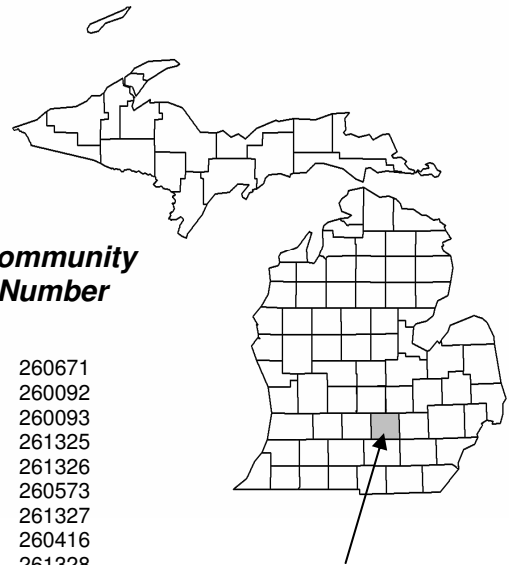


FLOOD INSURANCE STUDY



INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)



Ingham County

<i>Community Name</i>	<i>Community Number</i>	<i>Community Name</i>	<i>Community Number</i>
Alaiedon, Township of	260670	Locke, Township of	260671
Aurelius, Township of	261321	Mason, City of	260092
Bunker Hill, Township of	261322	Meridian, Charter Township of	260093
*Dansville, Village of	261320	Onondaga, Township of	261325
Delhi, Charter Township of	260088	Stockbridge, Township of	261326
East Lansing, City of	260089	Stockbridge, Village of	260573
Ingham, Township of	261323	Vevay, Township of	261327
Lansing, Charter Township of	260632	Webberville, Village of	260416
Lansing, City of	260090	Wheatfield, Township of	261328
Leroy, Township of	260906	White Oak, Township of	260417
Leslie, City of	260091	Williamston, City of	260094
Leslie, Township of	261324	Williamstown, Township of	260095

*No Special Flood Hazard Areas Identified

Effective: August 16, 2011



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26065CV000A

**NOTICE TO
FLOOD INSURANCE STUDY USERS**

Communities participating in the National Flood Insurance Program 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. Please 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 report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision 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:

<u>Old Zone(s)</u>	<u>New Zone</u>
A1 through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: August 16, 2011

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Gilbert Drain	Panels 02P-03P
Grand River	Panels 04P-10P
Herron Creek	Panels 11P-12P
Moon and Hamilton County Drain	Panel 13P
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Mud Lake / Foster Drain	Panels 15P-17P
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**FLOOD INSURANCE STUDY
INGHAM COUNTY, MICHIGAN (ALL JURISDICTIONS)**

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Ingham County, including the Cities of East Lansing, Lansing, Leslie, Mason, and Williamston; the Charter Townships of Delhi, Lansing, and Meridian; the Townships of Alaiedon, Aurelius, Bunker Hill, Ingham, Leroy, Leslie, Locke, Onondaga, Stockbridge, Vevay, Wheatfield, White Oak, and Williamstown; and the Villages of Dansville, Stockbridge, and Webberville, (referred to collectively herein as Ingham County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. 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.

Please note that the City of Lansing is geographically located in Eaton and Ingham Counties. Since the majority of this community lies inside of Ingham County, the City of Lansing will be shown in its entirety in this countywide FIS.

Please note that the City of East Lansing is geographically located in Clinton and Ingham Counties. The Clinton County portion of the City of East Lansing is not included in this FIS report. See the separately published FIS report and Flood Insurance Rate Map (FIRM) for flood hazard information.

Please also note that the Village of Dansville has no mapped special flood hazard areas.

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 FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Precountywide Analyses

Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below:

Delhi, Charter Township of

The hydrologic and hydraulic analyses for the Grand River, Sycamore Creek, Gilbert Drain, and Mud Lake Drain for the January 1981, Federal Insurance Administration (FIA) FIS Report (FIA, 1981a) and FIRM were performed by Snell Environmental Group, Inc. for FEMA, under Contract No. H-4536. The work was completed in November 1978.

The revised hydrologic and hydraulic analyses for Mud Lake Drain for the November 16, 1990, FIS Report and FIRM (FEMA, 1990a) was performed by the US Army Corps of Engineers, Detroit District as part of the Limited Map Maintenance Program.

East Lansing, City of

The hydrologic and hydraulic analyses for the Red Cedar River for the February 1980 FIS report (FIA, 1980a) and FIRM were performed by Snell Environmental Group, Inc. for FEMA, under Contract No. H-4536. The work was completed in November 1978.

Lansing, City of

The hydrologic and hydraulic analyses for the Grand River, Red Cedar River, Sycamore Creek, and Mud Lake Drain for the September 1980, FIS report (FIA, 1980c) and FIRM were performed by Snell Environmental Group, Inc. for FEMA, under Contract No. H-4536. The work was

Lansing, City of
(continued)

completed in November 1978.

The revised hydrologic and hydraulic analyses for Mud Lake Drain for the November 16, 1990, FIS Report and FIRM (FEMA, 1990b) was performed by the US Army Corps of Engineers, Detroit District as part of the Limited Map Maintenance Program.

Lansing, Charter Township of

The hydrologic and hydraulic analyses for the Grand River and the Red Cedar River for the August 4, 1980, FIS report (FIA, 1980b) and FIRM were performed by Snell Environmental Group, Inc. for FEMA, under Contract No. H-4536. The work was completed in October 1978.

Locke, Township of

The hydrologic and hydraulic analyses for the Red Cedar River for the September 1, 1981, FIS report and (FIA, 1981b) FIRM were performed by Commonwealth Associates, Inc. for FEMA, under Contract No. H-4729. The work was completed in June 1980.

Mason, City of

The hydrologic and hydraulic analyses for Sycamore Creek, Willow Creek, and Rayner Creek for the April 15, 1982, FIS report (FIA, 1982) and FIRM were performed by Commonwealth Associates, Inc. for FEMA, under Contract No. H-4729. The work was completed in March 1981.

Meridian, Charter Township of

The hydrologic and hydraulic analyses for the Red Cedar River, Herron Creek, Smith Drain and Lake Lansing, for the original FIS report dated August 1976 (FIA, 1976) and FIRM, were prepared by Johnson & Anderson, Inc., for the FIA, under Contract No. H-3685. The work was completed in August 1977.

The revised hydrologic and hydraulic analyses for the Red Cedar River, Herron Creek, Smith Drain, Lake Lansing, Pine

Meridian, Charter Township of
(continued)

Lake (Outlet) Drain, and Mud Lake / Foster Drain, for the FIS dated August 9, 2000 (FEMA, 2000), were prepared by STS Consultants, Ltd., for FEMA, under Contract No. EMW-91-C-3361. The work was completed in November 1994.

Williamston, City of

The hydrologic and hydraulic analyses for the Red Cedar River, Deer Creek, and Unnamed Tributary for the October 1, 1981, FIS report (FIA, 1981c) and FIRM were performed by Commonwealth Associates, Inc. for FEMA, under Contract No. H-4729. The work was completed in May 1980.

Williamstown, Township of

The hydrologic and hydraulic analyses for the Red Cedar River and Unnamed Tributary for the October 15, 1981, FIS report (FIA, 1981d) and FIRM were performed by Commonwealth Associates, Inc. for FEMA, under Contract No. H-4729. The work was completed in June 1980.

The City of Leslie; the Townships of Alaiedon, Aurelius, Bunker Hill, Ingham, Leroy, Leslie, Onondaga, Stockbridge, Vevay, Wheatfield, and White Oak; and the Villages of Dansville, Stockbridge, and Webberville have no previously printed FIS reports.

This Countywide FIS Report

The hydrologic and hydraulic analyses for the Red Cedar River and Remy Chandler Drain / Sanderson Drain were completed in April 2007, by Michigan Department of Environmental Quality (MDEQ), as a Cooperating Technical Partner (CTP) with FEMA.

The hydrologic and hydraulic analyses for Moon and Hamilton County Drain was completed in February 2007, by Spicer Group, as a CTP with FEMA.

The redelineation for studied streams, except for the Grand River from approximately 15,450 feet upstream of South Martin Luther King Jr. Boulevard to approximately 23,900 feet upstream of South Martin Luther King Jr. Boulevard, was performed by Post, Buckley, Schuh, and Jernigan Inc. (PBS&J), for FEMA, under Contract No. HSFEHQ-04-D-0025, Task Order No. 001 with FEMA. The work was completed in June 2006.

The redelineation for the Grand River from approximately 15,450 upstream of South Martin Luther King Jr. Boulevard to approximately 23,900 upstream of South Martin Luther King Jr. Boulevard was completed in December 2005 by Spicer Group, as a CTP with FEMA.

The redelineation of all streams previously studied by approximate methods was performed by PBS&J. The work was completed in May 2009.

Also, in this countywide FIS, approximate analyses for flooding sources not previously studied by approximate methods within Ingham County were developed by PBS&J using the HAZUS-MH computer program (FEMA, 2004). The work was completed January 2009.

Base map information shown on the FIRM was derived from 1-meter resolution imagery produced at a scale of 1:12,000, from National Agriculture Imagery Program photography dated 2005 or later. The projection used in the preparation of this map is Universal Transverse Mercator (UTM) zone 16, and the horizontal datum used is North American Datum (NAD 83), GRS80 spheroid.

1.3 Coordination

An initial meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied or restudied. A final meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

The initial and final meeting dates for the previous FIS reports for Ingham County and its communities are listed in the following table:

<u>Community</u>	<u>FIS Date</u>	<u>Initial Meeting</u>	<u>Final Meeting</u>
Delhi, Charter Township of	January 1981	June 1977	August 19, 1980
	November 16, 1990	*	*
East Lansing, City of	February 1980	June 1977	June 6, 1979
Lansing, City of	September 1980	June 1977	March 19, 1980
	November 16, 1990	*	*
Lansing, Charter Township of	August 4, 1980	June 1977	January 16, 1980
Locke, Township of	September 1, 1981	March 15, 1978	March 30, 1981
Mason, City of	April 15, 1982	March 15, 1978	November 30, 1981
Meridian, Charter Township of	August 1976	March 1968	September 23, 1975
	August 9, 2000	*	**
Williamston, City of	October 1, 1981	March 15, 1978	March 30, 1981
Williamstown, Township of	October 15, 1981	March 15, 1978	May 5, 1981

*Information not available

**Notified by letter January 9, 1997

For this Countywide FIS Report, the initial meeting was held on July 27, 2005, and attended by representatives of Ingham County, the Michigan Department of Natural Resources (MDNR), the MDEQ, FEMA, and PBS&J. The purpose of this meeting was to discuss the scope of the FIS.

The results of the study were reviewed at the final meeting held on January 5, 2010, and attended by representatives of PBS&J, MDEQ, the Cities of Mason and Williamston, and the Townships of Delhi, Leslie, Locke, Meridian, and Williamstown. All issues and/or concerns raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

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

Precountywide Analyses

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction at the time of the study. The streams studied by detailed methods in Ingham County are listed below.

Deer Creek	Mud Lake / Foster Drain	Sycamore Creek
Gilbert Drain	Pine Lake (Outlet) Drain	Unnamed Tributary
Grand River	Rayner Creek	Willow Creek
Herron Creek	Red Cedar River	
Moon and Hamilton County Drain	Remy Chandler Drain / Sanderson Drain	
Mud Lake Drain	Smith Drain	

The limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

This Countywide FIS Report

All areas studied by detailed methods were redelineated based on updated topography. All streams previously studied by approximate methods were redelineated based on updated topography. All other approximately studied streams were studied using HAZUS-MH (FEMA, 2004).

Streams listed in Table 1 were newly studied by detailed methods.

Table 1 - Streams Newly Studied by Detailed Methods

<u>Stream</u>	<u>Reach</u>
Moon and Hamilton County Drain	From Detention Area F Control Structure to Interstate Highway 96/69
Red Cedar River	From approximately 7,400 feet upstream of North Putnam Street to Gramer Road North
Remy Chandler Drain / Sanderson Drain	From approximately 3,675 feet downstream of West Lake Lansing Road to West Lake Lansing Road

For this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county, including both incorporated and unincorporated areas, is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD) to the North American Vertical Datum of 1988 (NAVD). In addition, the Universal Transverse Mercator coordinates, previously referenced to the North American Datum of 1927, are now referenced to the NAD83.

Approximate analyses were used to study those areas having low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA and Ingham County.

The following tabulation presents Letters of Map Change (LOMCs) incorporated into this countywide study:

<u>LOMC</u>	<u>Case Number</u>	<u>Date Issued</u>	<u>Project Identifier</u>
LOMR	03-05-0445P	July 7, 2003	Smith Drain
LOMR	03-05-1475P	December 1, 2003	Grand River Floodway limits
LOMR	03-05-5186P	August 29, 2004	Eyde Company Commercial Development
LOMR	07-05-6235P	January 30, 2008	Red Cedar River Analysis

LOMR = Letter of Map Revision

2.2 Community Description

Ingham County is located in south-central Michigan. The county is bordered by Clinton County to the Northwest, Shiawassee County to the Northeast, Livingston County to the East, Washtenaw County to the Southeast, Jackson County to the South, and Eaton County to the West. The county encompasses an area of approximately 559 square miles. According to the U.S. Census Bureau, in 2000

the population for all jurisdictions of Ingham County was 279,413 (U.S. Census Bureau, 2009).

The climate in the Ingham County area is characteristic of southern Michigan and varies from semi-marine to continental. The average summer high temperature in July is 82 degrees Fahrenheit (°F) and the average winter low temperature in January is 14°F. The average annual precipitation is 31.53 inches per year with June being the wettest month (The Weather Channel, 2009).

The topography varies from flat to gently rolling terrain.

2.3 Principal Flood Problems

Flood-producing storms may occur at any time during the year, but are more numerous in late winter through spring. Most of the high floods have resulted from heavy rain on frozen ground combined with snowmelt. However, floods may occur during the summer and fall due to intense local thunderstorms.

The largest flood known to have occurred in Ingham County was in March 1904 on the Grand River, Sycamore Creek, and Red Cedar River as a result of moderate rainfall on a heavy snowcover. Average rainfall over the Red Cedar River Basin exceeded one inch while snowcover amounted to 70 inches in East Lansing and over 110 inches near the Ingham County line east of the City of Williamston. With temperatures exceeding 60°F, the USGS gage (no. 04112500) at Farm Lane Bridge at the Michigan State University campus crested at 13.4 feet. The estimated peak discharge was about 8,000 cubic feet per second (cfs). The March 1904 flood had a recurrence interval of 175 years.

Under similar conditions, the flood of April 1947, crested at 11.58 feet and produced a peak discharge of 5,920 cfs. The flood of 1947 had an estimated recurrence interval of 40 years.

The April 1975 flood, the second greatest flood on record for the Red Cedar River, crested at 11.95 feet and produced a peak discharge of 5,940 cfs. The flood of 1975 caused interruption of transportation routes and considerable property damage. The storm resulted in more than five inches of rainfall, a precipitation depth equivalent to a 1-percent annual-chance storm.

2.4 Flood Protection Measures

There are two dams on the Red Cedar River. One is the Michigan State University dam, located on the campus approximately 1,200 feet downstream of Farm Lane. This dam has a spillway width that varies between 84 and 92 feet and a length of 30 feet. The spillway elevation is 826.9 feet, NAVD and has a working head of six feet. The ponding extends approximately four miles upstream. The other dam is Straight Dam, located approximately 550 feet

downstream of North Putnam Street in the City of Williamston. It has a spillway elevation of 859.8 feet, NAVD and a width of 167 feet. The working head of this dam is approximately nine feet. The ponding area extends through and beyond the City of Williamston. Both of these dams are located in broad portions of the flood plain. During large floods, their flood peak attenuation effects are almost negligible.

There are no flood protection measures known to exist in Ingham County.

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 1 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

Precountywide Analyses

The peak discharge-frequency relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance flood intervals on Deer Creek and Unnamed Tributary were established using the Soil Conservation Service (SCS) Computer Program TR-20 (SCS, 1965). The TR-20 computer program computes the stormwater runoff that would result from a given rain storm event. Parameters considered by this program when computing runoff include precipitation, land use, soil types, topography, time of concentration, and drainage area. In estimating peak flow rates, the TR-20 model is used to simulate time history hydrographs in order to describe the quantity of runoff that results from a rainfall event. These hydrographs are simulated for each sub-basin in the watershed and added together on a common time scale.

To verify the predicted flood flows for Deer Creek from the TR-20 computer program, data from the USGS gaging station located near Dansville (no. 04111500) was analyzed. The flood flows, determined by a log-Pearson Type III analysis and the drainage area proportion method, compared favorably with the results of the TR-20 predictions. The TR-20 predictions were selected for use because the gaging station is not a long-term station. The high-intensity storm of 1975 was used to check the performance of the TR-20 computer model of the Deer Creek watershed.

The peak discharge-frequency relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance flood intervals on Gilbert Drain, Mud Lake Drain, and Sycamore Creek, from confluence with Red Cedar River to College Road, were established using the SCS computer program TR-20 (SCS, 1965; Snell Environmental Group, Inc., 1978a, 1978c, 1978d). The results of this analysis were reviewed and approved by the MDNR.

For the Grand River and Red Cedar River from the confluence with Grand River to approximately 7,400 feet upstream of North Putnam Street, the hydrologic analyses was carried out by the MDNR to establish peak discharges for floods of the selected recurrence intervals. Further analyses were carried out by Snell Environmental Group using data from the USGS gages at Lansing (no. 04113000) and Eaton Rapids (no. 04111000). The Red Cedar River gage in East Lansing (no. 04112500) was also considered in the analysis. The peak discharges were obtained from a log-Pearson Type III analysis of the distribution of annual peak flow data (Snell Environmental Group, 1978b) using the relationships published in the USGS Water Supply Paper No. 1677 for the Grand River (USGS, 1965).

For Herron Creek and Smith Drain, the SCS computer program TR-20 (SCS, 1965) was used to estimate the 10-, 2-, 1-, and 0.2-percent-annual-chance flood flows. The rainfall data for Herron Creek and Smith Drain was taken from Computing Flood Discharges from Small Ungaged Watersheds (MDNR, 1991). The 10-, 2-, and 1-percent-annual-chance flood rainfall amounts were interpolated from Frequency-Discharge, Drainage Area Curves. The 0.2-percent-annual-chance flood event was extrapolated from the 1-, 2-, 10-percent-annual-chance flood events.

For Pine Lake (Outlet) Drain and Mud Lake / Foster Drain, flood flow-frequency data were determined using a watershed model developed for the Ingham County Drain Commission in 1970 (Ingham County Drain Commissioner, 1974).

For Rayner Creek, Sycamore Creek, from 1,120 downstream West Howell Road to East Kipp Road, and Willow Creek, the 10-, 2-, 1-, and 0.2-percent-annual-chance flood flows were calculated using the SCS TR-20 computer program (SCS, 1965). Rayner Creek and Willow Creek were included in the model as tributaries to Sycamore Creek.

For Lake Lansing, elevations and outflows were determined by routing selected storms through the lake (Brater and Sherill, 1973).

This Countywide FIS Report

The peak discharge-frequency relationships for Remy Chandler Drain/Sanderson Drain were established by hydrologic analyses using SCS methods for computing flood discharges as adapted to Michigan (MDEQ, 2003). This methodology uses drainage area, precipitation, time of concentration, soil types, land use, and an appropriate flood storage to determine peak flows. The drainage areas were determined from USGS 7.5-minute topographic quadrangle maps, (USGS, various dates) supplemented with drainage maps obtained from the Ingham County Drain Commissioner's office. The precipitation values were taken from the Illinois State Water Survey Bulletin No. 71 (Huff and Angel, 1992). The USACE's Hydrologic Engineering Center (HEC) computer program HEC-HMS 3.0.1 (HEC, 2006) was used to route flood flows through restrictive culverts in the vicinity of State Highway 127 Business and at West Lake Lansing Road and Coleman Road, respectively. Stage-storage relationships at this location were obtained from the surveyed cross sections and USGS 7.5-minute topographic maps. Elevation-discharge relationships used in the HEC-HMS model were developed using HEC-RAS (HEC, 1998).

Hydrologic calculations were also completed as part of the MDEQ permitting process for Moon and Hamilton County Drain. Routed flowrates in the USACE's HEC-RAS (HEC, 2005) were compared to the previously approved flow rates. Adjustments were made to the storage coefficient and runoff curve numbers to reflect recent changes within the watershed and to adjust the peak discharges.

The peak discharge-frequency relationships for the restudied portion of Red Cedar River, from approximately 7,400 feet upstream of North Putnam Street to Gramer Road North, were based on a log-Pearson Type III analysis of the annual peak flows recorded at the USGS gaging station near Williamston (no. 04111379). The Williamston gage values were extended based on the Red Cedar River gaging station at East Lansing (no. 04112500). Flood flows at various locations on the Red Cedar River were based upon a drainage area ratio to the Williamson gage, using an exponent of 0.89.

For the streams previously studied by approximate methods, peak discharges were estimated using the published USGS regional regression equations (USGS, 1984). Regression equations estimate peak discharges for ungaged streams based on characteristics of nearby gaged streams.

For all other approximate analyses, HAZUS-MH MR-1 (FEMA, 2004) and manually-delineated basins were used to model the 1-percent-annual-chance hydrologic conditions. The peak discharges were estimated with regional regression equations published by the USGS (USGS, 1984).

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 2.

Table 2 - Summary of Discharges

<u>Flooding Source and Location</u>	<u>Drainage Area (square miles)</u>	<u>Peak Discharges (cubic feet per second)</u>			
		<u>10-Percent- Annual-Chance</u>	<u>2-Percent- Annual-Chance</u>	<u>1-Percent- Annual-Chance</u>	<u>0.2-Percent- Annual-Chance</u>
DEER CREEK					
At Confluence with Red Cedar River	26.5	775	1,030	1,130	1,330
GILBERT DRAIN					
At Confluence with Grand River	6.2	400	575	685	900
GRAND RIVER					
At North Grand River Avenue	1,230	10,700	16,600	19,400	26,800
Just upstream of confluence with Red Cedar River	752	5,860	8,710	10,000	13,300
HERRON CREEK					
At Confluence with the Red Cedar River	4.59	290	470	560	750
At Interstate Highway 96	1.93	170	240	300	400
MOON AND HAMILTON COUNTY DRAIN					
Just upstream of Detention Area F Control Structure	1.2	60	70	80	160
At Interstate Highway 96/69	0.6	30	50	60	80
MUD LAKE DRAIN					
At Confluence with Sycamore Creek	5.0	180	235	270	385
At Aurelius Road	5.0	180	235	270	385
MUD LAKE / FOSTER DRAIN	10.5	450	760	880	1015
PINE LAKE (OUTLET) DRAIN	21.2	770	1028	1048	1094
RAYNER CREEK					
At Confluence with Sycamore Creek	2.6	170	240	295	435
At East Maple Street	1.8	130	185	225	330
RED CEDAR RIVER					
At Confluence with Grand River	474	5,500	8,280	9,600	13,000
At Farm Lane Road	355	4,120	6,200	7,200	9,740
At West Grand River Avenue/Meridian Road	291.8	3,460	5,220	6,050	8,190
Just downstream of confluence with Squaw Creek	175	1,700	2,600	3,000	4,100

Table 2 – Summary of Discharges (*continued*)

<u>Flooding Source and Location</u>	<u>Drainage Area (square miles)</u>	<u>Peak Discharges (cubic feet per second)</u>			
		<u>10-Percent- Annual-Chance</u>	<u>2-Percent- Annual-Chance</u>	<u>1-Percent- Annual-Chance</u>	<u>0.2-Percent- Annual-Chance</u>
RED CEDAR RIVER					
<i>(continued)</i>					
At Webberville Road	162	1,600	2,500	2,900	3,900
Just downstream with confluence of Wolf Creek	151	1,500	2,300	2,700	3,700
Just upstream of confluence with Kalamink Creek	133	1,400	2,100	2,400	3,300
REMY CHANDLER DRAIN / SANDERSON DRAIN					
At Soccer Complex Culvert	3.7	120	140	150	170
At Confluence with Sanderson Drain	4.5	140	180	200	290
At West Lake Lansing Road	2.6	130	190	220	270
SMITH DRAIN					
At Confluence with the Red Cedar River	2.28	240	400	465	600
SYCAMORE CREEK					
At Confluence with Red Cedar River	97.1	1,690	2,230	2,530	3,120
Just upstream of confluence with Rayner Creek	30.1	1,010	1,330	1,550	2,100
Just upstream of confluence of Willow Creek	17.7	655	845	980	1,300
UNNAMED TRIBUTARY					
At Confluence with Red Cedar River	1.68	190	270	305	375
Just upstream of Williamston Road	1.02	140	195	220	270
WILLOW CREEK					
At Confluence with Sycamore Creek	11.5	345	457	570	820

Stillwater elevations for Lake Lansing are shown in Table 3.

Table 3 - Summary of Stillwater Elevations

<u>Flooding Source</u>	<u>Water Surface Elevations (Feet NAVD¹)</u>			
	<u>10-Percent- Annual-Chance</u>	<u>2-Percent- Annual-Chance</u>	<u>1-Percent- Annual-Chance</u>	<u>0.2-Percent- Annual-Chance</u>
LAKE LANSING	852.8	853.0	853.1	853.7

¹ North American Vertical Datum of 1988

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 of 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 Table 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.

Precountywide Analyses

Cross section data for Deer Creek and Unnamed Tributary were obtained by field survey in February 1979. In addition to field measurements, information on high water marks was obtained from the City of Williamston Sewage Treatment Plant Supervisor.

In the Charter Township of Delhi, cross section data for Gilbert Drain, Grand River, Mud Lake Drain, and Sycamore Creek were obtained from field survey in March and April 1978, topographic maps, and previous reports (Snell Environmental Group, 1973; USGS 1970, 1973a, 1973b, 1976). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Cross section data for the Grand River in the Charter Township of Lansing and the Red Cedar River in the City of East Lansing and Charter Township of Lansing, were obtained from field survey performed in May 1978, topographic maps (USGS, 1973b), and previous reports (USACE, 1970). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Cross section data for the Grand River, Mud Lake Drain, Red Cedar River, and Sycamore Creek in the City of Lansing were obtained from field surveys in May 1978 and topographic maps (Abrams Aerial Survey Corporation, 1978). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Cross section data for Herron Creek were taken from the previously printed FIS for the Charter Township of Meridian (FEMA, 2000). Additional cross sections were added based on existing field surveys.

Cross sections for the backwater analyses of Moon and Hamilton County Drain were obtained from the 2-foot Digital Terrain Model (DTM) (Western Air Maps, Inc., 2003). The channel sections were obtained by field surveys completed

between 2000 and 2005. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Cross section data for Mud Lake / Foster Drain and Pine Lake (Outlet) Drain were obtained from existing field surveys.

Cross section data for Rayner Creek, Sycamore Creek from approximately 1,120 feet downstream of West Howell Road to East Kipp Road, and Willow Creek were obtained by survey crews in November 1978.

Cross section data for the Red Cedar River, in the Charter Township of Meridian and Township of Williamstown, were obtained from the 1968 USACE Flood Plain Information Study (USACE, 1968).

Cross sections for Smith Drain were obtained from topographic maps (Abrams Aerial Survey Corporation, 1991; Ingham County Drain Commissioner, unknown date).

For Deer Creek, Rayner Creek, Sycamore Creek from approximately 1,120 feet downstream of West Howell Road to East Kipp Road, Unnamed Tributary, and Willow Creek, the water-surface elevations (WSELs) of floods of the selected frequencies were calculated using HEC-2 (HEC, 1968).

For Gilbert Drain, Grand River, Mud Lake Drain, Red Cedar River from confluence with Grand River to South Hagadorn Road, and Sycamore Creek from confluence with Red Cedar River to College Road, the WSELs of floods of selected frequencies were calculated using the HEC-2 step-backwater computer program (HEC, 1977).

For Herron Creek and Smith Drain, WSELs of floods of the selected frequencies were calculated using HEC-2 step-backwater computer program (HEC, 1991).

For Moon and Hamilton County Drain, WSELs of floods of the selected recurrence intervals were computed using the USACE HEC-RAS (Version 3.1.3) computer program (HEC, 2005).

