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Big Rock and Welch Creek Flood Study
Kane County, Illinois

by
Amanda J. Flegel, Jennifer L. Byard, and Sally A. McConkey
Center for Watershed Science

Prepared for
Kane County Department of Environmental Concerns

January 2009

Illinois State Water Survey
Institute of Natural Resource Sustainability
University of Illinois at Urbana-Champaign

Champaign, Illinois

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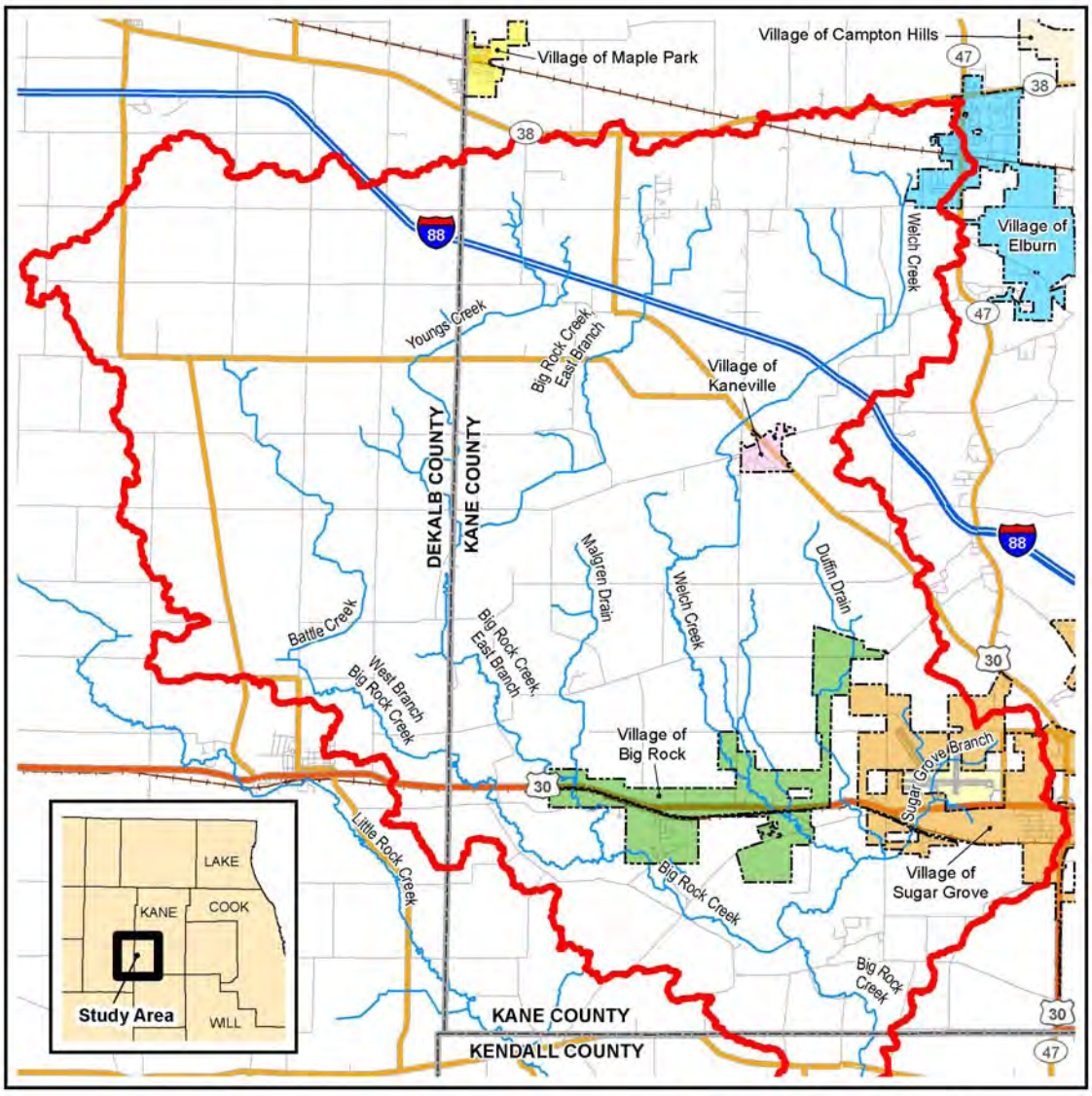

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Abstract

Big Rock and Welch Creeks are located in southwestern Kane County, Illinois. This area of Kane County is expected to experience development in the coming years; thus an accurate representation of local flood hazards is important. Regulatory floodplain maps now in effect for these streams show floodplain boundaries based on observations of flood events that occurred more than 30 years ago and lack engineering analyses that meet current standards and expectations. The purpose of this project is to better define flood hazards posed by streams in the Big Rock and Welch Creek watershed based on hydrologic and hydraulic analyses of existing conditions. Illinois State Water Survey (ISWS) staff worked with Kane County and community representatives to identify stream reaches for study and the level of study detail for each reach. Hydrologic and hydraulic analyses were conducted and used to delineate floodplain boundaries corresponding to the 1-percent-annual-chance flood, the base flood used by the Federal Emergency Management Agency (FEMA) for regulatory flood protection. Information was generated using spatial datasets and field data. Digital floodplain boundaries and attendant data are stored in the FEMA-prescribed Digital FIRM (DFIRM) database format for ready incorporation in the regulatory maps upon review and approval by FEMA. This study will provide information for floodplain management in both urban and rural areas.

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Project Overview

Big Rock and Welch Creeks are located in southwestern Kane County, Illinois. This area of Kane County is expected to experience development in the coming years; thus an accurate representation of local flood hazards is important. Flood hazards are depicted as floodplain boundaries on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs). These maps are used for regulatory purposes and for floodplain management. Accurate identification of flood hazards developed from engineering analyses provides important information for floodplain management and regulation, with the benefit of reduced risk for the public. FIRMs now in effect for these streams show floodplain boundaries based on observations of flood events that occurred more than 30 years ago and lack engineering analyses that meet current standards and expectations. The purpose of this project is to better define flood hazards posed by streams in the Big Rock and Welch Creek watershed based on hydrologic and hydraulic analyses of existing conditions.

Illinois State Water Survey (ISWS) staff worked with Kane County and community representatives to identify stream reaches for study and the level of study detail for each reach. Hydrologic and hydraulic analyses were conducted and used to delineate floodplain boundaries corresponding to the 1-percent-annual-chance flood, the base flood used by FEMA for regulatory flood protection. Information was generated using spatial datasets and field data. The flood study was conducted in accordance with Illinois and FEMA regulatory standards. Digital floodplain boundaries and attendant data are stored in the FEMA-prescribed Digital FIRM (DFIRM) database format for ready incorporation in the regulatory maps upon review and approval by FEMA. This study will provide information for floodplain management in both urban and rural areas.

Acknowledgments

This material is based on work supported by the Kane County Department of Environmental Concerns. This project is part of the Smart Growth Floodplain Monitoring Project, Kane County, Illinois, sponsored by the Natural Resources Conservation Service.

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the University of Illinois.

The project work involved a number of disciplines and talented individuals without whose contribution the project could not have been performed. The Illinois Department of Natural Resources, Office of Water Resources provided land surveying support. Many staff from the ISWS, Center for Watershed Science contributed to the project. Jim Slowikowski supervised the installation of gages and collection of the precipitation, stage, and discharge data. Aaron Thomas assisted with the preparation of the input for the HEC-RAS models, identification of gage locations, and site reconnaissance. Ryan Meekma provided geographic information system support and prepared the digital flood maps and the DFIRM geospatial database. Becky Howard formatted the report. Sara Olson provided guidance for preparation of the graphics. Lisa Sheppard edited the final report.

Scope of Work

The Big Rock Creek/Welch Creek watershed flood study includes approximately 68 stream miles. Two levels of flood study were conducted; a limited-detail flood study was conducted for 38 stream miles and an approximate study was conducted for 30 stream miles in the Big Rock Creek/Welch Creek watershed areas within Kane County.

Two meetings were held with Kane County and community representatives. The first meeting was to outline the project, identify stream reaches for which limited-detail and approximate study would be conducted, and collect community data such as bridge plans. A second meeting was held to examine preliminary floodplain boundaries generated from models prepared for the study and to collect documentation of observed flood extent.

The project included assimilating crest stage gages operated circa 1961-1975 and precipitation data at existing gages in the watershed vicinity. A temporary precipitation gage was installed as well as stream stage gages at four locations in the watershed. Precipitation and stream stage data, including periodic discharge measurements, were collected from May to November 2008 at the stream gage sites. Field measurement of bridge and culvert dimensions at critical locations was performed. Surveys conducted by the Illinois Department of Natural Resources, Office of Water Resources (IDNR/OWR) provided valuable stream channel configuration information, bridge elevation data, and datum of the temporary stage gages.

The U.S. Army Corps of Engineers' Hydrological Engineering Center-Hydrologic Modeling System (HEC-HMS), version 3.2 (Scharffenberg and Fleming, 2008), was used to compute flood discharges. The 1-percent-annual-chance discharge was calculated at locations throughout the watershed. Gage data collected during the project were used to prepare the hydrologic model.

The U.S. Army Corps of Engineers' Hydrological Engineering Center-River Analysis System (HEC-RAS), version 4.0 (Brunner, 2008; Warner et al., 2008), was used for hydraulic modeling. Digital elevation data available from Kane County were used to generate cross section data input for the model. Where available, as-built bridge plans were reviewed and used to model these structures. Where bridge plans were not available, field measurements and

survey data were collected. Photos were taken throughout the watershed to document existing conditions and determine roughness coefficients for modeling.

Modeling results were incorporated in the FEMA DFIRM database format, and maps and tabular data were prepared. The information will serve as the basis for submittals to the IDNR/OWR for discharge certification and to FEMA to update the regulatory DFIRM.

Level of Study Detail

Three levels of investigation are used for FEMA studies and are shown on Flood Insurance Rate Maps (FIRMs). The three levels are approximate, limited-detail, and detailed studies. The objective of each level of study is to determine the boundaries of floodplains representing the area that has a 1-percent chance of inundation in any given year (100-year floodplain). The type of analysis and data requirements are different for each level of study. The expected accuracy increases with an increasing level of study intensity.

Approximate floodplain boundaries may be delineated using a variety of information sources. Discharges may be estimated and simple engineering analyses are used such as normal depth or backwater model estimation of flood depths with minimal assessment of the influence of structures and significant confluences. This level of study produces floodplain boundaries with no attendant engineering data published in the FEMA Flood Insurance Study (FIS).

Limited-detail studies (also known as enhanced Zone A studies) require more rigorous analysis than approximate studies, and typically only the 1-percent-annual-chance flood is considered. FEMA is currently updating the requirements for limited-detail studies. In the past, limited studies could be conducted using hydrologic models or regression equations for discharge calculations, and hydraulic model input could be generated from detailed terrain data coupled with limited information on structures that may affect flood elevations (e.g., bridges and culverts included in the model do not require detailed hydraulic modeling). In the past, products from the limited-detail study were Zone A floodplain boundaries shown on the FIRMs. The community received 1-percent-annual-chance elevations at cross sections, flood profiles, and data tables that may be used for floodplain management, but these were not necessarily published in the FIS. Anticipated revisions to specifications for limited-detail studies include use of the Zone AE designation on the FIRMS as well as showing cross sections and base flood elevations (BFEs) and providing profiles in the FIS.

Detailed studies require hydrologic and hydraulic analyses that involve calculating discharges preferably from frequency analysis of gaging station records, or calibrating models to observed discharges and stages (or some combination of both) and detailed survey and topographic data. Study products are Zone AE floodplain boundaries and floodways, flood elevations and profiles for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods, and floodway data tables published in the FEMA Flood Insurance Study (FIS).

The level of study should reflect the level of risk associated with the flood hazard. This may be characterized as a function of population density within the floodplain and level of

anticipated growth. Floodplains in areas with high population density and/or high anticipated growth are mapped using information from detailed hydrologic and hydraulic analyses; floodplains with medium population density and modest growth may be adequately mapped using information from limited-detail studies; and floodplains in areas of low population and small or no anticipated growth are delineated adequately using approximate methods.

Identification of Reaches for Study

In northeastern Illinois, the IDNR/OWR regulates construction within the floodways of streams draining one or more square miles. Typically, floodplains are shown on FIRMs for stream reaches draining one or more square miles. A screening tool developed at the ISWS was used to identify the upstream limits for approximate floodplain mapping. Approximate floodplains were mapped for streams draining one or more square miles within the study watersheds. Stream reaches draining less than 1 square mile (sq mi) were mapped if there was an existing floodplain. Stream reaches in areas of apparent development were identified in collaboration with Kane County and community representatives through meetings and correspondence. The reaches selected for limited-detail and approximate study are shown in Figure 1.

Watershed Description

The Big Rock and Welch Creek watershed drains to the Fox River. Welch Creek joins Big Rock Creek 10.3 miles above its confluence with the Fox River. Big Rock Creek joins Fox River at 31 miles above the confluence with the Illinois River, south of the Kane–Kendall County boundary. The Big Rock and Welch Creek watershed is located in Kane, DeKalb, and Kendall counties in northeastern Illinois, and covers a drainage area of 108 sq mi at the southwestern Kane County boundary. Urban areas within the watershed include a small portion of the Village of Elburn to the northeast, the Village of Sugar Grove to the east, and the Villages of Big Rock and Kaneville.

Land use is primarily agricultural. The watershed is reported to consist of 78 percent row crops, 11 percent rural grassland, 5 percent forest, 1 percent surface water and 5 percent urban areas (IDOA, 2003). The watershed is 98 percent hydrologic soil group B (USDA/NRCS, 2007), and thus has a moderate infiltration rate when thoroughly wet, such as during a major flooding event.

Available Geospatial Datasets

Illinois land cover data circa 1999-2000 was used in this study (IDOA, 2003). This spatial database uses five major land use classifications (agricultural, forested, urban, wetland, and other) and 23 different categories, including seven different agricultural land use categories and three urban land use categories.

Soils data from the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS) were obtained from the Soil Data Mart, State Soil Geographic Database (USDA/NRCS, 2003). The database uses map unit compositions (MUID) to characterize the soil and define the hydrologic soil group.

Two sources of topographic data were used. Watershed boundaries and other inputs required for hydrologic models were determined from 1/3 arc/second (approximately 10 meters) digital elevation models (DEM) from the National Elevation Dataset prepared by the U.S. Geological Survey (USGS, 2005). Data for hydraulic modeling were extracted from the Kane County topographic data, which have 2-foot contour intervals, and were prepared using aerial photography obtained during spring 2001.

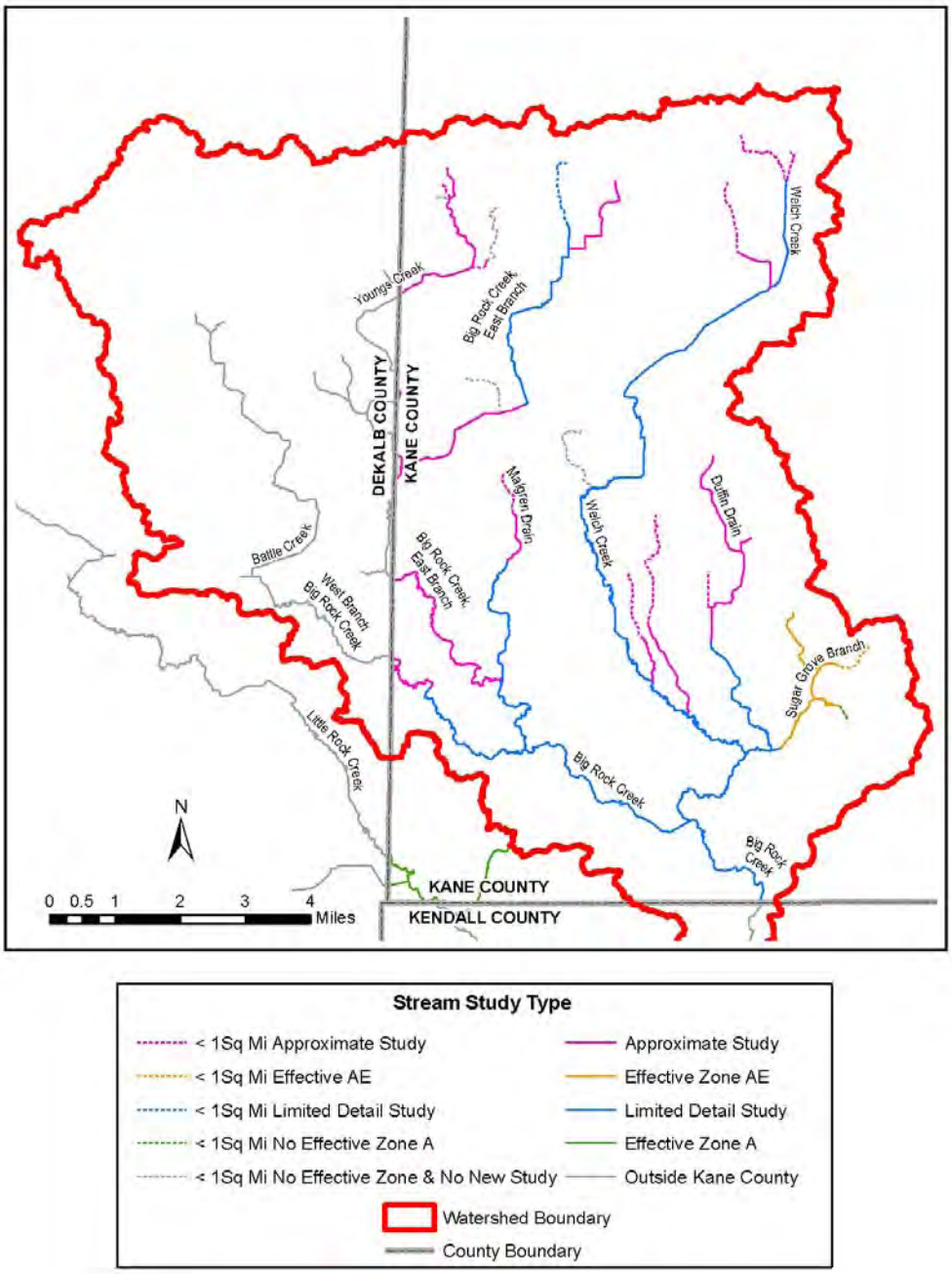

Figure 1. Limited-detail and approximate study reaches in the Big Rock and Welch Creek watershed

Historical Flood Events

Precipitation Data

Total daily precipitation data are available from the Aurora College station (National Climate Data Center, NCDC), cooperative station 110338, from January 1, 1948 to the present. The Aurora College station is about 8 miles east of the watershed near the Fox River. Hourly precipitation data have been collected at a gage located at the Aurora Municipal Airport since February 1, 1975. The Aurora Airport gage is at the far-eastern edge of the watershed just north of U.S. 30.

