FLOOD INSURANCE STUDY

IONIA COUNTY, MICHIGAN
(ALL JURISDICTIONS)

Community Name	Community Number
Belding, City of	260096
Berlin, Township of	261377
Boston, Township of	261428
Campbell, Township of	261432
*Clarksville, Village of	261437
Danby, Township of	261438
Easton, Township of	260727
Hubbardston, Village of	260418
Ionia, City of	260097
Ionia, Township of	260832
Keene, Township of	261439
Lake Odessa, Village of	260419
Lyons, Township of	261867
Lyons, Village of	261440
Muir, Village of	260916
North Plains, Township of	260420
Odessa, Township of	261441
*Orange, Township of	261442
*Orleans, Township of	261443
Otisco, Township of	261444
*Pewamo, Village of	261445
Portland, City of	260574
Portland, Township of	260831
*Ronald, Township of	261446
Saranac, Village of	260421
*Sebewa, Township of	261447

*No Special Flood Hazard Areas Identified

January 16, 2015

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26067CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. It is advisable to contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zones	New Zone
A1 through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: January 16, 2015

TABLE OF CONTENTS

TABLE OF CONTENTS *(continued)*

Page

FIGURE

TABLES

EXHIBITS

FLOOD INSURANCE STUDY

IONIA COUNTY, MICHIGAN
(ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in Ionia County, Michigan, including the Cities of Belding, Ionia, and Portland; the Townships of Berlin, Boston, Campbell, Danby, Easton, Ionia, Keene, Lyons, North Plains, Odessa, Orange, Orleans, Otisco, Portland, Ronald, and Sebewa; and the Villages Clarksville, Hubbardston, Lake Odessa, Lyons, Muir, Pewamo, and Saranac (hereinafter referred to collectively as Ionia County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The Townships of Orange, Orleans, Ronald, and Sebewa and the Villages of Clarksville and Pewamo have no Special Flood Hazard Areas (SFHAs) identified. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Information on the authority and acknowledgments for each of the previously printed FISs and Flood Insurance Rate Maps (FIRMs) for communities within Ionia County was compiled and is shown below.

City of Belding: A Flood Hazard Boundary Map (FHBM) was prepared by the Federal Insurance Administration (FIA) and published on January 17, 1975, under the Emergency Phase. The FHBM was superseded by a Flood Insurance Rate Map (FIRM) on

June 17, 1986. That FIRM is superseded by this countywide FIS.

Village of Hubbardston: A FHBM was prepared by the FIA and published on September 26, 1975, under the Emergency Phase. The FHBM was converted by letter to a FIRM on June 1, 1995. That FIRM is superseded by this countywide FIS.

City of Ionia: A FHBM was prepared by the FIA and published on June 7, 1974, under the Emergency Phase. A Flood Insurance Study (FIS) was published by FEMA on May 2, 1983. The FHBM was superseded by a FIRM on November 2, 1983. The 1983 FIRM incorporated the information contained in the Floodplain Information Report prepared by the Detroit District Corps of Engineers in 1975. This countywide FIS incorporates the 1983 FIS data, and supersedes the 1983 FIRM.

Ionia Township: A FIRM was prepared by the Federal Emergency Management Agency (FEMA) and published on May 2, 1999. That FIRM is superseded by this countywide FIS.

Village of Lake Odessa: A FHBM was prepared by the FIA and published on July 18, 1975, under the Emergency Phase. The FHBM was superseded by a FIRM on September 29, 1986. That FIRM is superseded by this countywide FIS.

Village of Muir: A FIRM was prepared by the Federal Emergency Management Agency (FEMA) and published on November 6, 1996. That FIRM is superseded by this countywide FIS.

North Plains Township: A FHBM was prepared by the FIA and published on June 17, 1977, under the Emergency Phase. It was rescinded on December 1, 1982.

City of Portland: A FHBM was prepared by the FIA and published on October 10, 1975, under the Emergency Phase. The FHBM was superseded by a Flood Insurance Study and FIRM on May 1, 1984. The hydrologic and hydraulic analyses for the 1984 study for the City of Portland were performed by the Detroit District Corps of Engineers in preparation for a special Flood Hazard Study for the City of Portland (unpublished, Reference 1). The 1984 study is superseded by this countywide FIS.

Portland Township: A FIRM was prepared by the Federal Emergency Management Agency (FEMA) and published on November 6, 1996. That FIRM is superseded by this countywide FIS.

Village of Saranac: A FHBM was prepared by the FIA and published on July 11, 1975, under the Emergency Phase. The FHBM was superseded by a FIRM on June 17, 1986. That FIRM is superseded by this countywide FIS.

New detailed and approximate study areas were incorporated in this FIS. The hydrologic and hydraulic analyses for these studies were prepared by the Michigan Department of Environmental Quality (DEQ) Water Resources Division for FEMA under Grant No. EMC-2007-CA-7028. This work was completed in May, 2012.

This countywide FIS includes new detailed and approximate studies, redelineation of effective profiles, and incorporation of approved Letters of Map Change (LOMCs). The vertical datum was shifted to North American Vertical Datum of 1988 (NAVD88). The digital floodplain data was merged into a single, updated Digital FIRM (DFIRM). The DFIRM includes 2005 digital orthophotography, political boundaries, road centerlines with street names, railroads with names, airports, rivers, lakes, streams, bridges and other hydraulic structures, and elevation reference marks.

The coordinate system used for the production of the DFIRMs is State Plane Michigan South, Zone 2113, referenced to the North American Datum of 1983 and the Geodetic Reference System 1980 ellipsoid.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

The initial CCO meeting was held on November 5, 2007, and was attended by representatives of the Cities of Belding, Portland, and Ionia, Ronald Township, Ionia County, the National Weather Service, the American Red Cross, and the DEQ.

