Ea	$ 5,000.00	$ 80,000.00
20	Water Service	75	Ea	$ 2,000.00	$ 150,000.00

Estimated Construction Cost: $ 3,045,708.75

Engineering, Legal, and Admin. (25%): $ 761,427.19
Contingency (20%): $ 609,141.75

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 4,416,277.69

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Michigan Ave
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 229,418.60	$ 229,418.60
3	Curb and Gutter, Rem	200	Ft	$ 10.00	$ 2,000.00
4	Pavt, Rem	506	Syd	$ 10.00	$ 5,060.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	112	Cyd	$ 20.00	$ 2,240.00
7	Aggregate Base, 8 inch	506	Syd	$ 12.00	$ 6,072.00
8	HMA, LVSP	112	Ton	$ 125.00	$ 14,000.00
9	Curb and Gutter, Conc, Det F4, Modified	200	Ft	$ 25.00	$ 5,000.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
15	Water Main, DI, 6 inch, Tr Det G, Modified	350	Ft	$ 200.00	$ 70,000.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	2,000	Ft	$ 300.00	$ 600,000.00
17	Water Main, DI, 16 inch, Tr Det G, Modified	6,700	Ea	$ 500.00	$ 3,350,000.00
21	Gate Valve and Box, 16 inch, Modified	11	Ea	$ 4,000.00	$ 44,000.00
22	Live Tap, 8 inch by 8 inch	27	Ea	$ 5,000.00	$ 135,000.00
24	Hydrant Assembly	16	Ea	$ 5,000.00	$ 80,000.00
25	Water Service	75	Ea	$ 2,000.00	$ 150,000.00

Estimated Construction Cost: $ 4,817,790.60

Engineering, Legal, and Admin. (25%): $ 1,204,447.65
Contingency (20%): $ 963,558.12

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 6,985,796.37

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Ottawa St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 18,480.75	$ 18,480.75
3	Curb and Gutter, Rem	200	Ft	$ 10.00	$ 2,000.00
4	Pavt, Rem	1,120	Syd	$ 10.00	$ 11,200.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	249	Cyd	$ 20.00	$ 4,980.00
7	Aggregate Base, 8 inch	1,120	Syd	$ 12.00	$ 13,440.00
8	HMA, LVSP	247	Ton	$ 125.00	$ 30,875.00
9	Curb and Gutter, Conc, Det F4, Modified	200	Ft	$ 25.00	$ 5,000.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 10,000.00	$ 10,000.00
13	Water Main, DI, 4 inch, Tr Det G, Modified	100	Ft	$ 90.00	$ 9,000.00
14	Water Main, DI, 6 inch, Tr Det G, Modified	20	Ft	$ 96.00	$ 1,920.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	600	Ft	$ 120.00	$ 72,000.00
16	Gate Valve and Box, 4 inch, Modified	4	Ea	$ 1,800.00	$ 7,200.00
17	Gate Valve and Box, 6 inch, Modified	4	Ea	$ 2,000.00	$ 8,000.00
18	Live Tap, 8 inch by 8 inch	4	Ea	$ 5,000.00	$ 20,000.00
19	Hydrant Assembly	2	Ea	$ 5,000.00	$ 10,000.00
20	Water Service	27	Ea	$ 2,000.00	$ 54,000.00

Estimated Construction Cost: $ 388,095.75

Engineering, Legal, and Admin. (25%): $ 97,023.94
Contingency (20%): $ 77,619.15

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 562,738.84

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Ottawa St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/out CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 26,117.75	$ 26,117.75
3	Curb and Gutter, Rem	200	Ft	$ 10.00	$ 2,000.00
4	Pavt, Rem	1,120	Syd	$ 10.00	$ 11,200.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	249	Cyd	$ 20.00	$ 4,980.00
7	Aggregate Base, 8 inch	1,120	Syd	$ 12.00	$ 13,440.00
8	HMA, LVSP	371	Ton	$ 125.00	$ 46,375.00
9	Curb and Gutter, Conc, Det F4, Modified	200	Ft	$ 25.00	$ 5,000.00
10	Cold Milling HMA Surface	1,120	Syd	$ 2.00	$ 2,240.00
11	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
12	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
13	Lawn Restoration	1	LSUM	$ 50,000.00	$ 50,000.00
14	Water Main, DI, 4 inch, Tr Det G, Modified	100	Ft	$ 90.00	$ 9,000.00
15	Water Main, DI, 6 inch, Tr Det G, Modified	20	Ft	$ 96.00	$ 1,920.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	600	Ft	$ 120.00	$ 72,000.00
17	Gate Valve and Box, 4 inch, Modified	4	Ea	$ 1,800.00	$ 7,200.00
18	Gate Valve and Box, 6 inch, Modified	4	Ea	$ 2,000.00	$ 8,000.00
19	Live Tap, 8 inch by 8 inch	4	Ea	$ 5,000.00	$ 20,000.00
20	Hydrant Assembly	2	Ea	$ 5,000.00	$ 10,000.00
21	Water Service	27	Ea	$ 2,000.00	$ 54,000.00