Discharge Data

There are no active stage or discharge gages in the watershed. The United States Geological Survey (USGS) has published annual peak discharge values for two crest-stage gages in the watershed. One of these gages was located on East Branch Big Rock Creek near Big Rock (USGS gage 05551900), providing 15 years (1965-1979) of estimated peak discharge data. The other gage, located on Welch Creek near Big Rock (USGS gage 05551930), also resulted in estimated peak discharge values for 16 years (1965-1980). Crest-stage data were collected at eight additional sites in the watershed during approximately the same time period. The locations, streams, years of record, and dates of peak gage height are noted in Table 1. No single storm event set the peak year of record for the entire watershed during the period of record.

The peak discharge published for the East Branch Big Rock gage (05551900) is 1580 cubic feet per second (cfs) on May 16, 1974. The second highest published discharge is 1410 cfs on June 15, 1972. Likewise, peak discharge of 694 cfs, published at the Welch Creek gage (05551930), is on May 16, 1974, and the second largest discharge published for the period is 563 cfs on June 15, 1972.

Twenty-four-hour precipitation totals (6 p.m. to 6 p.m.) are available for May 1974 and June 1972 from the Aurora College station (located east of the watershed). The May 1974 storm started on May 13 with 0.21 inches of rain. From May 14 through 6 p.m. on May 16, an additional 2.16 inches of rain occurred. By 6 p.m. on May 17, another 1.45 inches were recorded. Storms typically travel from west to east in this area. Given the location of the precipitation gage relative to the watershed, some of the precipitation recorded by 6 p.m. on May 17 may have contributed to the observed peak flows recorded on May 16, 1974. A rainfall estimate for the May 1974 event is at least 2.5 inches over about 72 hours. The June 1972 storm started on June 12, 1972, and between June 12 and June 15, 3.56 inches of rain fell over about 96 hours.

The extent of flooding that occurred during the October 1954 flood event is recorded in the U.S. Geological Survey Hydrologic Atlases (Allen, 1966a, 1966b; Mycyk and Walter, 1972; Mycyk et al., 1973). More than 3 inches of rain fell early in October, but the storm event that

Table 1. Historical Stream Stage Gages in the Big Rock/Welch Creek Watershed

Stream name/location	*USGS station*	*Road crossing*	*Drainage area*	*Period of record*		*Peak year of record* Highest	*Peak year of record* 2nd Highest
Big Rock Creek at Big Rock	05551915	Price Road	51.4	1965	1975	5/16/1974	6/15/1972
East Branch Big Rock							
near Kaneville	05551860	Harter Road	4.89	1965	1975	2/6/1965	2/10/1966
near Hinckley	05551890	Lasher Road	13.5	1965	1975	5/16/1974	5/12/1966
near Big Rock *	05551900	U.S. 30	21	1965	1979	5/16/1974	6/15/1972
West Branch Big Rock							
at Hinckley	05551910	Pritchard Road	24.4	1965	1975	2/6/1965	2/10/1966
Youngs Creek							
near Maple Park	05551870	County Line Road	4.79	1965	1975	6/15/1972	4/22/1973
near Kaneville	05551880	McGirr Road	11.4	1965	1975	2/6/1965	6/15/1972
Welch Creek							
at Kaneville	05551920	Dauberman Road	10.4	1965	1975	6/15/1972	5/16/1974
near Kaneville	05551925	Scott Road	16.4	1965	1975	6/15/1972	5/16/1974
near Big Rock*	05551930	Granart Road	22.4	1965	1980	5/16/1974	6/15/1972

Note: *Discharge also recorded.

resulted in the highest flood observed by local residents in 71 years (Mycyk et al., 1973) occurred after 10.48 inches of rain fell on October 10, 1954.

Since the 1954 flood, the largest flood on record occurred on July 18, 1996 when 16.91 inches of rain were recorded at the Aurora College station. No discharge or stage elevations were recorded on the Big Rock and Welch Creek streams.

Water surface elevations recorded on the East Branch Big Rock and Welch Creeks are shown in Table 2.

Table 2. Water Surface Elevations on the East Branch Big Rock and Welch Creeks

		Elevation, feet msl			
Stream	*Location*	*10/10/1954*	*06/15/1972*	*05/16/1974*	*09/13/2008*
East Branch Big Rock	Near Big Rock at U.S. Highway 30	708 (estimated)	703.61	703.95	NA
Welch Creek	Near Big Rock at Granart Road	689 (estimated)	687.44	688.09	689.01

Field Data Collection

The key to an accurate hydrologic and hydraulic model is having observed data for calibration. To this end, one precipitation gage and four stage gages were installed in the watershed. The Big Rock/Welch Creek project (BRWC) gages were operated from May to November 2008. During their operation, a precipitation event near the one-percent-annual-chance flood occurred. This event was used to calibrate the model, and is described in detail in this report. Gage descriptions can be found in Appendix A.

Field surveying was performed by the Illinois Department of Natural Resources, Office of Water Resources (IDNR/OWR) staff. Surveying included establishing the datum of the state gages and measuring eight bridge sites with stream cross sections. Surveyed bridge locations can be seen on Figure 18 in this report. A table reporting surveyed and bridge source data is located in Appendix B.

Field visits by ISWS staff were also conducted to collect measurements of bridge heights, widths, and culvert dimensions. Photographs taken during these field trips helped to determine the appropriate Manning's roughness coefficient (Manning's *n*) values.

Precipitation Gage

The BRWC precipitation gage was located near the center of the watershed. A map of the precipitation gage in relation to the watershed and sub-basins is provided in Figure 2. Precipitation was recorded at intervals of 15 minutes. A summary of peak precipitation events is noted in Table 3.

Table 3. Precipitation Events Recorded at Project Gage

Time period	*Duration (hours)*	*Total precipitation (inches)*	*Corresponding Bulletin 70, % annual event*
September 12, 1:00 p.m. to September 14, 1:45 p.m.	48.75	8.24	Approximately 100-year event
September 4, 5:15 a.m. to 9:45 p.m.	16.5	2.88	Approximately 2-year event
July 12, 5:15 a.m. to 8:15 a.m.	3	2.54	Approximately 7-year event
May 11, 1:00 a.m. to 11:00 a.m.	10	2.19	Approximately 2-year event

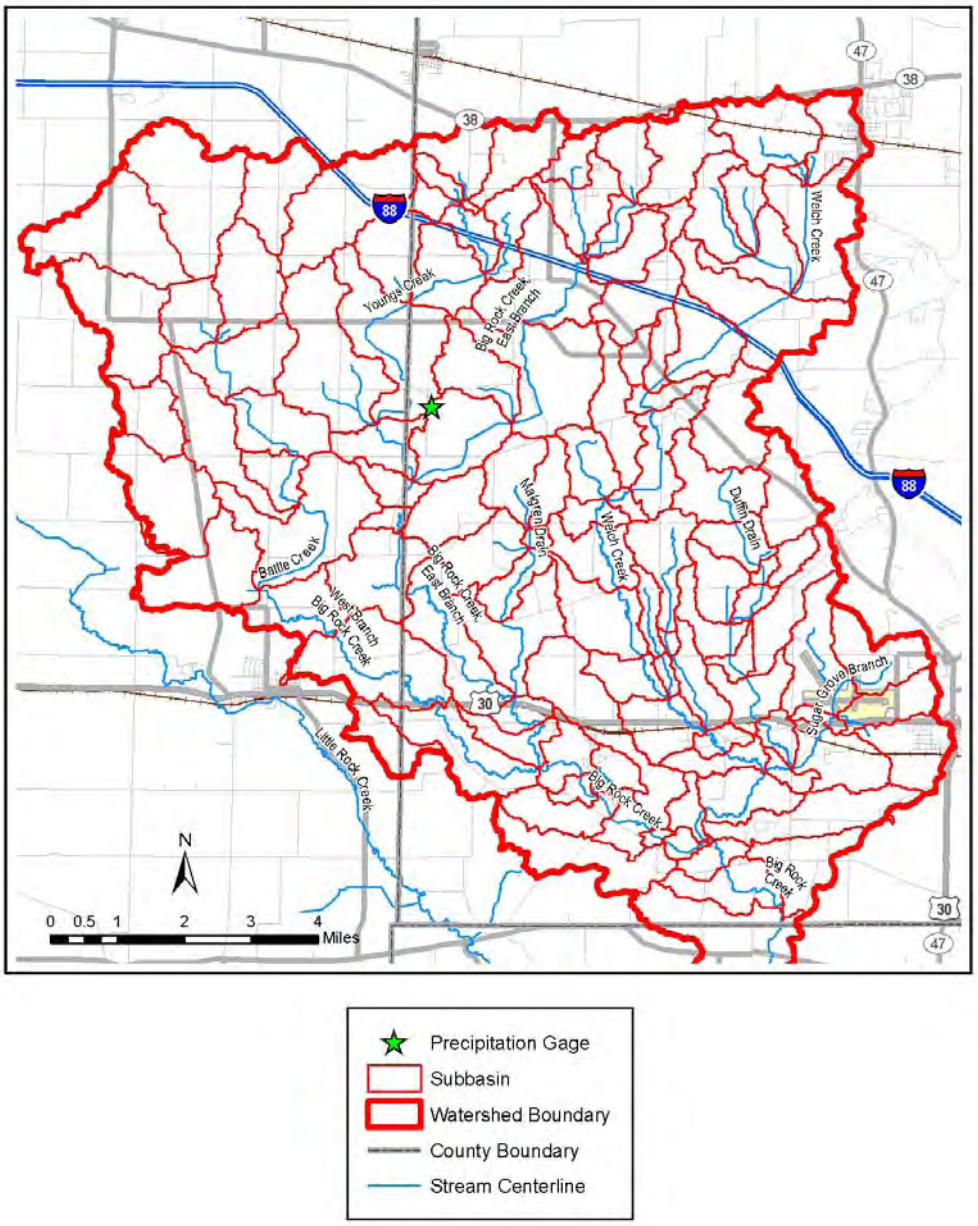

Figure 2. Big Rock/Welch Creek flood study sub-basins and precipitation gage location

Stream Stage Gages

Stage gages were installed at four locations at the downstream reaches of the watershed, and the data were used to calibrate hydrologic and hydraulic models. Gages were located in pairs, two on each stream, so that the stage information also could be used to estimate reach discharges and calibrate the hydrologic model. Gage locations are shown in Figure 3. The stage data were collected in increments of 15 minutes. Discharges were measured periodically to estimate the stage-discharge relationship at the gages. Observations at the gages were compared with model-simulated water surface elevations.

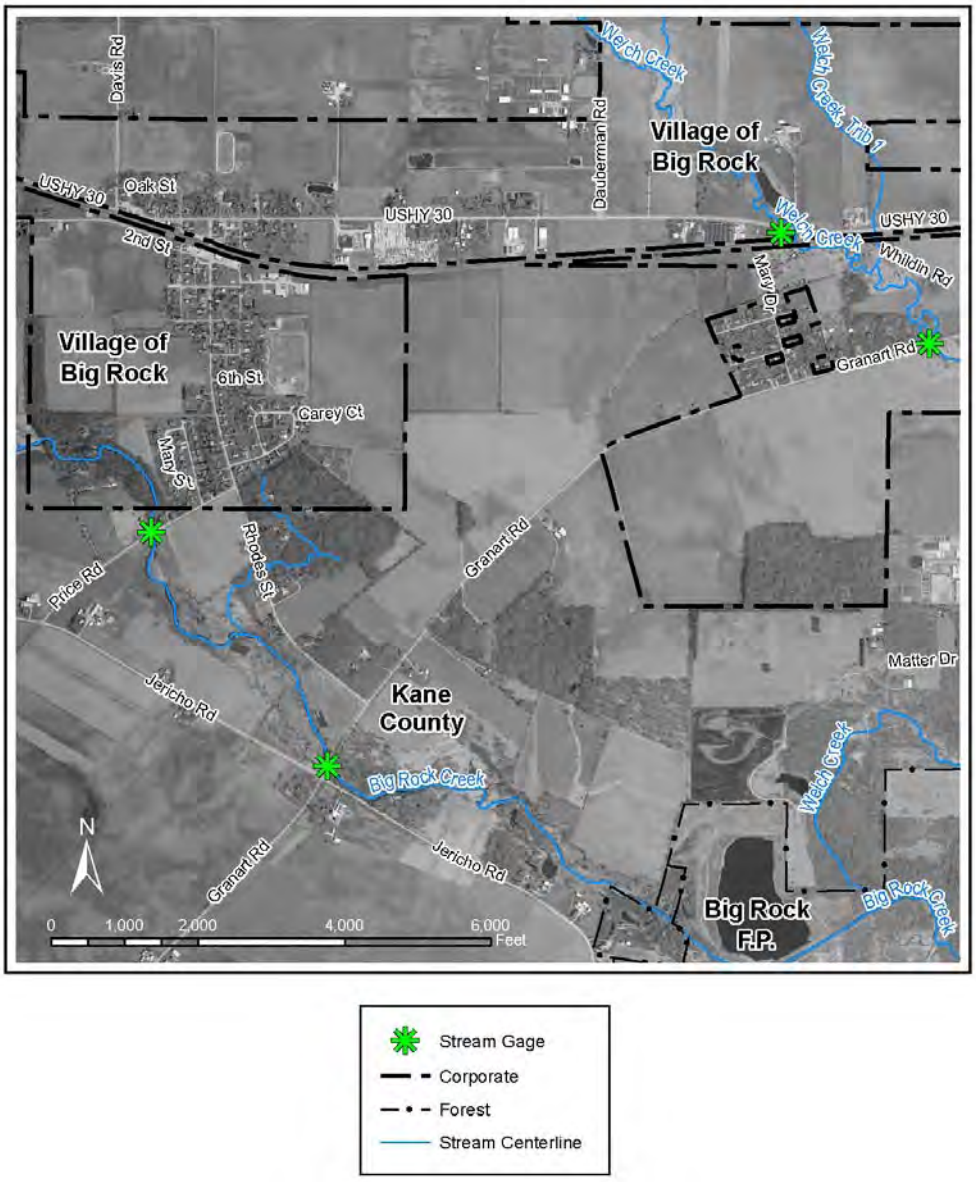

Figure 3. Big Rock/Welch Creek flood study stage gage locations

September 12-14, 2008 Event

Based on the project gage data, the mid-September storm began in the afternoon of September 12, with the first precipitation recorded at 1 p.m. The storm was preceded by 2.9 inches of precipitation recorded on September 4 and 0.07 inches of rainfall fell September 6-10. Rainfall was 0.39 inches on September 12. Rain continued throughout most of the day on September 13 with periods of intense rain; by 4:15 p.m., another 6.58 inches of rain were recorded at the watershed gage. Total accumulation for September 13 was 6.7 inches. Another 1.2 inches of rain fell on September 14.