Coordination with these officials and agencies produced information pertaining to flood history and the location of historic flooded stream crossings.

The results of the study were reviewed at three final CCO meetings. The first was held on November 28, 2013; the second was held on January 10, 2013; the third was held on January 23, 2013. The first meeting was attended by representatives of the Villages of Clarksville, Lake Odessa, Lyons, Muir, Pewamo, and Saranac; Ionia County; and the DEQ. The second meeting was attended by representatives of the City of Belding; the Townships of Berlin, Boston, Danby, Easton, Lyons, Odessa, and Ronald; the Village of Clarksville; Ionia County; and the DEQ. The third meeting was attended by representatives of the Townships of Danby, North Plains, and Portland; the Village of Hubbardston; and the MDEQ. All problems raised at these meetings have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Ionia County, Michigan, including the communities listed in Section 1.1.

The flooding sources previously studied by detailed methods are listed in Table 1.

TABLE 1 – Limits of Previous Detailed Studies

Flooding Source	Limits of Detailed Study
Grand River	Within City of Ionia

Revised detailed studies were performed using data from previous detailed studies for the flooding sources listed in Table 2.

TABLE 2 – Limits of Revised Detailed Studies

Flooding Source	Limits of Detailed Study
Grand River	Within the City of Portland

New detailed studies were performed for the flooding sources listed in Table 3 as part of this study.

TABLE 3 – Limits of Detailed Studies

Flooding Source	Limits of Detailed Study
Lake Creek	Morrison Lake to Portland Road
Morrison Lake	Entire Lakeshore

Approximate analyses are used to study those areas having a low development potential or minimal flood hazard. Approximate analyses were performed to identify flood hazard areas on the flooding sources shown in Table 4.

TABLE 4 – Limits of Approximate Studies

Flooding Source	Limits of Approximate Study
Fish Creek	Mouth to Montcalm County Line
Flat River	White's Dam to Montcalm County Line
Grand River	Kent County Line to the City of Ionia; upstream corporate limits of the City of Ionia to Portland Municipal Dam; upstream corporate limits of the City of Portland to Clinton County line.
Little Thornapple River	Jordan Lake
Looking Glass River	Mouth to Clinton County line
Maple River	Mouth to Clinton County line
Prairie Creek	Mouth to Nickel Plate Road
Tupper Creek	Mouth (Jordan Lake) to Harwood Road

This countywide FIS also incorporates the determination of letters issued by FEMA resulting in map amendments (Letters of Map Amendment (LOMAs)). Letters of Map

Amendment (LOMAs) incorporated for this study are summarized in the Summary of Map Actions (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update. Copies of the TSDN may be obtained from the Community Map Repository.

2.2 Community Description

Ionia County is in the west-central part of Michigan's Lower Peninsula. It is approximately 30 miles northwest of Lansing and about 30 miles east of Grand Rapids. The area of the county is about 575 square miles, and it is bordered on the east by Clinton County, on the south by Barry County, on the west by Kent County, and on the north by Montcalm County. The major transportation arteries are I-96, M-21, and M-66.

Land use in Ionia County, outside of cities and villages, is primarily agricultural, including numerous dairy farms. A wide range of crops are grown, including mint, celery, potatoes, apples, corn, wheat, and beans (References 2 and 3).

Development within Ionia County consists principally of single unit residential dwellings and some commercial development. The 2010 population of Ionia County was estimated by the U.S. Census Bureau to be 63,905. The City of Ionia, which is the county seat, had an estimated 2010 population of 11,394. Following the City of Ionia in terms of population is the City of Belding which had an estimated 2009 population of 5,757 (Reference 4).

Ionia County's climate is predominately continental: warm in the summer and moderately cold in the winter. The inland location of Ionia County, away from Lake Michigan, substantially reduces the Lake's effect on the climate. The Lake's influence is most evident during predominantly westerly winds, which cause increased cloudiness in fall and winter. The average annual daily temperature is 48 degrees Fahrenheit. The maximum average daily high temperature occurs in July at 84 degrees Fahrenheit. The minimum average daily low temperature occurs in January at 15 degrees Fahrenheit. The average annual precipitation is 31 inches, which includes 40 inches of snowfall, and is well distributed. The growing season averages 135 days annually (Reference 2).

Landforms are glacial in origin and consist of a variety of glacial till, end moraines, and glacial outwash. The topography of Ionia County ranges from level to gently rolling throughout the county. Soil types range from poorly drained loams to moderately drained loams and well drained sandy soils (Reference 3).

2.3 Principal Flood Problems

In the Grand River basin, floods generally occur as a result of heavy winter and spring rains coupled with snowmelt. The most notable floods experienced in Ionia County occurred when frontal storms of great intensity, lengthy duration, and widespread areal extent moved over the basin when infiltration conditions were conducive to high runoff rates.

The flood of record on the Grand River occurred in March, 1904. Newspapers in the surrounding areas reported the disastrous proportions of this flood and left no doubt that it was greater than any flood known to the oldest residents at that time. In the City of Ionia, the 1904 flood reached an elevation of 643.1 feet, North American Vertical Datum of 1988 (NAVD 88) downstream of State Highway 66. The estimated frequency of this flood was approximately a 1-percent-annual-chance (100-year) flood. The elevation of the flood waters in April, 1960, was approximately a 10-percent-annual-chance (10-year) flood.

Table 5 lists the ten largest floods on the Grand River recorded at State Highway 66 in Ionia.