Estimated Construction Cost: $ 548,472.75

Engineering, Legal, and Admin. (25%): $ 137,118.19
Contingency (20%): $ 109,694.55

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 795,285.49

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: CSO Ottawa St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 21,379.00	$ 21,379.00
3	Curb and Gutter, Rem	100	Ft	$ 10.00	$ 1,000.00
4	Pavt, Rem	100	Syd	$ 10.00	$ 1,000.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	23	Cyd	$ 20.00	$ 460.00
7	Aggregate Base, 8 inch	100	Syd	$ 12.00	$ 1,200.00
8	HMA, LVSP	22	Ton	$ 125.00	$ 2,750.00
9	Curb and Gutter, Conc, Det F4, Modified	100	Ft	$ 25.00	$ 2,500.00
10	Non-reinforced Conc, 6 inch	50	Syd	$ 71.00	$ 3,550.00
11	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
12	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
13	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
14	Water Main, DI, 4 inch, Tr Det G, Modified	100	Ft	$ 90.00	$ 9,000.00
15	Water Main, DI, 6 inch, Tr Det G, Modified	20	Ft	$ 96.00	$ 1,920.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	600	Ft	$ 300.00	$ 180,000.00
17	Gate Valve and Box, 4 inch, Modified	4	Ea	$ 1,800.00	$ 7,200.00
18	Gate Valve and Box, 6 inch, Modified	4	Ea	$ 2,000.00	$ 8,000.00
19	Live Tap, 8 inch by 8 inch	4	Ea	$ 5,000.00	$ 20,000.00
20	Hydrant Assembly	2	Ea	$ 5,000.00	$ 10,000.00
21	Water Service	27	Ea	$ 2,000.00	$ 54,000.00

Estimated Construction Cost: $ 448,959.00

Engineering, Legal, and Admin. (25%): $ 112,239.75
Contingency (20%): $ 89,791.80

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 650,990.55

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO Shiawassee St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 33,178.45	$ 33,178.45
3	Curb and Gutter, Rem	100	Ft	$ 10.00	$ 1,000.00
4	Pavt, Rem	3,112	Syd	$ 10.00	$ 31,120.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	249	Cyd	$ 20.00	$ 4,980.00
7	Aggregate Base, 8 inch	3,112	Syd	$ 12.00	$ 37,344.00
8	HMA, LVSP	685	Ton	$ 125.00	$ 85,625.00
9	Curb and Gutter, Conc, Det F4, Modified	100	Ft	$ 25.00	$ 2,500.00
10	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
12	Lawn Restoration	1	LSUM	$ 10,000.00	$ 10,000.00
15	Water Main, DI, 8 inch, Tr Det G, Modified	2,000	Ft	$ 120.00	$ 240,000.00
18	Live Tap, 4 inch by 8 inch	1	Ea	$ 2,000.00	$ 2,000.00
19	Hydrant Assembly	3	Ea	$ 5,000.00	$ 15,000.00
20	Water Service	62	Ea	$ 2,000.00	$ 124,000.00

Estimated Construction Cost: $ 696,747.45

Engineering, Legal, and Admin. (25%): $ 174,186.86
Contingency (20%): $ 139,349.49

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 1,010,283.80

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO Shiawassee St
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Open Cut Option w/out CSO

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 43,593.40	$ 43,593.40
3	Curb and Gutter, Rem	620	Ft	$ 10.00	$ 6,200.00
4	Pavt, Rem	3,112	Syd	$ 10.00	$ 31,120.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	249	Cyd	$ 20.00	$ 4,980.00
7	Aggregate Base, 8 inch	3,112	Syd	$ 12.00	$ 37,344.00
8	HMA, LVSP	1,028	Ton	$ 125.00	$ 128,500.00
9	Curb and Gutter, Conc, Det F4, Modified	620	Ft	$ 25.00	$ 15,500.00
10	Cold Milling HMA Surface	3,112	Syd	$ 2.00	$ 6,224.00
11	Pavement Markings	1	LSUM	$ 20,000.00	$ 20,000.00
12	Traffic Control	1	LSUM	$ 100,000.00	$ 100,000.00
13	Lawn Restoration	1	LSUM	$ 50,000.00	$ 50,000.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	2,000	Ft	$ 120.00	$ 240,000.00
19	Live Tap, 4 inch by 8 inch	4	Ea	$ 2,000.00	$ 8,000.00
20	Hydrant Assembly	3	Ea	$ 5,000.00	$ 15,000.00
21	Water Service	62	Ea	$ 2,000.00	$ 124,000.00