At the Aurora Municipal Airport cumulative precipitation on September 12 was 0.52 inches (midnight to midnight). On September 13 total accumulation was 5.52 inches, and on September 14 the total recorded precipitation was 0.33 inches.

More intense hourly precipitation was recorded at the study gage than recorded at the Aurora Municipal Airport gage located to the east of the study gage. The storm lost intensity as it moved from west to east across the watershed. The precipitation distribution resulting in the September flood event can be seen in the two graphs below (Figures 4 and 5). Eighty percent of rain occurred in the first 24 hours at the project gage.

The September flood event was recorded at each stage gage. An increase in water depth of 7 and 9 feet was recorded at the Big Rock Creek gages, and an increase of 6 and 8 feet was seen at Welch Creek gages. Peak stages occurred on September 13 at approximately 5:15 p.m. at the Welch Creek gages (about 28 hours after the start of the precipitation) and at approximately 11:15 p.m. at the Big Rock Creek gages (about 34 hours after the start of the precipitation). The stages recorded at the gages are shown in Figures 6 and 7. A second peak is visible in the Welch Creek records, while Big Rock Creek has a steadily descending limb.

During the September event a number of roads in the watershed were overtopped and extensive flooding was observed. These observations provided additional insights to the nature of flooding in the watershed.

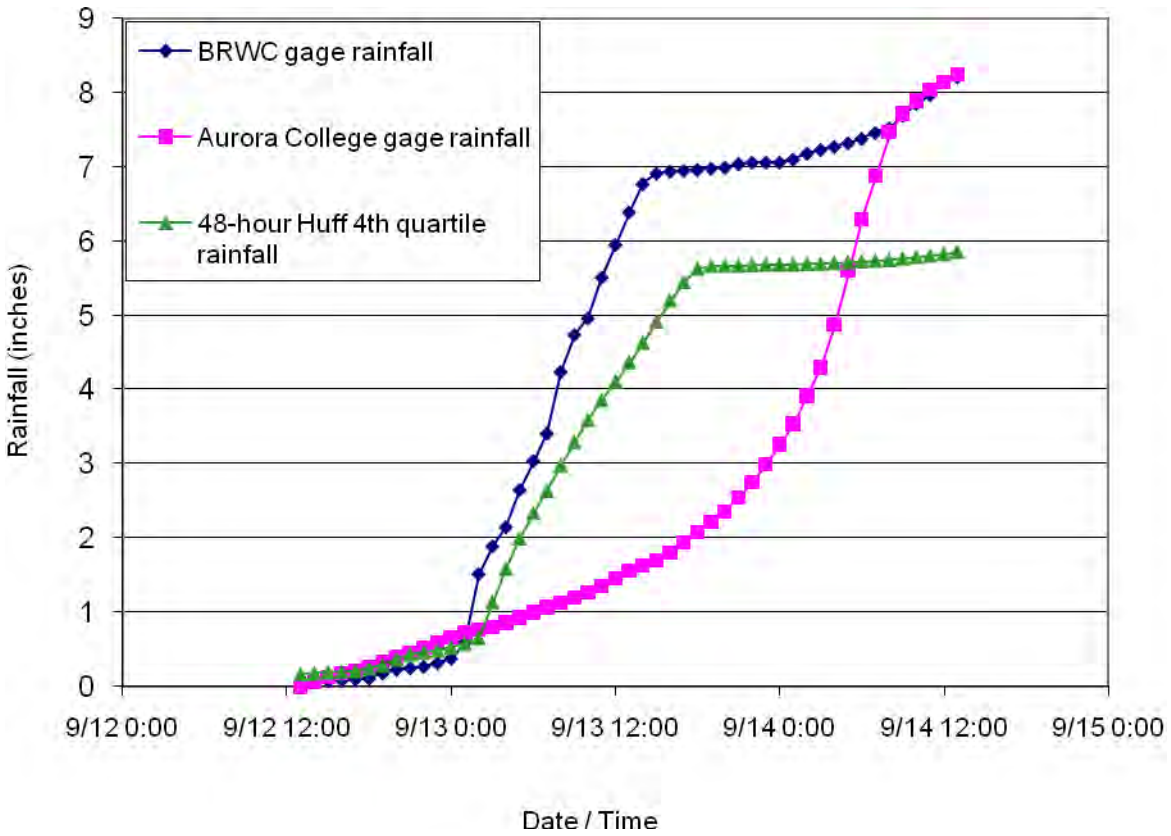

Figure 4. Comparison of the September 12-14, 2008 rainfall distribution at the project and Aurora College rain gages to the 48-hour Huff 4th quartile rainfall distribution

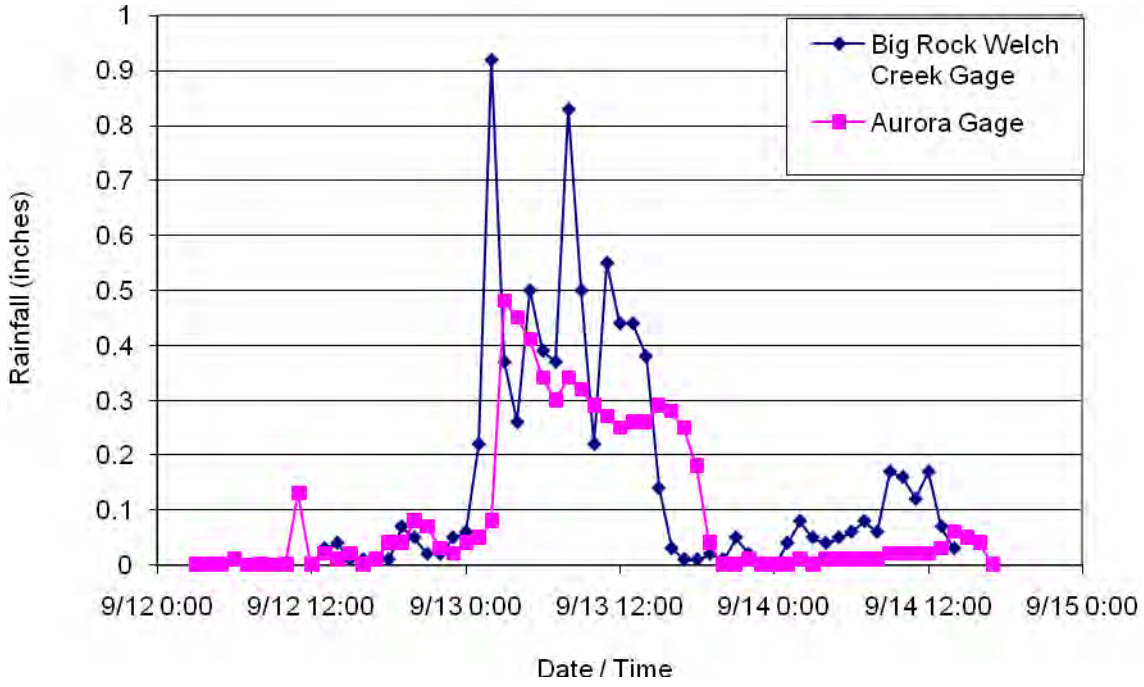

Figure 5. Hourly precipitation for the Big Rock/Welch Creek project and Aurora gages, September 12-14, 2008

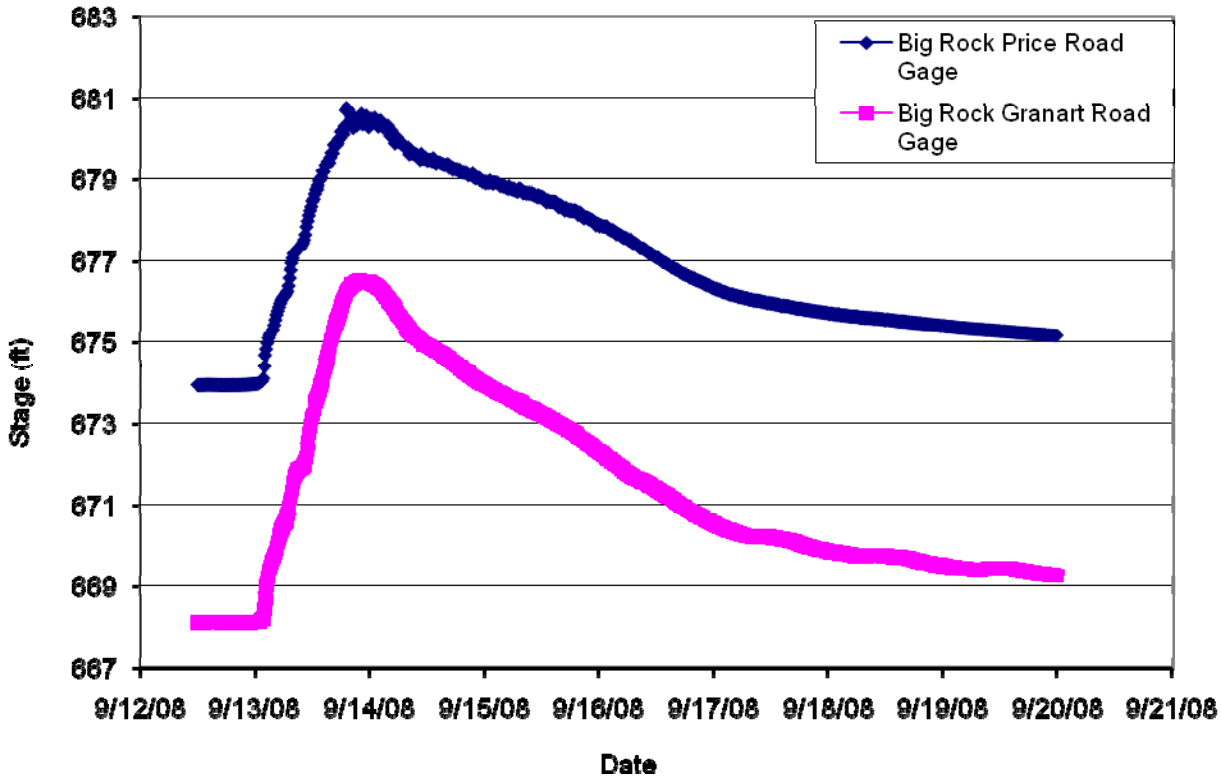

Figure 6. Big Rock Creek stage gage records for September 2008 flood event

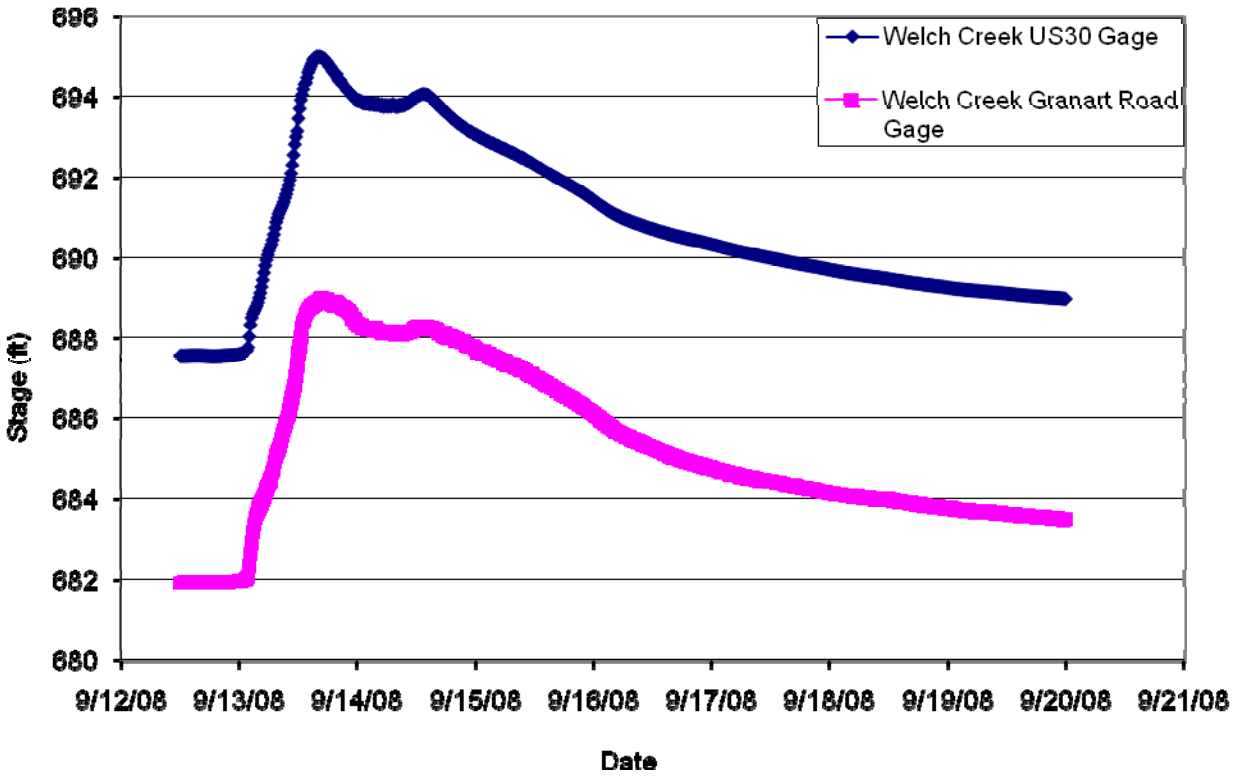

Figure 7. Welch Creek stage gage records for September 2008 flood event

Hydrologic Modeling

The goal of the hydrologic analysis was to create a model, calibrate it to a large storm event, and use the model to simulate the 1-percent-annual-chance flood discharge at locations throughout the watershed. The Big Rock and Welch Creek watershed hydrology was modeled using HEC-HMS version 3.2 (Scharffenberg and Fleming, 2008). The analysis was performed using the SCS Curve number loss method, Clark Unit Hydrograph translation method, and Muskingum Cunge and Modified Puls routing calculations. Total rainfall of 7.83 inches from *Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois* (Huff and Angel, 1989) and the 48 hour, fourth-quartile Huff distribution, reported in *Time Distributions of Heavy Rainstorms in Illinois* (Huff, 1990), were used for the 1-percent-annual-chance event simulation.

Subwatershed Delineation and Hydrologic Model Data

HEC-HMS modeling uses spatial information, including sub-basin data and river reach routing information. Sub-basin areas, river reach lengths and river reach slopes were determined by using the DEM downloaded from the USGS National Elevation Dataset. This dataset was used for hydrology rather than using Kane County topography, which has a higher resolution, because of the availability of topography for the portion of the watershed in DeKalb County. The USGS DEM has adequate resolution for the hydrologic modeling aspect of this study. Both ArcHydro (Maidment, 2002) and HEC-geoHMS version 1.1 (USACE, 2003) were used to determine the physical hydrologic parameters and to generate required input.

Sub-basins were initially divided based on desired calculation points and then further subdivided to create a more uniform division of the watershed area. Sub-basins were divided into areas less than 3 square miles. Sub-basin divisions are shown in Figure 2 as well as on the work map available in Appendix E. The total drainage area was calculated using automated methods and the drainage areas agree with the drainage areas reported at former USGS gage stations on Welch and East Branch Big Rock Creeks (Soong et al., 2004).

Soils data and land use spatial data were reviewed to estimate precipitation losses due to infiltration using the SCS Curve number method. State Soil Geographic Database (STATSGO) soil data for the watershed are shown in Figure 8. STATSGO soil data are generalized for use with large areas by grouping soil associations as map units. Map unit compositions IL10, IL12, IL14, and IL 46 were found in the studied watershed. These units are characterized by hydrologic soil group percentages, noted in Table 4. Land cover data from Land Cover of Illinois 1999-2000 classification are displayed in Figure 9.