TABLE 5 – Flood Crest Elevations for the Grand River at Ionia
(References 5 and 6)

Date of Crest	Stage, feet	Elevation, Feet (NAVD 88)
March 28, 1904	28.1	643.1
June 7, 1905	26.0	641.0
March 21, 1948	24.3	639.3
March 17, 1918	24.1	639.1
April 6, 1947	23.7	638.7
March 29, 1916	23.5	638.5
April 1, 1960	23.4	638.4
April 18, 1919	23.4	638.3
May 25, 2004	23.4	638.3
April 6, 1912	23.3	638.3

In the City of Portland, the 1975 flood on the Grand River reached a peak stage of 709.1 feet, NAVD 88 at Grand River Avenue, and had a discharge estimated to be 12,400 cubic feet per second (cfs). The 1975 and 2004 floods on the Grand River in Portland were estimated to be 10-percent-annual-chance flood events.

In 1960, a lake level of 808.5 feet (NAVD88) was recorded for Morrison Lake (Reference 7), which is estimated to be slightly above a 2-percent-annual-chance flood event.

2.4 Flood Protection Measures

No structural protection against floods exists in this county.

The Michigan Dam Safety Program lists 18 dams in Ionia County. Eleven are regulated under the state dam safety statute, and four are regulated by the Federal Energy Regulatory Commission. These dams were constructed for recreational and power generation purposes and do not offer significant storage for flood protection.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

The flood-flow frequencies for the Grand River were based on a statistical analysis of discharge records covering a 49-year period at the U.S. Geological Survey (USGS) gaging station on the Grand River at Portland (USGS gage no. 04114000) extended with the 108-year record on the Grand River at Lansing (USGS gage no. 04113000); and a previous statistical analysis of discharge records at the gaging station on the Grand River at Ionia (USGS gage no. 04116000) (Reference 5).

This analysis followed the standard log-Pearson Type III method as outlined by the U.S. Water Resources Council (Reference 8), using a regional skew coefficient determined specifically for Michigan (Reference 9).

The flood-flow frequency for the Looking Glass River, the Maple River, and at ungaged locations on gaged streams were estimated with the *Drainage Area Ratio Method* (Reference 10), where the point of "known" peak discharge and drainage area was one of the flood-flow frequency values estimated as described above.

The peak flows for Lake Creek at Morrison Lake Dam were developed using the U.S. Army Corps of Engineers (USACE) *Hydrologic Modeling System* (HEC-HMS) computer model (Reference 11). The HEC-HMS model generates runoff hydrographs for each drainage basin according to SCS methodology, and allows the user to combine and route these hydrographs to simulate the hydrologic interaction of multiple sub-basins in a watershed. The design precipitation for this method was obtained from the Midwest Climate Center Bulletin 71, *Rainfall Frequency Atlas of the Midwest* (Reference 12).

The flood-flow-frequency relationships for the Flat River, Prairie Creek, and Fish Creek were developed using the regional regression technique described in *Statistical Models for Estimating Flow Characteristics of Michigan Streams* (Reference 13).

The hydrologic analyses for Tupper Creek used the methodology described in the DEQ report entitled *Computing Flood Discharges for Small Ungaged Watersheds* (Reference 14). The method detailed in this report is similar to SCS methodology, but implements a state-specific dimensionless unit hydrograph and a relationship between the unit hydrograph peak and the time of concentration developed from an analysis of peak flows at gaged streams in Michigan. Bulletin 71 precipitation data were also used with this method. DEQ's Water Resources Division developed a spreadsheet that was used to calculate peak discharges using this method. The spreadsheet calculates the time of concentration based on the length, slope, and flow regime of the flow path to the most hydraulically distant point in the basin. The curve number is estimated by a procedure developed by the DEQ Hydrologic Studies Program that utilizes geographic information system (GIS) shape files for soil type and land use and lookup tables to assign curve numbers to specific combinations of soil type and land use (Reference 15). The ponded storage areas used in the calculations were also calculated using GIS.

The peak flows for Little Thornapple River were taken from Spicer Group, Inc.'s *Hydraulic Analysis of Little Thornapple Intercounty Drain* (Reference 16).

Peak discharges calculated for detailed riverine studies are presented in Table 6.

TABLE 6 – Summary of Peak Discharges

Flooding Source and Location	Drainage Area (Sq. Miles)	Peak Discharge (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Grand River					
Below Bellamy Creek	2940	22,000	35,000	40,000	55,000
Gage 04110600 at Ionia	2884	22,000	35,000	39,000	54,000
Below Prairie Creek	2861	21,000	34,000	39,000	54,000
Below Looking Glass River	1713	14,000	21,000	24,000	33,000
Gage 04114000 at Portland	1397	12,000	19,000	22,000	28,000
Lake Creek					
Morrison Lake Level Control Structure	10.9	80	110	120	180

The 10-, 2-, 1-, and 0.2-percent annual chance water surface elevations for Morrison Lake were developed using the flood profiles developed for Lake Creek (outlet of Morrison Lake). These elevations are presented in Table 7.

TABLE 7 – Summary of Stillwater Elevations

Flooding Source and Location	Peak Elevation, ft (NAVD 88) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Morrison Lake	807.7	808.4	808.7	809.6

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods for the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data Tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Water-surface elevations for floods of the selected recurrence intervals were computed with the USACE *Hydrologic Engineering Center-River Analysis System* (HEC-RAS) computer model (Reference 17). The HEC-RAS computer model calculates water-surface profiles for steady, gradually-carried flow based on the solution of the one-dimensional energy equation.

The method used to obtain cross section data used in the Lake Creek hydraulic model is described in Table 8.