For Mud Lake / Foster Drain, Pine Lake (Outlet) Drain, and the Red Cedar River, WSELs of floods of the selected frequencies were calculated using HEC-2 step-backwater computer program.

For the Red Cedar River, in the Township of Williamstown, floods of the selected frequencies were calculated using HEC-2 step-backwater computer program (HEC, 1968).

Flooding which occurs on Deer Creek and Unnamed Tributary is often elevated by flooding associated with the Red Cedar River. Therefore, the starting WSELs for

Deer Creek and Unnamed Tributary are based on the unit hydrograph for the Red Cedar River, with adjustments made to reflect the different times of concentration.

Starting WSELs for Gilbert Drain, Herron Creek, Mud Lake / Foster Drain, Pine Lake (Outlet) Drain, Smith Drain, and Sycamore Creek from approximately 1,120 feet downstream of West Howell Road to East Kipp Road, were calculated using the slope-area method.

Starting WSELs for Moon and Hamilton County Drain were determined by using normal depth routines in HEC-RAS. A downstream hydraulic gradient was estimated for this routine using survey data.

Starting WSELs for Mud Lake Drain and Willow Creek were obtained from Sycamore Creek.

Starting WSELs for Rayner Creek were obtained from the TR-20 hydrographs for Rayner Creek and Sycamore Creek.

Starting WSELs for the Red Cedar River from confluence with Grand River to South Hagadorn Road were determined from the Grand River.

Starting WSELs for Red Cedar River from South Hagadorn Road to approximately 7,400 feet upstream of North Putnam Street were taken from the USACE Flood Plain Information report with allowance made for a railroad bridge that was removed downstream from the Michigan State University dam since the time of the report (USACE, 1968).

Starting WSELs for Sycamore Creek from confluence with Red Cedar River to College Road were determined from the Red Cedar River.

For Lake Lansing, elevations were determined from peaks of hydrographs routed through the lake. It was assumed during the analysis that the lake was level with the weir at the beginning of the storm.

This Countywide FIS Report

For Remy Chandler Drain/Sanderson Drain and the Red Cedar River from approximately 7,400 feet upstream of North Putnam Street to Gramer Road North, cross sections data were obtained by field surveys in January 2006 through July 2006 by the MDEQ. The cross sections were located at regular intervals along the drain, at all stream crossings, and at significant changes in topography within the study area. All bridges were field surveyed to obtain elevation data and conveyance geometry.

For Remy Chandler Drain/Sanderson Drain and the Red Cedar River from approximately 7,400 feet upstream of North Putnam Street to Gramer Road North,

WSELs of floods of the selected recurrence intervals were computed using HEC-RAS Version 3.1.3 (HEC, 2005).

For the restudied portion of the Red Cedar River, from approximately 7,400 feet upstream of North Putnam Street to Gramer Road North, starting WSELs were calculated using a stage-discharge rating curve from the downstream flood insurance study in the City of Williamston.

For Remy Chandler Drain/Sanderson Drain, starting WSELs were calculated using normal depth downstream of the Interstate Highway 69 crossing.

The estimated flood elevations for the restudied portion of the Moon and Hamilton County Drain in Ingham County applied the starting WSEL for the drain in the City of Lansing in Clinton County, Michigan (FEMA, 1990b).

For all other streams studied by approximate methods, hydraulic analyses were performed using HAZUS-MH MR-1 (FEMA, 2004). Using the USGS 30 meter digital elevations models cross sections were automatically generated perpendicular to the estimated flow direction. The cross sections were placed along the HAZUS-generated streamlines every 1000 feet.

Floodplains were delineated using a proprietary model which extracted the topographic and flow data, modeled the stream using a step-backwater calculation, and then delineated the floodplain. Roads were generally modeled as weirs, or with ineffective flow areas set to the bridge opening.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

Manning's "n" was automatically estimated by HAZUS for all cross sections in the stream reaches modeled. The peak discharges estimated during the hydrology phase were added to each cross section. HAZUS used Manning's equation to estimate depth of flow. The depth was calculated for each cross section, and an elevation was interpolated between each cross section to generate an estimated floodplain. All floodplains were then compared to the effective floodplain and USGS quads and revised as necessary to correlate with this data.

Channel roughness factors (Mannings "n") used in the hydraulic computations were chosen by engineering judgment and field inspection. The Manning's "n" values for all detailed studied streams are listed below.

Manning's "n" Values

<u>Stream</u>	<u>Channel "n"</u>	<u>Overbank "n"</u>
Deer Creek	0.040-0.045	0.075-0.100
Gilbert Drain	0.030-0.070	0.030-0.110
Grand River	0.030-0.040	0.035-0.080
Herron Creek	0.035	0.040-0.100
Moon and Hamilton County Drain	0.030-0.100	0.035-0.120
Mud Lake Drain	0.030-0.100	0.030-0.100
Mud Lake / Foster Drain	*	*
Pine Lake (Outlet) Drain	*	*
Rayner Creek	0.030-0.040	0.050-0.060
Red Cedar River	0.030-0.067	0.039-0.165
Remy Chandler Drain/ Sanderson Drain	0.040-0.065	0.030-0.130
Smith Drain	0.035	0.040-0.100
Sycamore Creek	0.025-0.070	0.035-0.100
Unnamed Tributary	0.035	0.060-0.080
Willow Creek	0.020-0.040	0.060-0.080

* Data not available

The profile baselines depicted on the FIRM represent the hydraulic modeling baselines that match the flood profiles on this 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.

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.

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 NGVD. With the finalization of NAVD, many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base Flood Elevations

(BFEs) across the corporate limits between the communities. Some of the data used in this study were taken from the prior effective FIS reports and adjusted to NAVD. The average conversion factor that was used to convert the data in this FIS report to NAVD was calculated using the National Geodetic Survey's (NGS) VERTCON online utility (NGS, 2006). The data points used to determine the conversion are listed in Table 4.

Table 4 – Vertical Datum Conversion

<u>Quad Name</u>	<u>Corner</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Conversion from NGVD to NAVD</u>
Lansing South	NE	42.750	-84.625	-0.436
East Lansing	NE	42.750	-84.500	-0.446
Williamston	NE	42.750	-84.375	-0.433
Webberville	NE	42.750	-84.251	-0.430
Fowlerville	NE	42.750	-84.126	-0.427
Aurelius	NE	42.625	-84.625	-0.404
Mason	NE	42.625	-84.500	-0.423
Dansville	NE	42.625	-84.375	-0.420
Millville	NE	42.625	-84.251	-0.430
Parkers Corners	NE	42.625	-84.126	-0.440
Onondaga	NE	42.500	-84.625	-0.404
Leslie	NE	42.500	-84.500	-0.407
Pleasant Lake	NE	42.500	-84.375	-0.410
Stockbridge	NE	42.500	-84.251	-0.413
Gregory	NE	42.500	-84.126	-0.423
			Average:	-0.423

For additional information regarding conversion between NGVD and NAVD, visit the NGS website at www.ngs.noaa.gov, or contact the NGS at the following address:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

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 associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data Table, and Summary of Stillwater Elevations Table. Users should reference the data presented in the 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 flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community.

For each stream 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. Between cross sections, for all streams studied by detailed methods, except for Remy Chandler Drain, the boundaries were interpolated using two foot contours derived from LiDAR data (Western Air Maps, Inc., 2003).

Between cross sections, for Remy Chandler Drain / Sanderson Drain, the boundaries were interpolated using topographic maps at a scale of 1:4,800 with a contour interval of 5 feet (Abrams Aerial Survey Corporation, 1979).

For all streams previously studied by approximate methods, the 1-percent-annual-chance floodplain boundaries were delineated using two foot contours derived from LiDAR data (Western Air Maps, Inc., 2003).

For all other streams studied by approximate methods, floodplain boundaries were delineated using the USGS National Elevation Dataset (NED) data (USGS, 2008).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). 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. In cases where the 1- and 0.2-percent-annual-chance 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 streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

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 1-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 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. In Michigan, however, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (State of Michigan, 1968), encroachment in the floodplain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Bureau of the Water Management, a floodway having no more than a 0.1 foot surcharge has been delineated for this study. 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 floodways presented in this FIS report and on the FIRM were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 5). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 1-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 WSEL of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

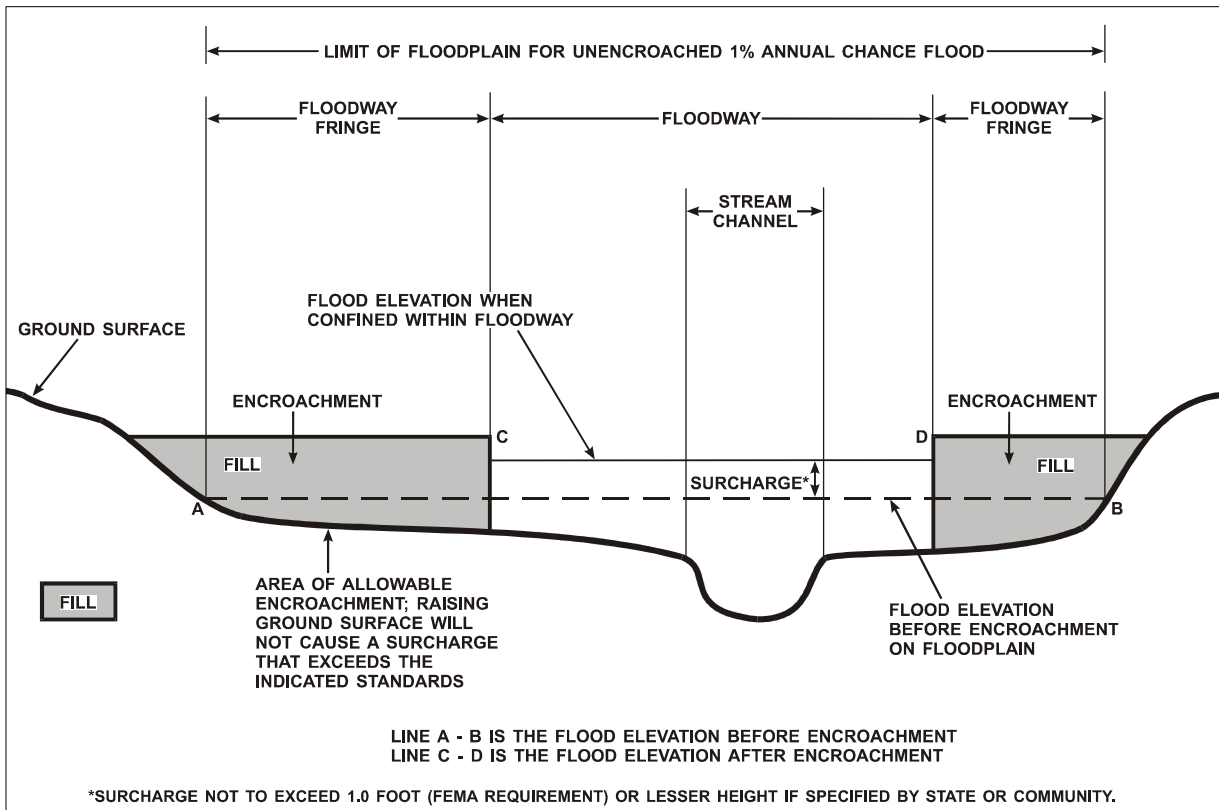


Figure 1 - Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
DEER CREEK								
A	90 ¹	23	248	4.5	864.1	860.7 ²	860.7 ²	0.0
B	840 ¹	238	1,123	1.0	864.1	861.2 ²	861.2 ²	0.0
C	1,416 ¹	20	230	4.9	864.1	862.8 ²	862.8 ²	0.0
D	2,443 ¹	1,000	3,779	0.3	864.1	863.3 ²	863.3 ²	0.0
E	3,327 ¹	1,261	3,374	0.3	864.1	863.3 ²	863.3 ²	0.0
F	4,578 ¹	504	2,027	0.6	864.1	863.4 ²	863.4 ²	0.0
GILBERT DRAIN								
A	323 ³	414	322	2.0	864.2	864.2	864.2	0.0
B	762 ³	437	1,040	0.2	864.3	864.3	864.3	0.0
C	2,361 ³	219	437	0.6	864.3	864.3	864.3	0.0
D	3,093 ³	356	321	0.8	864.4	864.4	864.4	0.0
E	3,953 ³	567	1,755	0.2	864.5	864.5	864.5	0.0
F	5,853 ³	1,500	1,065	0.2	864.5	864.5	864.5	0.0
G	7,136 ³	732	1,688	0.2	864.6	864.6	864.6	0.0
H	7,914 ³	1,200	3,825	0.0	865.5	865.5	865.5	0.0
I	9,445 ³	333	207	0.8	865.5	865.5	865.5	0.0

¹Feet above confluence with Red Cedar River

²Elevation computed without consideration of backwater effects from Red Cedar River

³Feet above North Waverly Road

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

DEER CREEK – GILBERT DRAIN

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
GRAND RIVER								
A	204	391	5,142	3.8	817.9	817.9	818.0	0.1
B	1,204	212	3,117	6.3	818.1	818.1	818.2	0.1
C	2,754	598	5,022	3.9	819.3	819.3	819.4	0.1
D	4,454	274	4,012	4.9	820.0	820.0	820.1	0.1
E	6,954	565	6,906	2.8	821.0	821.0	821.1	0.1
F	9,304	496	5,616	3.5	821.4	821.4	821.5	0.1
G	10,204	232	3,664	5.3	821.8	821.8	821.9	0.1
H	10,726	475	5,076	3.8	822.7	822.7	822.8	0.1
I	11,566	235	4,210	4.6	822.9	822.9	823.0	0.1
J	11,839	265	3,841	5.1	823.0	823.0	823.1	0.1
K	12,939	275	3,927	4.9	823.5	823.5	823.5	0.0
L	15,189	249	3,274	5.9	824.5	824.5	824.5	0.0
M	15,519	210	3,772	5.1	825.1	825.1	825.1	0.0
N	15,927	506	6,481	3.0	825.6	825.6	825.7	0.1
O	16,477	541	5,226	3.7	825.7	825.7	825.8	0.1
P	17,252	448	4,325	4.5	826.0	826.0	826.1	0.1
Q	17,552	175	3,523	5.5	826.1	826.1	826.2	0.1
R	17,924	216	4,068	4.8	827.2	827.2	827.3	0.1
S	18,254	272	5,682	3.4	827.5	827.5	827.6	0.1
T	18,349	252	4,629	4.2	827.7	827.7	827.8	0.1

¹ Feet above North Waverly Road

TABLES	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	GRAND RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
GRAND RIVER (CONTINUED)								
U	18,929	480	4,683	4.1	827.8	827.8	827.9	0.1
V	19,104	666	4,877	4.0	827.9	827.9	828.0	0.1
W	19,556	763	6,802	2.9	828.1	828.1	828.2	0.1
X	20,006	724	5,345	3.6	828.1	828.1	828.2	0.1
Y	20,878	737	6,351	3.1	828.9	828.9	829.0	0.1
Z	21,403	583	3,690	5.3	828.9	828.9	829.0	0.1
AA	21,757	356	4,144	4.7	829.2	829.2	829.3	0.1
AB	22,332	485	3,292	5.9	829.4	829.4	829.5	0.1
AC	22,642	550	3,884	5.0	829.7	829.7	829.8	0.1
AD	23,120	628	3,982	4.9	829.8	829.8	829.9	0.1
AE	23,720	459	4,640	4.2	830.1	830.1	830.2	0.1
AF	24,191	703	4,664	4.2	830.2	830.2	830.3	0.1
AG	24,391	678	5,869	3.3	830.4	830.4	830.5	0.1
AH	25,291	699	7,371	2.6	830.6	830.6	830.7	0.1
AI	25,741	561	5,528	3.5	830.6	830.6	830.7	0.1
AJ	25,987	452	5,000	3.9	830.7	830.7	830.8	0.1
AK	26,327	533	3,898	5.0	830.8	830.8	830.9	0.1
AL	26,704	621 ²	6,697	2.9	831.2	831.2	831.3	0.1
AM	27,504	183	2,955	3.4	831.3	831.3	831.4	0.1

¹ Feet above North Waverly Road

² Combined floodway width with Grand River and Red Cedar River

TABLE 5	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	GRAND RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
GRAND RIVER (CONTINUED)								
AN	27,754	122	2,144	4.7	831.3	831.3	831.4	0.1
AO	28,058	220	3,243	3.1	831.5	831.5	831.6	0.1
AP	28,658	463	3,962	2.5	831.6	831.6	831.7	0.1
AQ	28,933	313	2,695	3.7	831.6	831.6	831.7	0.1
AR	29,142	258	3,806	2.6	831.8	831.8	831.9	0.1
AS	29,792	176	2,927	3.4	831.8	831.8	831.9	0.1
AT	30,074	316	5,013	2.0	832.4	832.4	832.5	0.1
AU	30,302	389	5,854	1.7	832.5	832.5	832.6	0.1
AV	31,102	401	4,653	2.1	832.5	832.5	832.6	0.1
AW	31,875	135	1,529	6.5	834.3	834.3	834.4	0.1
AX	32,705	327	4,385	2.3	835.1	835.1	835.2	0.1
AY	33,355	333	3,991	2.5	835.2	835.2	835.3	0.1
AZ	33,595	269	3,805	2.6	835.2	835.2	835.3	0.1
BA	33,860	427	5,681	1.8	835.3	835.3	835.4	0.1
BB	34,140	604	4,892	2.0	835.3	835.3	835.4	0.1
BC	34,795	418	4,510	2.2	835.4	835.4	835.5	0.1
BD	36,595	382	3,177	3.1	835.7	835.7	835.8	0.1
BE	38,445	402	3,974	2.5	836.1	836.1	836.2	0.1
BF	39,345	362	3,308	3.0	836.2	836.2	836.3	0.1

¹ Feet above North Waverly Road

TABLES

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

GRAND RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
GRAND RIVER (CONTINUED)									
BG	40,995	339	3,457	2.9		836.6	836.6	836.7	0.1
BH	42,595	458	4,166	2.4	19	836.9	836.9	837.0	0.1
BI	44,095	396	4,300	2.3	28	837.1	837.1	837.2	0.1
BJ	44,895	374	4,322	2.3	50	837.2	837.2	837.3	0.1
BK	45,345	247	3,199	3.1		837.2	837.2	837.3	0.1
BL	50,593	565/0 ²	4,140	2.4		838.0	838.0	838.1	0.1
BM	52,693	623/127 ²	4,722	2.1		838.2	838.2	838.3	0.1
BN	54,943	443/130 ²	4,138	2.4		838.5	838.5	838.6	0.1
BO	56,893	992/0 ²	6,919	1.4		838.8	838.8	838.9	0.1
BP	91,456	236	2,616	3.6		852.6	852.6	852.7	0.1
BQ	91,734	236	2,410	3.9		853.0	853.0	853.1	0.1
BR	92,984	235	2,036	4.7		853.7	853.7	853.8	0.1
BS	95,359	992	8,143	1.2		854.6	854.6	854.7	0.1
BT	97,584	1,617	10,926	0.9		854.7	854.7	854.8	0.1
BU	99,334	1,547	10,566	0.9		854.9	854.9	855.0	0.1
BV	102,334	949	6,415	1.5		855.2	855.2	855.3	0.1
BW	103,959	958	7,958	1.2		855.4	855.4	855.5	0.1
BX	106,334	1,484	6,805	1.4		855.7	855.7	855.8	0.1
BY	107,134	1,155	5,213	1.8		855.8	855.8	855.9	0.1

¹ Feet above North Waverly Road

² Total width / width within county boundary

TABLE 5	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	
		GRAND RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
HERRON CREEK								
A	1,740 ¹	487	1,952	0.3	842.2	835.5 ²	835.6 ²	0.1
B	5,800 ¹	115	419	1.3	842.2	839.0 ²	839.0 ²	0.0
C	6,550 ¹	101	291	1.9	842.2	839.7 ²	839.8 ²	0.1
D	7,450 ¹	347	1,512	0.4	843.0	843.0	843.1	0.1
E	9,350 ¹	748	6,159	0.1	846.8	846.8	846.8	0.0
F	12,800 ¹	330	1,209	0.5	846.8	846.8	846.8	0.0
G	15,500 ¹	745	3,145	0.2	853.6	853.6	853.6	0.0
H	18,100 ¹	545	1,125	0.5	853.7	853.7	853.7	0.0
MOON AND HAMILTON COUNTY DRAIN								
A	33,098 ³	223	2,264	0.0	861.1	861.1	861.2	0.1
B	36,040 ³	210/156 ⁴	1,534	0.0	861.1	861.1	861.2	0.1

¹Feet above confluence with Red Cedar River

⁴Total width/width within county boundary

²Elevation computed without consideration of backwater effects from Red Cedar River

³Feet above confluence with Grand River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

**HERRON CREEK – MOON AND HAMILTON COUNTY
DRAIN**

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUD LAKE DRAIN									
A	131	42	118	3.8		839.0	838.2 ²	838.3 ²	0.1
B	1,066	28	108	4.2	14	841.4	841.4	841.4	0.0
C	1,325	45	118	3.8		842.3	842.3	842.3	0.0
D	1,667	54	172	2.6		844.4	844.4	844.4	0.0
E	2,034	45	129	3.4		845.0	845.0	845.0	0.0
F	2,431	47	140	3.3		846.1	846.1	846.1	0.0
G	2,733	47	140	3.4		847.1	847.1	847.1	0.0
H	3,146	43	118	4.0		848.5	848.5	848.5	0.0
I	3,556	46	140	3.4		849.9	849.9	849.9	0.0
J	3,881	47	140	3.4		850.9	850.9	850.9	0.0
K	4,278	42	108	4.3		852.2	852.2	852.2	0.0
L	4,915	47	129	3.6		854.8	854.8	854.8	0.0
M	5,184	37	97	4.7		855.8	855.8	855.8	0.0
N	5,774	46	161	2.9		858.6	858.6	858.6	0.0
O	6,266	41	151	3.1		859.4	859.4	859.4	0.0
P	7,011	47	194	0.8		860.2	860.2	860.3	0.1
Q	7,139	49	183	2.5		860.3	860.3	860.4	0.1
R	7,634	45	172	2.6		860.9	860.9	861.0	0.1
S	7,775	30	129	1.1		861.1	861.1	861.2	0.1

¹Feet above confluence with Sycamore Creek

²Elevations computed without consideration of backwater effects from Sycamore Creek

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

MUD LAKE DRAIN

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUD LAKE DRAIN (CONTINUED)									
T	7,808	10	75	1.8		861.1	861.1	861.2	0.1
U	8,667	10	77	1.8		862.8	862.8	862.8	0.0
V	9,769	21	82	1.7	20	863.4	863.4	863.4	0.0
W	10,733	20	104	1.3	21	864.3	864.3	864.3	0.0
X	10,959	6	15	9.3		864.6	864.6	864.6	0.0

¹Feet above confluence with Sycamore Creek

TABLE 5	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	MUD LAKE DRAIN

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUD LAKE / FOSTER DRAIN									
A	400	20	177	8.4		842.1	*	*	0.0
B	2,900	470	2,075	0.6		842.1	*	*	0.0
C	5,860	1,263	5,714	0.2		842.1	*	*	0.0
D	10,656	265	1,904	0.5		846.3	846.3	846.3	0.0
E	12,772	290	1,428	0.6		846.9	846.9	846.9	0.0
F	14,901	800	3,461	0.1		847.1	847.1	847.1	0.0
G	15,961	600	1,738	0.2		847.1	847.1	847.1	0.0
H	18,999	248	325	1.2	45	852.8	852.8	852.8	0.0
I	21,200	28	96	4.1	4	855.3	855.3	855.3	0.0
J	23,399	35	209	1.9		862.9	862.9	862.9	0.0
K	26,800	856	1,157	0.3	38	863.3	863.3	863.3	0.0
L	28,400	29	86	4.6		864.1	864.1	864.1	0.0

¹Feet above confluence with Red Cedar River

*Data not available

TABLES

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

MUD LAKE / FOSTER DRAIN

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
PINE LAKE (OUTLET) DRAIN								
A	1,500 ¹	500	680	0.4	842.1	*	*	0.0
B	3,150 ¹	125	201	1.5	842.1	*	*	0.0
C	5,700 ¹	12	127	2.4	847.5	847.5	847.5	0.0
D	8,300 ¹	10	92	3.2	848.1	848.1	848.1	0.0
E	11,000 ¹	1,000	5,451	0.2	849.2	849.2	849.2	0.0
F	13,150 ¹	220	125	0.9	852.7	852.7	852.7	0.0
RAYNER CREEK								
A	707 ²	10	60	4.9	876.0	875.4 ³	875.5 ³	0.1
B	2,291 ²	330	330	0.4	877.7	877.7	877.7	0.0
C	2,710 ²	349	352	0.8	879.3	879.3	879.3	0.0
D	3,746 ²	159	236	1.3	883.5	883.5	883.5	0.0
E	4,986 ²	24	81	3.7	884.1	884.1	884.1	0.0

¹Feet above confluence with Mud Lake / Foster Drain

²Feet above confluence with Sycamore Creek

³Elevations without considering overflow effects from Sycamore Creek

*Data not available

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

PINE LAKE (OUTLET) DRAIN – RAYNER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED CEDAR RIVER								
A	200	621 ²	6,694	2.9	831.2	831.2	831.3	0.1
B	600	515	4,615	2.1	831.3	831.3	831.4	0.1
C	1,150	415	2,951	3.3	831.3	831.3	831.4	0.1
D	1,690	422	3,552	2.7	831.9	831.9	832.0	0.1
E	2,260	256	3,389	2.8	832.1	832.1	832.2	0.1
F	2,520	260	3,202	3.0	832.7	832.7	832.8	0.1
G	2,883	320	3,269	2.9	832.7	832.7	832.8	0.1
H	3,435	402	4,395	2.2	834.2	834.2	834.3	0.1
I	4,050	505	6,029	1.6	834.4	834.4	834.4	0.0
J	4,525	663	1,993	4.8	834.4	834.4	834.5	0.1
K	5,051	991	10,407	0.9	835.0	835.0	835.1	0.1
L	5,600	1,113	14,639	0.7	835.0	835.0	835.1	0.1
M	6,975	804	10,271	0.9	835.0	835.0	835.1	0.1
N	8,525	1,360	21,185	0.5	835.1	835.1	835.2	0.1
O	9,475	1,735	29,688	0.2	835.1	835.1	835.2	0.1
P	10,340	1,612	22,796	0.3	835.1	835.1	835.2	0.1
Q	11,170	893	12,612	0.6	835.1	835.1	835.2	0.1
R	11,836	720	10,909	0.7	835.2	835.2	835.3	0.1
S	13,473	162	2,815	2.6	835.2	835.2	835.3	0.1
T	14,634	219	2,652	2.7	835.7	835.7	835.8	0.1

¹Feet above confluence with Grand River

²Combined floodway width of Grand River and Red Cedar River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

RED CEDAR RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED CEDAR RIVER (CONTINUED)								
U	15,515	225	2,675	2.7	835.9	835.9	836.0	0.1
V	16,116	472	4,605	1.6	836.1	836.1	836.2	0.1
W	17,217	1,987	15,307	0.5	836.2	836.2	836.3	0.1
X	19,218	1,110	10,152	0.7	836.2	836.2	836.3	0.1
Y	20,493	194	1,946	3.7	836.2	836.2	836.3	0.1
Z	21,243	295	1,799	4.0	836.5	836.5	836.6	0.1
AA	23,828	827	8,928	0.8	837.3	837.3	837.4	0.1
AB	24,938	722	7,091	1.0	837.3	837.3	837.4	0.1
AC	26,049	339	2,397	3.0	837.5	837.5	837.6	0.1
AD	26,612	157	1,625	4.4	837.6	837.6	837.7	0.1
AE	26,864	103	1,390	5.2	837.7	837.7	837.8	0.1
AF	27,790	116	1,667	4.3	838.4	838.4	838.5	0.1
AG	28,445	273	2,821	2.6	838.8	838.8	838.9	0.1
AH	29,370	146	1,953	3.7	838.9	838.9	839.0	0.1
AI	30,152	224	2,411	3.8	839.3	839.3	839.4	0.1
AJ	31,652	419	3,540	3.0	839.6	839.6	839.7	0.1
AK	32,336	543	1,629	4.4	839.6	839.6	839.7	0.1
AL	35,029	516	4,985	1.5	840.9	840.9	840.9	0.0