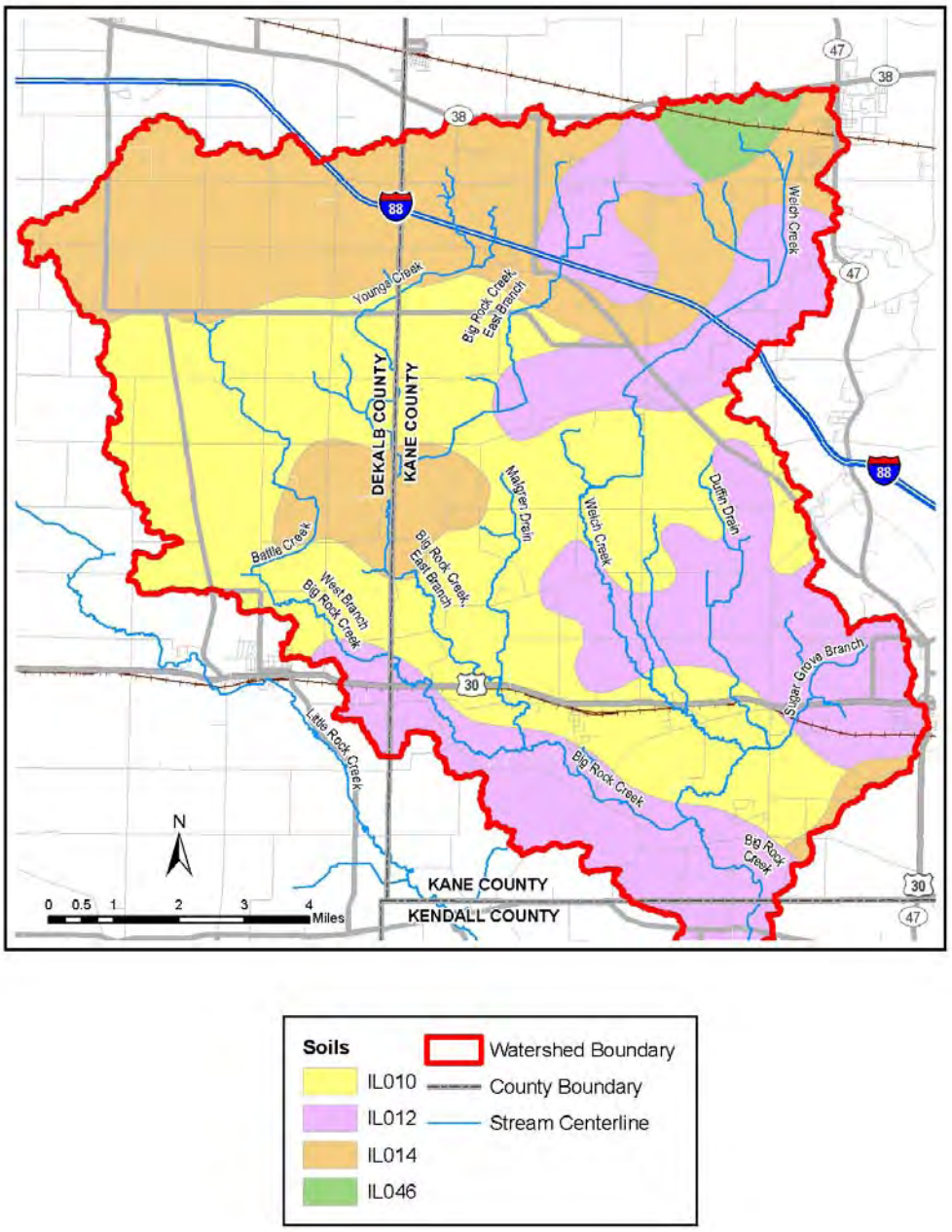

Figure 8. Soil data map for Big Rock/Welch Creek watershed depicting the Stat Soil Geographic Database (STATSGO) map unit identification numbers

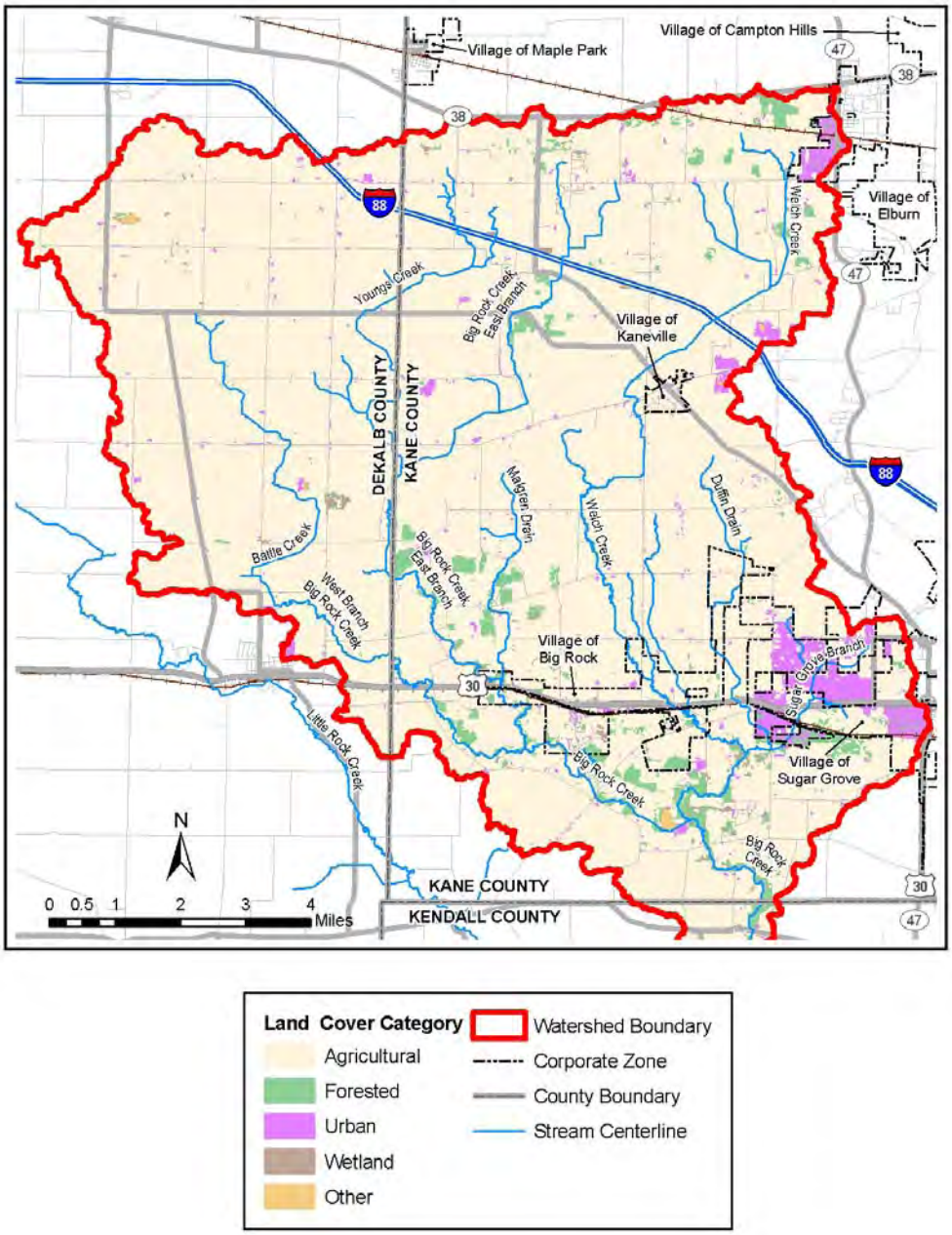

Figure 9. Land cover data for the Big Rock/Welch Creek watershed from Land Cover of Illinois 1999-2000

Table 4. Soil Map Units

	Hydrologic Soil Group Percentage			
MUID	*A*	*B*	*C*	*D*
IL010	0	97	3	0
IL012	0	100	0	0
IL014	0	100	0	0
IL046	0	100	0	0

ArcCN is a script written to generate curve numbers given soil and land-use data using ArcGIS (Zhan and Huag, 2004). ArcCN was used to calculate a weighted average curve number for each sub-basin based on hydrologic soil type-land use combinations. These initial curve numbers were adjusted using a single multiplier over the watershed during the calibration process.

The Clark Unit Hydrograph option was selected for transformation calculations in the hydrologic model. Initial parameters for this method of determining time of concentration and storage coefficients were determined using the USGS 2000 *Equations for Estimating Clark Unit-Hydrograph Parameters for Small Rural Watersheds in Illinois* (Straub et al., 2000). These initial time-of-concentration and routing coefficient values were adjusted evenly over the watershed during the calibration process, which is outlined below.

Channel routing calculations were completed with the Muskingum-Cunge method for the majority of the watershed. Multiple eight-point cross sections were created for different channel bottom widths. These simplified cross sections were determined per engineering review of the available surveyed cross sections in the watershed. The simplified cross sections have an 8-foot channel depth, 2:1 channel side slopes, and an overbank width of 600 feet. The channel depth and overbank width were designated with the goal of providing a reasonable, simplified, and conservative cross section template for the entire watershed. The eight-point cross section allowed the specification of channel and right and left overbank Manning's *n* values. For the hydrologic routing calculations, the channel Manning's *n* value is estimated to be 0.045, and the overbank value is estimated to be 0.07. Reach length and slope were determined using automated methods, as noted above.

A review of the hydraulic model indicated there were some reaches with significant storage caused by restrictive bridges with large embankments. In these reaches, the results from the HEC-RAS model were used to determine a discharge/volume rating curve. The rating curve was then used with the Modified Puls routing calculation in the hydrologic model.

Base flow was not used in this model as the base flow would not be considered critical for the 1-percent-annual-chance flood event.

Flood Discharge Calculation of September 12-17, 2008 Using the Slope-Area Method

As noted in the Field Data Collection section, a precipitation gage and four stage gages captured data for the September 2008 flood event in the watershed. This information was used to compute reach discharges for Big Rock and Welch Creek.

The method for calculating discharges from the stage data was based on equations presented in *A Simplified Slope-Area Method for Estimating Flood Discharges in Natural Channels* (Riggs, 1976). This method removes the subjective Manning's *n* values and calculates discharge with only water-surface slope and cross sectional area. The standard error is reported to be 20 percent. The discharge equation is:

$$\log Q = 0.366 + 1.33 \log A + 0.05 \log S - 0.056(\log S)^2$$

where Q = discharge in cfs; A = reach average flow area in square feet; S = bed slope.

Equations for the average cross sectional area of the reach based on the downstream gage height were determined using the HEC-RAS model to create a rating curve for the downstream water depth and average flow area in the reach. The results of the RAS model were plotted to determine the depth-area relationship, as shown in Figure 10. The resulting best fit equations for the average cross section area are:

$A = 8.461D^2 + 38.755D$ for water depths below 8' and

$A = 7.2195D^2 + 94.703D-354.11$ for water depths above 8'

where A is the reach average flow area in square feet and D is depth in feet at the Granart Road gage.

Discharge values calculated with the Riggs Simplified Slope Area Method and the field discharge measurements made during the September 2008 flood are shown in Figure 11. The field measurement values were used to evaluate the accuracy of the discharge calculation. As shown in Figure 11, the Riggs method values appear to be low when compared to the field measurement. The calculated discharge value of 4770 cfs is 76 percent of the measured field discharge value of 6260 cfs at approximately 5 p.m. on September 13. A comparison of the calculated depth discharge rating curve and multiple field measurements taken at the gage reach during the gaging period is shown in Figure 12.

A stage discharge graph of Riggs equation discharge calculations and all field discharge measurements were reviewed to determine if the low-flow discharges could be estimated from the Riggs equation. A closer examination shows the calculated discharges are high when compared to field-measured low-flow discharges (Figure 13). As the goal of the project is to delineate the 1-percent-annual-chance floodplain, Riggs discharge calculation was selected, but it should not be used for low-flow discharge calculations. Further review of gage data could be

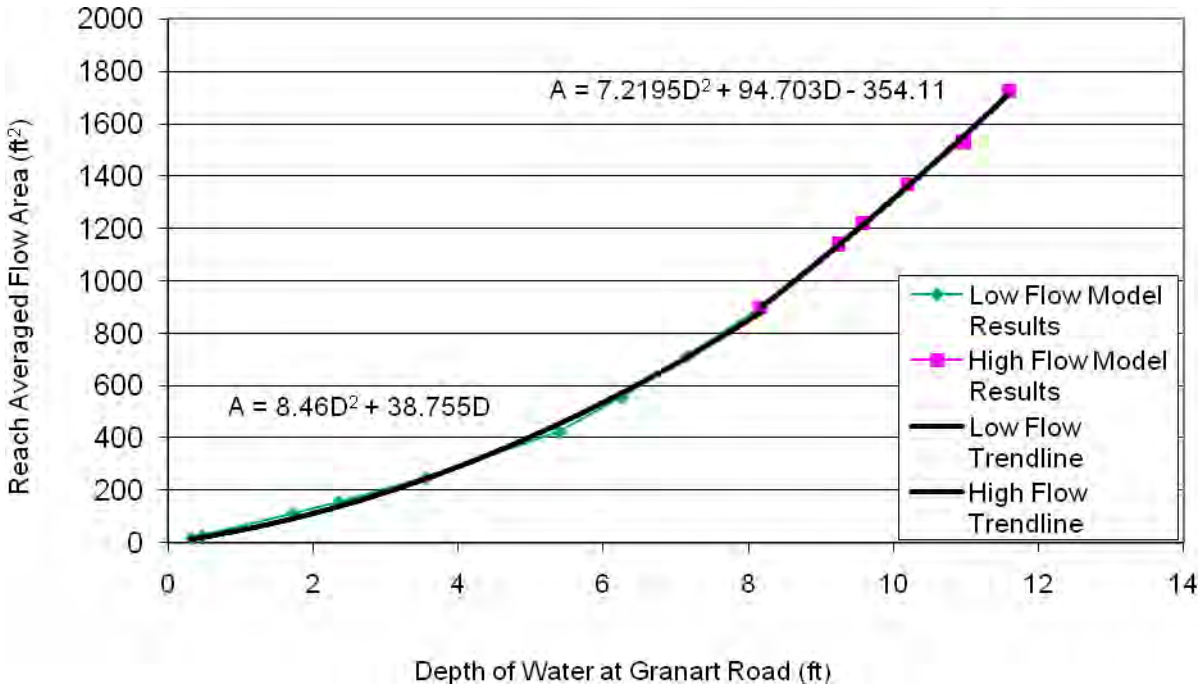

Figure 10. Depth/average flow area rating curve for the reach of Big Rock Creek between the two project stage gages at Granart Road and Price Road

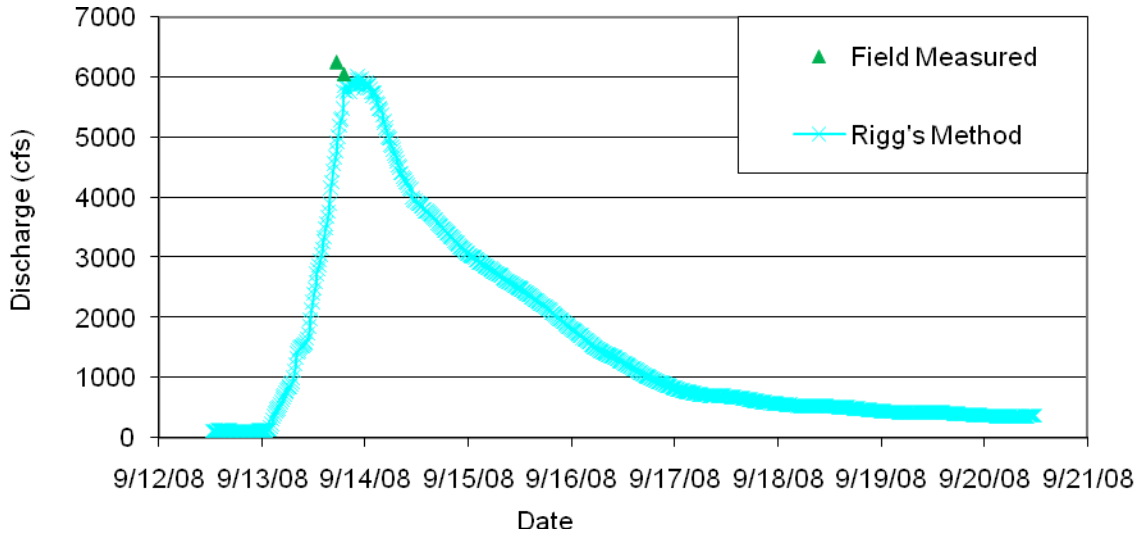

Figure 11. Comparison field measurements and calculated hydrographs for Big Rock gage reach (Price Road to Granart Road)