TABLE 8 – Cross Section Data

Flooding Source	Year	Description
Lake Creek	2009	Land survey of channel and structures

The cross sectional information and locations for the Grand River in the City of Portland were obtained from the U.S. Army Corps of Engineers, Detroit District (Reference 1).

Locations of selected cross sections used in the hydraulic analyses for Lake Creek and the Grand River (Cities of Ionia and Portland) are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are shown on the FIRM.

Roughness factors were chosen by engineering judgment and based on field observations, photographs, aerial photographs (Reference 18), and methods used by Chow (Reference 19), the Soil Conservation Service (Reference 20), and the USGS (Reference 21). Table 9 shows the channel and overbank "n" values typical for early summer conditions for the flooding sources.

TABLE 9 – Manning's "n" Values

	Mannings "n" Values	
Flooding Source	Channel	Overbank
Grand River within the City of Portland	0.030 – 0.070	0.015 – 0.120
Lake Creek	0.035 – 0.050	0.040 – 0.100

The methods for determining starting water surface elevations are described in Table 10.

TABLE 10 – Starting Water Surface Elevations

Flooding Source	Description of Method
Grand River within the City of Portland	Critical depth at Portland Municipal Dam
Lake Creek	Normal depth

The analysis for Lake Creek was based on a normal depth starting condition in HEC-RAS for determining the starting water-surface elevations. A downstream gradient was estimated using USGS topographic maps, and survey information.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail, and if channel and overbank conditions remain essentially the same as ascertained during this study.

Flood profiles were drawn showing the computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. In cases where two or more profiles are close together, due to limitation of the profile scale, only the higher profile has been shown.

All elevations are referenced from North American Vertical Datum of 1988 (NAVD88); elevation reference marks used in the study are shown on the maps.

Streams studied by approximate methods are listed in Section 3.1. Elevation data for bridges and culverts for those streams studied by approximate methods were obtained by land survey or from construction drawings, if available. Manning's "n" values were based on field reconnaissance and aerial imagery.

The starting water surface elevation for the approximate model of the Grand River at the Kent County Line was based on an extension of the base flood elevation for the Grand River published in the City of Lowell FIS (Reference 22). The starting water surface elevation for the Grand River upstream of the City of Ionia was the base flood elevation published in the FIS for the City of Ionia (Reference 23). The starting water surface elevation for the approximate Grand River model upstream of the City of Portland was based on the base flood elevation published in the FIS for the City of Portland (Reference 24). The starting water surface elevation for the approximate Flat River model was based on the estimated 1-percent-annual-chance flood elevation of the impoundment upstream of White's Dam. The starting water surface elevations for the approximate models for the Maple and Looking Glass Rivers were based on the approximate 1-percent-annual-chance flood elevation of the Grand River at their respective confluences with the Grand River. The starting water surface elevation for the approximate Tupper Creek model was the approximate 1-percent-annual-chance flood elevation for Jordan Lake. The models for Fish Creek, Little Thornapple River, and Prairie Creek used normal depth as the starting condition. The slope used for normal depth was determined from the USGS

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities.

The average conversion of -0.426 feet (see Table 11) was applied to convert all effective BFEs for Ionia County.

TABLE 11 – Datum Conversion Calculation

USGS Quadrangle	Corner	Latitude	Longitude	Conversion (ft) from NGVD29 to NAVD88
Smyrna	NW	43.125	-85.375	-0.420
Belding	NW	43.125	-85.250	-0.433
Shiloh	NW	43.125	-85.125	-0.436
Palo	NW	43.125	-85.000	-0.453
Hubbardston	NW	43.125	-84.875	-0.472
Hubbardston	NE	43.125	-84.750	-0.489
Lowell	NW	43.000	-85.375	-0.417
Saranac	NW	43.000	-85.250	-0.413
Ionia	NW	43.000	-85.125	-0.430
Portland North	NW	43.000	-85.000	-0.449
Westphalia	NW	43.000	-84.875	-0.449
Westphalia	NE	43.000	-84.750	-0.456
Freeport	NW	42.875	-85.375	-0.417
Lake Odessa	NW	42.875	-85.250	-0.407
Woodbury	NW	42.875	-85.125	-0.417
Portland South	NW	42.875	-85.000	-0.427
Eagle	NW	42.875	-84.875	-0.449
Eagle	NE	42.875	-84.750	-0.453
			Average Conversion	-0.426
			Range	-0.377 through -0.489
			Max Offset	0.063

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (Reference 25), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, 20910 (http://www.ngs.noaa.gov).

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with this FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides l-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and l-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of this FIS report, including Flood Profiles, Floodway Data Tables, and Summary of Stillwater Elevations Table. Users should reference the data presented in this FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each watercourse studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. The floodplain boundaries between cross sections for detailed study areas were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 10 feet (References 27 and 28).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards (Zone X). In cases where the 1- and 0.2-percent-annual-chace floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the watercourses studied by approximate methods, only the l-percent-annual-chance floodplain boundary is shown on the FIRM.

Approximate 1-percent annual-chance floodplain boundaries were delineated using base map information described above.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the l-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the l-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The area between the floodway and l-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the l-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

In Michigan, under the State's Floodplain Regulatory Authority, found in Part 31, Water Resources Protection, of the *Natural Resources and Environmental Protection Act*, 1994 PA 451 (Reference 29), encroachment in the floodplain is limited to that which will cause only insignificant increases in flood heights. At the recommendation of the Michigan Department of Environmental Quality, Water Resources Division, a floodway having no more that a 0.1-foot surcharge has been delineated for this FIS.