¹Feet above confluence with Grand River

TABLES

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

RED CEDAR RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED CEDAR RIVER (CONTINUED)									
AM	36,824	134	1,820	4.2		841.3	841.3	841.3	0.0
AN	39,147	1,468	11,358	0.6		842.1	842.1	842.1	0.0
AO	41,787	1,400	9,391	0.8		842.4	842.4	842.4	0.0
AP	43,794	875	5,346	1.3		843.0	843.0	843.0	0.0
AQ	46,751	90	1,241	5.9		843.7	843.7	843.7	0.0
AR	47,965	1,419	11,814	0.6		845.2	845.2	845.2	0.0
AS	51,027	672	4,170	1.7		845.6	845.6	845.6	0.0
AT	54,037	494	4,569	1.6		847.0	847.0	847.0	0.0
AU	56,888	104	1,312	5.5		847.7	847.7	847.7	0.0
AV	59,053	373	3,766	1.9		849.1	849.1	849.1	0.0
AW	63,171	502	6,045	1.2		850.0	850.0	850.0	0.0
AX	67,871	1,377	13,995	0.5		850.3	850.3	850.3	0.0
AY	70,511	1,410	7,024	1.0		850.4	850.4	850.4	0.0
AZ	73,626	907	7,308	0.9	18	851.1	851.1	851.1	0.0
BA	76,899	1,261	11,788	0.6	26	851.7	851.7	851.7	0.0
BB	79,434	627	4,525	1.5		852.3	852.3	852.3	0.0
BC	79,684	458	6,217	1.0	265	852.9	852.9	852.9	0.0
BD	84,013	526	4,174	1.4		854.2	854.2	854.2	0.0

¹Feet above confluence with Grand River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

RED CEDAR RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANGE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED CEDAR RIVER (CONTINUED)								
BE	91,828	581	4,602	1.3	857.0	857.0	857.1	0.1
BF	96,580	150	1,787	3.4	859.3	859.3	859.4	0.1
BG	102,388	717	5,194	1.1	862.3	862.3	862.4	0.1
BH	104,130	1,423	6,393	0.9	862.9	862.9	863.0	0.1
BI	106,612	815	6,986	0.8	863.5	863.5	863.6	0.1
BJ	108,988	1,553	11,078	0.5	863.9	863.9	864.0	0.1
BK	112,208	214	946	5.4	864.3	864.3	864.4	0.1
BL	112,789	73	823	6.2	865.0	865.0	865.1	0.1
BM	114,056	561	3,486	1.5	866.3	866.3	866.4	0.1
BN	115,799	268	224	2.3	867.0	867.0	867.1	0.1
BO	120,307	1,318	10,333	0.3	867.5	867.5	867.6	0.1
BP	124,920	455	3,123	1.0	867.6	867.6	867.8	0.2
BQ	127,740	679	3,745	0.8	867.9	867.9	868.0	0.1
BR	131,328	442	2,588	1.1	868.2	868.2	868.3	0.1
BS	132,636	313	2,240	1.3	869.1	869.1	869.2	0.1
BT	136,078	191	1,728	1.7	869.6	869.6	869.7	0.1
BU	138,144	582	2,981	1.0	870.0	870.0	870.1	0.1

¹Feet above confluence with Grand River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

RED CEDAR RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANGE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED CEDAR RIVER (CONTINUED)								
BV	140,306	415	2,363	1.2	870.4	870.4	870.6	0.2
BW	142,679	430	2,262	1.3	871.0	871.0	871.1	0.1
BX	146,466	213	1,549	1.9	872.5	872.5	872.6	0.1
BY	147,819	434	2,984	1.0	873.5	873.5	873.7	0.2
BZ	149,748	643	3,881	0.6	873.8	873.8	873.9	0.1
CA	151,205	818	4,240	0.6	873.9	873.9	874.1	0.2
CB	153,321	504	2,270	1.1	874.2	874.2	874.3	0.1
CC	155,431	211	1,372	1.8	874.7	874.7	874.8	0.1

¹Feet above confluence with Grand River

TABLES

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

RED CEDAR RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
REMY CHANDLER DRAIN / SANDERSON DRAIN								
A	44,845 ¹	55	194	0.6	841.1	841.1	841.1	0.0
SMITH DRAIN								
A	440 ²	116	204	2.4	846.1	838.0 ³	835.1 ³	0.1
B	1,600 ²	55	72	4.0	846.1	843.7 ³	843.8 ³	0.1
C	2,490 ²	184	1,329	0.3	853.8	853.8	853.9	0.1
D	3,800 ²	105	332	1.6	855.2	855.2	855.2	0.0
E	5,690 ²	23	53	5.5	857.2	857.3	857.4	0.1
F	6,490 ²	20	100	3.0	861.9	861.9	861.9	0.0
G	6,840 ²	132	547	0.9	864.8	864.8	865.0	0.2
H	8,380 ²	71	159	2.8	865.4	865.4	865.5	0.1
I	10,300 ²	149	877	0.4	865.9	865.9	866.0	0.1
J	12,245 ²	36	157	2.4	873.2	873.2	873.2	0.0

¹Feet above confluence with Looking Glass River

²Feet above confluence with Red Cedar River

³Elevation computed without consideration of backwater effects from Red Cedar River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

**REMY CHANDLER DRAIN / SANDERSON DRAIN –
SMITH DRAIN**

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SYCAMORE CREEK									
A	650	494	5,823	0.4		835.1	835.1	835.2	0.1
B	1,300	1,051	7,630	0.3		835.1	835.1	835.2	0.1
C	3,166	1,177	14,656	0.2		835.1	835.1	835.2	0.1
D	5,666	1,420	16,934	0.1		835.1	835.1	835.2	0.1
E	7,441	1,376	11,188	0.2		835.1	835.1	835.2	0.1
F	10,266	1,682	15,787	0.2		835.1	835.1	835.2	0.1
G	11,091	1,168	6,565	0.4		835.1	835.1	835.2	0.1
H	12,641	474	3,766	0.7		835.3	835.3	835.4	0.1
I	13,871	586	2,366	1.1		835.5	835.5	835.6	0.1
J	16,313	78	616	4.1		835.8	835.8	835.9	0.1
K	17,185	510	3,263	0.8		836.5	836.5	836.6	0.1
L	17,761	608	2,285	1.1		836.6	836.6	836.7	0.1
M	18,541	591	1,387	1.6		836.9	836.9	837.0	0.1
N	19,971	711	3,138	0.7		837.7	837.7	837.8	0.1
O	22,041	688	1,720	1.3		838.3	838.3	838.3	0.0
P	23,391	101	820	2.8		839.1	839.1	839.2	0.1
Q	24,866	164	1,043	2.2		839.9	839.9	840.0	0.1
R	26,566	641	4,011	0.6		840.2	840.2	840.3	0.1
S	28,097	112	793	2.9	12	840.4	840.4	840.5	0.1

¹Feet above confluence with Red Cedar River

TABLE 5	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	SYCAMORE CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SYCAMORE CREEK (CONTINUED)									
T	28,543	589	2370	1.0		840.7	840.7	840.8	0.1
U	30,343	878	4098	0.6		840.9	840.9	840.9	0.0
V	31,593	932	2432	0.9	20	841.1	841.1	841.1	0.0
W	32,243	80	542	4.2	21	841.5	841.5	841.5	0.0
X	35,515	434	1886	1.2		844.3	844.3	844.3	0.0
Y	37,265	517	2,560	0.9		844.7	844.7	844.8	0.1
Z	42,515	743	2,510	0.9		845.5	845.5	845.6	0.1
AA	43,415	62	522	4.4		845.9	845.9	846.0	0.1
AB	80,159	93	536	3.2		873.7	873.7	873.7	0.0
AC	82,310	492	2,128	0.8		874.6	874.6	874.6	0.0
AD	83,610	439	1,041	1.7		875.3	875.3	875.4	0.1
AE	85,361	61	388	4.0		879.0	879.0	879.0	0.0
AF	86,698	18	135	11.5		882.6	882.6	882.6	0.0
AG	87,170	15	139	11.1		884.7	884.7	884.7	0.0
AH	87,347	160	665	2.3		887.4	887.4	887.4	0.0
AI	87,740	26	279	5.6		888.0	888.0	888.0	0.0
AJ	88,090	254	2,168	0.7	18	888.7	888.7	888.7	0.0
AK	88,140	216	1,682	0.9		888.7	888.7	888.7	0.0

¹Feet above confluence with Red Cedar River

TABLE 5	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	INGHAM COUNTY, MI (ALL JURISDICTIONS)	SYCAMORE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SYCAMORE CREEK (CONTINUED)								
AL	88,723	141	779	2.0	889.8	889.8	889.8	0.0
AM	89,077	176	1,175	1.3	890.0	890.0	890.0	0.0
AN	90,227	190	1,383	1.1	890.2	890.2	890.2	0.0
AO	91,249	30	210	4.7	890.5	890.5	890.5	0.0
AP	92,750	122	352	2.8	891.8	891.8	891.8	0.0
AQ	93,147	17	83	11.8	893.8	893.8	893.8	0.0
UNNAMED TRIBUTARY								
A	965	409	681	0.4	863.9	858.4 ²	858.4 ²	0.0
B	1,687	302	190	1.6	863.9	861.8 ²	861.8 ²	0.0
C	2,638	82	173	1.8	863.9	862.5 ²	862.5 ²	0.0
D	4,661	6	34	6.4	867.2	867.2	867.2	0.0

¹Feet above confluence with Red Cedar River

²Elevations without considering backwater effects from Red Cedar River

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

SYCAMORE CREEK – UNNAMED TRIBUTARY

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
WILLOW CREEK								
A	617	15	133	4.3	890.6	890.6	890.6	0.0
B	1,627	196	907	0.6	891.2	891.2	891.2	0.0
C	2,227	239	779	0.7	891.3	891.3	891.3	0.0
D	2,292	232	768	0.7	891.3	891.3	891.3	0.0
E	2,902	20	151	3.8	892.0	892.0	892.1	0.1
F	4,252	537	1,219	0.5	892.7	892.7	892.8	0.1
G	5,777	747	1,034	0.6	892.9	892.9	893.0	0.1

¹Feet above confluence with Sycamore Creek

TABLES

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

FLOODWAY DATA

WILLOW CREEK

5.0 INSURANCE APPLICATIONS

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.

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 as 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.

The countywide FIRM presents flooding information for the entire geographic area of Ingham County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary

and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 6.

7.0 OTHER STUDIES

This report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for purposes of the NFIP.

8.0 LOCATION OF DATA

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

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Alaiedon, Township of	May 13, 1977	None	September 28, 1979	None
Aurelius, Township of	August 16, 2011	None	August 16, 2011	None
Bunker Hill, Township of	August 16, 2011	None	August 16, 2011	None
*Dansville, Village of	N/A	None	N/A	None
Delhi, Charter Township of	July 26, 1974	July 16, 1976	July 16, 1981	November 16, 1990
East Lansing, City of	May 24, 1974	July 30, 1976	August 1, 1980	None
Ingham, Township of	August 16, 2011	None	August 16, 2011	None
Lansing, Charter Township of	February 4, 1981	None	February 4, 1981	None
Lansing, City of	June 7, 1974	February 6, 1976	March 2, 1981	November 16, 1990
Leroy, Township of	August 16, 2011	None	August 16, 2011	None
Leslie, City of	June 14, 1974	September 5, 1975	August 10, 1979	None
Leslie, Township of	August 16, 2011	None	August 16, 2011	None
Locke, Township of	February 17, 1978	None	August 10, 1979	March 1, 1982
Mason, City of	May 31, 1974	June 4, 1976	October 15, 1982	None

*No special flood hazard areas identified

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Meridian, Charter Township of	June 28, 1974	None	February 2, 1977	August 9, 2000
Onondaga, Township of	August 16, 2011	None	August 16, 2011	None
Stockbridge, Township of	August 16, 2011	None	August 16, 2011	None
Stockbridge, Village of	October 3, 1975	None	September 4, 1986	None
Vevay, Township of	August 16, 2011	None	August 16, 2011	None
Webberville, Village of	October 17, 1975	None	August 10, 1979	November 2, 1983
Wheatfield, Township of	August 16, 2011	None	August 16, 2011	None
White Oak, Township of	October 10, 1975	None	July 16, 1990	None
Williamston, City of	May 3, 1974	July 30, 1976	April 1, 1982	None
Williamstown, Township of	August 27, 1976	None	April 15, 1982	None

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

**INGHAM COUNTY, MI
(ALL JURISDICTIONS)**

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

Abrams Aerial Survey Corporation, Topographic Maps, Scale, 1:1,200, Contour Interval 2 Feet; City of Lansing, Michigan, 1978.

Abrams Aerial Survey Corporation, Topographic Maps, Scale 1:4,800, Contour Interval 5 feet: Lansing, Michigan, 1979.

Abrams Aerial Survey Corporation, Topographic Maps, Scale, 1:1,200, Contour Interval 2 Feet; Smith Drain, Michigan, August 1991.

Brater, Ernest and Sherill, James, Rainfall Runoff Relations in Urban and Rural Areas, Project #011013, 1973.

Federal Emergency Management Agency, Flood Insurance Study, Charter Township of Delhi, Michigan, November 11, 1990a.

Federal Emergency Management Agency, Flood Insurance Study, City of Lansing, Michigan, November 16, 1990b.

Federal Emergency Management Agency, Flood Insurance Study, Charter Township of Meridian, Michigan, August 9, 2000.

Federal Emergency Management Agency, HAZUS-MH Flood MR1 Build 39, 2004.

Federal Insurance Administration, Flood Insurance Study, Charter Township of Meridian, Ingham County, Michigan, Flood Insurance Study Report, August 2, 1976; Flood Insurance Rate Map, February 2, 1977.

Federal Insurance Administration, Flood Insurance Study, City of East Lansing, Michigan, Flood Insurance Study Report, February 1980a; Flood Insurance Rate Map, August 1, 1980.

Federal Insurance Administration, Flood Insurance Study, Township of Lansing, Michigan, Flood Insurance Study Report, August 4, 1980b; Flood Insurance Rate Map, February 4, 1981.

Federal Insurance Administration, Flood Insurance Study, City of Lansing, Ingham, Eaton, and Clinton Counties, Michigan, Flood Insurance Study Report September 1980c; Flood Insurance Rate Map, March 2, 1981.

Federal Insurance Administration, Flood Insurance Study, Charter Township of Delhi, Ingham County, Michigan, January 1981a.

Federal Insurance Administration, Flood Insurance Study, Township of Locke, Michigan, Flood Insurance Study Report, September 1, 1981b; Flood Insurance Rate Map, March 1, 1982.

Federal Insurance Administration, Flood Insurance Study, City of Williamston, Michigan, Flood Insurance Study Report, October 1, 1981c; Flood Insurance Rate Map, April 1, 1982.

Federal Insurance Administration, Flood Insurance Study, Township of Williamstown, Michigan, Flood Insurance Study Report, October 15, 1981d; Flood Insurance Rate Map, April 1, 1982.

Federal Insurance Administration, Flood Insurance Study, City of Mason, Michigan, Flood Insurance Study Report, April 15, 1982; Flood Insurance Rate Map, October 15, 1982.

Huff, Floyd A. and James R. Angel, Rainfall Frequency Atlas of the Midwest, Illinois State Water Survey, Champaign, IL, Bulletin No. 71, 1992.

Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, U.S. Army Corps of Engineers, Davis, California, December 1968.

Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, U.S. Army Corps of Engineers, Davis, California, November 1976, updated August 1977.

Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, U.S. Army Corps of Engineers, Davis, California, May 1991.

Hydrologic Engineering Center, HEC-RAS River Analysis System, U.S. Army Corps of Engineers, Davis, California, 1998.

Hydrologic Engineering Center, HEC-RAS River Analysis System, Version 3.1.3, U.S. Army Corps of Engineers, Davis, California, May 2005.

Hydrologic Engineering Center, HEC-HMS Hydrologic Modeling System, U.S. Army Corps of Engineers, Davis, California, April 2006.

Ingham County Drain Commissioner, Urban Systems Engineering Demonstration – The Hydrologic Information Program, 1974.

Ingham County Drain Commissioner, Topographic Map, Scale, 1:40, Contour Interval 1 Feet; Smith Drain Pond, Michigan, Unknown Date.

Michigan Department of Environmental Quality, Computing Flood Discharges for Small Ungaged Watersheds, Geological and Land Management Division, Lansing, Michigan, July 2003.

Michigan Department of Natural Resources, Computing Flood Discharges for Small Ungaged Watersheds, David A. Hamilton and Richard C. Sorrell, Land and Waste Management Division, October 1991.

National Geodetic Survey, VERTCON-North American Vertical Datum Conversion Utility. Retrieved January 17, 2006, from <http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html> .

Soil Conservation Service, Technical Release No. 20, Computer Program for Project Formulation – Hydrology, U.S. Department of Agriculture, 1965.

Snell Environmental Group, Preliminary report for Mud Lake and Bolter Drains, Lansing, Michigan, April 1973.

Snell Environmental Group, Gilbert Drain, Hydrologic Analysis Report, July 1978a.

Snell Environmental Group, Hydrology, Grand River and Red Cedar Confluence, August 1978b.

Snell Environmental Group, Mud Lake Drain, Hydrologic Analysis Report, (revised) September 1978c.

Snell Environmental Group, Sycamore Creek, Hydrologic Analysis Report, (revised) August 1978d.

State of Michigan, Act 25, Public Acts of 1929, as amended by Act 167, Public Acts of 1968.

U.S. Army Corps of Engineers, Detroit District, Flood Plain Information, Red Cedar River, Ingham County, Michigan, 1968.

U.S. Army Corps of Engineers, Detroit District, Flood Plain Information, Grand River, Red Cedar River, and Sycamore Creek, Lansing, Michigan and Vicinity, April 1970.

U.S. Census Bureau, American FactFinder, Ingham County, Michigan, 2007. Retrieved February 17, 2009, from <http://factfinder.census.gov>.

U.S. Geological Survey, Magnitudes and Frequency of Floods in the U.S., Part 4, St. Lawrence River Basin, Water Supply Paper No. 1677, S.W. Wiitala, U.S. Department of the Interior, 1965.

U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: East Lansing, Michigan, U.S. Department of the Interior, 1970.

U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Bath, Michigan, 1972; Bath, Michigan, 1978; Corunna, Michigan, 1972; East Lansing, Michigan, 1976; Laingsburg, Michigan, 1972; Lansing, Michigan, 1973; Lansing North, Michigan, 1973; Owosso South, Michigan, 1972; Price, Michigan, 1972; Contour Interval 5 feet: Ovid East, Michigan, 1974; Ovid West, Michigan, 1974; Owosso North, Michigan, 1974, St. Johns South, Michigan, 1973, U.S. Department of the Interior, various dates.

U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: Aurelius, Michigan, U.S. Department of the Interior, 1965, (photorevised) 1973a.

U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: Lansing, Michigan, U.S. Department of the Interior, 1965, (photorevised) 1973b.

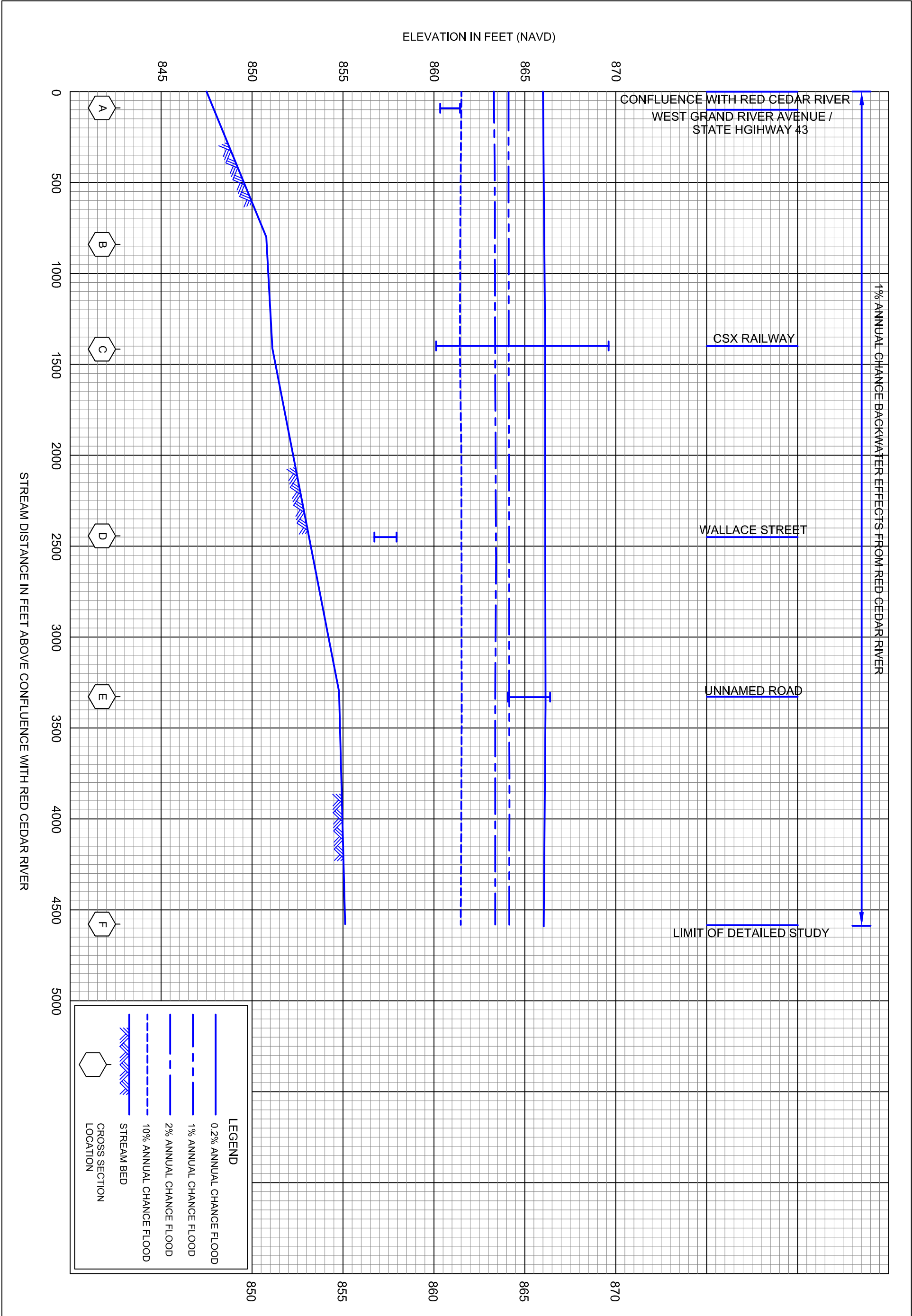
U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: Mason, Michigan, 1970, U.S. Department of the Interior, (photo inspected) 1976.

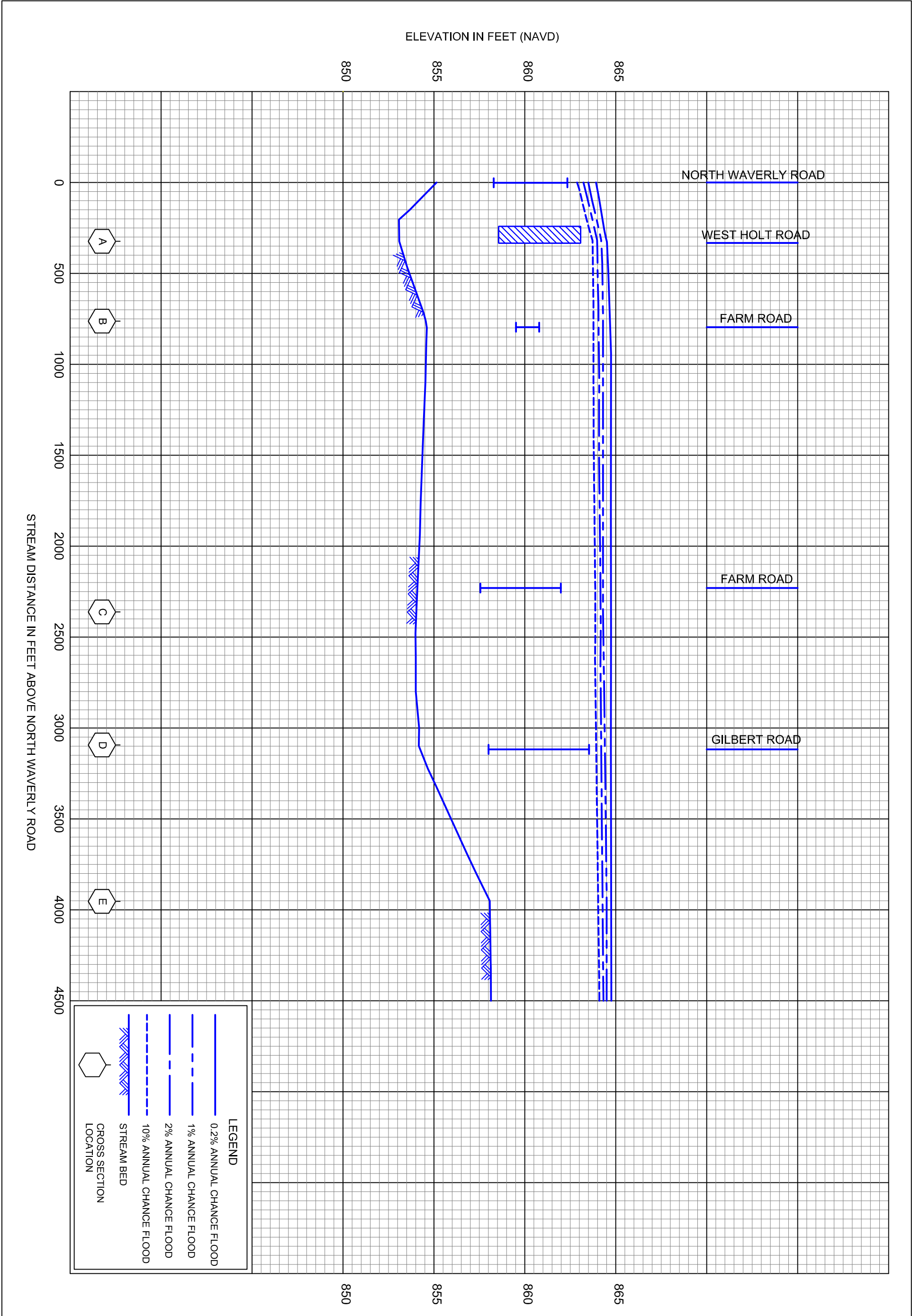
U.S. Geological Survey, Statistical Models for Estimating Flow Characteristics of Michigan Streams. U.S. Geological Survey Water Resources Investigations Report 84-4207, 80 p., U.S. Department of the Interior, 1984.

U.S. Geological Survey, National Elevation Dataset. Retrieved June 1, 2008, from <http://ned.usgs.gov>.