Estimated Construction Cost: $ 915,461.40

Engineering, Legal, and Admin. (25%): $ 228,865.35
Contingency (20%): $ 183,092.28

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 1,327,419.03

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: CSO Shiawassee St.
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate - Directional Drill

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 44,955.50	$ 44,955.50
3	Curb and Gutter, Rem	620	Ft	$ 10.00	$ 6,200.00
4	Pavt, Rem	100	Syd	$ 10.00	$ 1,000.00
5	Erosion Control	1	LSUM	$ 60,000.00	$ 60,000.00
6	Subbase, CIP	23	Cyd	$ 20.00	$ 460.00
7	Aggregate Base, 8 inch	100	Syd	$ 12.00	$ 1,200.00
8	HMA, LVSP	22	Ton	$ 125.00	$ 2,750.00
9	Curb and Gutter, Conc, Det F4, Modified	620	Ft	$ 25.00	$ 15,500.00
11	Pavement Markings	1	LSUM	$ 5,000.00	$ 5,000.00
12	Traffic Control	1	LSUM	$ 20,000.00	$ 20,000.00
13	Lawn Restoration	1	LSUM	$ 15,000.00	$ 15,000.00
16	Water Main, DI, 8 inch, Tr Det G, Modified	2,000	Ft	$ 300.00	$ 600,000.00
19	Live Tap, 4 inch by 8 inch	4	Ea	$ 2,000.00	$ 8,000.00
20	Hydrant Assembly	3	Ea	$ 5,000.00	$ 15,000.00
21	Water Service	62	Ea	$ 2,000.00	$ 124,000.00

Estimated Construction Cost: $ 944,065.50

Engineering, Legal, and Admin. (25%): $ 236,016.38
Contingency (20%): $ 188,813.10

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 1,368,894.98

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: Elevated Storage
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Audiovisual Coverage	1	LSUM	$ 25,000.00	$ 25,000.00
2	Mobilization, Max 5%	1	LSUM	$ 308,875.00	$ 308,875.00
3	Clearing and Grubbing	1	LSUM	$ 1,500.00	$ 1,500.00
4	Lawn Restoration	1	LSUM	$ 7,500.00	$ 7,500.00
5	Site Grading	1	LSUM	$ 2,500.00	$ 2,500.00
6	Erosion Control	1	LSUM	$ 5,000.00	$ 5,000.00
7	Electrical	1	LSUM	$ 15,000.00	$ 15,000.00
8	5 1/4" Fire Hydrant Setting	1	Ea	$ 5,000.00	$ 5,000.00
9	Water Main, Connect to Existing	2	Ea	$ 2,500.00	$ 5,000.00
10	Chain Link Fence (6' High)	500	Ft	$ 100.00	$ 50,000.00
11	Gate (4' x 6') (Swing)	1	Ea	$ 1,000.00	$ 1,000.00
12	Water Main	1	LSUM	$ 100,000.00	$ 100,000.00
12	3,000,000 Gallon Pedesphere Water Tower	1	LSUM	$ 5,960,000.00	$ 5,960,000.00
				Estimated Construction Cost:	$ 6,486,375.00
				Engineering, Legal, and Admin. (25%):	$ 1,621,593.75
				Contingency (20%):	$ 1,297,275.00
				TOTAL OPINION OF PROBABLE CONSTRUCTION COST =	**$ 9,405,243.75**

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT: Well Replacement
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization, Max 5%	1	LSUM	$ 19,125.00	$ 19,125.00
2	Well Pit and Cabinet	1	LSUM	$ 25,000.00	$ 25,000.00
3	Electrical	1	LSUM	$ 40,000.00	$ 40,000.00
4	Test Well Construction (Convert to Production upon approval)	1	LSUM	$ 150,000.00	$ 150,000.00
5	System Startup and Testing	1	LSUM	$ 27,500.00	$ 27,500.00
6	Pitless Adapter and Pumping	1	LSUM	$ 60,000.00	$ 60,000.00
7	Service Main	1	LSUM	$ 80,000.00	$ 80,000.00
8	Engineering and Testing	1	LUSM	90000	$ 90,000.00