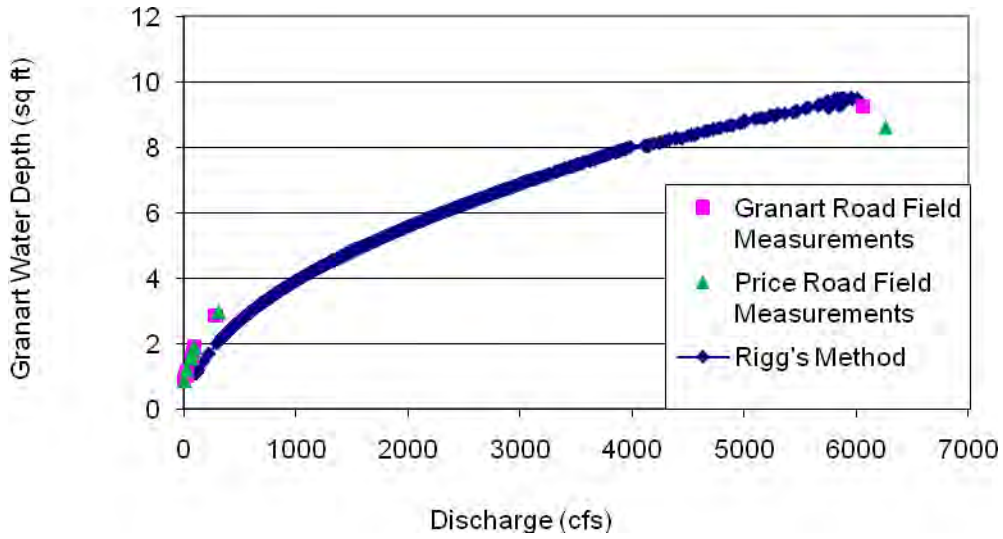

Figure 12. A comparison of the results of the Manning's equation depth-discharge rating curve used to calculate the discharge from the stage gage data and the field measured discharges

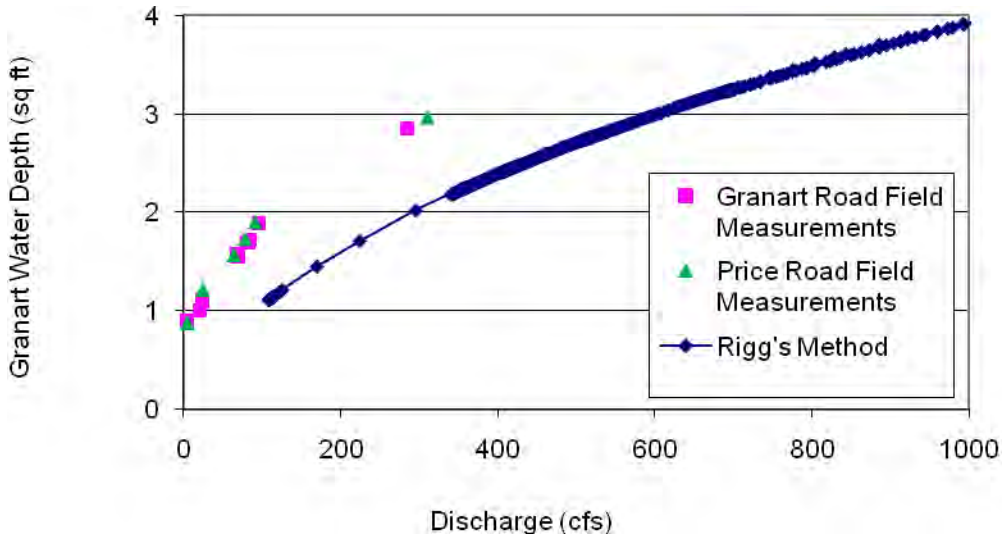

Figure 13. A closer look at the differences in the low flow results of the Manning's equation depth-discharge rating curve used to calculate the discharge from the stage gage data and the field measured discharges

completed to address the calculation of low flows given the recorded stage data, but this is beyond the scope of the project.

Analysis of the discharge calculation method was also completed for Welch Creek stage gages. However, from the analysis it was determined that the railroad bridge between the two gages causes backwater that affects the slope of the water surface profile during high discharge events. As a result of this effect, discharges computed using the simplified slope calculations are expected to be inaccurate. For this reason, the Welch Creek discharges alone were used for model calibration.

Model Discharge Calibration to September 12, 2008 Event Gage Data

Calibration of the HEC-HMS model was achieved by refining the curve number, initial abstraction, time of concentration, routing coefficient, and Manning's *n* values to adjust the model output based on observations. These input variables were determined using estimation equations and knowledge based on physical data, as described above, but their final values are a result of the calibration process.

Measured precipitation during the September 12-14, 2008 event was compared for two recording rain gages: the rain gage installed specifically for this project, located near the center of the watershed, and the gage located at the Aurora Airport. A review of the radar data available from the National Climatic Data Center NEXRAD Data Inventory showed that more than 80 percent of the watershed had a total storm precipitation over 8 inches. The project precipitation data, which recorded a total precipitation of 8.24 inches, was used for the entire watershed without integrating the Aurora Airport rainfall gage data, which recorded a total precipitation of 6.37 inches.

The September 12-22 precipitation data from the project gage were input to calibrate the HEC-HMS model to the discharges on Big Rock Creek. The initial intent of the project was to calibrate the model using the discharge values calculated using the paired stage information. As a field discharge measurement was taken within two hours of the peak stage on Big Rock Creek, the field measurement served as the primary measure of calibration. Secondary consideration was given to the discharge values calculated via the Riggs slope-area method, as described above.

The peak flow and peak time of the hydrograph were of primary consideration for model calibration. The Price Road field discharge measurement of 6260 cfs was taken 2 hours before the peak stage reading. From the time of the discharge measurement, the stage increased 1 foot before reaching the peak stage. The peak discharge was calibrated above the field measurements and Riggs discharge values based on this data. Total volume was not a primary consideration for calibration.

Final calibration of the HEC-HMS model was achieved by uniformly increasing the routing coefficient from its initial values and making peak flow adjustments with the curve number values. Final model input values can be found in Appendix C.

A comparison of the initial model hydrograph, the calibrated model hydrograph, the calculated hydrograph, and field measurements are provided in Figure 14. Table 5 lists the final results of the calibrated model at key locations. A spreadsheet with the full global summary of model results is also located in Appendix C.

Total volume was not considered a primary goal for calibration, as peak discharge and time of peak discharge are the key storm characteristics for floodplain management. The model has been calibrated to these values for this purpose. However, it should be noted that there is a difference between the calculated hydrograph using the stage data recorded at Big Rock Creek and the model results in respect to the falling limb of the hydrographs. For this study, the Clark routing coefficients were adjusted by a single coefficient to provide a hydrograph that lacked the second peak seen in the pre-calibration HMS results. The adjustment puts the routing coefficient much higher than initial values calculated using *Equations for Estimating Clark Unit-Hydrograph Parameters for Small Rural Watersheds in Illinois* (Straub et al., 2000). The large routing coefficient adjustment and remaining difference in the hydrographs may indicate a storage issue within the watershed upstream of the Big Rock gage location. Further discharge data and consideration for the low flow issues previously noted would be required to address these inconsistencies.

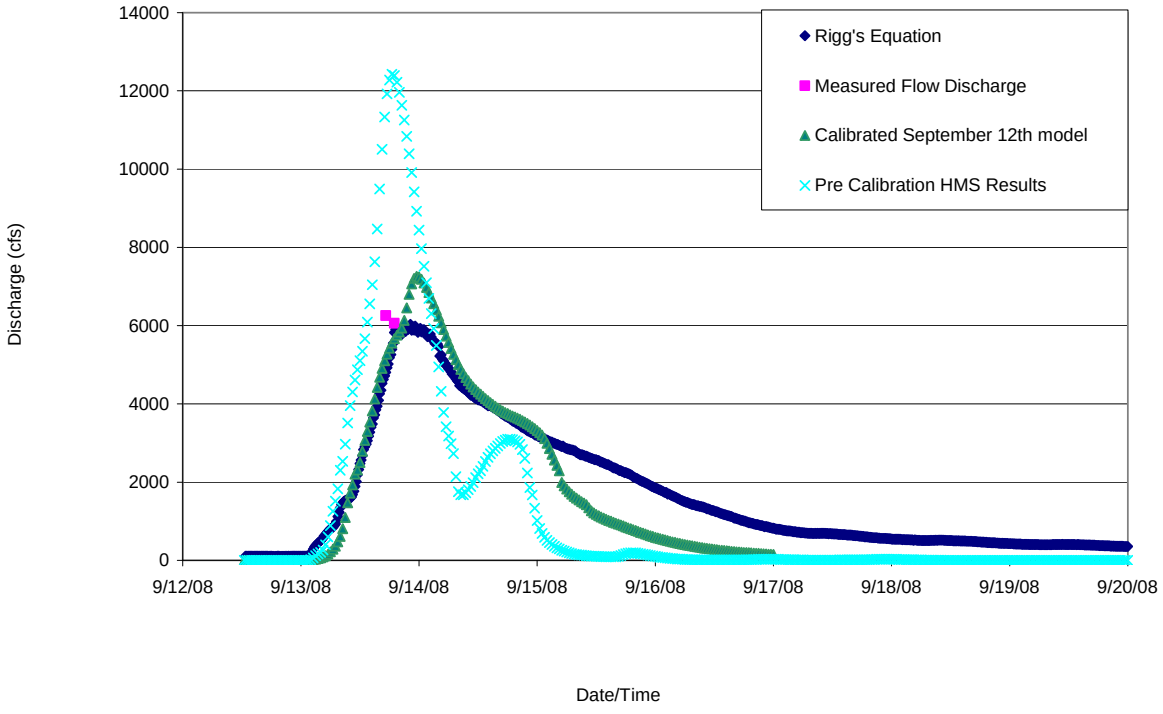

Figure 14. Comparison of the measured discharge, calculated discharge using Manning's equation, and HMS initial and final September 2008 flood event discharge hydrographs at Big Rock Creek at Granart Road

Table 5. Big Rock/Welch Creek September 2008 Flood Event HMS Model Results

			Final September 2008 flood calibration		
Location	*HEC-HMS station*	*Drainage area (sq. miles)*	*Peak discharge (cfs)*	*Time of peak*	*Volume (inches)*
Confluence of Young's Creek & East Branch Big Rock	J_EB&YC	22.5	3,202	13Sep2008, 17:00	5.7
Confluence of East Branch Big Rock and Malgren Drain	J_EB&MD	31.7	4,050	13Sep2008, 19:30	5.66
Confluence of Welch Creek and Welch Creek Tributary 1	J_WC_WCT1	21.1	2,432	13Sep2008, 18:00	5.62
Confluence of Welch Creek and Sugar Grove	J_WC&SG	36.1	3,973	13Sep2008, 18:30	5.62
Confluence of East Branch and West Branch Big Rock Creek	J_BR&EB&WB	60.7	7,175	13Sep2008, 22:30	5.67
Confluence of Big Rock Creek and Welch Creek	J_BR&WC	104.4	11,158	14Sep2008, 00:00	5.63
Downstream county boundary and Big Rock Creek	Outlet	108.2	11,340	14Sep2008, 01:00	5.62

One-Percent-Annual-Chance Flood HMS Simulation

Rainfall data from *Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois* (Huff and Angel, 1989), commonly known as ISWS Bulletin 70, are coupled with rainfall distributions reported in *Time Distributions of Heavy Rainstorms in Illinois* (Huff, 1990) for the 1-percent-annual-chance flood model. Bulletin 70 rainfall and appropriate Huff distributions are required for Illinois and Federal approval of flood studies. Total storm rainfall depths for the 1-percent-annual-chance storm event were adjusted using the aerial reduction factors for the 108 sq mi watershed. Rainfall used in the hydrologic model is listed in Table 6. These total depth rainfall values were then paired with one of the four Huff distributions based on the storm duration to simulate the 1-percent-annual-peak flood discharge values.

Table 6. Northeastern Illinois Bulletin 70 Rainfall in Inches (Sectional Frequency Distributions Reduced by Aerial Reduction Factors)

Storm period	*Recurrence interval (%)*				
(hr)	*20%*	*10%*	*2%*	*1%*	*0.2%*
3	2.11	2.49	3.60	4.22	6.09
6	2.54	2.98	4.32	5.06	7.39
12	3.05	3.58	5.17	6.06	8.74
*18	3.26	3.82	5.53	6.48	9.39
24	3.57	4.20	6.07	7.13	10.15
48	3.93	4.62	6.57	7.83	11.04

Note: *Aerial-point ration interpolated from the 12 hr and 24 hr adjustment factors.

A critical duration analysis was completed. To determine the appropriate storm time period, each of the 6-hr, 12-hr, 18-hr, 24-hr, 48-hr, and 72-hr storms were considered. As shown in Table 7, the 48-hour storm resulted in the largest discharge values.

The 48-hour peak 1-percent-annual-chance flows were input to the HEC-RAS model for floodplain determination.

Hydrologic Model Discharge Analysis and Comparison to Historical Data and Similar Watersheds

The results of the 1-percent-annual-chance HEC-HMS simulations were compared with other discharge estimates from regression equations, discharge observations, and peak discharges published in the literature (Figure 15). Big Rock and Welch Creek Regression Analysis values at gage locations using the equations outlined in *Estimating Flood-Peak Discharge Magnitudes and Frequencies for Rural Streams in Illinois* (Soong et al., 2004) are included for comparison. Additional nearby watershed 1-percent-annual-chance discharge values from the same publication are also graphed. Blackberry Creek watershed study discharge values from the USGS Scientific Investigations Report *Continuous Hydrologic Simulation and Flood Frequency, Hydraulic and Flood-Hazard Analysis of the Blackberry Creek Watershed, Kane County, Illinois* (Soong et al., 2005) were considered most relevant as the watershed study was recently completed. A table with specific locations, discharge sources, discharges, and drainage areas is provided in Appendix D.

Total rainfall on the 49-hour September event, an observed 8.24 inches, resulted in an HEC-HMS simulated peak flow of 11,340 cfs at the downstream boundary. The 1-percent-annual-chance flood event simulated using the HEC-HMS model had a corresponding rainfall of 7.83 inches over 48 hours and resulted in higher peak flow of 12,624 cfs. Although the rainfall durations were similar, the model simulation produced a higher peak discharge from a smaller rainfall because of differences in the temporal distribution of the rainfall. The observed rainfall distribution can be seen in Figure 4.

Table 7. One-Percent-Annual-Chance Critical Duration Results

Location	6-hour storm event			12-hour storm event			18-hour storm event		
	Peak discharge (cfs)	*Time of peak*	*Volume (in)*	*Peak discharge (cfs)*	*Time of peak*	*Volume (in)*	*Peak discharge (cfs)*	*Time of peak*	*Volume (in)*
Confluence of Young's Creek and East Branch Big Rock	2,407	Day 1, 09:00	2.78	2,974	Day 1, 12:15	3.65	2,963	Day 1, 15:30	4.03
Confluence of East Branch Big Rock and Malgren Drain	2,907	Day 1, 12:00	2.75	3,661	Day 1, 15:30	3.62	3,746	Day 1, 18:30	3.99
Confluence of Welch Creek and Welch Creek Tributary 1	1,787	Day 1, 10:30	2.7	2,210	Day 1, 13:45	3.56	2,257	Day 1, 17:15	3.93
Confluence of Welch Creek and Sugar Grove	2,866	Day 1, 10:30	2.71	3,581	Day 1, 14:15	3.57	3,681	Day 1, 17:45	3.94
Confluence of East Branch and West Branch Big Rock Creek	5,185	Day 1, 14:45	2.74	6,479	Day 1, 19:00	3.6	6,731	Day 1, 22:00	3.97
Confluence of Big Rock Creek and Welch Creek	7,946	Day 1, 16:00	2.71	9,893	Day 1, 20:15	3.56	10,383	Day 1, 23:30	3.92
Downstream county boundary and Big Rock Creek	8,071	Day 1, 17:00	2.7	10,043	Day 1, 21:15	3.56	10,542	Day 2, 00:15	3.92

Location	24-hour storm event			48-hour storm event			72-hour storm event		
	Peak discharge (cfs)	*Time of peak*	*Volume (in)*	*Peak discharge (cfs)*	*Time of peak*	*Volume (in)*	*Peak discharge (cfs)*	*Time of peak*	*Volume (in)*
Confluence of Young's Creek and East Branch Big Rock	3,393	Day 1, 23:15	4.61	3,473	Day 3, 00:00	5.21	3,266	Day 3, 20:20	5.5
Confluence of East Branch Big Rock and Malgren Drain	4,256	Day 2, 02:00	4.57	4,386	Day 3, 02:45	5.12	4,239	Day 3, 22:40	5.28
Confluence of Welch Creek and Welch Creek Tributary 1	2,553	Day 2, 00:15	4.5	2,638	Day 3, 01:00	5.03	2,542	Day 3, 21:40	5.23
Confluence of Welch Creek and Sugar Grove	4,195	Day 2, 00:30	4.51	4,408	Day 3, 01:30	5.05	4,251	Day 3, 23:00	5.2
Confluence of East Branch and West Branch Big Rock Creek	7,714	Day 2, 05:00	4.53	7,990	Day 3, 05:30	5.03	7,714	Day 4, 01:40	5.13
Confluence of Big Rock Creek and Welch Creek	11,874	Day 2, 06:15	4.49	12,403	Day 3, 06:15	4.98	12,310	Day 4, 02:20	5.05
Downstream county boundary and Big Rock Creek	12,068	Day 2, 07:00	4.48	12,624	Day 3, 07:00	4.97	12,585	Day 4, 03:20	4.98