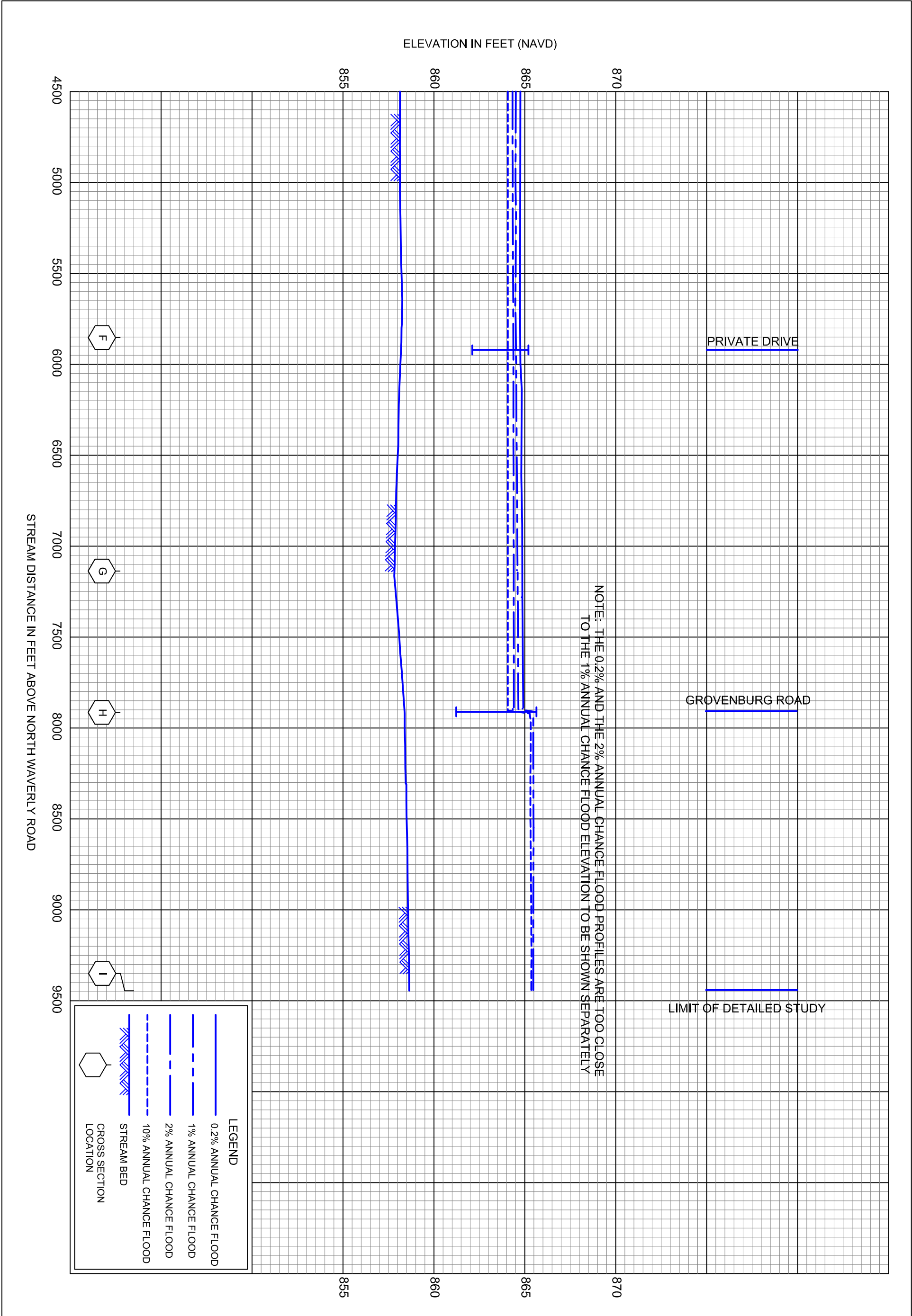
The Weather Channel, Monthly Averages for Lansing, MI. Retrieved February 17, 2009, from <http://www.weather.com>.

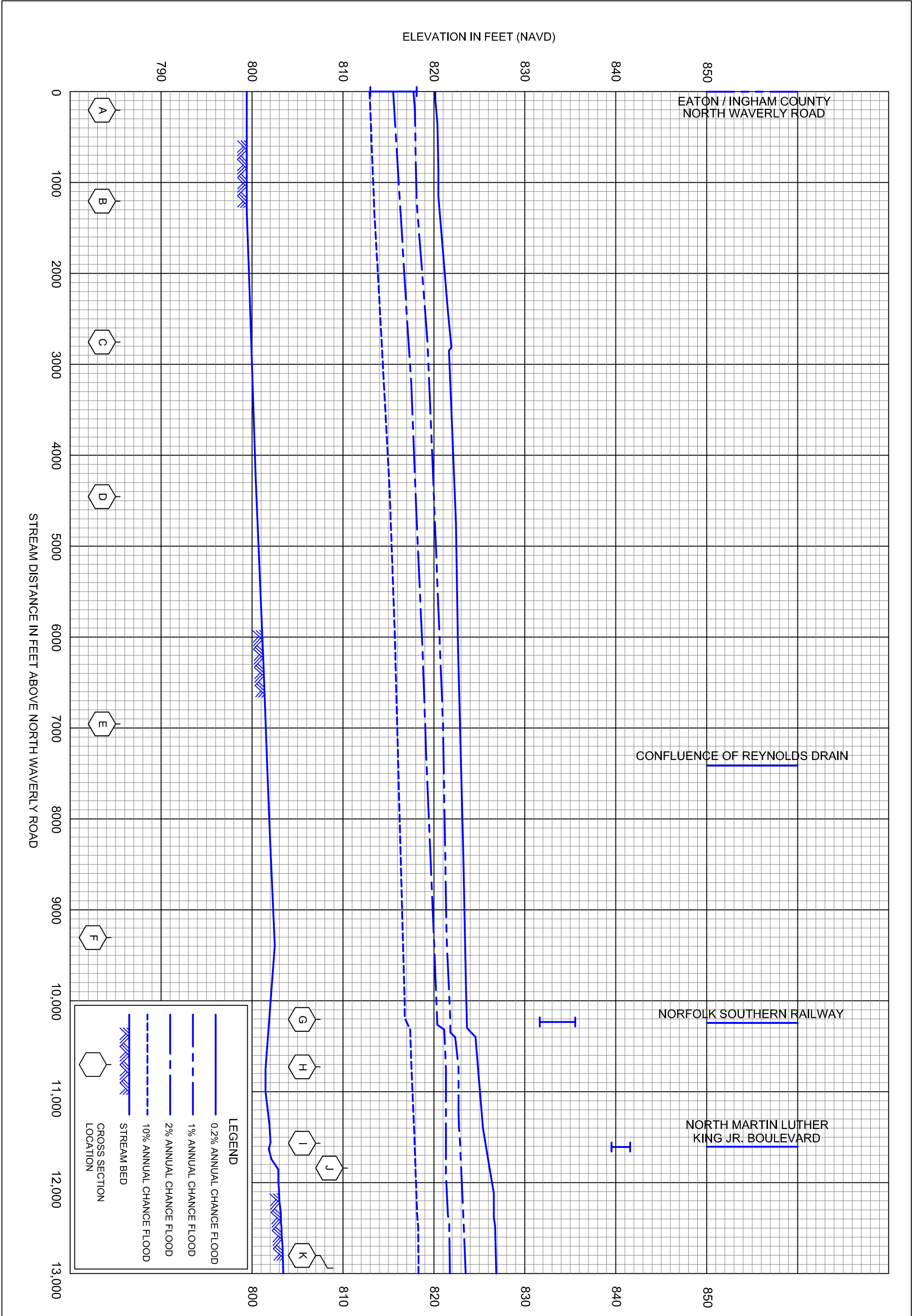
Western Air Maps, Inc., LiDAR Data, Contour Interval 2 Feet: Ingham County, Michigan, May 21 and 22, 2003.

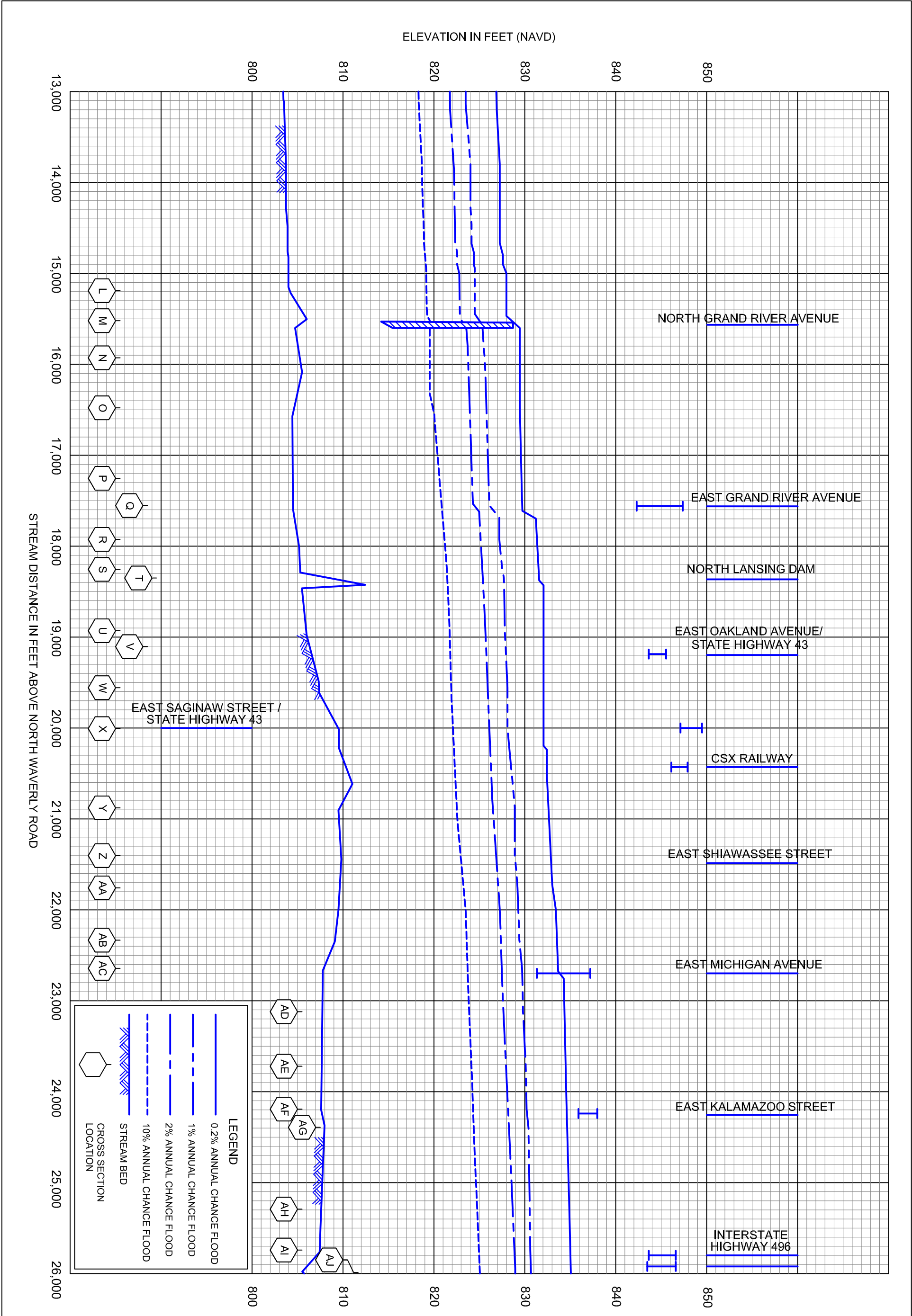


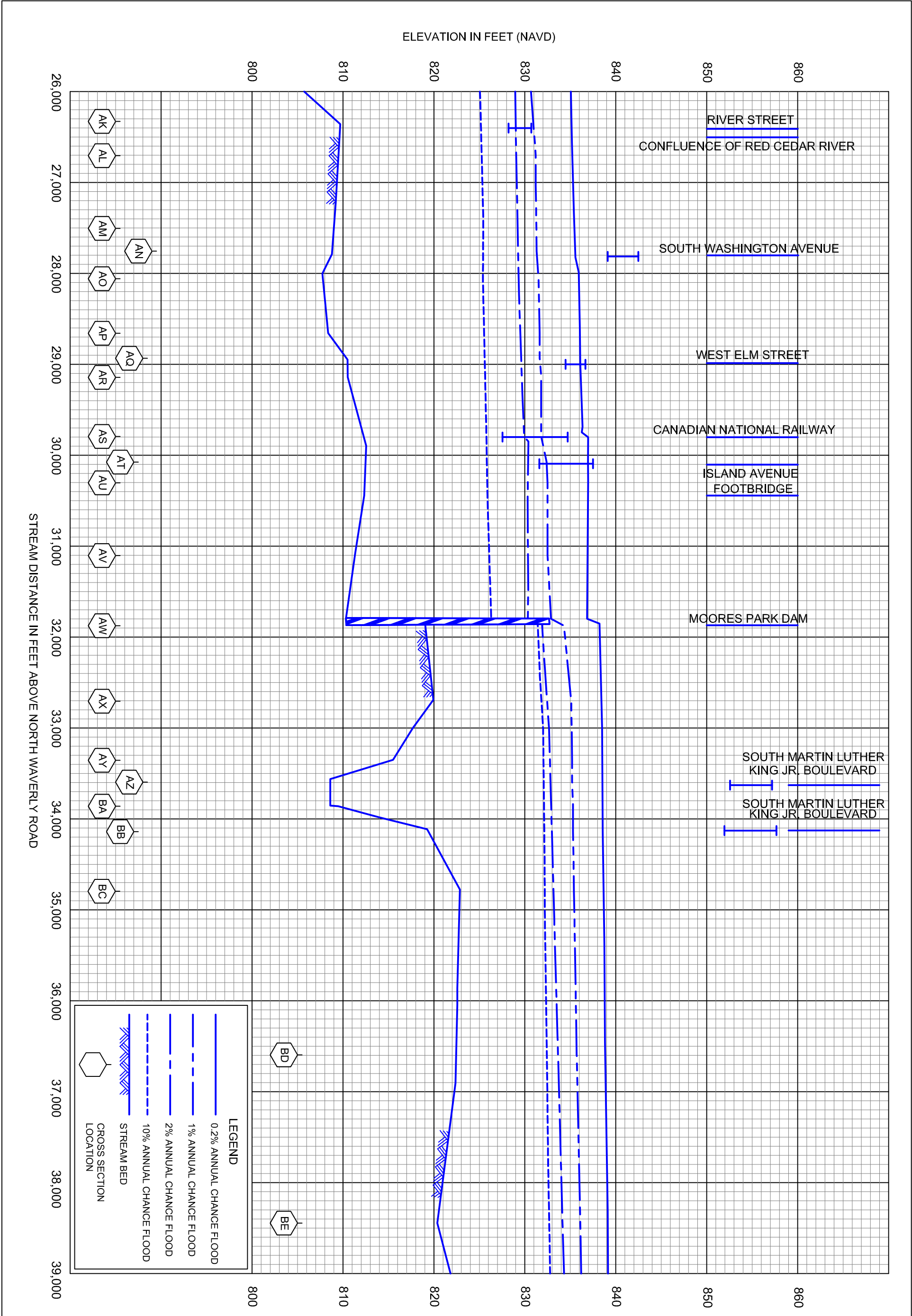


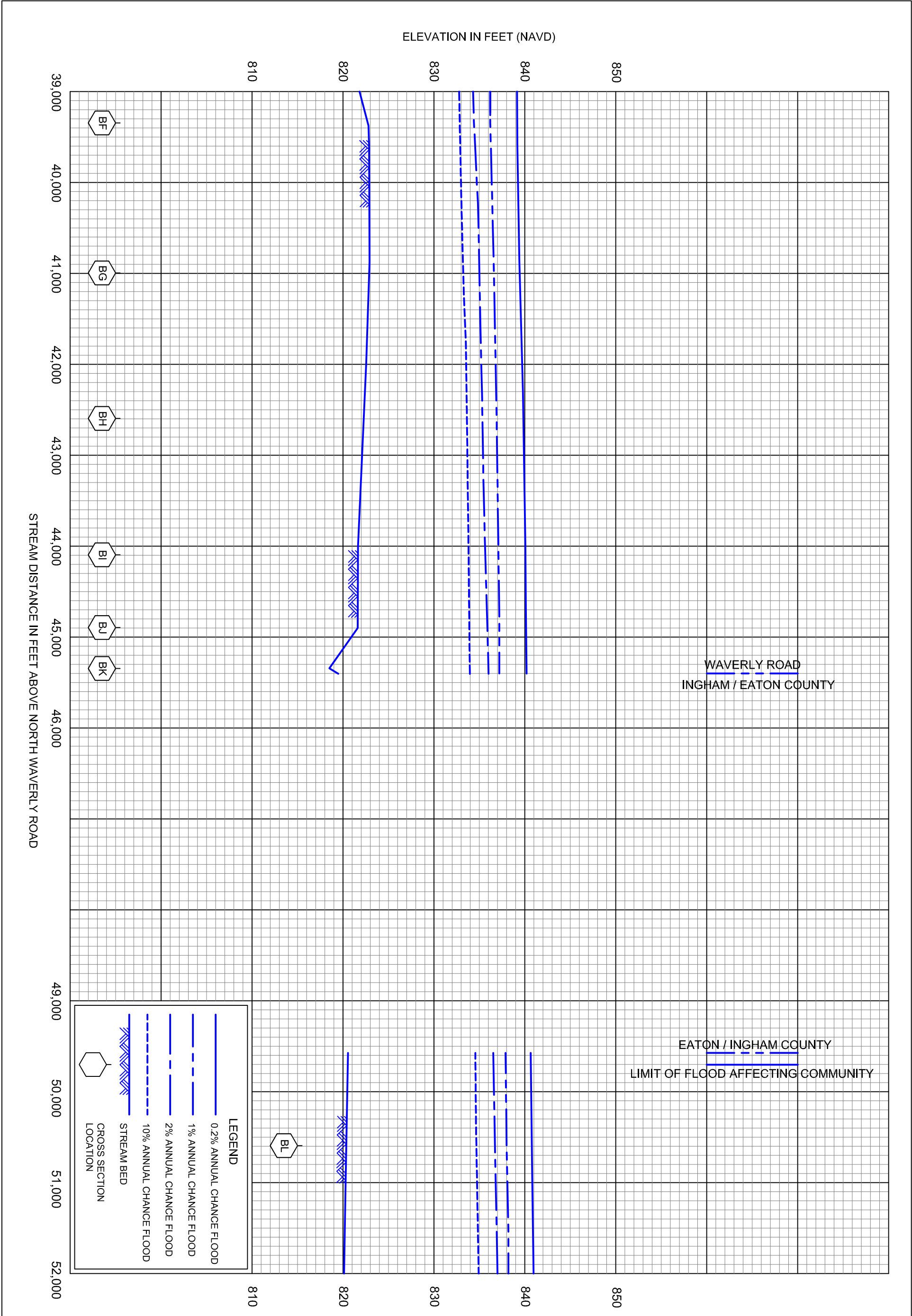
LEGEND	
	0.2% ANNUAL CHANCE FLOOD
	1% ANNUAL CHANCE FLOOD
	2% ANNUAL CHANCE FLOOD
	10% ANNUAL CHANCE FLOOD
	STREAM BED
	CROSS SECTION LOCATION