Estimated Construction Cost: $ 491,625.00

Engineering, Legal, and Admin. (25%): $ 122,906.25
Contingency (20%): $ 98,325.00

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 712,856.25

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: Dye Ammonia Conversion
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization, Max 5%	1	LSUM	$ 67,471.50	$ 67,471.50
2	Demo	1	LSUM	$ 120,000.00	$ 120,000.00
3	Tanks	1	LSUM	$ 84,000.00	$ 84,000.00
4	Equipment	1	LSUM	$ 240,000.00	$ 240,000.00
5	Mechanical	1	LSUM	$ 240,000.00	$ 240,000.00
6	Electrical	1	LSUM	$ 245,430.00	$ 245,430.00
7	I&C	1	Ea	$ 180,000.00	$ 180,000.00
8	Misc PED	2	Ea	$ 120,000.00	$ 240,000.00

Estimated Construction Cost: $ 1,416,901.50

Engineering, Legal, and Admin. (25%): $ 354,225.38
Contingency (20%): $ 283,380.30

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 2,054,507.18

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: Wise Road Chemical Building
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization, Max 5%	1	LSUM	$ 44,574.50	$ 44,574.50
2	Demo	1	LSUM	$ 36,000.00	$ 36,000.00
3	Building	1	LSUM	$ 270,000.00	$ 270,000.00
4	Tanks	1	LSUM	$ 72,000.00	$ 72,000.00
5	Equipment	1	LSUM	$ 120,000.00	$ 120,000.00
6	Mechanical	1	LSUM	$ 120,000.00	$ 120,000.00
7	Electrical	1	LSUM	$ 125,430.00	$ 125,430.00
8	I&C	1	Ea	$ 102,000.00	$ 102,000.00
9	Misc PED	2	Ea	$ 23,030.00	$ 46,060.00

Estimated Construction Cost: $ 936,064.50

Engineering, Legal, and Admin. (25%): $ 234,016.13
Contingency (20%): $ 187,212.90

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 1,357,293.53

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
401 S. Mechanic St. Suite B
Jackson, MI 49201
P: (517) 889-5189

OPINION OF PROBABLE

CONSTRUCTION COST

PROJECT: Dye/Cedar Dry Chemical Handling (Lime System)
LOCATION: Lansing Board of Water & Light
WORK: DWSRF Cost Estimate

DATE: March 18, 2022
PROJECT #: 20220131
ESTIMATOR: BRC
CHECKED BY: KKF
CURRENT ENR:

Item Code	Item Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization, Max 5%	1	LSUM	$ 82,200.00	$ 82,200.00
2	Lime Bin Slide Gates	1	LSUM	$ 192,000.00	$ 192,000.00
3	Lime Bine 9" Screw Feeders	1	LSUM	$ 288,000.00	$ 288,000.00
4	Lime Screw Feeder Discharge Chute	1	LSUM	$ 5,000.00	$ 5,000.00
5	Lime Slaking Equipment and Controls	1	LSUM	$ 984,000.00	$ 984,000.00
6	Demolition of Existing Chemical Feed Equipment	1	LSUM	$ 100,000.00	$ 100,000.00
7	Misc Electrical Improvements	1	LSUM	$ 75,000.00	$ 75,000.00

Estimated Construction Cost: $ 1,726,200.00

Contractor OHP, General Conditions, Permitting (22%): $ 379,764.00
Engineering, Legal, and Admin. (50%): $ 863,100.00
Contingency (20%): $ 345,240.00

TOTAL OPINION OF PROBABLE CONSTRUCTION COST = $ 3,314,304.00

APPENDIX F: PUBLIC PARTICIPATION DOCUMENTATION

HRC OFFICE LOCATIONS

- **Bloomfield Hills**
  555 Hulet Drive
  Bloomfield Hills, MI 48302
  (248) 454-6300 | Fax: (248) 454-6312
- **Detroit**
  Buhl Building, Suite 1650
  535 Griswold Street | Detroit, MI 48226
  (313) 965-3330
- **Howell**
  105 West Grand River
  Howell, MI 48843
  (517) 552-9199
- **Kalamazoo**
  834 King Highway, Suite 107
  Kalamazoo, MI 49001
  (269) 665-2005
- **Delhi Township**
  2101 Aurelius Road, Suite 2
  Holt, MI 48842
  (517) 694-7760
- **Grand Rapids**
  801 Broadway NW, Suite 215
  Grand Rapids, MI 49504
  (616) 454-4286
- **Jackson**
  401 S. Mechanic Street, Suite B
  Jackson, MI 49201
  (517) 292-1295
- **Lansing**
  215 South Washington Square
  Lansing, MI 48933
  (517) 292-1488