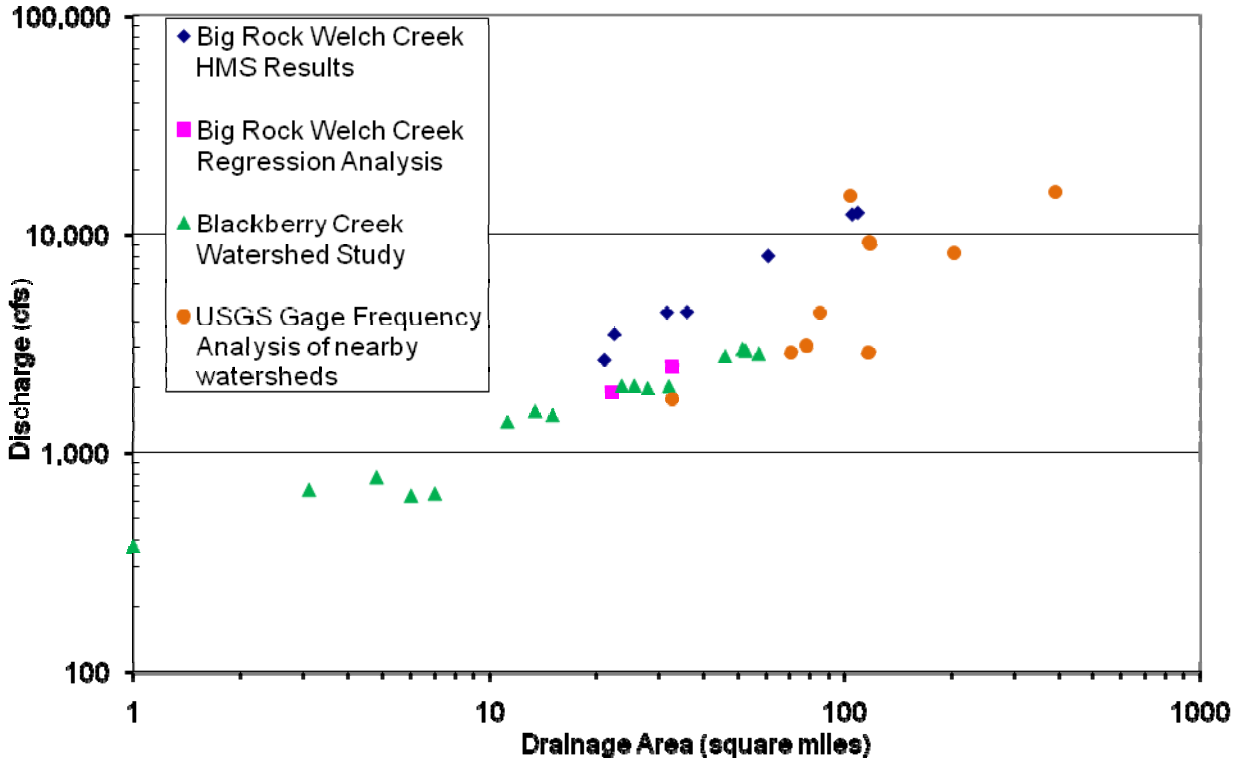

Figure 15. Comparison of the 1-percent-annual-chance discharge/drainage area relationship for the Big Rock/Welch Creek and other published watershed discharges in the area

Areas Requiring Further Review for a Detailed Analysis

Further comparison of Big Rock/Welch Creek and the northern watershed hydrology results could be completed if the county should desire a more detailed study warranting a model calibrated to the total volume of the storm. The additional calibration points from the northern Kishwaukee headwater watersheds would allow an analysis of curve number values, initial abstraction, transformation parameters, and discharge volume between the two studies for further refinement of the HEC-HMS model.

Given the objectives and scope of this project, some assumptions, further detailed below, were made with respect to the characteristics of Big Rock Lake, the Rich Harvest property, field tiling, and split flows. The issues are identified and should be considered when a detailed flood study of the area is conducted.

Big Rock Lake is located on Big Rock Creek just upstream of the confluence of Welch Creek and Big Rock Creek. Its impact on flood discharge was reviewed to estimate the effect of this relatively large storage area on the 1-percent- annual peak discharge calculations. No physical data were available on the size, elevations, or depth of the lake. Given the scope of work for this study, a simplistic view of the impact of this lake on peak discharges was considered. It was estimated that the lake surface area is approximately 34 acres and the low point of the berm is 10 feet above the normal water elevation, and would store 340 acre-feet (ac-ft) of water prior

to filling the storage area. After filling the storage area, it was assumed the water diverted into the lake would flow through the lake to the "outlet" low point at the downstream end of the lake. With some very approximate assumptions, it was calculated the lake would be full in the first quarter of the storm hydrograph, while peak discharge would occur closer to the midpoint of the storm. The lake appears to have a minimal effect on storm peak discharge. Given the lack of data, the complicated nature of correctly modeling the lake, and minimal downstream impact, no further analysis was pursued. This storage area was not incorporated into the HEC-HMS model.

The Rich Harvest property includes multiple inline streams and large detention ponds that may provide storage that could have an effect on the watershed hydrographs. However, storage areas have not been included in this hydrologic model. The impact of the storage area is not expected to be large enough on peak flows and subsequent delineation of the floodplain area.

Field tiles were not incorporated in the watershed study. All tile drains were considered to have a minimal impact on the high flows of the 1-percent-annual-chance flood event. No allowance was provided for flow that is diverted from the stream channel to a field tile or flow from a field tile into the stream. This assumption may require further review for a detailed study. Specifically, along Duffin Drain there is a culvert that discharges just upstream of the crossing with U.S. 30. The location and source of the tile drain is unknown and thus could not be accounted for in this study.

There appears to be a split flow location on Welch Creek Tributary 1 northwest of the Dauberman and Wheeler intersection. The elevation data suggest that flow may divert from the indicated channel and follow the Dauberman ditch to join Welch Creek Tributary 2. This would impact the flows calculated for both tributaries below this intersection. The final hydrologic model for this watershed study assumes no diverted flow at this location.

Hydraulic Modeling

A hydraulic model was prepared to simulate water surface elevations. The HEC-RAS version 4.0 (Brunner, 2008) model was selected as it is accepted by FEMA and widely used in the industry. The HEC-RAS model was calibrated using data from the September 2008 storm event. The calibrated model in turn was used to simulate 1-percent-annual-chance flood elevations for the stream reaches. Output from this simulation provides the basis for profiles and flood hazard mapping.

Study Reaches

Hydraulic analysis of the watershed was divided into two levels of study: limited detail and approximate. The level of study for each reach was reviewed at the stakeholder meeting and finalized by the county. A limited-detail study was completed on the more urban and developing reaches, while an approximate study was completed on the more rural stream reaches. Figure 1 shows the level of study completed for each reach.

Two hydraulic models were prepared: one hydraulic model for Welch Creek and its tributaries and one for Big Rock Creek and its tributaries. The decision to use two independent hydraulic models was based on practical use issues. The watersheds were kept separate to keep the size of the model appropriate for ease of use. Limited-detail and approximate study reaches did not need to be separated.

The level of study determines the detail of data input to the hydraulic model. Table 8 summarizes some differences in the hydraulic modeling for each type of study. Stream hydraulics for both levels of study were completed using HEC-RAS version 4.0 software (Brunner, 2008).

Input Data

HEC-RAS requires riverine geometry, Manning's *n* values, structure geometry, and flow data to perform the one-dimensional riverine water surface elevation analysis.

Table 8. HEC-RAS Input Data for Each Level of Study

	Limited detail	*Approximate*
Cross sections	LiDAR/surveying/Kane contours with engineering review	Automated using Kane County 2001 topography
Manning's	Engineering review	Automated calculation using Manning's *n* values associated with land cover
Bridges	Surveyed/plans/field measurements	None

Much of the required input data concerns the physical aspects of the river reach: channel dimensions, slope, etc. This information was primarily gleaned from the Kane County 2001 topography. The Kane County topographic data were derived using photogrammetric techniques from photography taken on 4/14/2001 and 4/18/2001. The mapping meets United States National Map Accuracy Standards (NMAS) for 1inch equal to 100 feet scale maps and has a horizontal accuracy of plus or minus 3 feet and exceeds the standard for mapping at 1inch equal to 500 feet scale maps. Kane County topographic data have a vertical accuracy of plus or minus 1 foot at the 90 percent confidence level. These data meet the standards for mapping at 1 inch equal to 500 feet with an equivalent topographic contour of 2 feet. Kane County provided countywide digital datasets including a Digital Terrain Model (DTM) dataset with mass points and break lines. A uniform grid digital elevation model (DEM) with 2-foot cells was created from this data for this project. The uniform grid with this resolution can be readily and quickly processed in the ArcGIS environment. The U.S. Army Corps of Engineers HEC-GeoRAS (Ackerman, 2005) software was used to automate the input process. Cross section locations for all reaches are shown on the work map in Appendix E.

The downstream boundary condition for Big Rock Creek was determined using the normal depth method with a slope of 0.0015. The downstream boundary condition for the Welch Creek model was the water surface elevation simulated by the Big Rock model. The 1-percent-annual-chance peak water surface elevation on Big Rock Creek was used for the downstream boundary condition in the Welch Creek model because the hydrologic model indicates a coincident peak flow.

Flows calculated as described in the hydrology section of this report were input to the hydraulic model at the upstream end of the hydrologic reach.

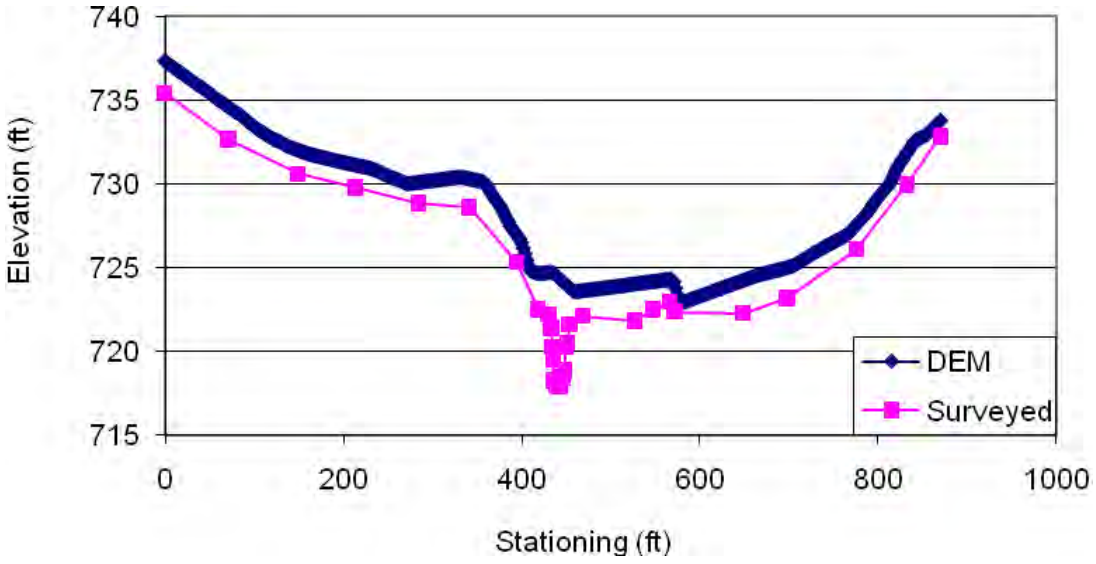

Figure 16. Cross section survey comparison to Kane County topography

Limited-Detail Study Input Data

The majority of the cross section and stream geometry data for the limited-detail study were determined from the Kane County topography. A few cross sections were surveyed by the IDNR/OWR in key locations. Cross sections outside of Kane County topographic data limits were determined from the USGS National Elevation Dataset. Additional cross section information was taken from available existing bridge plans.

Sixteen river cross sections and seven bridges in the watershed were surveyed by the IDNR/OWR. The surveyed cross sections were compared to those created with the Kane County topography. Figure 16 shows the cross section data comparison on Welch Creek just downstream of Scott Road. As the Kane topography was generated from photogrammetric data, stream channels are not represented in the topographical data. The comparison also shows survey data elevations to be lower than the DEM at this location. Along the overbanks, the survey data are an average of 1.57 feet below the DEM cross section at this particular location. Due to the limited number of surveyed cross sections and their location near bridge crossings, the comparison cannot be assumed to hold for the entire watershed. In general, consideration should be given to the stated vertical accuracy of the LiDAR data when comparing other topographic sources or in future detailed studies.

DEM data often do not represent the deeper channel geometry. The geometry of cross sections generated from the DEM were reviewed and edited to add the stream channel. Stream channel bed elevations were interpolated using the slope between known bed elevations, generally at the bridge cross section. Stream widths were estimated from aerial photography, and side slopes were assumed to be approximately 1:2. Figure 17 shows the edited channel geometry of a cross section.

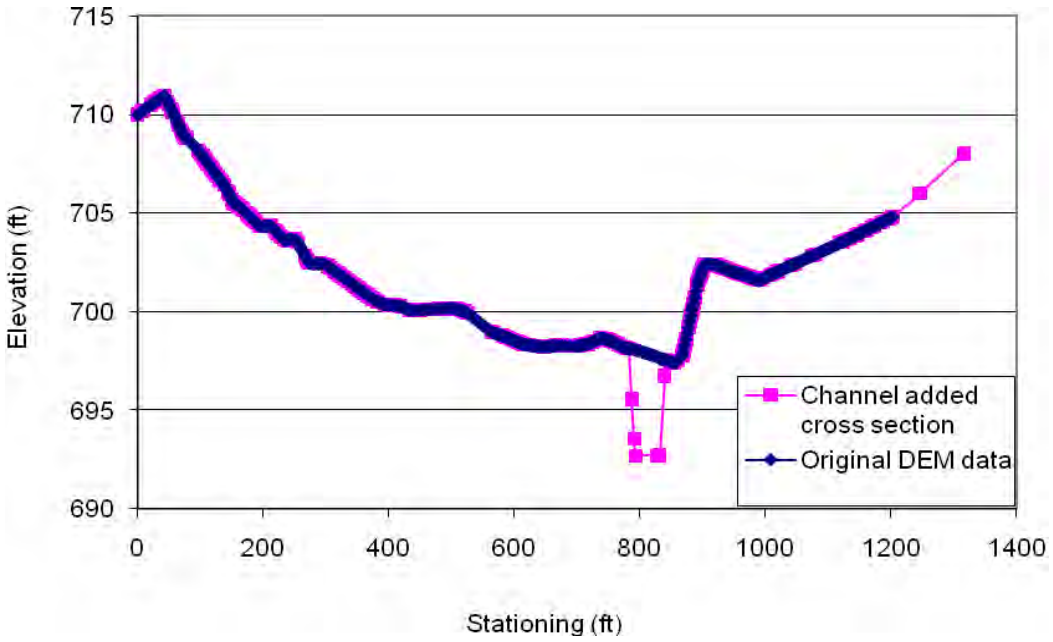

Figure 17. Edited channel geometry for a DEM cross section

Manning's *n* values were based on multiple field visits and aerial photography. The overbank Manning's *n* values range from 0.01 to 0.11 and the channel Manning's *n* values range from 0.02 to 0.045. A value of 0.01 was used at pond and Big Rock Lake locations.

Bridge data were acquired by three methods. First, an effort was made to gather existing bridge plans. If bridge plans were not available, field measurements were made. Field measurements included basic structural geometry such as culvert size and material, or bridge opening width and height. The IDNR/OWR completed surveying at six bridges in the watershed. Figure 18 summarizes the source of watershed bridge data.