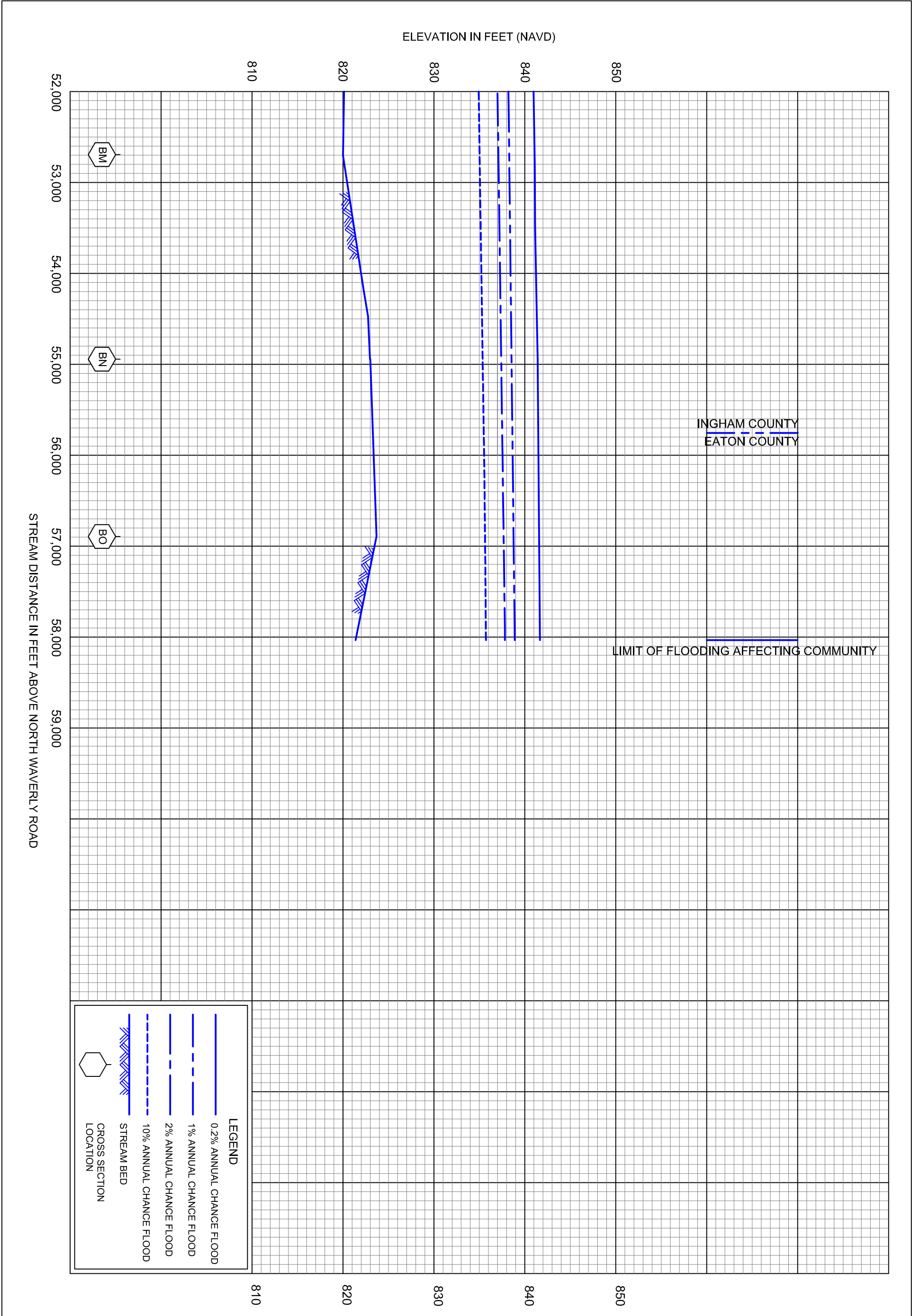






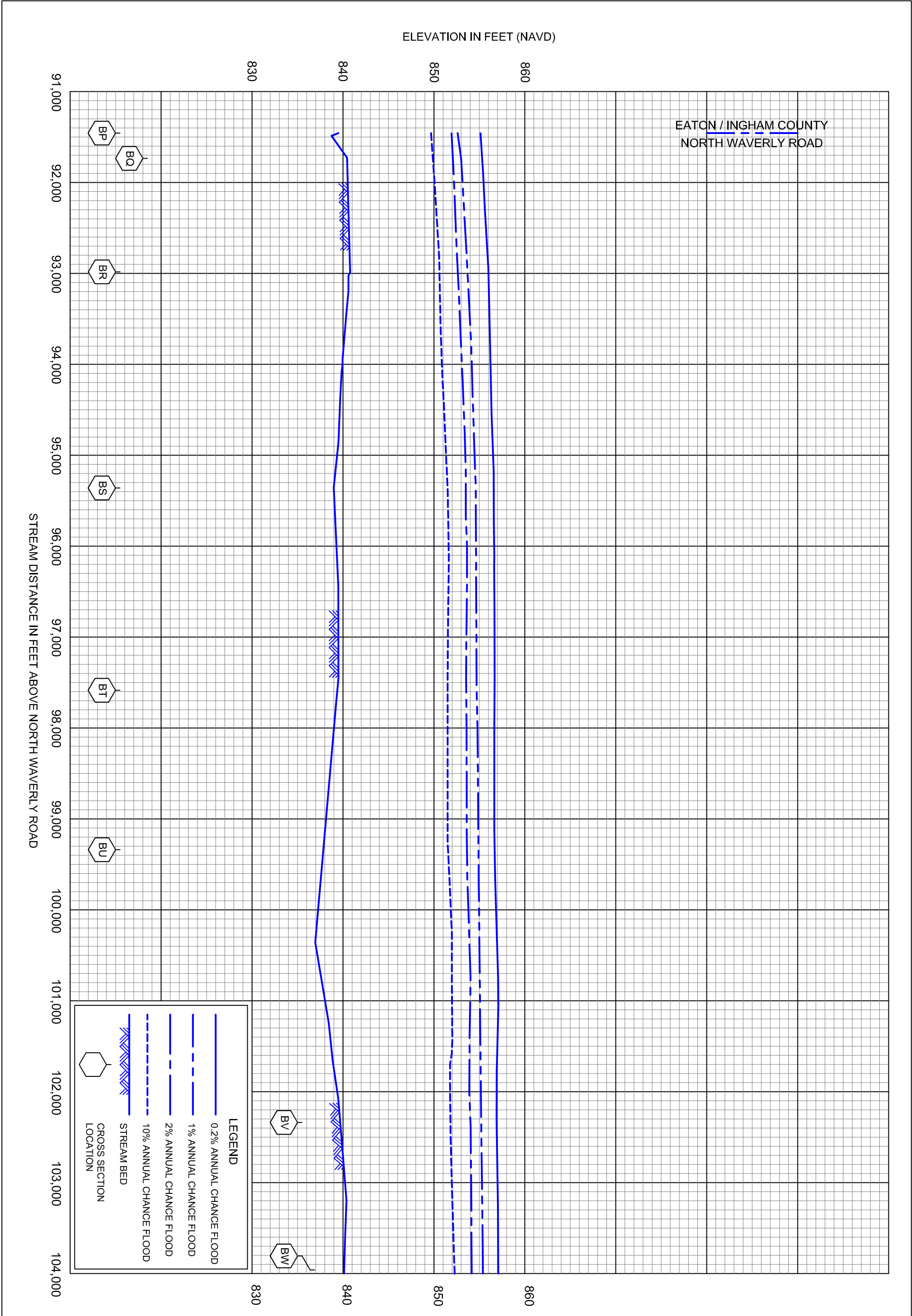






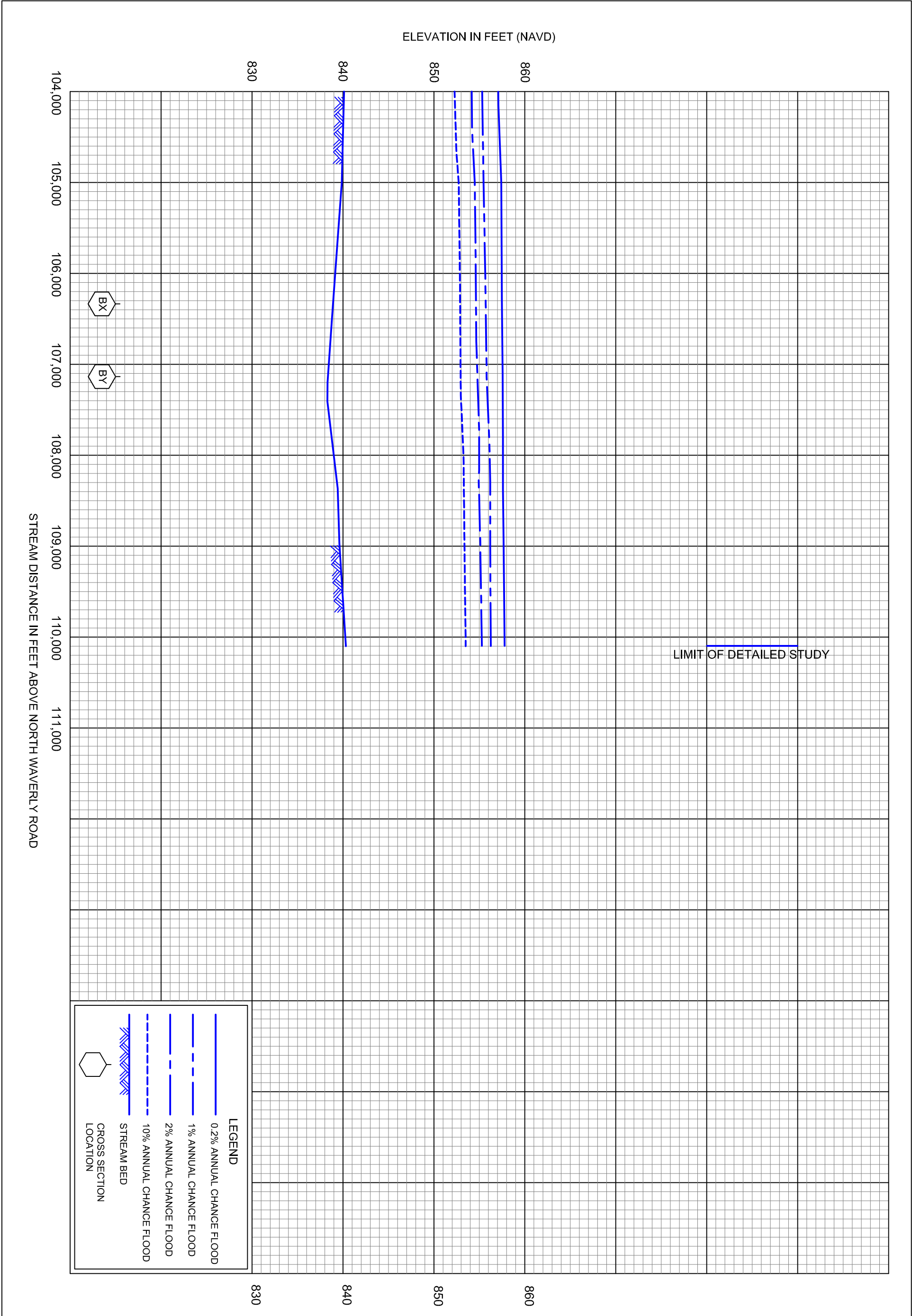
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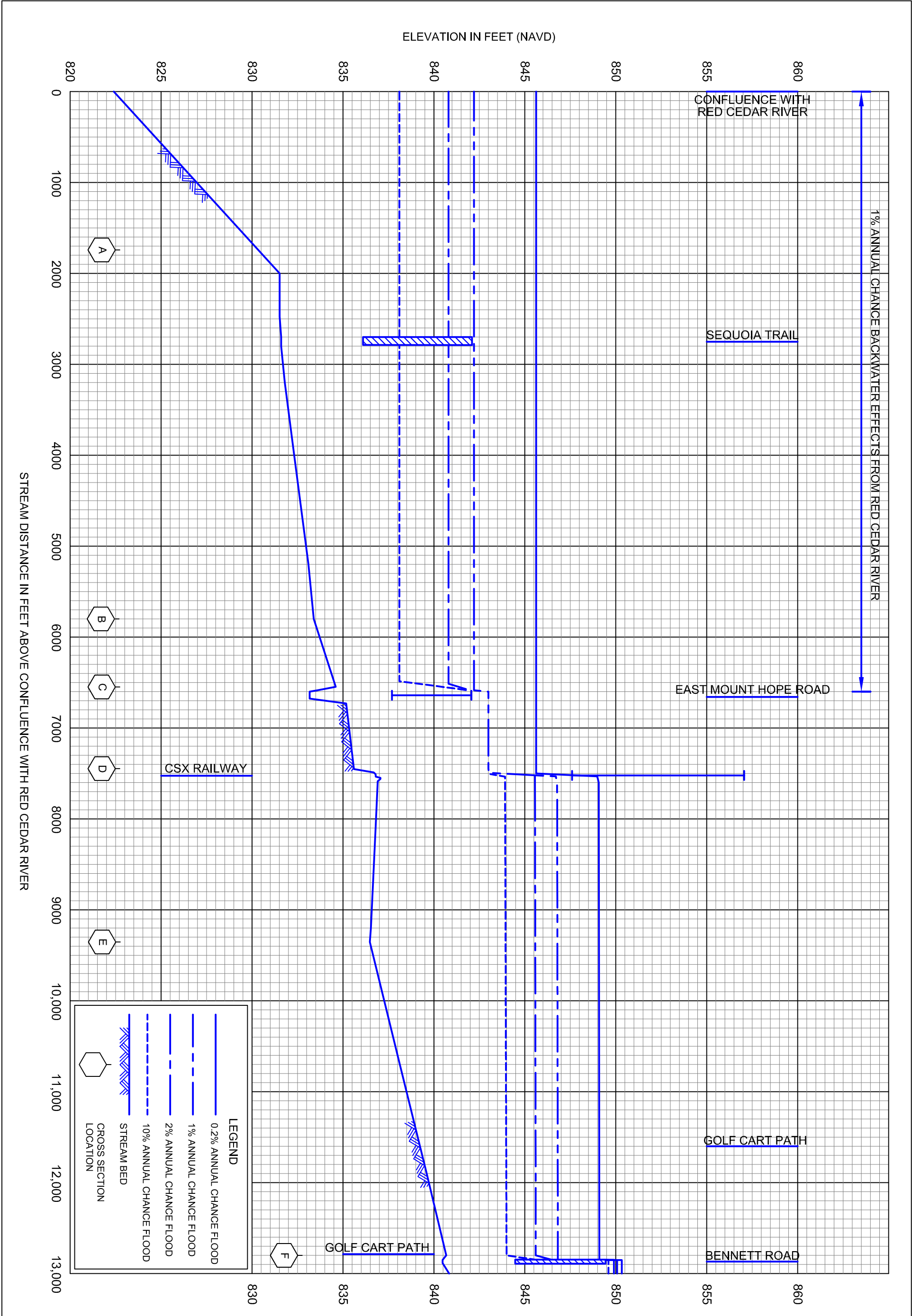
- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

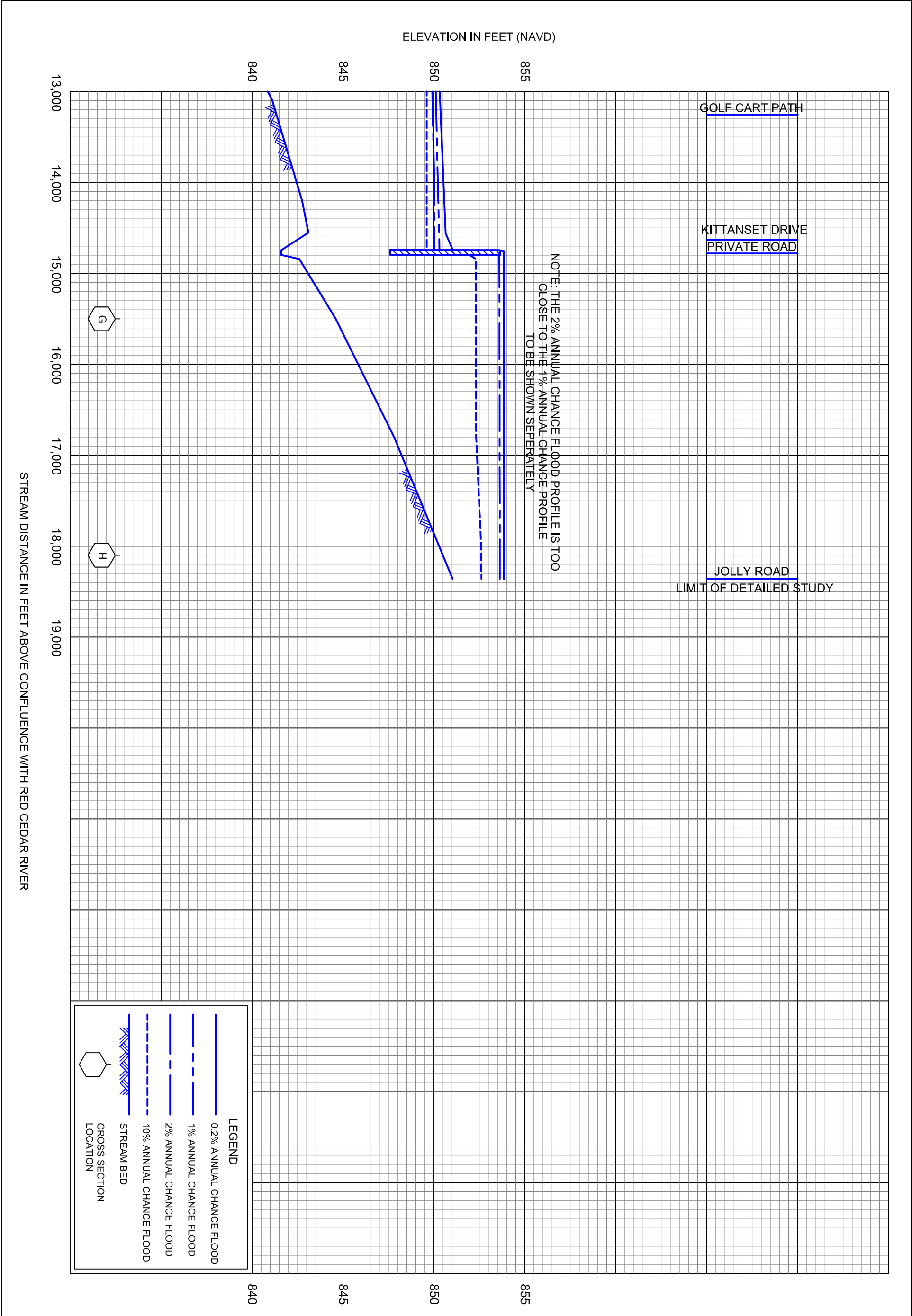


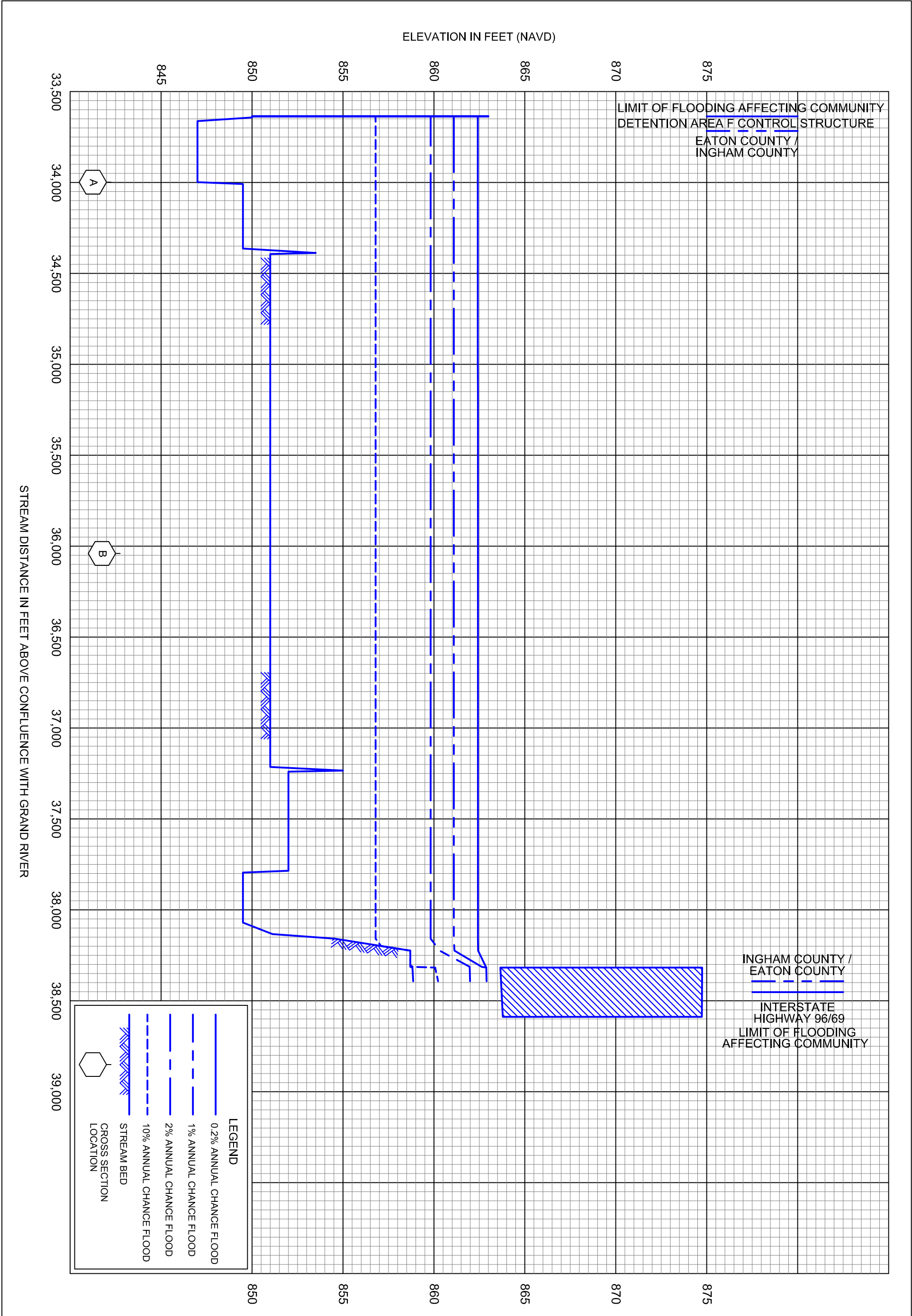
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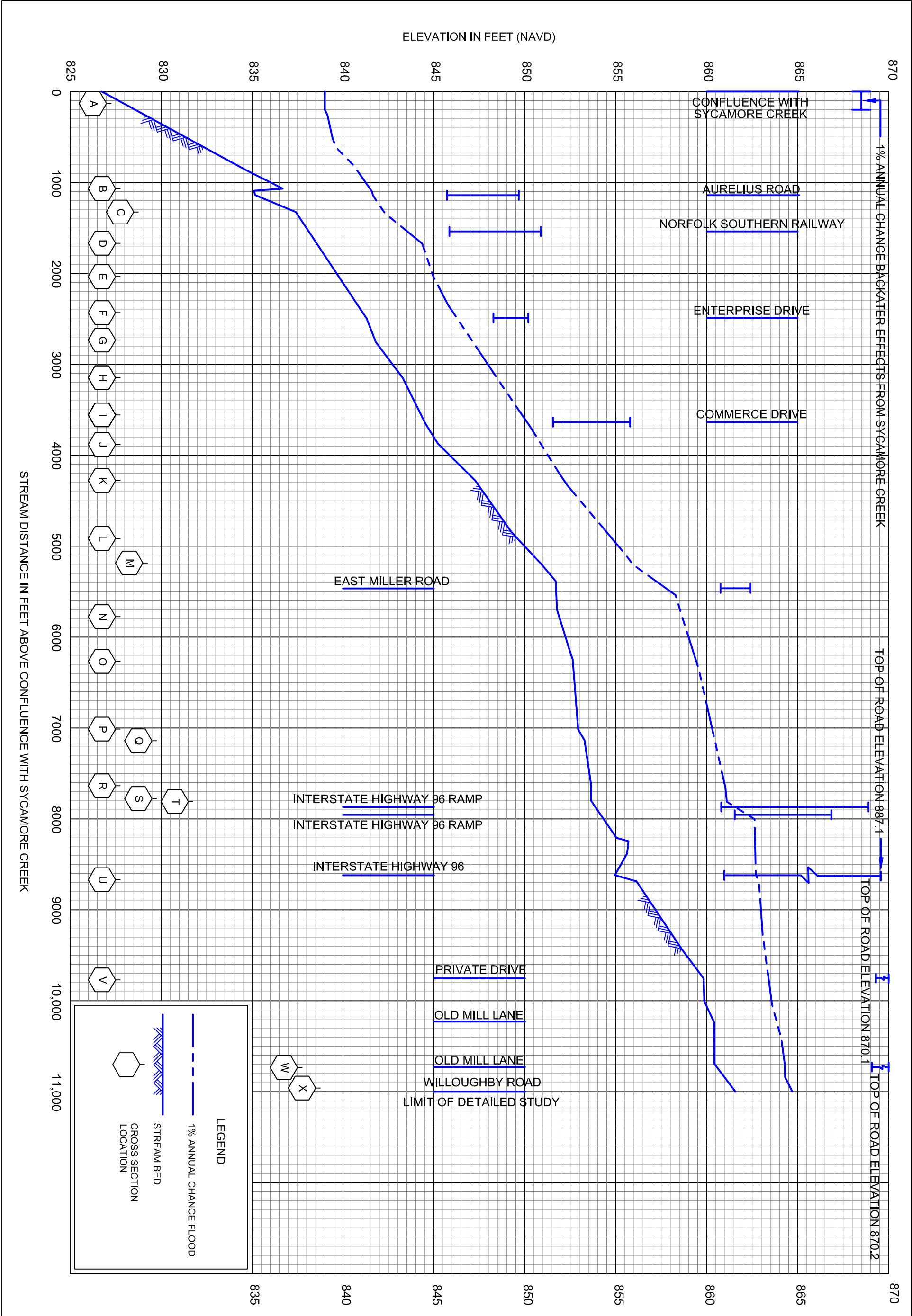
- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