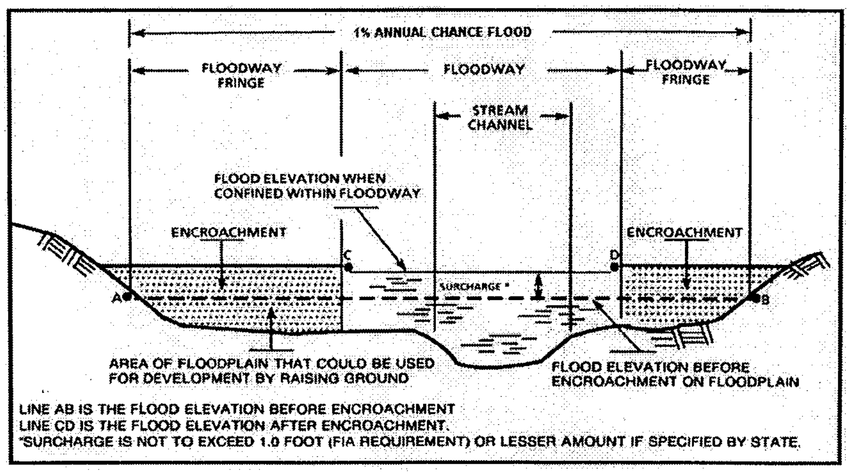

FIGURE 1 – Floodway Schematic

FIGURE 1 – Floodway Schematic

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain.

Water surface elevations, with and without a floodway, the mean velocity in the floodway, and the location and area at each surveyed cross section as determined by hydraulic methods are presented in Table 12, Floodway Data Table. The width of the floodway depicted by the FIRM panels and the amount of reduction to fit the floodway inside the 1-percent annual chance floodplain, if necessary, is also listed.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
GRAND RIVER								
A	78,996	*	*	*	643.6	643.6	*	*
B	81,029	*	*	*	643.7	643.7	*	*
C	88,633	*	*	*	644.2	644.2	*	*
D	206,997	1026[2]	6508	3.7	704.6	704.6	704.6	0.0
E	208,928	664	3993	6.0	705.5	705.5	705.5	0.0
F	210,218	770	4584	5.2	706.7	706.7	706.8	0.1
G	213,214	277	2687	8.9	708.3	708.3	708.4	0.1
H	213,737	345	2642	9.1	710.6	710.6	710.7	0.1
I	214,161	204	2622	8.4	712.5	712.5	712.5	0.0
J	214,620	397[3]	2859	7.7	713.6	713.6	713.6	0.0
K	214,769	476	4028	5.5	714.3	714.3	714.3	0.0
L	215,704	536	5685	3.9	714.9	714.9	714.9	0.0
M	216,864	505	4423	5.0	715.3	715.3	715.4	0.1
N	217,934	919	9238	2.4	716.1	716.1	716.1	0.0

[1]Distance in feet above county line
[2]Portion of floodway lies outside detailed study limits
[3]Width does not include non-floodway area adjacent to left bank
*No Floodway Data Computed

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

GRAND RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
LAKE CREEK								
A	38,809	46	99	2.4	804.8	804.8	804.8	0.0
B	38,957	61	142	1.4	805.2	805.2	805.2	0.0
C	39,337	28	50	2.4	805.4	805.4	805.4	0.0
D	39,644	16	67	2.4	805.7	805.7	805.8	0.1
E	39,745	48	128	0.9	808.1	808.1	808.1	0.0
F	39,935	23	70	1.7	808.4	808.4	808.4	0.0
G	40,142	103	175	0.9	808.7	808.7	808.7	0.0

[1]Distance in feet above mouth

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

LAKE CREEK

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or base flood depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

This FIRM presents flooding information for the entire geographic area of Ionia County. Previously, separate FIRMs were prepared for each community with special flood hazard areas.

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for purposes of the National Flood Insurance Program.

FEMA has previously published FIS reports and FIRMs for the City of Ionia (References 23 and 25) and the City of Portland (References 24 and 31), and FIRMs for the City of Belding (Reference 32), the Village of Hubbardston (Reference 33), Ionia Township (Reference 34), the Village of Lake Odessa (Reference 35), the Village of Muir (Reference 36), Portland Township (Reference 37) and Village of Saranac (Reference 38). The results presented in this FIS report and on the FIRM for Ionia County are in exact agreement with the results for the City of Ionia, and supersede those for the City of Portland. A list of Ionia County communities and their flood insurance map history is presented on Table 13.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Belding, City of	January 17, 1975	May 28, 1976	June 17, 1986	
[2] Berlin, Township of	N/A	N/A	N/A	
[2] Boston, Township of	N/A	N/A	N/A	
[2] Campbell, Township of	N/A	N/A	N/A	
[1,2] Clarksville, Village of	N/A	N/A	N/A	
[2] Danby, Township of	N/A	N/A	N/A	
[2] Easton, Township of	N/A	N/A	N/A	
Hubbardston, Village of	September 26, 1975	N/A	June 1, 1995	
Ionia, City of	June 7, 1974	June 4, 1976 February 5, 1982	November 2, 1983	
Ionia , Township of	January 22, 1991	N/A	May 2, 1999	
[2] Keene, Township of	N/A	N/A	N/A	
Lake Odessa, Village of	July 18, 1975	N/A	September 29, 1986	
[2] Lyons, Village of	N/A	N/A	N/A	
[2] Lyons, Township of	N/A	N/A	N/A	
Muir, Village of	November 6, 1996	N/A	November 6, 1996	
[2] North Plains, Township of	N/A	N/A	N/A	
[2] Odessa, Township of	N/A	N/A	N/A	
[1,2] Orange, Township of	N/A	N/A	N/A	
[1,2] Orleans, Township of	N/A	N/A	N/A	
[2] Otisco, Township of	N/A	N/A	N/A	
[1,2] Pewamo, Village of	N/A	N/A	N/A	
Portland, City of	October 10, 1975	January 30, 1976	May 1, 1984	
Portland, Township of	June 16, 1992	N/A	June 16, 1992	
[1,2] Ronald, Township of	N/A	N/A	N/A	
Saranac, Village of	July 11, 1975	March 11, 1977	June 17, 1986	September 4, 1987
[1,2] Sebewa, Township of	N/A	N/A	N/A	