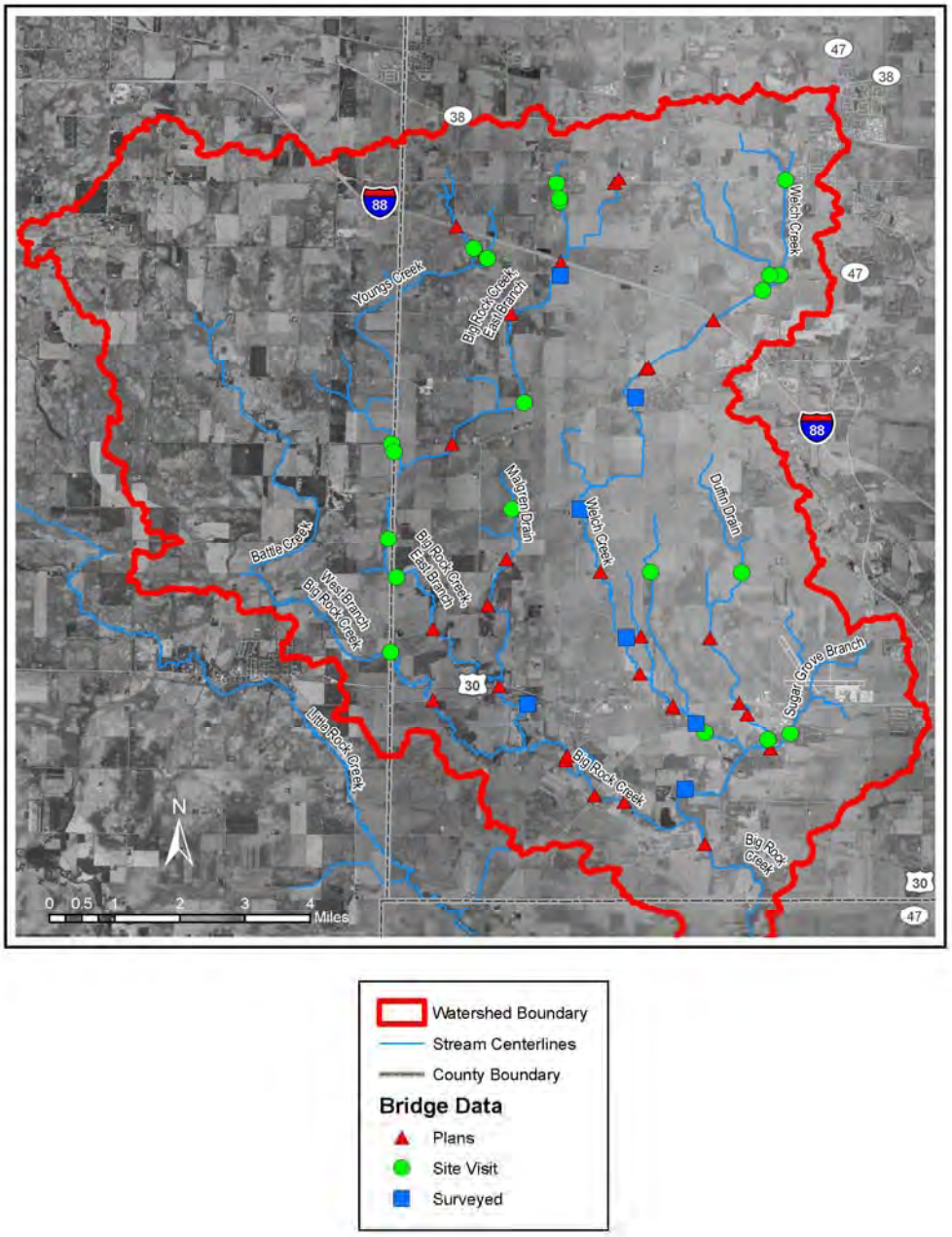

Figure 18. Type of bridge data available for use in the HEC-RAS hydraulic models of Big Rock and Welch Creek

Bridge ineffective flow areas were used based on contraction and expansion ratios of 1:1 and 2:1, respectively.

Approximate Study Input Data

Cross sections derived from the topographic data were not altered or enhanced to show the stream channel on approximate study reaches. Also, no bridges were input to the approximate study reaches.

Manning's *n* values were determined with different methods for the approximate and limited-detail reaches. Values for the approximate reaches were automatically generated from land cover data using HEC-GeoRAS routines. Manning's *n* values were assumed for each land use category from the Land Cover 1999-2000 dataset (USDA/NRCS, 2003). The Manning's *n* values corresponding to each land use category are given in Table 9.

Model Calibration Using the September 12, 2008 Flood Event

The model was calibrated using data from the September 2008 flood event. Peak discharges calculated using HEC-HMS were input to the RAS model, and water surface elevations and subsequent extent of flooding simulated by the model were compared with observations and information recorded at the stage gages. Input parameters such as Manning's *n* values and ineffective flow areas were adjusted so that model simulation would approximate observation as closely as possible. Table 10 summarizes the comparison of the model results

Table 9. Manning's *n* Values Associated with Land Use Data

LU code	*Land cover category*	*Manning's value*
10	**Agricultural Land**	
11	Corn	0.05
12	Soybeans	0.05
17	Rural Grassland	0.04
20	**Forested Land**	
21	Upland	0.11
30	**Urban Land**	
31	High Density	0.045
32	Low/Medium Density	0.05
35	Urban Open Space	0.04
40	**Wetland**	
41	Shallow Marsh/Wet Meadow	0.09
50	**Other**	
51	Surface Water	0.01

Table 10. Big Rock and Welch Creek September 13 Peak Gage and Model Water Surface Elevations

Stream	*Location*	*Gage data (feet)*	*Model results (feet)*
Big Rock Creek	Price Road	680.72	682.68
Big Rock Creek	Granart Road	676.53	676.34
Welch Creek	U.S. 30	695.0	695.1
Welch Creek	Granart Road	689.0	689.45

with water surface elevations recorded at the four gages. Table 11 compares observations made by persons on site during the flood event to model results. Anecdotal observations were collected at a meeting of the stakeholders. Maps of the watershed showing the first simulation of the September 2008 event were examined by the stakeholders at the meeting. The maps were marked to show observations at bridges and flow patterns throughout the watershed.

Discussion of Observations and Model Simulation

The model peak water surface elevation results are within one-half foot of the recorded peak stages at Welch Creek gages and Big Rock Creek gage at Granart Road. The model results for the Big Rock Creek gage at Price Road are 2.0 feet higher than the gage data. The profile between the two gages roughly matches the slope of the channel bed and appears reasonable. The Big Rock Creek stormwater system outlets just downstream of Price Road gage. Storm sewers were not considered for the watershed hydrology, and the impact of the system should be reviewed when a detailed study is conducted.

Granart Road across Duffin Drain was reported to have overtopped during the September flood. The model does not show the bridge to have overtopped. It is recommended that further review of this area be completed for a detailed study. Plan data from 1998 were used for this bridge data. Surveyed data or further study of the crossing would allow for consideration of sedimentation as a cause of the increased water surface elevation.

Keslinger Road on Welch Creek was also reported to have overtopped during the flood event. However, the model simulation does not indicate overtopping. This difference may be due to flows from the water treatment facility of Elburn. These flows were not included in this study. These flows and their effect on the water surface elevation at the upstream reaches of Welch Creek should be reviewed for a detailed analysis.

Observation of the September flood and the model results both show Duffin Drain overtopping U.S. 30. The model also shows the railroad just downstream of Duffin Drain overtopping. Further review should be given to this area for a detailed study. The Duffin Drain flood may extend to the east tributary between U.S. 30 and the railroad. The 30- inch culvert at the tributary may convey some of the Duffin Drain flow and reduce the water-surface elevation between these two structures. Surveying would be required to confirm there is a flow between these two streams.

Table 11. September 2008 Flood Observations

Stream	*Location*	*Verification data*	*Model results*
Big Rock Creek Watershed			
Big Rock Creek	Pedestrian Bridge	Observation of bridge not being overtopped	Approx. model water surface elevation is 665.78 ft with an estimated bridge floor elevation of 666 ft
Big Rock Creek	Jericho Road	Observation of bridge not being overtopped	Model peak water surface elev. overtops roadbed by 0.8 ft
West Branch Big Rock Creek	U.S. 30	Observation of bridge not being overtopped	Model water surface elevation 9 ft below the road profile
East Branch Big Rock Creek	U.S.30	Observation of bridge not being overtopped	Model water surface elevation 5 ft below the road profile
East Branch Big Rock Creek	Hinckley Road West of East Branch	Observations show area is inundated	The topography does not support flooding due to river flow in this area. These homes are estimated to be 12 ft above the floodplain
East Branch Big Rock Creek	Perry Road	Photographs of bridge being overtopped	Model peak water surface elev. overtops roadbed by 0.2 ft
Welch Creek Watershed			
Welch Creek	Camp Dean (north)	Observed estimation of crest over 3 ft above road	Model water surface peak is 2.6 ft above road
Welch Creek	U.S. 30	Observation of bridge being overtopped by a few inches	Stream gage results were used for verification
Welch Creek	Rich Harvest Bridge	Observed stage crest at bridge floor	Model water surface elevation is 0.75 ft above bridge deck
Welch Creek	U.S. 30 to confluence with Sugar Grove	Agreement with preliminary map of modeled September 12 flood limits	No changes to this area since public meeting
Welch Creek	Keslinger Road	Observation of bridge being overtopped	Model water surface elevation 5 ft below the road profile
Duffin Drain	Granart Road	Observation of bridge being overtopped	Model water surface elevation 2.5 ft below the road profile
Duffin Drain	Rich Harvest Private Drive	Observation that the flooding reaches but doesn't overtop Dugan Road	Water surface elevation supports observation
Duffin Drain	U.S. 30	Agreement with preliminary map of modeled September 12 flood limits	No changes to this area since public meeting

Hydraulics at Big Rock Lake should be examined for a detailed study. A two-dimensional flow model is required to accurately model stream conditions at this location. For the purposes of this model, only the portion of the lake 100 feet east of the berm was considered as an active flow area. This area appears to convey flow through the lake to the downstream outlet. The lake area east of this active flow area was modeled as ineffective flow.

There is a significant increase in the water surface elevation just upstream of the lake. This jump is a critical flow transition, and is believed to be caused by the steep slope of the channel bed and the narrowing of the floodplain at the lake, combined with the backwater effect from the confluence.

Some of the observed flooding appears to be a consequence of inadequate storm water drainage, rather than flooding from the overtopping of the receiving streams. These include the Village of Elburn, flooding west of East Branch Big Rock Creek between U.S. 30 and Hinckley, and flooding near Oaken and Dugan Roads 1 mile east of Big Rock Creek. Confirmation of the source of flooding, whether these flooded areas are from stormwater or overbank river flow, will require more specific data. A review of the area should be completed for a detailed study.

One-Percent-Annual-Chance Floodplain

After calibrating the HEC-RAS Big Rock Creek and Welch Creek models using the September event, they were used to simulate the 1-percent-annual-chance flood elevations. The 1-percent-annual-chance discharges computed using the HEC-HMS model were input to the hydraulic model and an additional review was completed to revise any ineffective flow areas as necessary.

HEC-RAS output data for the regulatory 1-percent-annual-chance floodplain are located in Appendix F. Profiles for the limited-detail reaches are provided in Appendix G. The Key to Cross Sections, also located in Appendix G and organized by stream with the profiles (the style used in FEMA flood insurance studies), provides the cross reference between model cross section numbers and lettered cross sections.

The area inundated by the proposed 1-percent-annual-chance flood was mapped using the Kane County 2001 topographical data. All floodplain mapping was completed in accordance with FEMA standards. Floodplain boundaries are interpolated between cross sections. Floodplain boundaries were initially delineated using the digital elevation model and computer-assisted techniques. The floodplain was then refined with a GIS and engineering review and compared with the Kane County contours. Base flood elevations (BFEs) have been included for the limited-detail reaches. Floodplain maps have been included in Appendix H.

The watershed study joins the effective detailed study on Sugar Grove Branch. The proposed water surface elevation of 679.89 feet (North American Vertical Datum, 1988) matches the existing floodplain water surface elevation of 679.8 feet at the downstream end of the detailed reach within the FEMA-required .50 feet. This is approximately 3,790 feet above the confluence with Welch Creek and Sugar Grove Branch.

The proposed and effective floodplains can be compared by viewing the pdf files provided in Appendix E. The proposed floodplain generally follows the effective Zone A or is slightly narrower than the existing floodplain.

Summary

Big Rock and Welch Creeks are located in southwestern Kane County, Illinois, an area that is expected to experience significant population growth and attendant development in the coming years. The purpose of this project was to prepare updated maps showing watershed flood hazard areas that reflect current conditions. There are approximately 81 stream miles within Kane County in the Big Rock and Welch Creek watershed. Two levels of flood study were conducted; a limited-detail flood study was conducted for 38 stream miles and approximate study was conducted for 30 stream miles in Big Rock Creek and Welch Creek watershed areas within Kane County. These two levels of study were selected to estimate adequately the extent of the flood hazards while maximizing the number of stream miles studied. More detailed and rigorous analyses were used along reaches where development is anticipated, and less rigorous analyses were used in areas expected to remain primarily rural in nature.

The study included evaluation of existing data, including precipitation, stage, flood hazard mapping, and plans and specifications for structures such as bridges. Available stream data were collected more than 30 years ago and no long-term stream discharge or stage records were available for statistical determination of the annual chance of discharge. A model was required for hydrologic analysis, and precipitation, stream stage, and discharge data were collected for model calibration. Given that the purpose of the modeling effort was to simulate conditions during an extreme flood event (1-percent-annual chance-flood), the intent of the model calibration was for high flow events. Data collected during the September 2008 storm provided valuable information for model calibration.

Hydrologic and hydraulic models were prepared using spatial datasets, survey data, and field measurements. These models were calibrated to the September 2008 storm event using recorded precipitation, discharge, stage data, and field observations of the extent of flooding during the event. The calibrated models were then used to simulate discharges and flooding elevations for a 1-percent-annual-chance event, which is the base flood used for floodplain mapping. The extent of flooding is depicted by interpolating calculated flood elevations at locations along each stream reach and using these elevations to delineate the floodplain boundary.

The results of the analyses are summarized with profiles showing flood elevations along stream reaches that were studied using limited-detail methods. The 1-percent-annual-chance floodplain boundary is shown for both limited-detail and approximate study reaches on accompanying maps. These results will assist floodplain managers and planners. Should development in any area increase significantly, then it would be appropriate to perform a more detailed study with higher accuracy standards and evaluation of the floodway. This report provides information on additional analyses that should be taken into consideration when a detailed study is performed in the future.

The Federal Emergency Management Agency (FEMA) is the primary agency responsible for preparing and distributing maps and studies defining flood hazards. These maps and studies are used for regulatory purposes and for flood insurance determinations. FEMA has published guidelines and specifications for hydrologic and hydraulic analyses as well as mapping standards

and digital data standards. These standards were used in preparation of this study with the anticipation of submitting the technical data to FEMA for adoption as part of the Kane County's Flood Insurance Study and Flood Insurance Rate Maps.

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Appendix A. Gage Descriptions

Illinois State Water Survey
Center for Watershed Science

Station Description

Big Rock Creek @ Price Road - 801

Site Location
N 41.75238
W 088.55013
Big Rock Township, Kane County, Illinois on the upstream side of the Price Road bridge, just south of the town of Big Rock, IL. This site is approximately 1 mile upstream from site 802- Big Rock @ Granart Road.

Establishment
Gage Shelter and water level pressure transducer sensor installed on 3/25/08.

Drainage Area
Drainage area at this point was determined using automated methods outlined in the Big Rock Welch Creek report to be 61.3 square miles.

Gage
A Design Analysis WaterLOG H-310 vented pressure transducer, with data logged to a Campbell Scientific CR10x data logger. Equipment is powered by a 12V 32 AH AGM battery and housed in a 30" x 30" robot head steal shelter mounted on the upstream side of the bridge near the RDB. The pressure transducer is mounted horizontally to a sign post and is located under the bridge towards the upstream side and approximately 15 ft from the RDB bridge abutment. The stage is measured at 15 minute intervals and data is downloaded at regular site visits, not greater than 14 days apart.

Reference Points and Benchmarks
RP1: 2 file marks on NE corner of upstream bridge rail T-post support at the marked bridge rail cross section location of 24'. Elevation: 102.49'
TBM1: Chiseled square on NW bridge abutment (upstream right descending bank). 2" square painted orange. Elevation: 100.00'
TBM2: Chiseled square on SE bridge abutment (downstream left descending bank). 2" square painted orange. Elevation: 99.94'

Channel and Control
The confluence of the east and west branch of Big Rock Creek is approximately 1 mile upstream. Upstream, the channel is tree lined and borders residential yards for several hundred feet. The channel meanders downstream through pasture to site 802 on Granart Road. The streambed consists of silt, sand and gravel with a few cobbles. Low flow control is a cobble riffle located about 200 ft downstream. High flow is channel controlled. The channel widens at the gage and may become split or braided at lower flows downstream.

Discharge Measurement Locations
Low to Medium Flow: measurements are taken 75 - 100 ft downstream of the gage. The channel is straight for 100 ft upstream from cross section. Streambed consists of sand, gravel and cobbles. Measurements are made by wading, using a Sontek Flowtracker ADV with a topset wading rod.

High Flow: measurements are taken from the upstream side of the bridge. The cross section widens at the bridge and downstream. Measurements are collected using a Price AA meter, bridgeboard/crane with appropriate cable reel and sounding weight.