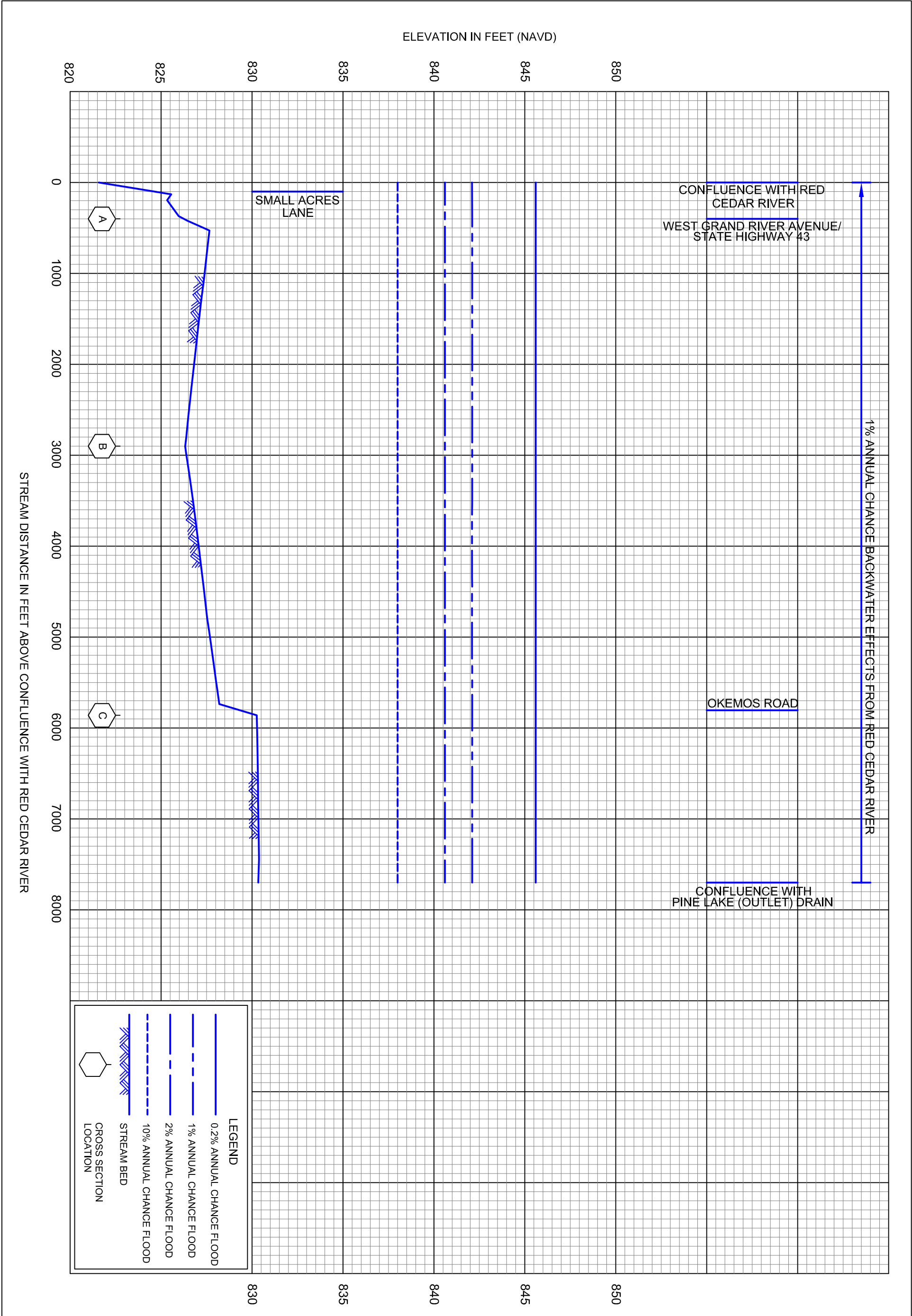






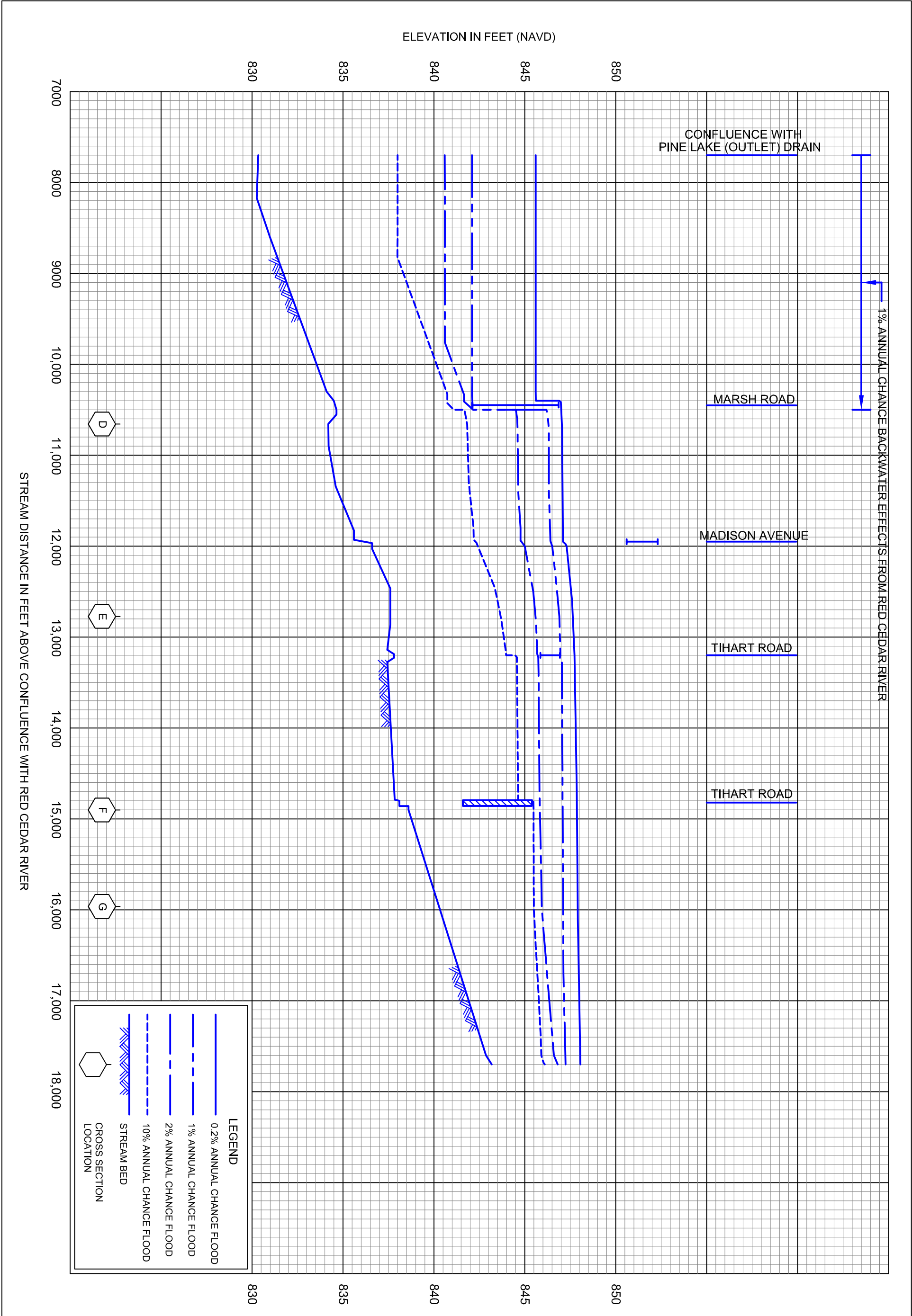


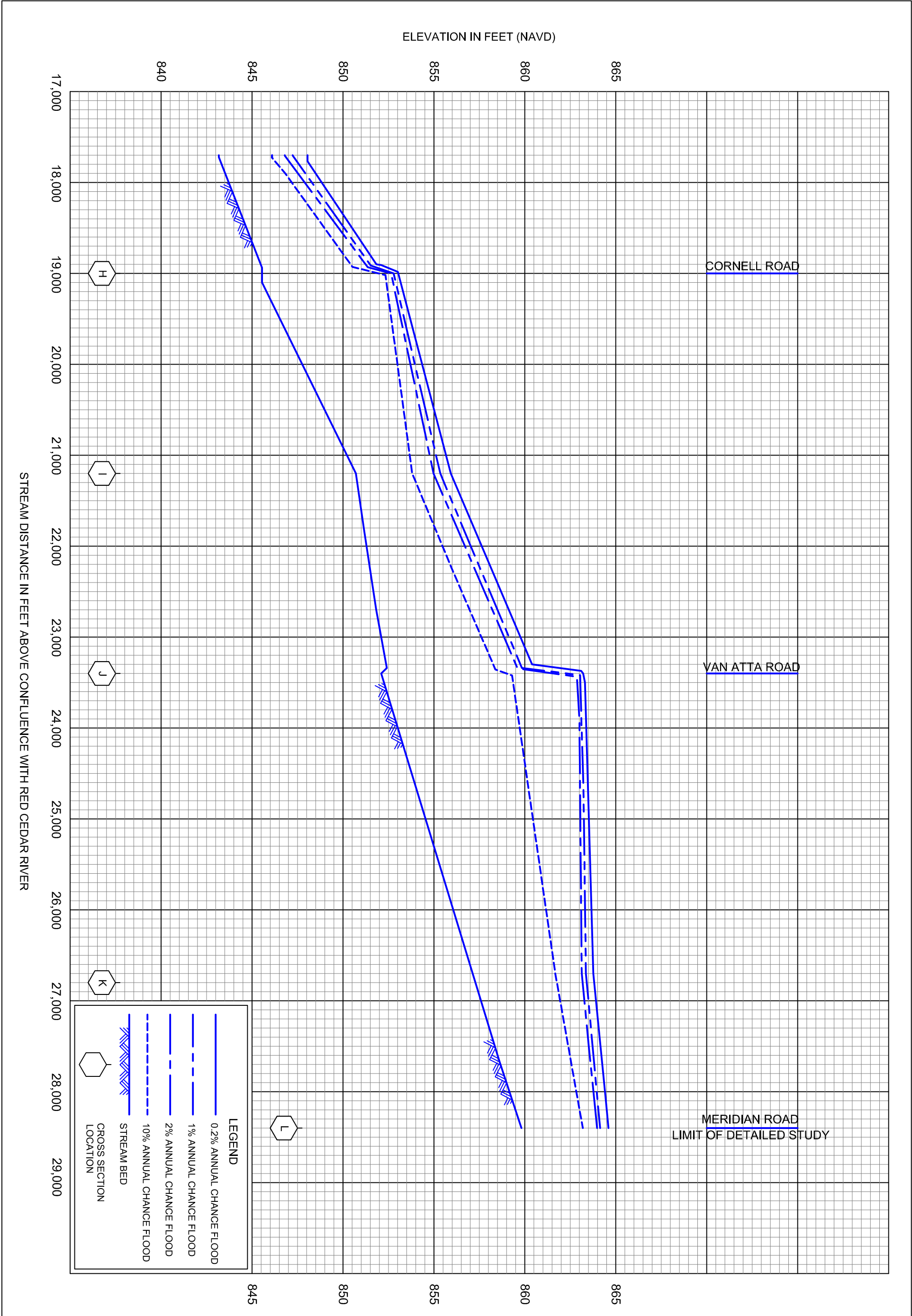


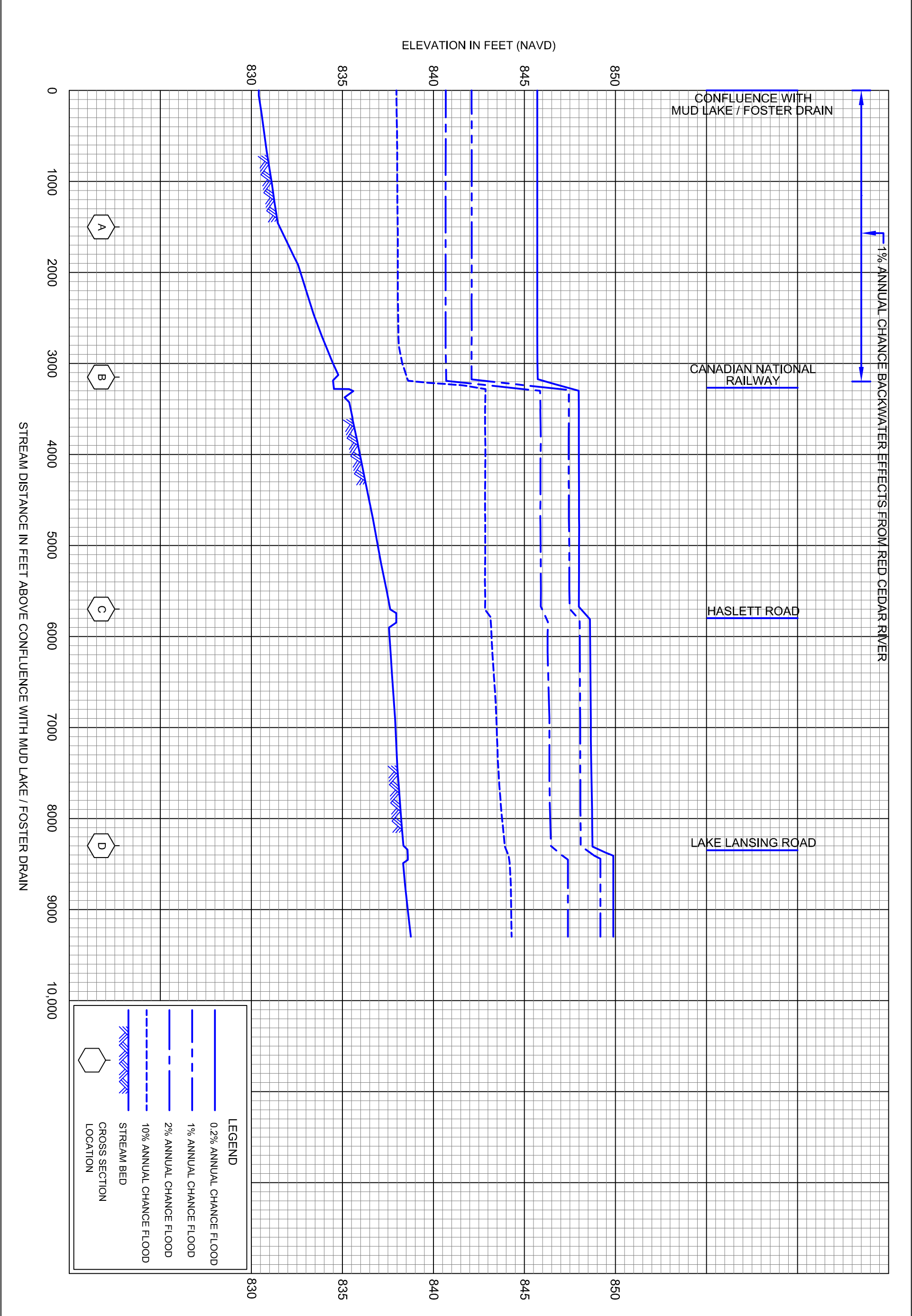


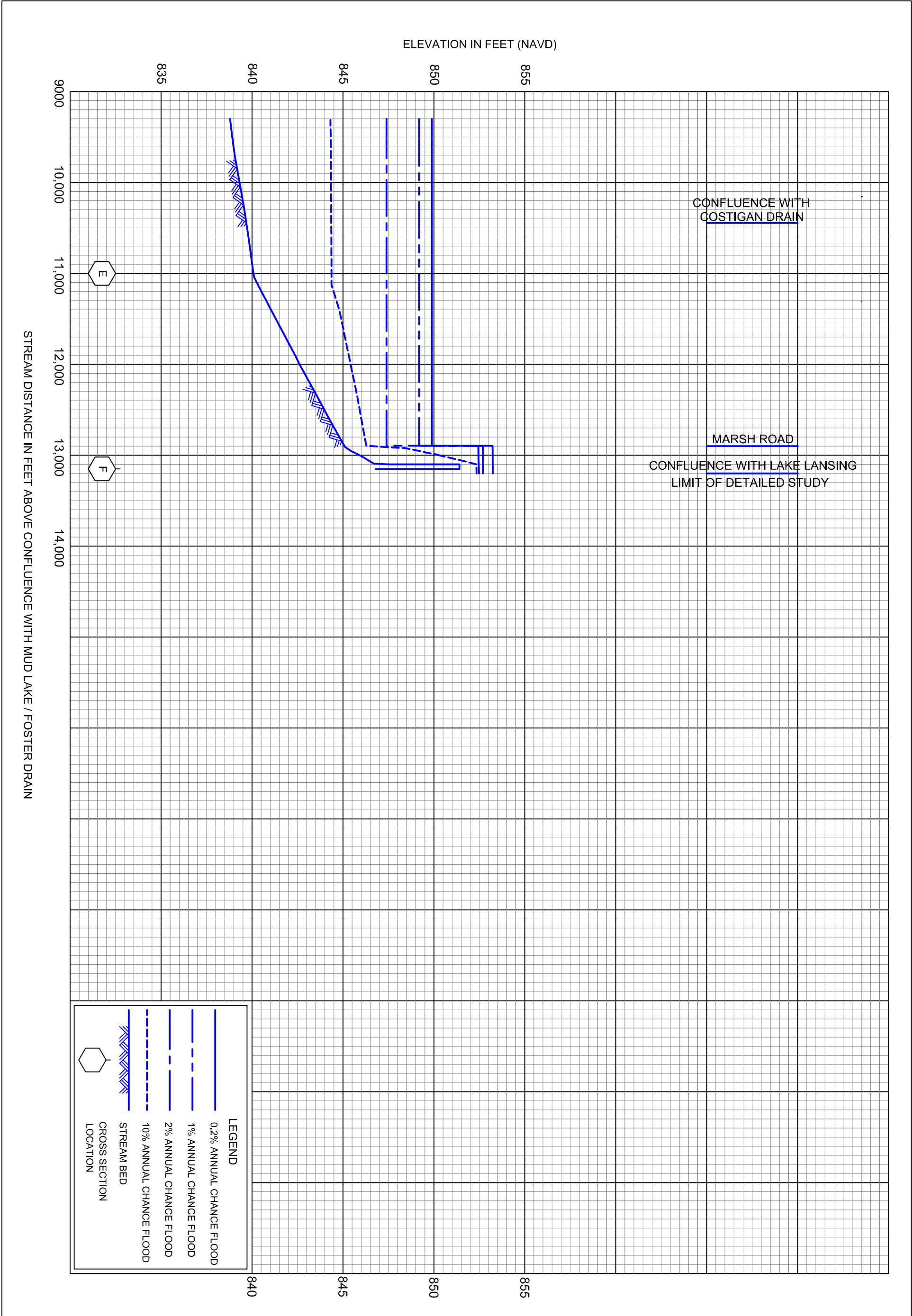
LEGEND

- 0.2% ANNUAL CHANGE FLOOD
- 1% ANNUAL CHANGE FLOOD
- 2% ANNUAL CHANGE FLOOD
- 10% ANNUAL CHANGE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

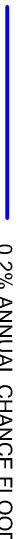
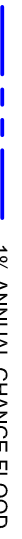

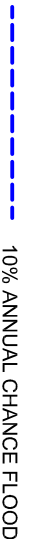
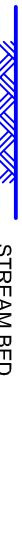
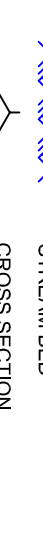


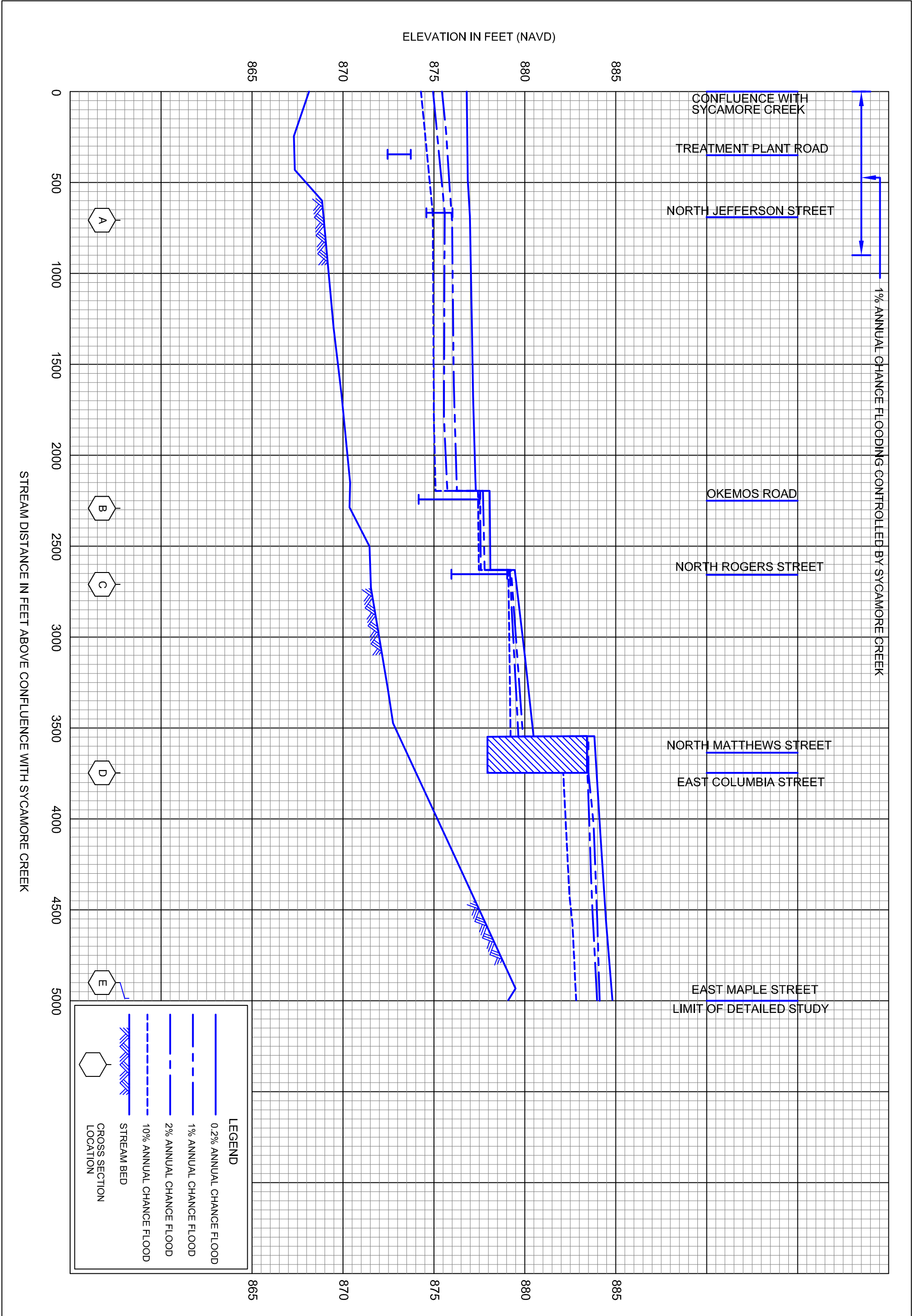


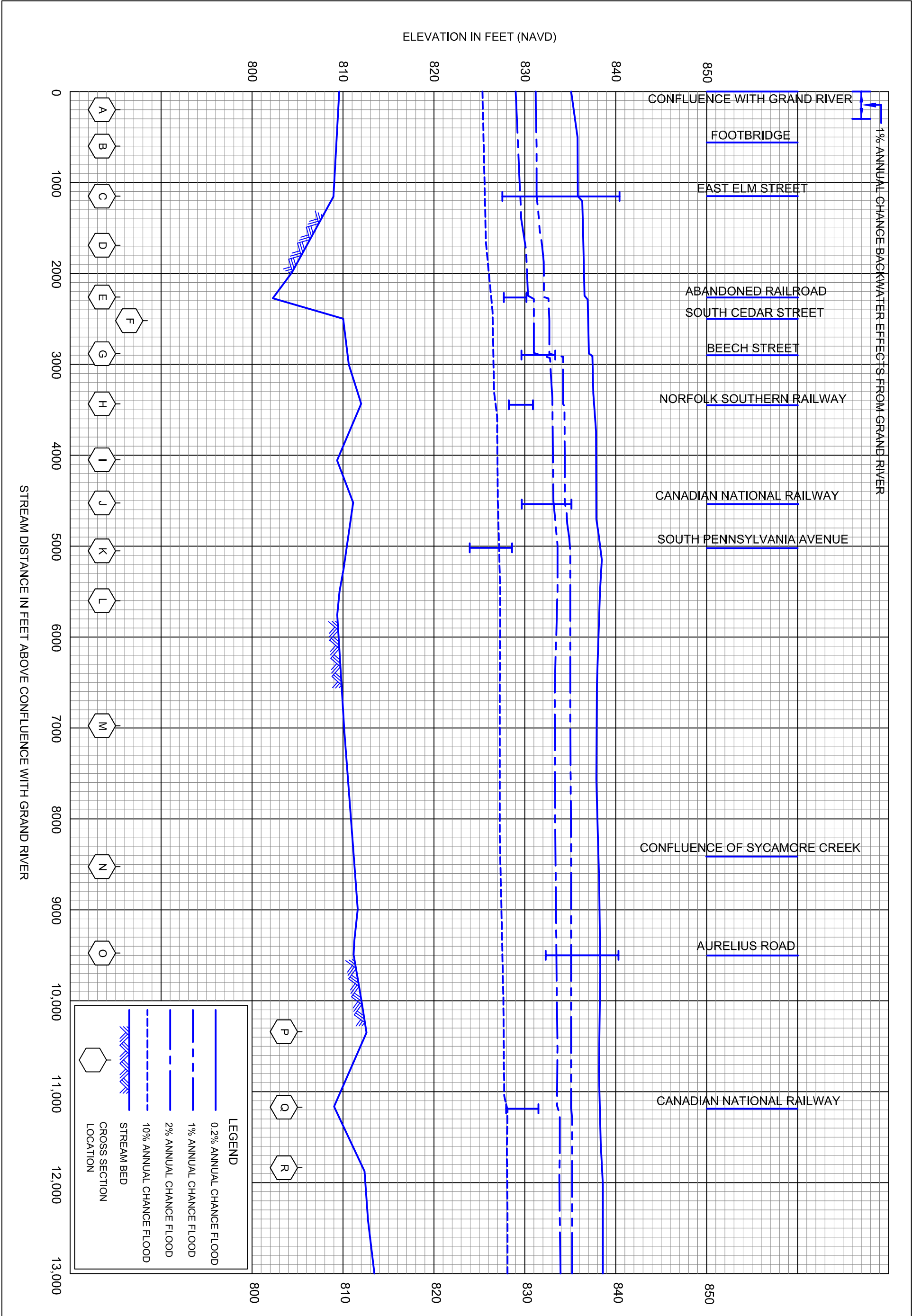


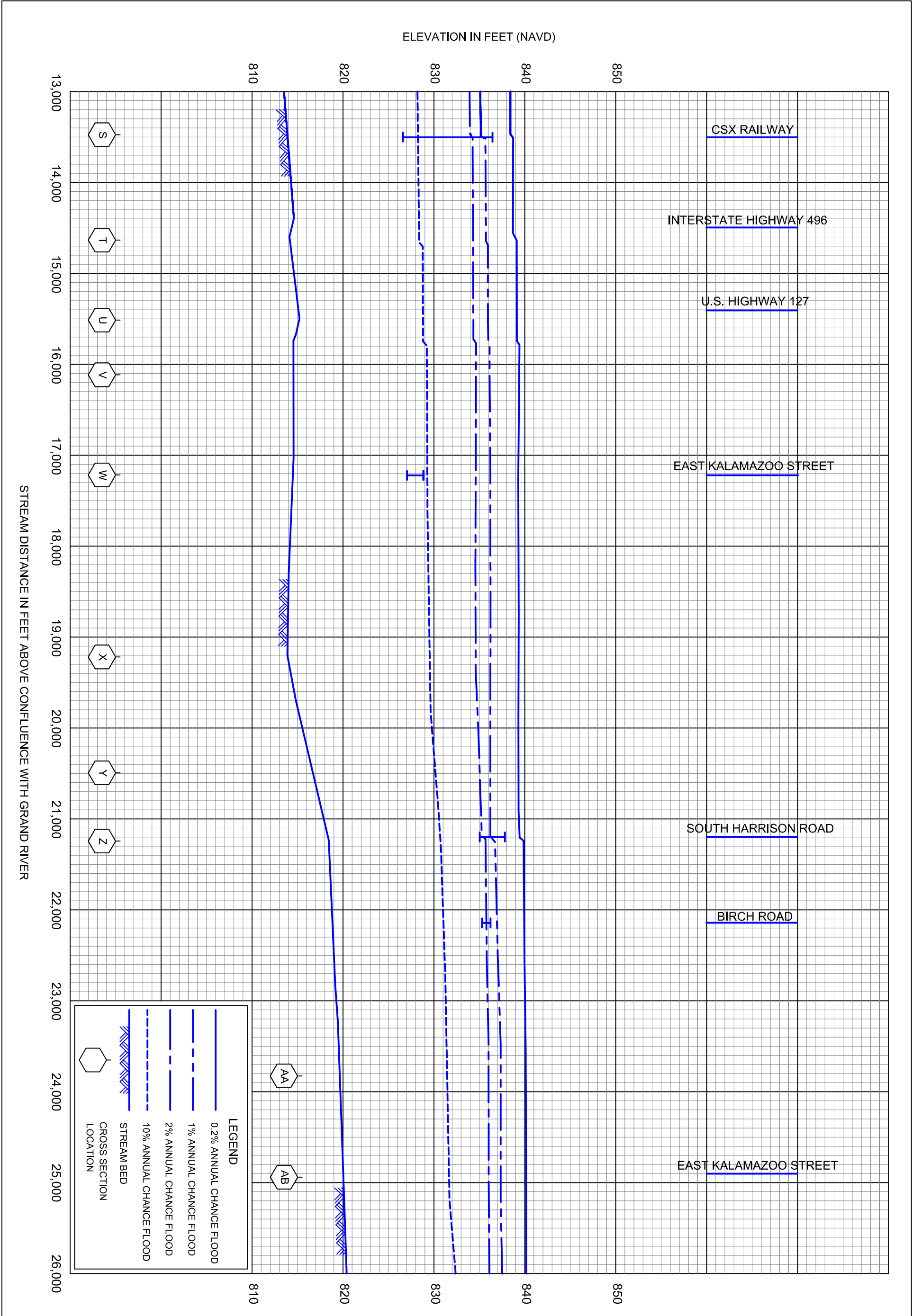


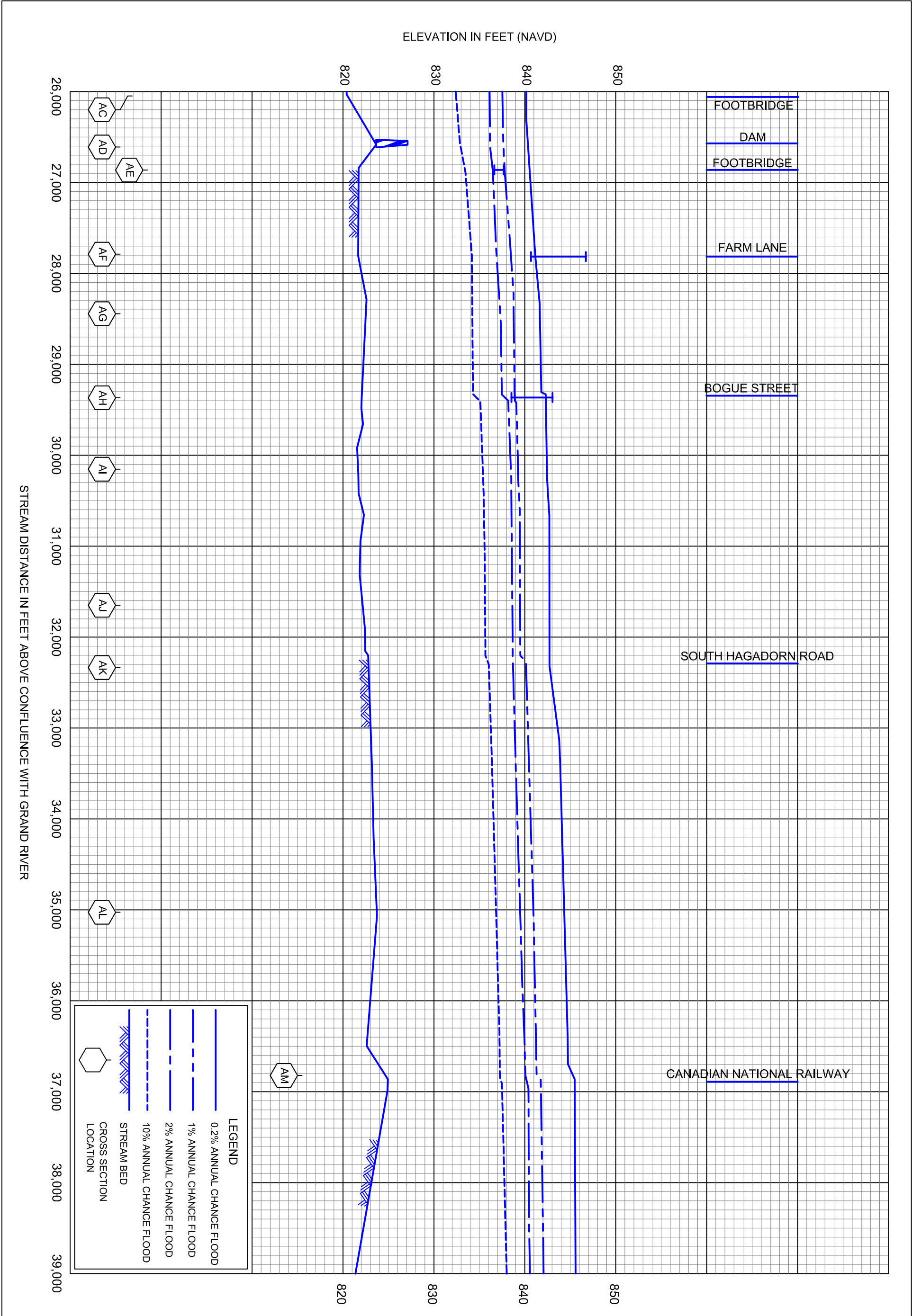
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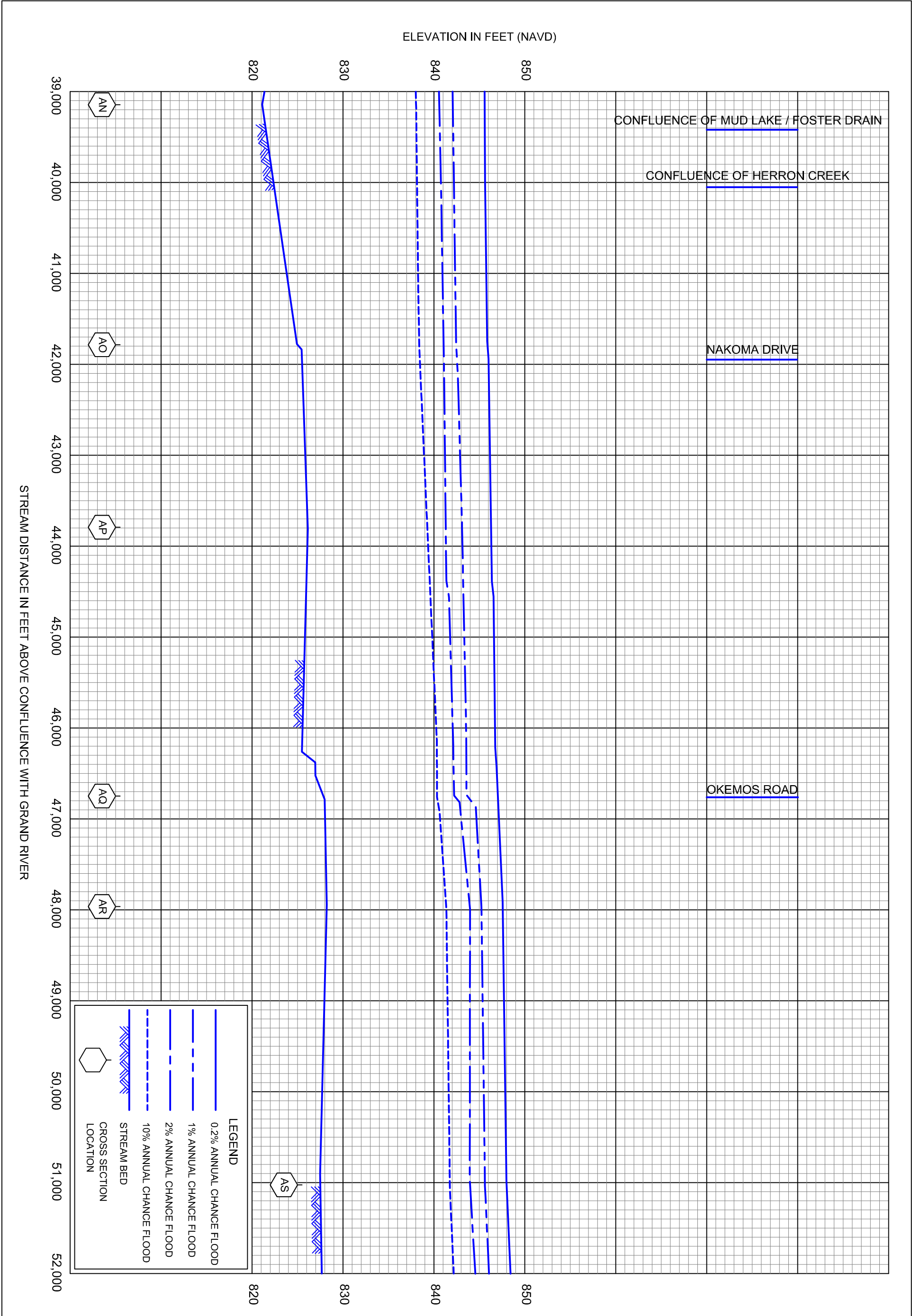
-  0.2% ANNUAL CHANCE FLOOD
-  1% ANNUAL CHANCE FLOOD
-  2% ANNUAL CHANCE FLOOD
-  10% ANNUAL CHANCE FLOOD
-  STREAM BED
-  CROSS SECTION LOCATION