N/A – Not Applicable
[1]No Special Flood Hazard Areas Identified
[2]This community does not have map history prior to the first countywide mapping

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Insurance and Mitigation Division, Federal Emergency Management Agency, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605.

9.0 BIBLIOGRAPHY AND REFERENCES

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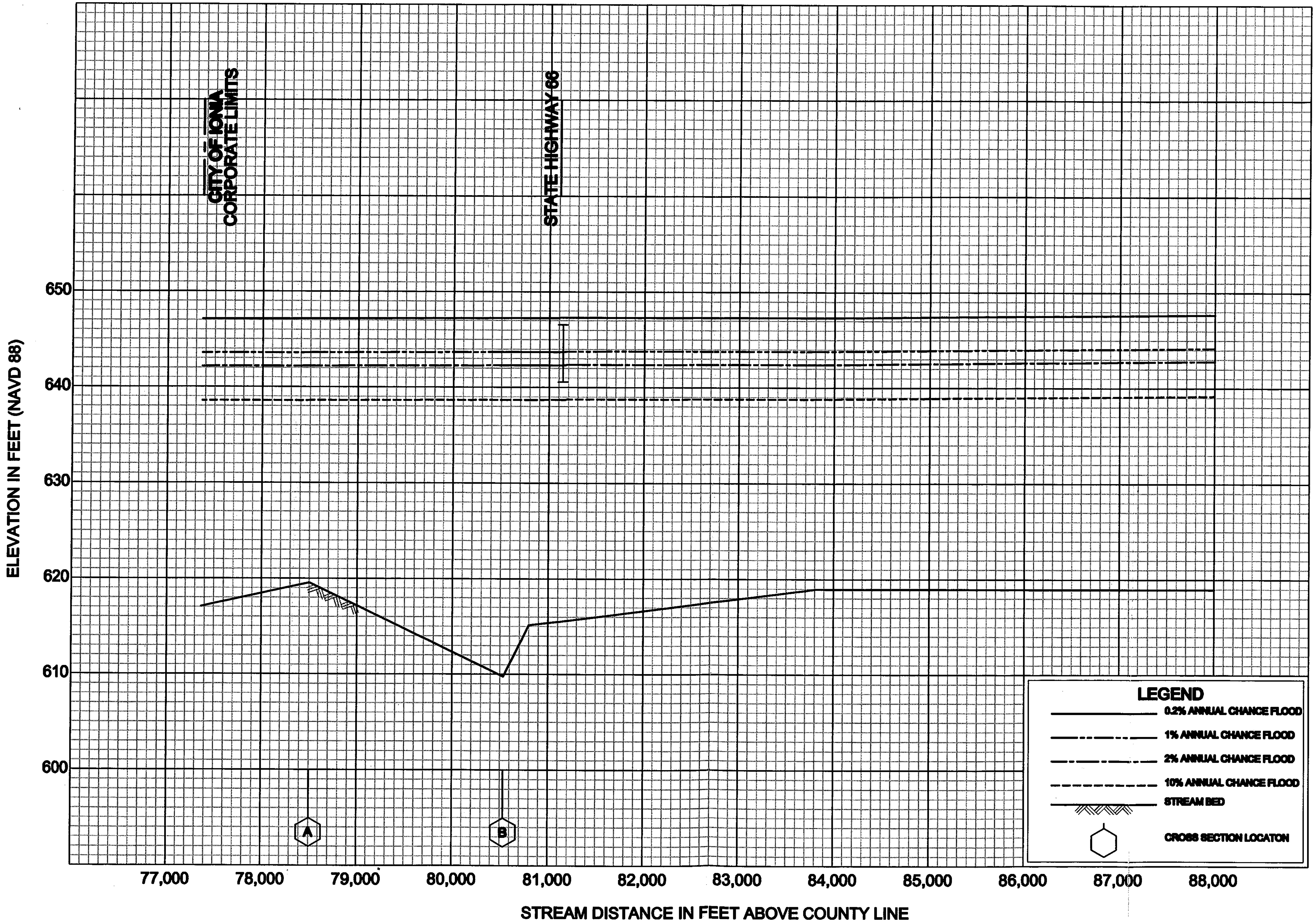

FLOOD PROFILES

GRAND RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI

(ALL JURISDICTIONS)