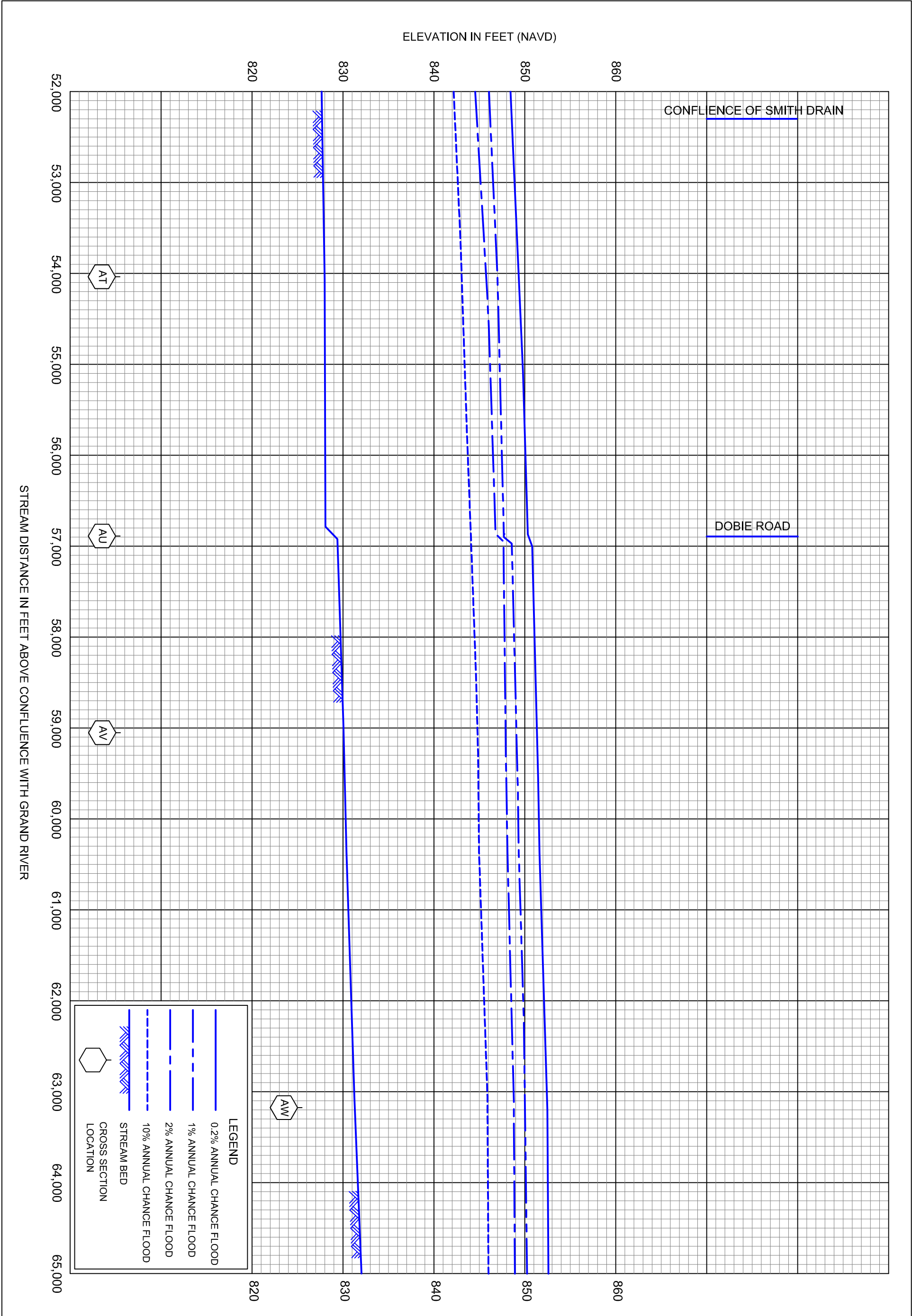


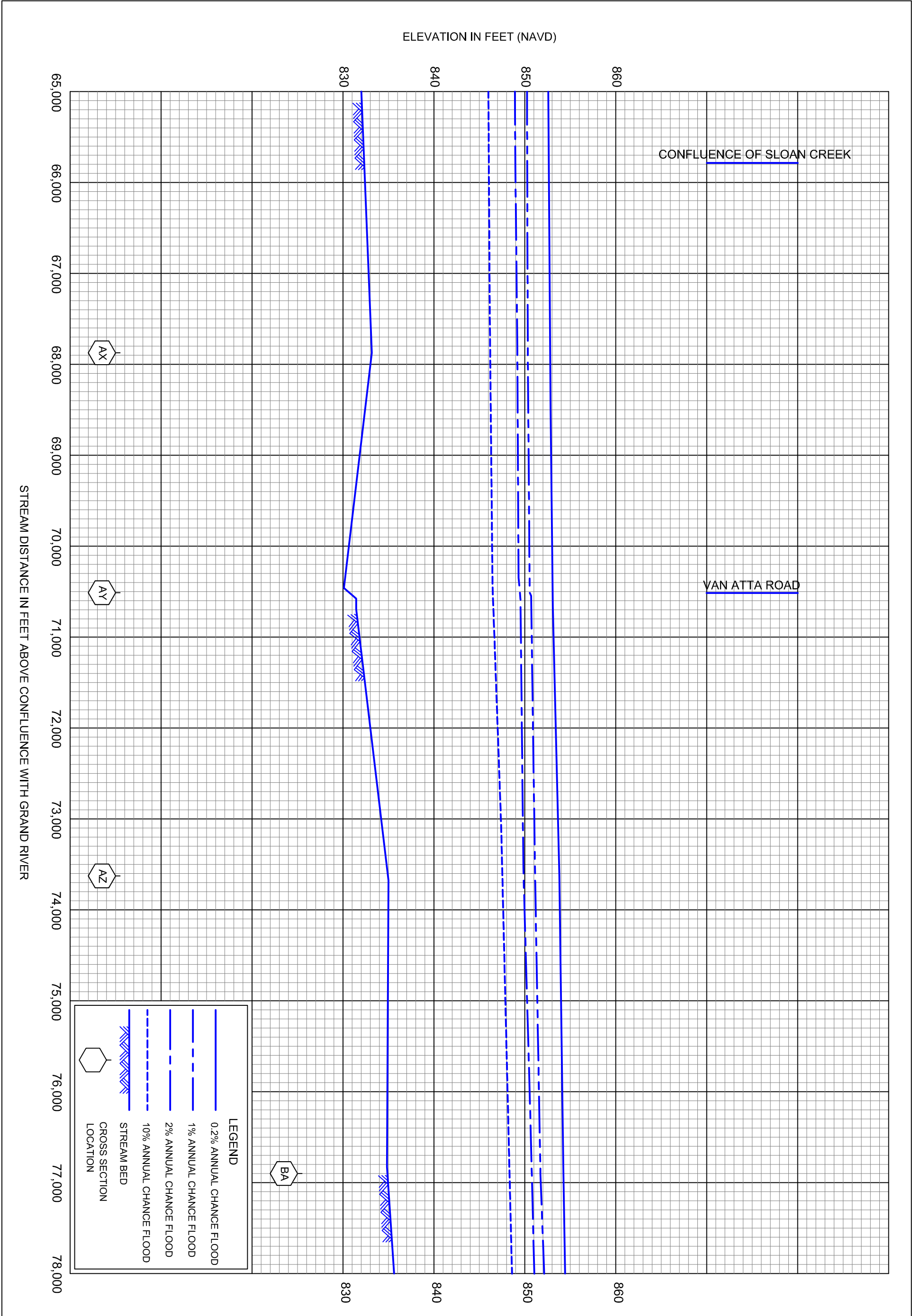


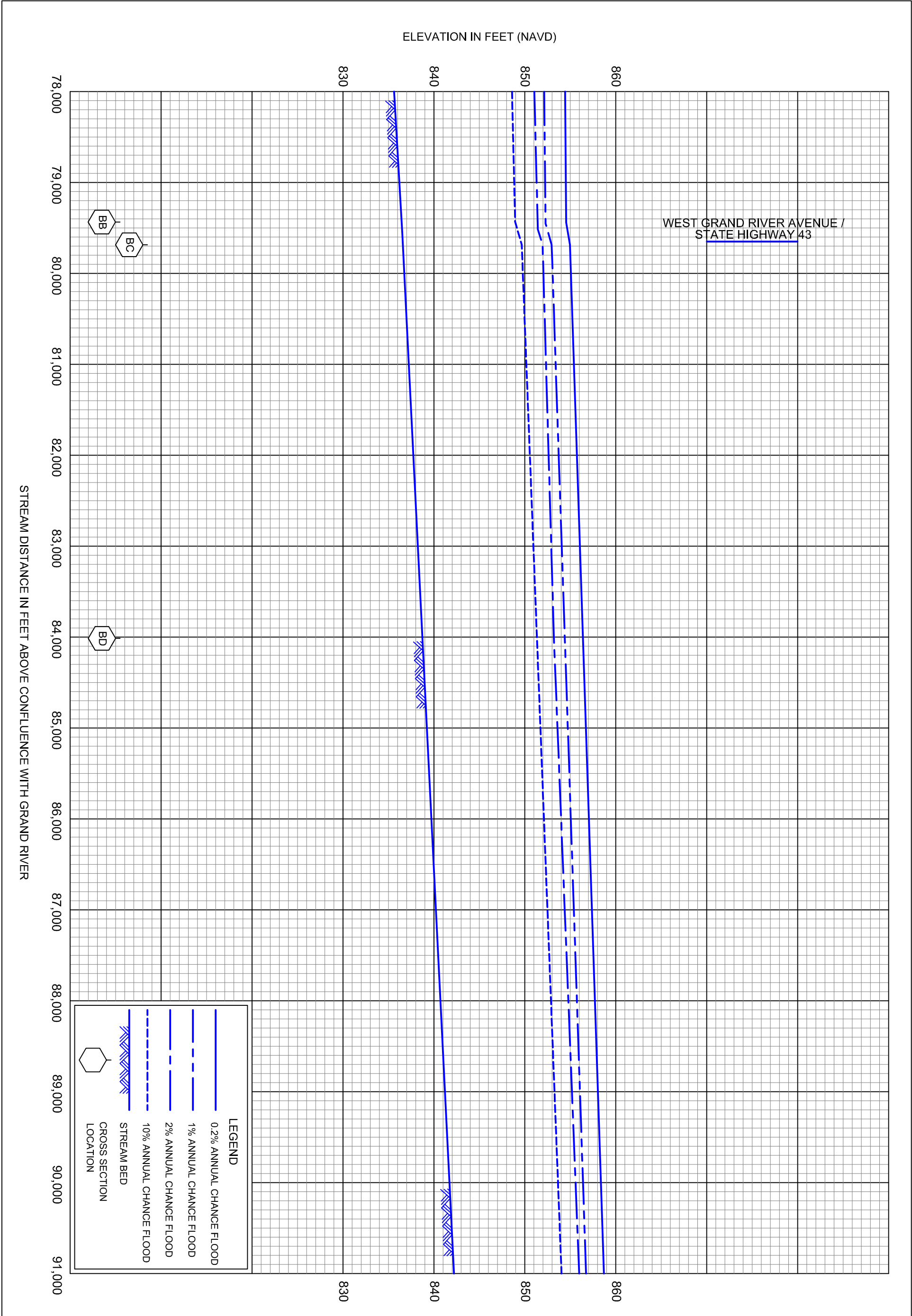


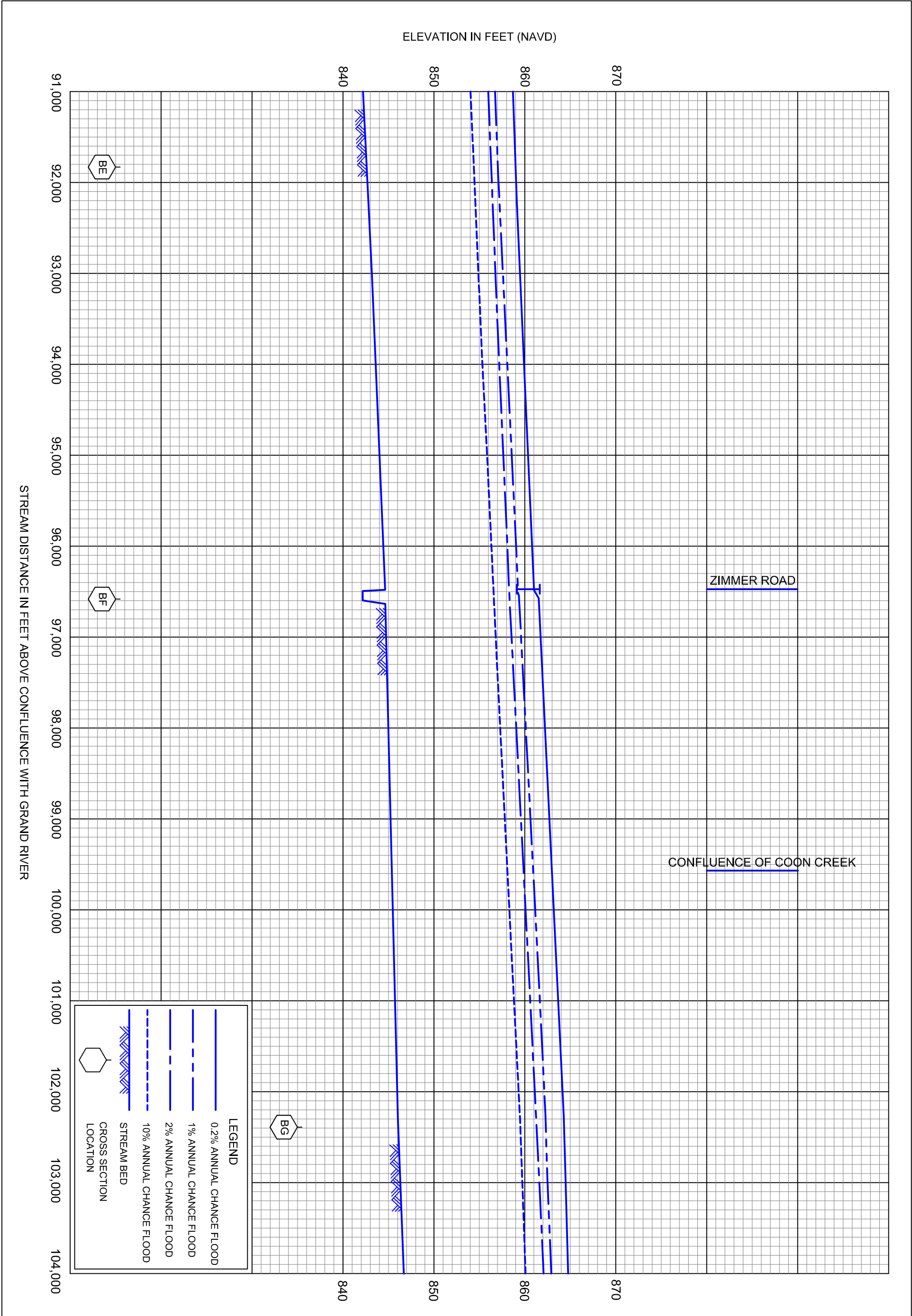


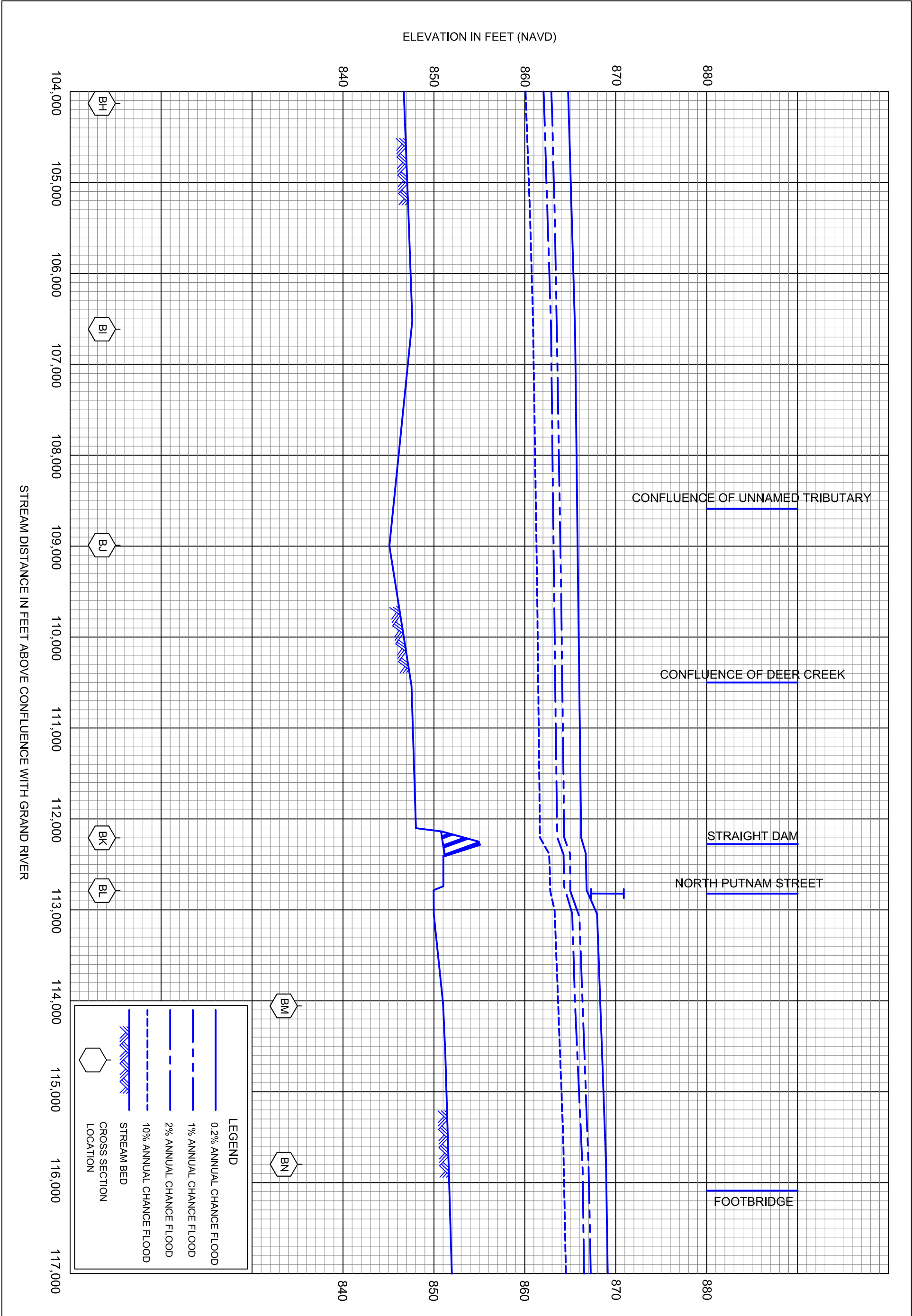


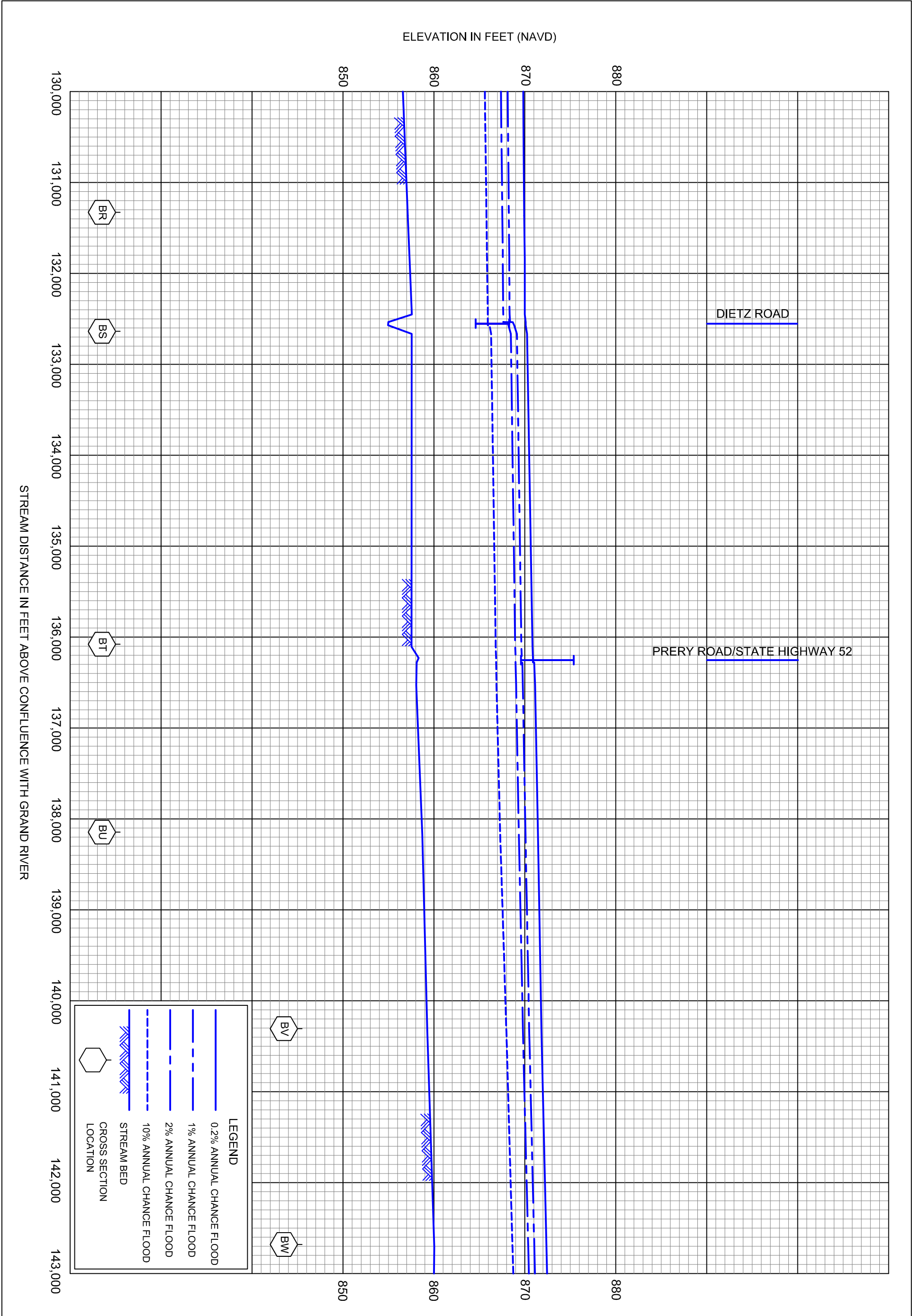


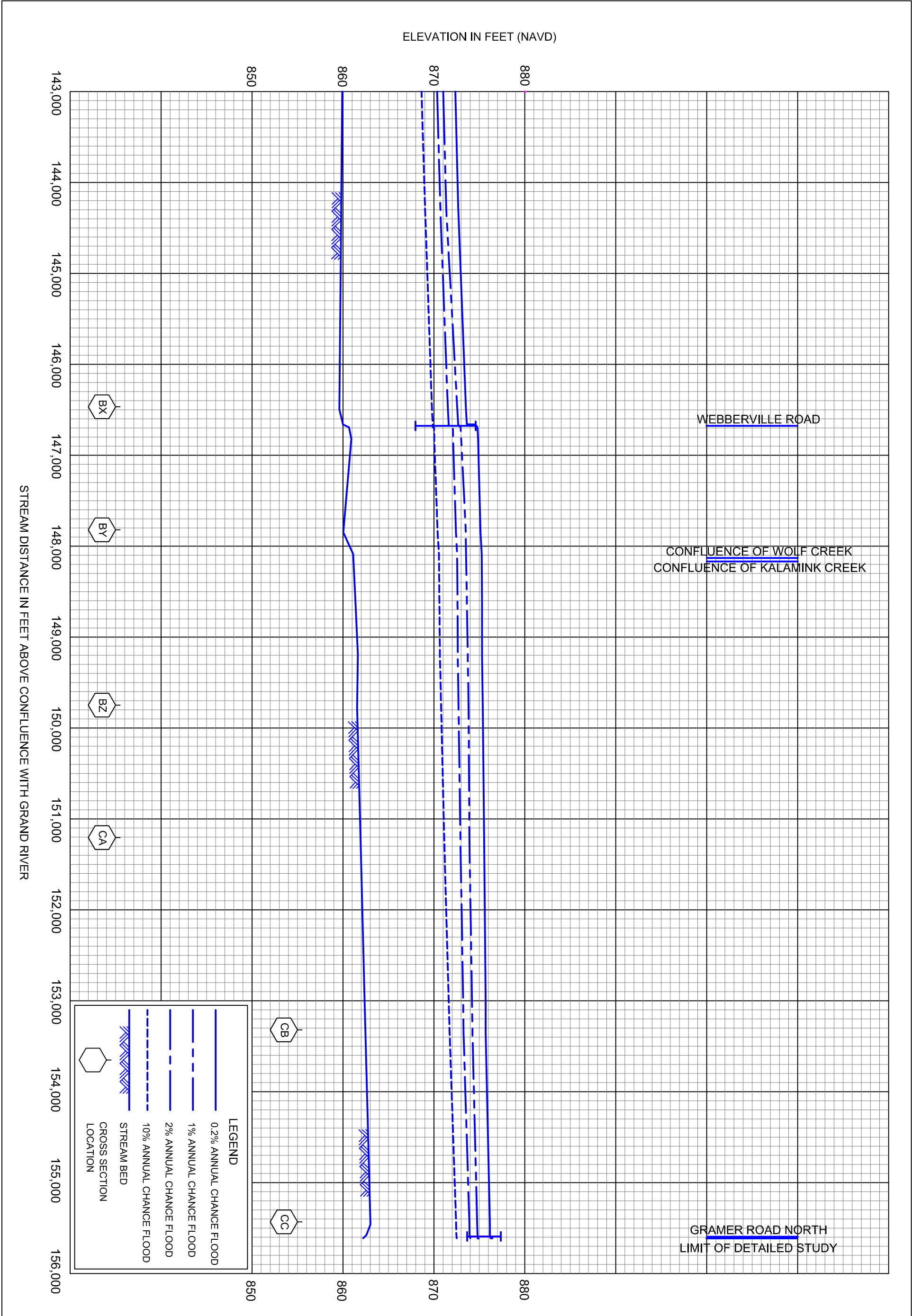


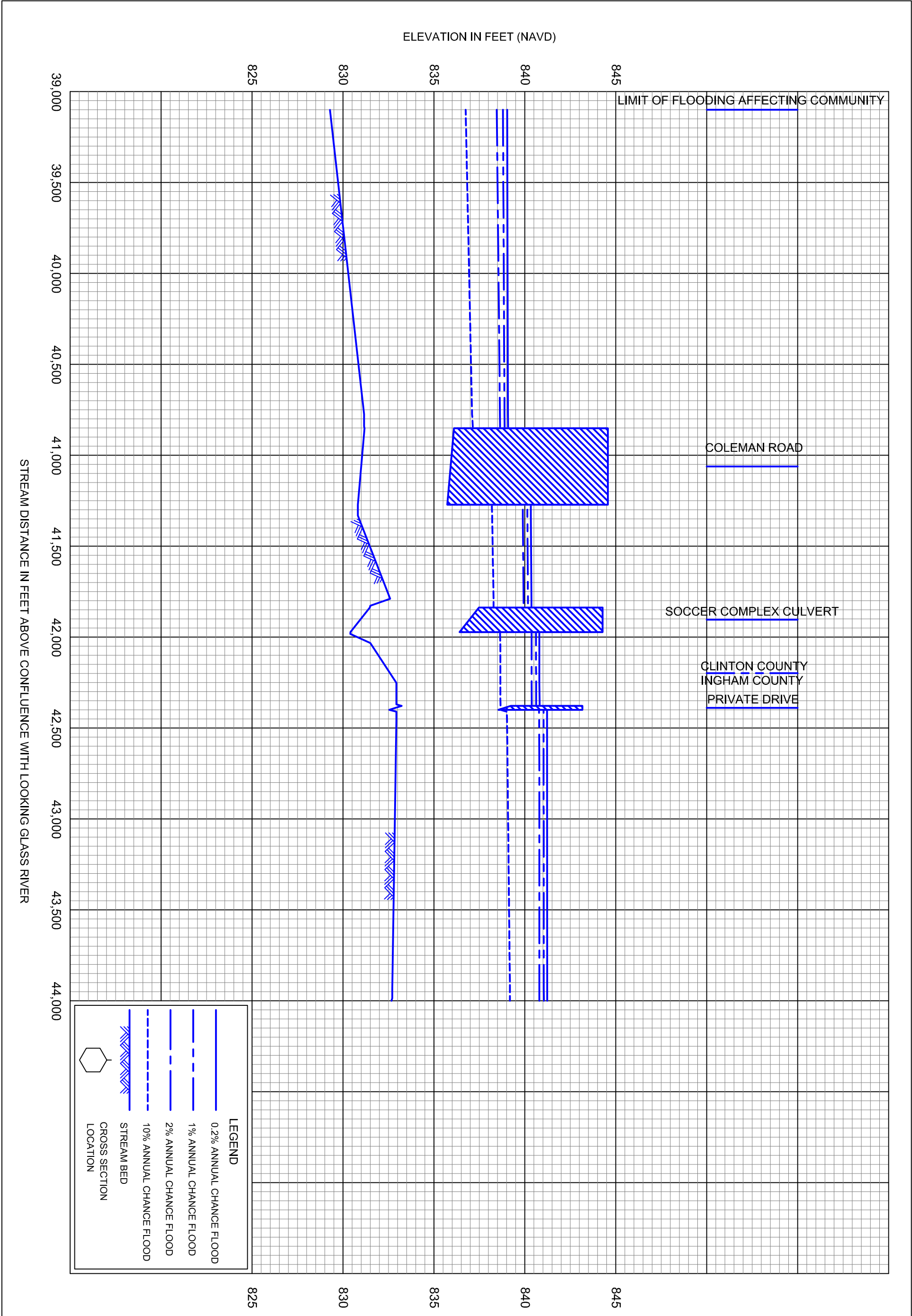




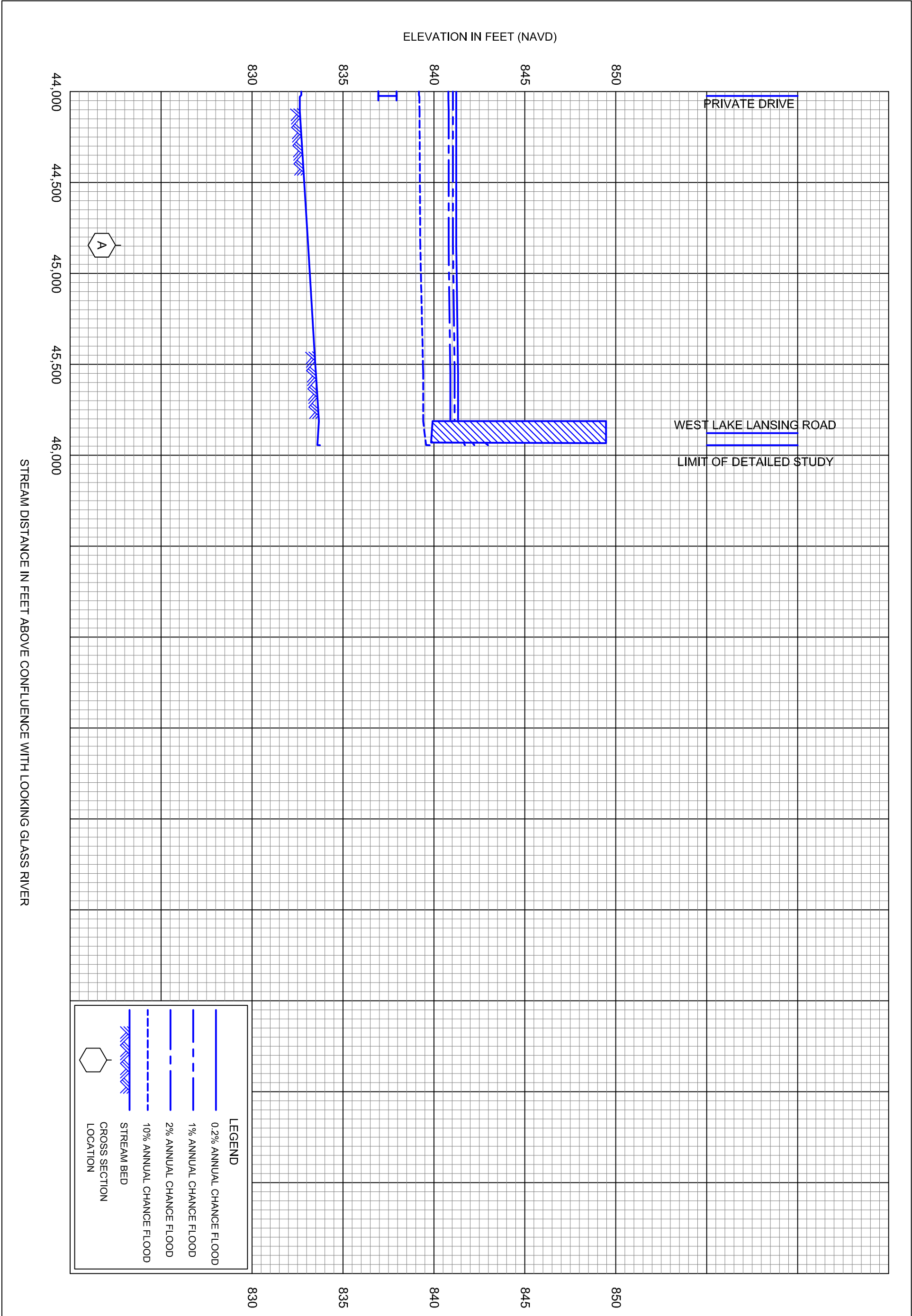


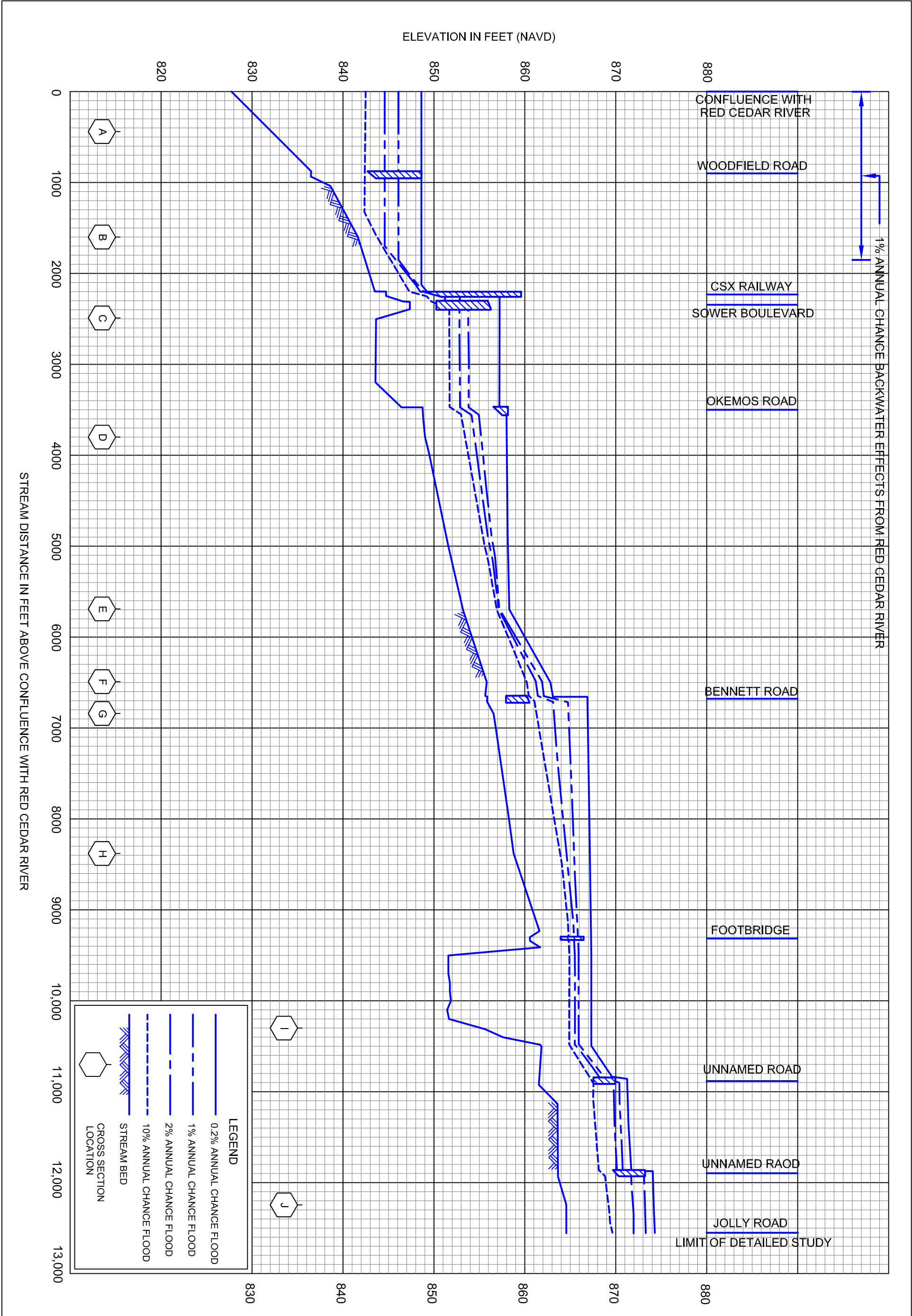


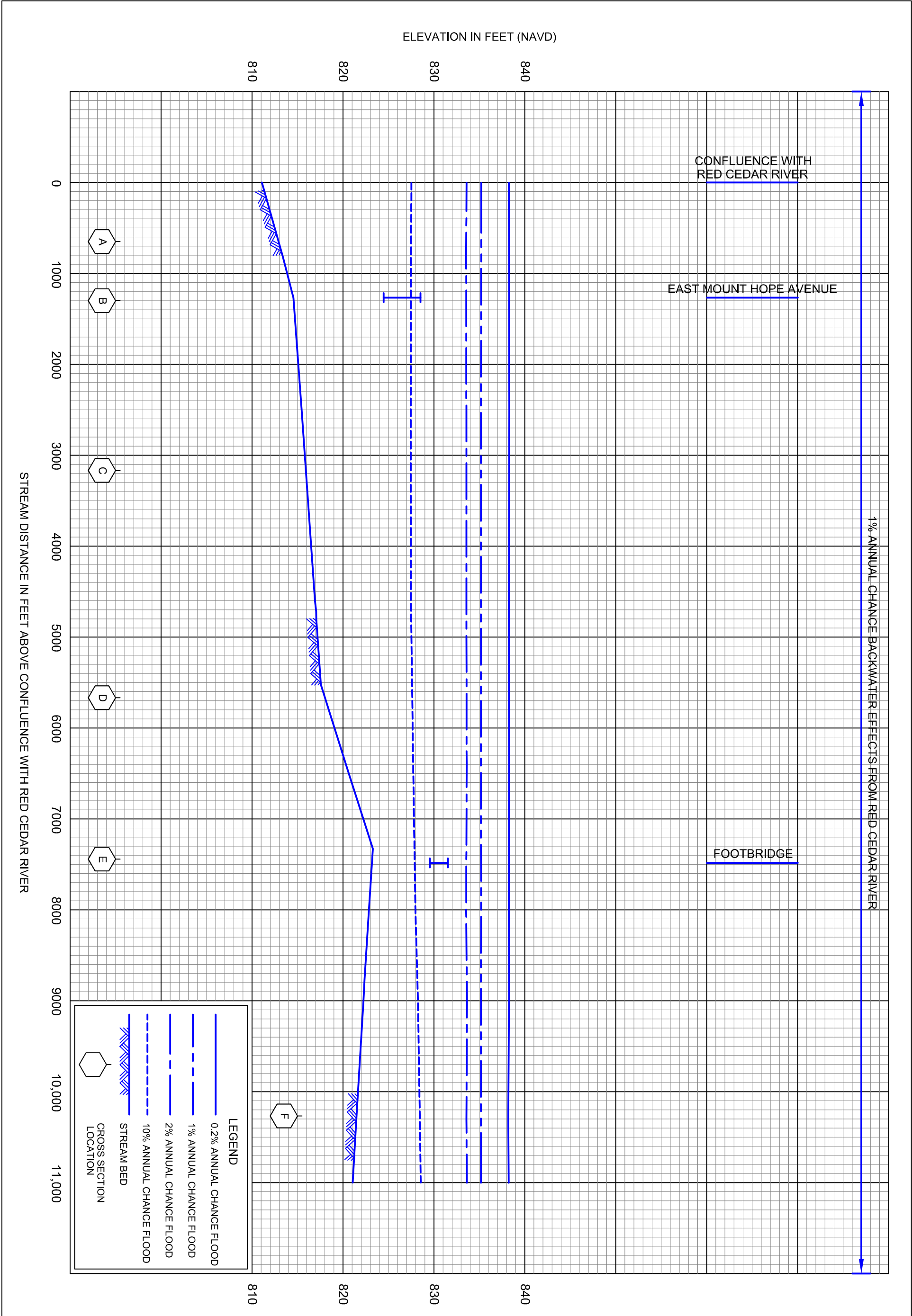


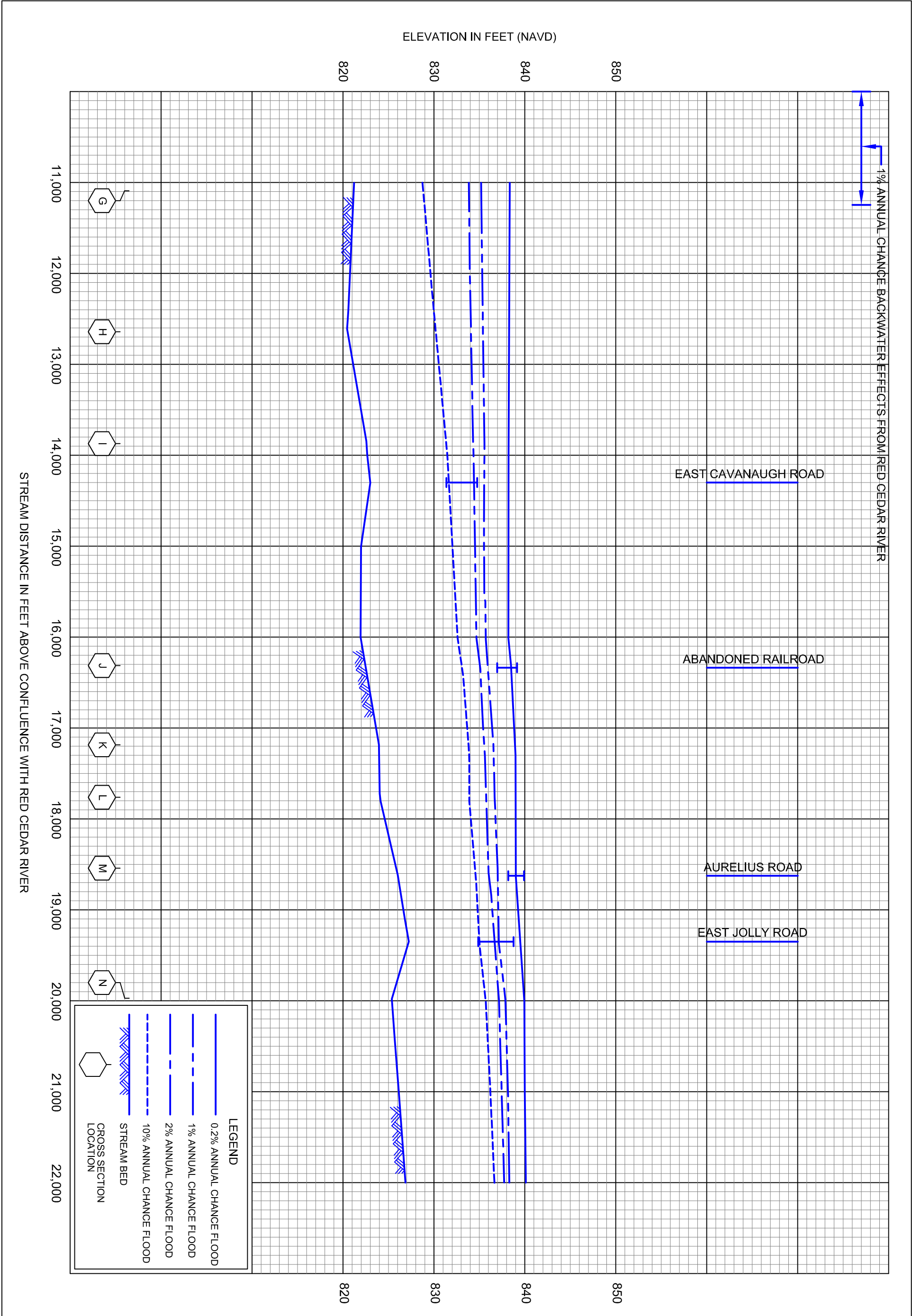


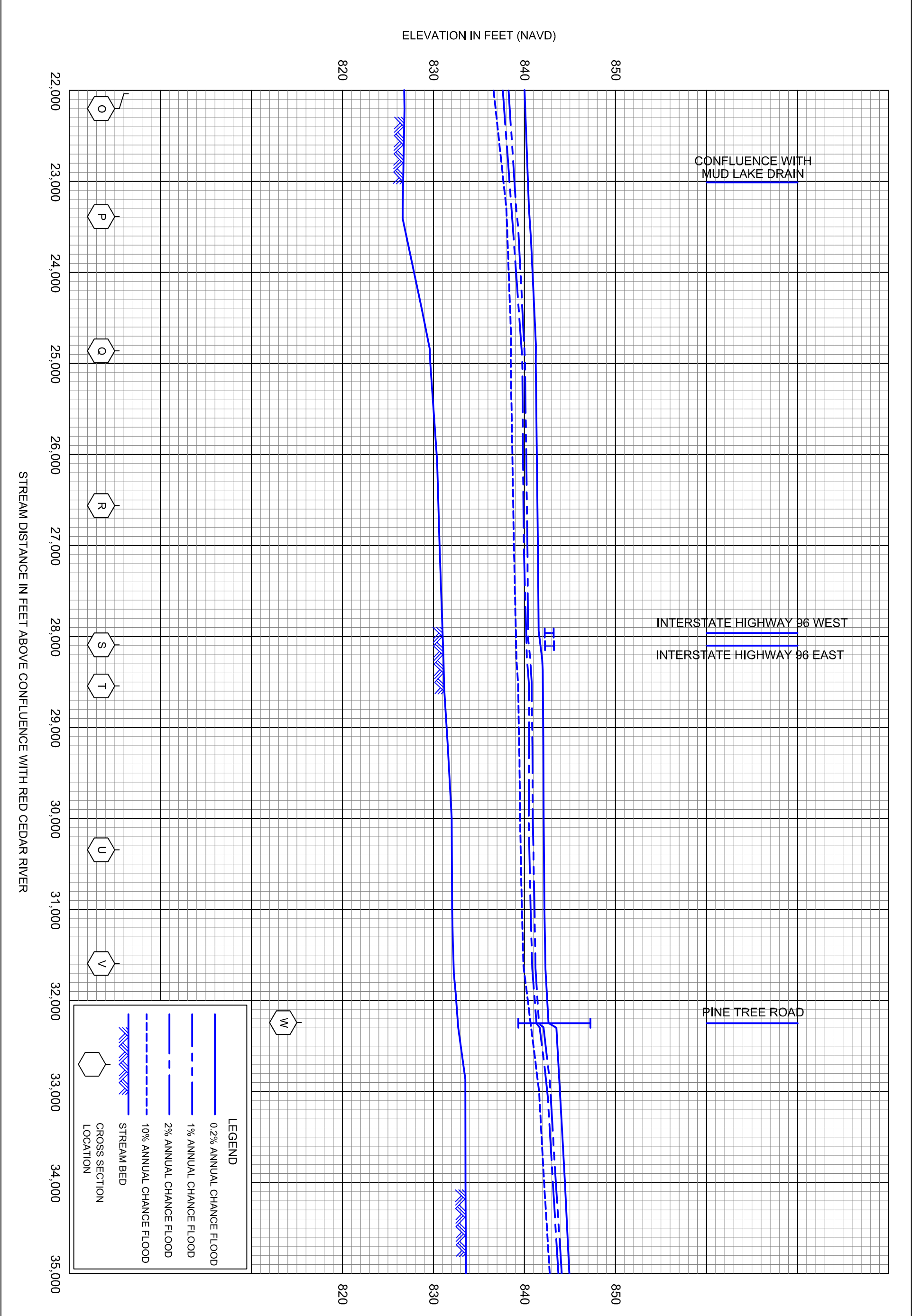
LEGEND	
	0.2% ANNUAL CHANCE FLOOD
	1% ANNUAL CHANCE FLOOD
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	STREAM BED
	CROSS SECTION LOCATION

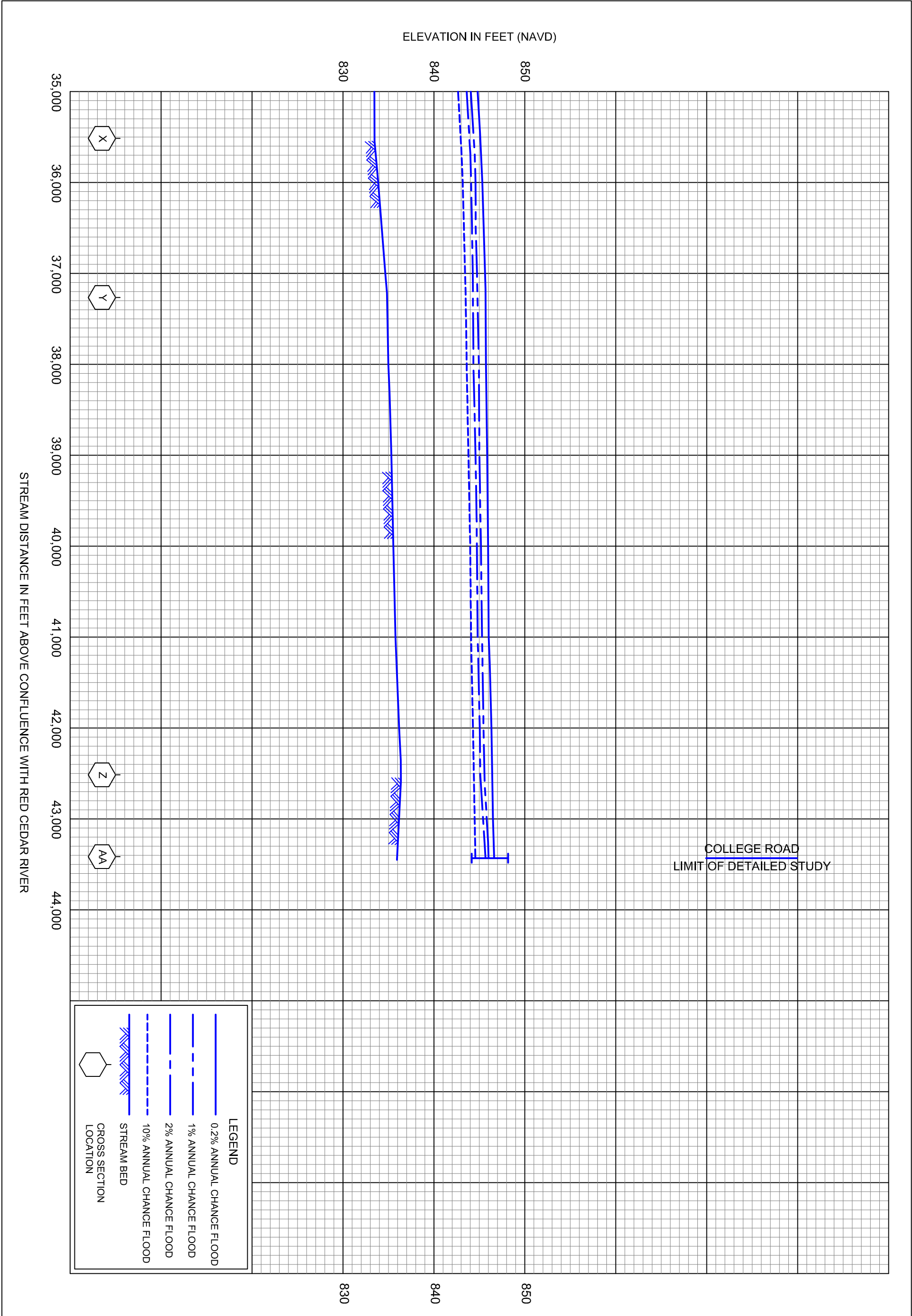


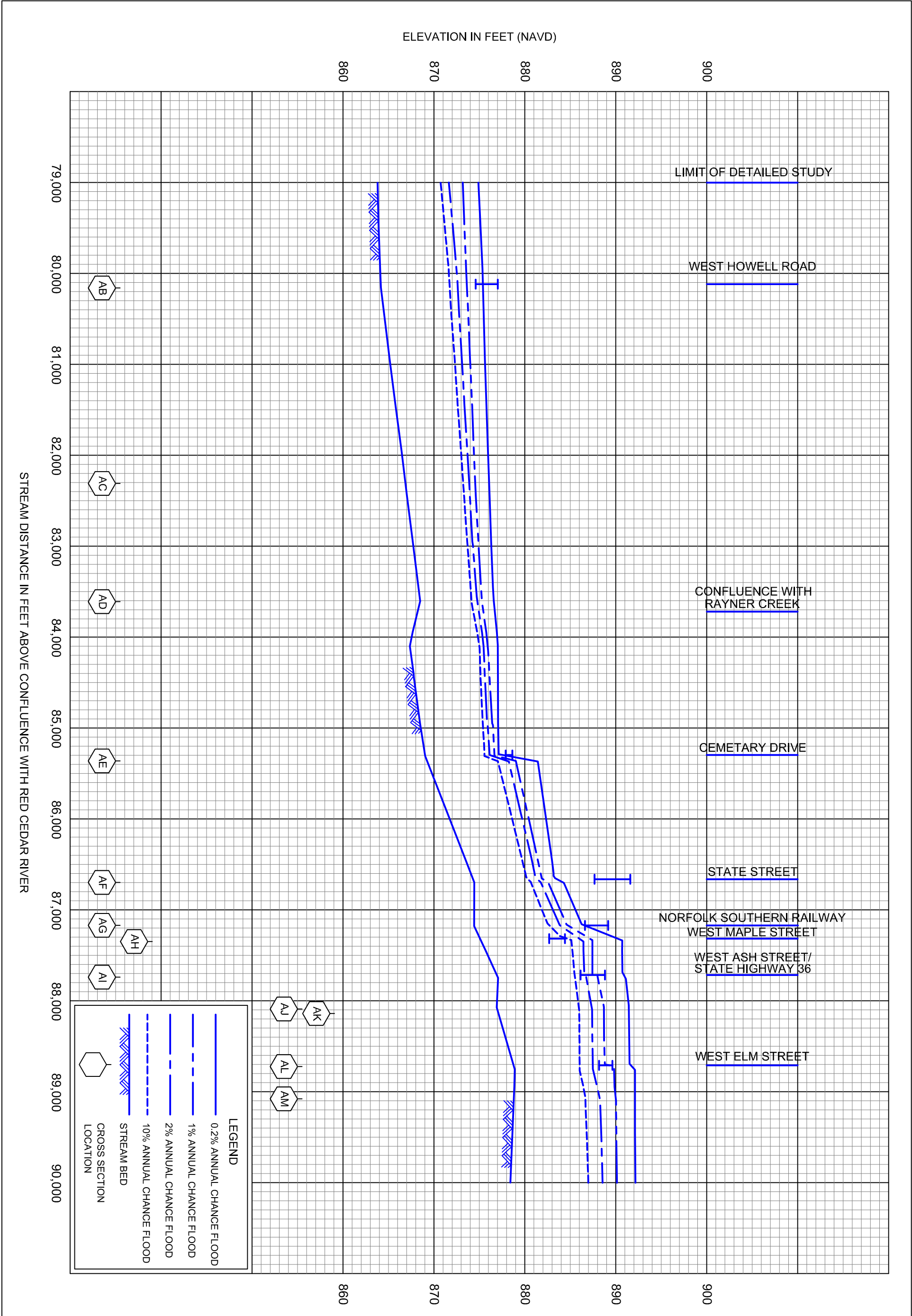












ELEVATION IN FEET (NAVD)

870
880
890
900

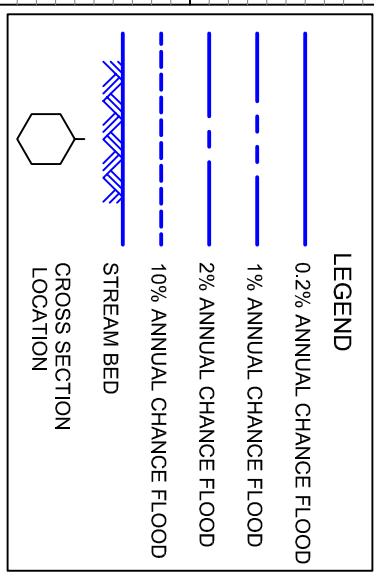
90,000
91,000
92,000
93,000
94,000

CONFLUENCE WITH
WILLOW CREEK

SOUTH JEFFERSON STREET

EAST KIPP ROAD
LIMIT OF DETAILED STUDY

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH RED CEDAR RIVER



880
890
900

41P

FEDERAL EMERGENCY MANAGEMENT AGENCY
INGHAM COUNTY, MI
(ALL JURISDICTIONS)

FLOOD PROFILES
SYCAMORE CREEK