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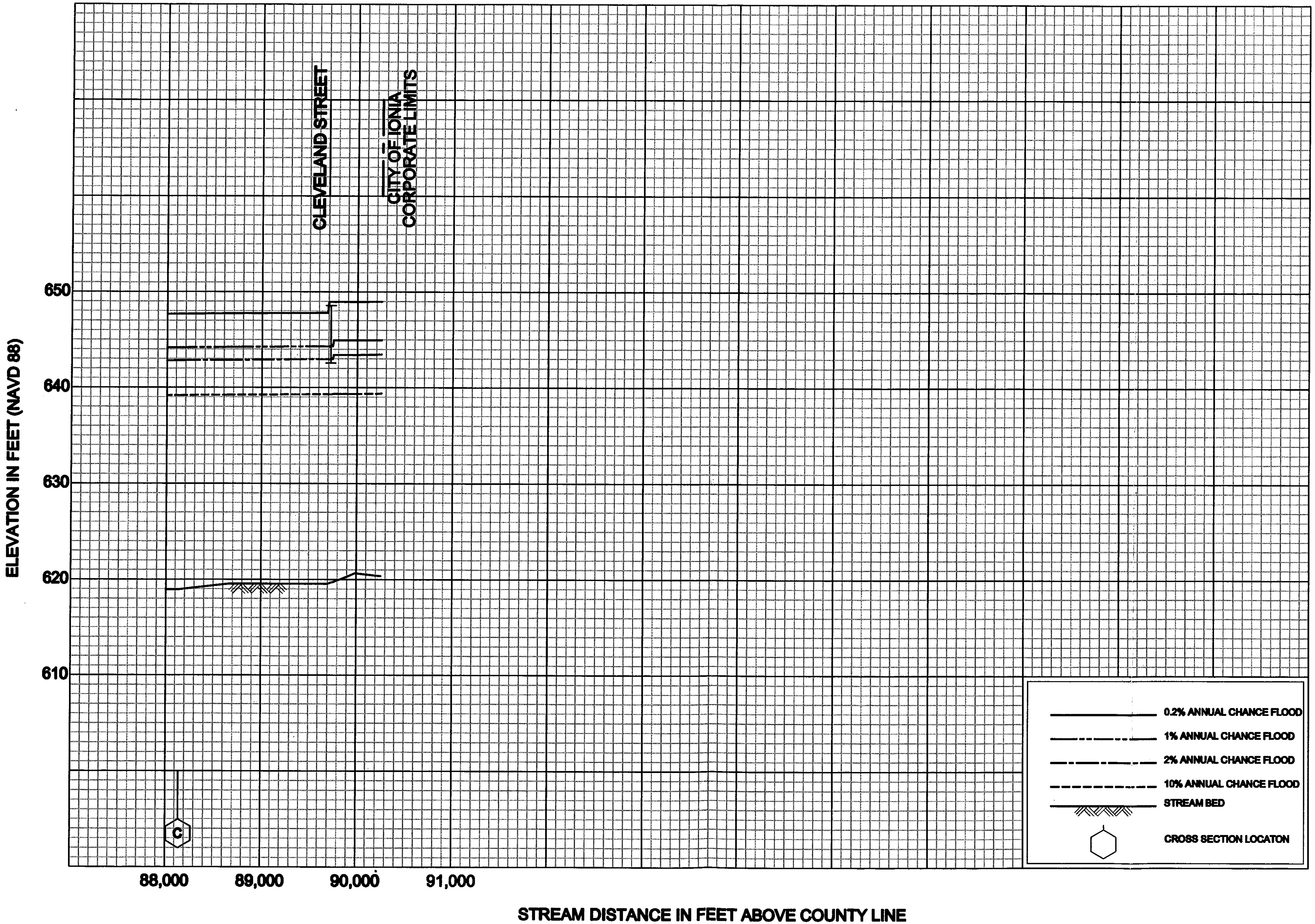


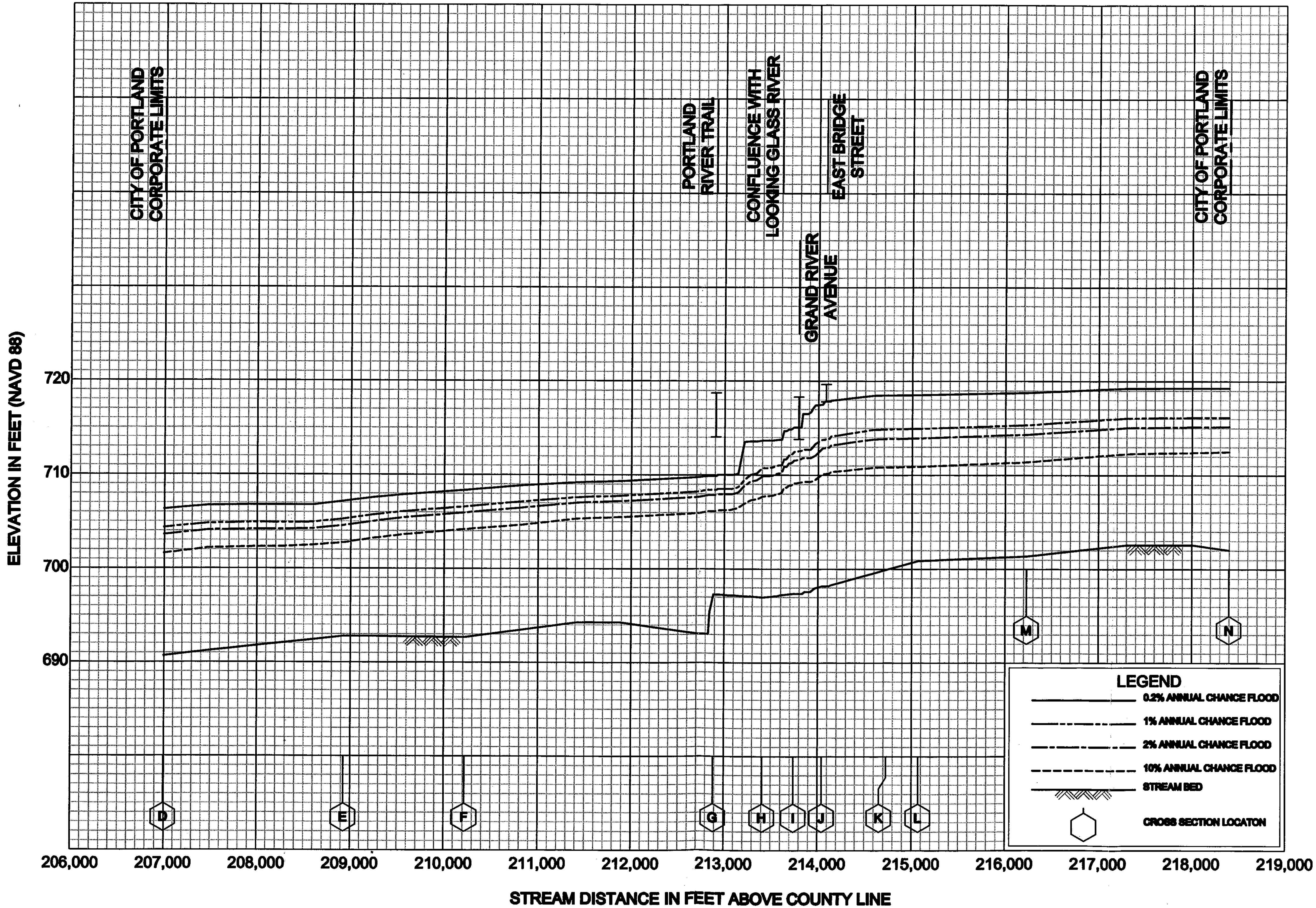
FLOOD PROFILES

GRAND RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI

(ALL JURISDICTIONS)



FLOOD PROFILES

GRAND RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI

(ALL JURISDICTIONS)

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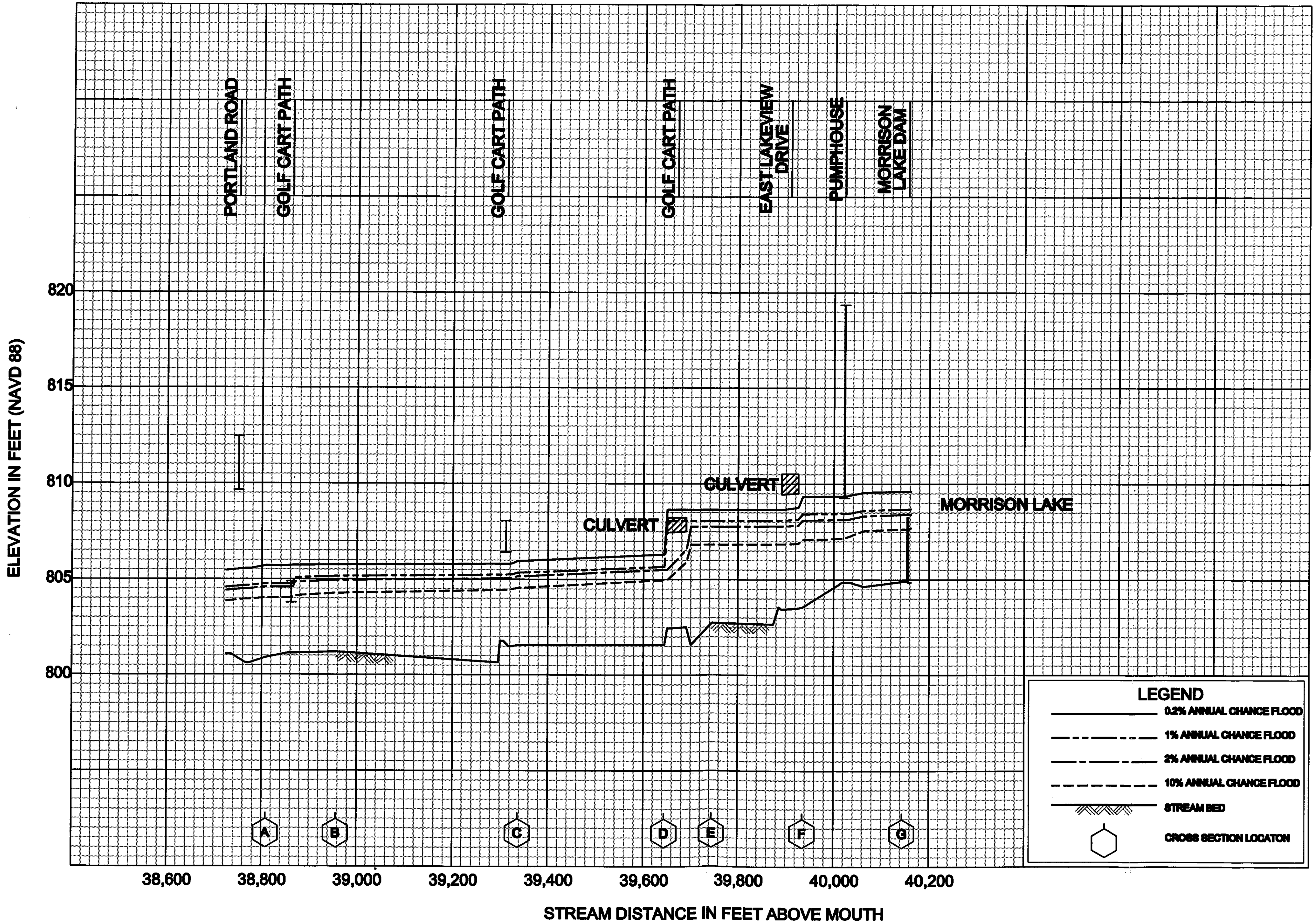

FLOOD PROFILES

LAKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

IONIA COUNTY, MI

(ALL JURISDICTIONS)

04P