Illinois State Water Survey
Center for Watershed Science

Station Description

Big Rock Creek @ Granart Road - 802

Site Location
N 41.74363
W 088.54084
Big Rock Township, Kane County, Illinois on the downstream side of the Granart Road bridge just NE of the intersection of Granart and Jericho Road. This site is approximately 1 mile downstream from site 801-Big Rock Creek @ Price Road.

Establishment
Gage Shelter installed 3/25/08
Gage established 4/2/08 with a water level radar sensor.

Drainage Area
Drainage area at this point was determined using automated methods outlined in the Big Rock Welch Creek report to be 62.8 square miles.

Gage
OTT RLS Radar Level Sensor, with data logged to a Campbell Scientific CR510 data logger. Equipment is powered by a 12V 32 AH AGM battery and housed in a 30" x 30" robot head steal shelter mounted on the downstream side of the bridge near the thalweg. The Radar level sensor measures stage at 15 minute intervals and data is downloaded at regular site visits, not greater than 14 days apart.

Reference Points and Benchmarks
RP1 Elevation: 101.45
Location: Inside platform (base) of gage house on the LDB side
TBM1: chiseled square on northerly concrete bridge rail (upstream left descending bank). 2" square painted orange. Elevation: 100.00'

Channel and Control
The channel meanders through upstream pasture all the way from site 801 on Price Road. Downstream the channel straightens and runs parallel with Jericho Road for about 800 ft. The downstream banks are lined with woody and herbaceous vegetation. The streambed consists of silt, sand and gravel with a few cobbles. Low flow control is a cobble riffle located 250 ft downstream. High flow is channel controlled.

Discharge Measurement Locations
Low to Medium Flow: measurements are taken 250 ft downstream of the gage near the low flow control. The channel is straight for 100 ft upstream from cross section with relatively uniform flow. Streambed consists of sand, gravel and cobbles. Measurements are made by wading, using a Sontek Flowtracker ADV with a topset wading rod.

High Flow: measurements are taken from the downstream side of the bridge. The cross section widens on upstream side of the bridge. Measurements collected using a Price AA meter, bridgeboard/crane with appropriate cable reel and sounding weight.

Illinois State Water Survey
Center for Watershed Science

Station Description

Welch Creek @ U. S. Highway 30 - 803

Site Location
N 41.76409
W 088.51804
Big Rock Township, Kane County, Illinois on the downstream side of the U.S. 30 bridge, about 1.5 miles east of the town of Big Rock, IL. This site is approximately 0.5 mile upstream from site 804- Welch Creek @ Granart Road.

Establishment
Gage Shelter and water level pressure transducer sensor installed on 4/4/08.

Drainage Area
Drainage area at this point was approximated using automated methods outlined in the Big Rock Welch Creek report to be 19.3 square miles.

Gage
A Design Analysis WaterLOG H-310 vented pressure transducer mounted vertically to the downstream side of the middle bridge pier, with data logged to a Campbell Scientific CR10x data logger. Equipment is powered by a 12V 32 AH AGM battery and housed in a 30" x 30" robot head steal shelter mounted on the downstream side of the bridge above the middle pier. The stage is measured at 15 minute intervals and data is downloaded at regular site visits, not greater than 14 days apart.

Reference Points and Benchmarks
RP1: 2 paint marks on inside platform (base) of gage house on the LDB side. Elevation: 103.80'
TBM1: chiseled square on NE concrete bridge abutment (upstream left descending bank). 2" square painted orange. Elevation: 100.00'

Channel and Control
Upstream the channel flows through agriculture fields. Downstream the channel flows through uncultivated field and woodland to site 804 on Granart Road. The channel flows east following U.S. 30 for 200ft and then takes a sharp turn south 30 ft upstream of the bridge. The channel takes a sharp turn east again approximately 130 ft downstream. The streambed generally consists of high organic sediment near the edges of water and silt, sand and gravel mid channel. Low flow control is a cobble riffle located about 100 ft downstream, above the downstream R.R. bridge. High flow is channel controlled.

Discharge Measurement Locations
Low to Medium Flow: measurements are taken 80 ft downstream of the gage. The channel is rather straight for 100 ft upstream from cross section. Streambed at the cross section consists of high organic sediment near the edges of water and silt, sand and gravel mid channel. Measurements are made by wading, using a Sontek Flowtracker ADV with a topset wading rod.

High Flow: measurements are taken from the downstream side of the bridge. Measurements are collected using a Price AA meter, bridgeboard/crane with appropriate cable reel and sounding weight.

Illinois State Water Survey
Center for Watershed Science

Station Description

Welch Creek @ Granart Road - 804

Site Location
N 41.75998
W 088.51118
Big Rock Township, Kane County, Illinois on the downstream side of the Granart Road bridge, about 2 miles east of the town of Big Rock, and 3 miles west of Sugar Grove, IL. This site is approximately 0.5 mile downstream from site 803- Welch Creek @ U.S. 30.

Establishment
Gage Shelter and water level pressure transducer sensor installed on 3/26/08.

Drainage Area
Drainage area at this point was approximated using automated methods outlined in the Big Rock Welch Creek report to be 21.2 square miles.

Gage
A Design Analysis WaterLOG H-310 vented pressure transducer mounted vertically to the downstream side of the LDB bridge abutment, with data logged to a Campbell Scientific CR10x data logger. Equipment is powered by a 12V 32 AH AGM battery and housed in a 30" x 30" robot head steal shelter mounted on the downstream side of the bridge on the LDB bridge abutment. The stage is measured at 15 minute intervals and data is downloaded at regular site visits, not greater than 14 days apart.

Reference Points and Benchmarks
RP1: 2 file marks on vertical T-post rail support on DS side of bridge @ bridge rail cross section location 84 (2nd post to right of gage house looking DS). Elevation: 101.66'
TBM1: chiseled square on southerly concrete bridge abutment (downstream right descending bank). 2" square painted orange next to USGS crest gage. Elevation: 100.00'

Channel and Control
Upstream the channel flows through uncultivated field and woodland. Downstream the channel flows through an undeveloped wetland field about a ¼ mile and then flows through a golf course. The channel is fairly perpendicular to the bridge up and downstream for about 50 ft. The channel deepens and widens at the bridge and is more narrow and shallow on the up and downstream sides. The streambed generally consists of high organic sediment near the edges of water and sand/pebble/cobble at mid channel. The stream banks are lined with woody vegetation on both upstream banks and on the downstream RDB. The downstream LDB is primarily grass covered with several old stumps and a few trees. Low flow control is a cobble riffle located about 50 ft downstream. High flow is channel controlled.

Discharge Measurement Locations
Low to Medium Flow: measurements are taken 150 ft downstream of the gage. The channel is rather straight for 50 ft upstream from the cross section. Streambed at the cross section consists of high organic sediment near the edges of water and pebble/gravel and cobble mid channel. Measurements are made by wading, using a Sontek Flowtracker ADV with a topset wading rod.

High Flow: measurements are taken from the downstream side of the bridge. Measurements are collected using a Price AA meter, bridgeboard/crane with appropriate cable reel and sounding weight.

Illinois State Water Survey
Center for Watershed Science

Station Description

Rain Gage 81

Site Location

N 41.83219
W 088.59486
Hitzsche Fertilizer, Inc. 2s181 County Line Rd
Big Rock Township, Kane County, Settlement of Troxel, Illinois
Rain gage located 50 ft south of parking area south of equipment garages that are east of the office building and 20 ft north of agriculture field.

Establishment

Rain gage installed on 4/9/08

Gage

An ETI NOAH III Precipitation Weighing Assembly, with data logged to a Campbell Scientific CR10x data logger. Equipment is powered by a 12V 12 AH AGM battery and housed in a Belfort rain gage enclosure. The precipitation is measured at 15 minute intervals and data is downloaded at regular site visits, not greater than 14 days apart.

Appendix B. Bridge Data Source

Bridge Data Source

Stream	Road	Data source	Date
Duffin Drain			
	Wheeler Road	KDOT plans	2001
	US 30	IDOT plans	1981
	Railroad	IDOT plans	1981
	Granart Road	KDOT plans	1998
Sugar Grove Branch			
	Dugan Road	KDOT plans	1974
Welch Creek			
	I-88	ISTHA plans	1971
	Harter Road	KDOT plans	1990
	Dauberman Road (north)	KDOT plans	1987
	Main Street	OWR project survey	2008
	Lasher Road	OWR project survey	2008
	Scott Road	KDOT plans	1996
	Wheeler Road	OWR project survey	2008
	Dauberman Road (south)	KDOT plans	1975
	US 30	IDOT plans	1967/1981
	Railroad downstream of US 30	IDOT plans	1967/1981
	Granart Road	OWR project survey	2008
	Camp Dean (south)	OWR project survey	2008
Big Rock Creek			
	Price Road	KDOT plans	1974
	Granart Road	KDOT plans	1995
	Jericho Road	KDOT plans	1998
East Branch Big Rock			
	I-88	ISTHA plans	1971
	Harter Road	OWR project survey	2008
	Perry Road	KDOT plans	1971
	US 30	IDOT plans	1981
	Railroad	IDOT plans	1981
	Hinckley Road	OWR project survey	2008
West Branch Big Rock			
	US 30	IDOT plans	1983
	Hinckley Road	plans	1974
Malgren Drain			
	Swan Road	KDOT plans	1997
	Scott Road	KDOT plans	1977

KDOT- Kane County Department of Transportation
IDOT- Illinois Department of Transportation
ISTHA- Illinois State Toll Highway Authority
OWR- Office of Water Resources

Appendix C. HMS Input and Output

Hydrologic Model Subbasin Input Summary

		Subbasin Data			
HMS Label	*Drainage Area (mi sq)*	*CN*	*Initial Abstraction (in)*	*Tc (hrs)*	*R (hrs)*
BC1000	2.43	77.66	0.58	3.10	27.00
BC1100	0.58	78.49	0.55	1.66	12.70
BC1110	1.51	79.16	0.53	3.40	20.25
BC1200	1.10	78.82	0.54	2.00	14.50
BC1300	1.28	78.89	0.54	1.80	10.95
BC1400	1.35	78.90	0.53	2.36	11.35
BC1410	0.80	78.68	0.54	1.21	6.20
BC1420	2.28	77.48	0.58	2.73	8.80
BC1421	2.48	78.44	0.55	2.83	10.30
BC1500	2.15	78.17	0.56	2.67	12.85
BC1510	1.13	78.17	0.56	2.12	11.45
BR1100	0.88	74.35	0.69	2.10	10.45
BR1110	1.12	76.80	0.60	1.76	8.35
BR1200	0.38	73.93	0.71	1.09	5.40
BR1300	0.01	60.18	1.32	0.17	1.15
BR1310	1.45	76.27	0.62	3.45	17.65
BR1400	0.20	50.22	1.98	0.96	14.50
BR1500	0.09	74.21	0.70	0.44	2.65
BR1510	1.46	78.87	0.54	3.49	26.25
BR1600	0.49	73.64	0.72	1.18	7.25
BR1610	1.95	75.10	0.66	4.06	29.60
BR1700	0.82	77.66	0.58	1.74	8.90
BR1800	0.22	75.34	0.65	0.76	3.90
BR1810	0.40	71.17	0.81	1.12	7.90
BR1900	0.62	73.93	0.71	1.10	5.70
DD1000	0.34	76.01	0.63	1.22	7.45
DD1100	0.77	79.23	0.52	1.78	21.15
DD1200	0.26	78.67	0.54	1.40	21.35
DD1210	0.98	78.41	0.55	3.20	19.40
DD1300	0.60	79.32	0.52	1.77	8.90
DD1400	0.25	79.22	0.52	1.07	9.90
DD1410	0.71	79.25	0.52	1.34	6.35
DD1500	0.11	77.40	0.58	0.56	6.95
DD1510	0.32	79.47	0.52	1.34	9.70
DD1520	1.03	75.21	0.66	1.95	8.65
DD1600	0.64	78.24	0.56	1.17	6.45
DD1700	1.17	78.57	0.55	1.80	8.55
DD1800	1.29	76.00	0.63	2.29	12.25
EB1000	0.57	74.20	0.70	1.57	7.45
EB1100	0.37	73.75	0.71	1.21	8.30
EB1200	1.63	75.17	0.66	3.60	20.30
EB1300	1.41	77.38	0.58	1.68	13.85
EB1400	0.20	77.27	0.59	0.84	5.80
EB1410	1.01	79.24	0.52	2.07	17.70
EB1500	0.42	79.43	0.52	1.16	5.90
EB1600	1.45	78.95	0.53	2.20	13.15
EB1700	2.31	77.41	0.58	2.53	14.15
EB1710	1.03	79.21	0.53	2.05	12.60
EB1800	2.00	77.98	0.56	2.94	13.80
EB1900	0.01	76.50	0.61	0.21	3.60
EB1910	0.72	78.46	0.55	1.92	14.05
EB2000	0.96	76.48	0.61	1.71	7.95
EB2010	0.39	79.13	0.53	1.63	10.60
EB2020	1.27	77.14	0.59	2.05	10.85
EB2021	0.69	77.08	0.59	1.29	6.30
EB2100	0.43	75.17	0.66	1.04	4.95
MD1000	1.51	74.82	0.67	2.11	10.00
MD1100	0.54	74.47	0.69	1.44	10.80
MD1200	0.13	79.09	0.53	0.56	5.25
MD1210	0.94	77.43	0.58	1.86	15.60
MD1300	0.86	78.78	0.54	1.68	14.55
MD1310	0.56	79.25	0.52	1.69	12.15
SG1000	0.24	70.94	0.82	0.86	4.50
SG1100	1.09	74.10	0.70	1.89	11.45
SG1200	0.16	79.26	0.52	0.75	5.00

Hydrologic Model Subbasin Input Summary

		Subbasin Data			
HMS Label	*Drainage Area (mi sq)*	*CN*	*Initial Abstraction (in)*	*Tc (hrs)*	*R (hrs)*
SG1300	1.39	79.11	0.53	2.65	14.35
SG1310	0.75	78.60	0.54	2.09	16.55
SG1320	1.04	78.11	0.56	1.72	12.85
SG1400	1.12	78.79	0.54	1.74	13.40
WB1000	1.48	75.17	0.66	2.95	13.75
WB1100	2.22	77.83	0.57	3.97	28.60
WB1200	1.05	78.49	0.55	2.64	23.95
WB1300	1.63	79.12	0.53	2.16	15.45
WB1400	1.88	79.14	0.53	2.55	17.60
WB1500	0.85	79.27	0.52	1.70	13.70
WB1600	1.86	79.25	0.52	2.17	7.95
WC1000	0.34	68.01	0.94	1.00	4.45
WC1100	0.93	70.24	0.85	1.83	9.15
WC1200	0.49	74.90	0.67	1.80	11.55
WC1300	0.28	73.35	0.73	1.02	7.45
WC1400	0.88	75.04	0.67	1.77	13.65
WC1410	0.69	78.66	0.54	2.06	14.65
WC1420	0.08	79.22	0.52	0.55	5.40
WC1430	1.01	79.14	0.53	2.10	11.95
WC1500	0.62	77.39	0.58	1.58	10.85
WC1510	0.15	78.76	0.54	0.90	13.40
WC1520	0.35	78.40	0.55	1.28	6.30
WC1600	1.27	78.56	0.55	2.33	11.00
WC1700	0.96	77.91	0.57	1.91	10.30
WC1800	0.39	78.33	0.55	0.81	5.35
WC1900	0.16	79.04	0.53	0.76	4.55
WC1910	0.73	79.36	0.52	1.40	7.55
WC2000	1.05	76.75	0.61	2.29	12.10
WC2010	1.01	79.01	0.53	2.84	13.90
WC2100	0.37	76.26	0.62	1.26	9.80
WC2200	0.41	77.55	0.58	1.41	8.50
WC2210	0.29	78.36	0.55	1.42	10.75
WC2220	1.20	77.99	0.56	2.76	18.30
WC2300	1.04	74.70	0.68	2.24	15.55
WC2400	2.04	77.12	0.59	2.02	16.05
WC2500	1.88	76.70	0.61	2.88	28.30
WC2510	0.85	78.77	0.54	2.08	14.65
WC2515	0.92	77.84	0.57	1.90	8.40
WC2520	0.53	78.57	0.55	1.34	6.60
WC2600	0.06	76.86	0.60	0.50	3.15
WC2610	0.82	76.77	0.61	1.65	5.50
WC2700	1.35	75.26	0.66	1.60	7.60
YC1000	0.77	79.04	0.53	1.65	10.20
YC1100	2.32	78.65	0.54	3.22	14.60
YC1110	2.56	78.74	0.54	2.91	14.25
YC1200	1.04	78.79	0.54	1.53	7.05
YC1210	1.05	78.75	0.54	1.77	7.85
YC1300	0.47	78.13	0.56	1.40	8.30
YC1310	0.69	78.80	0.54	1.75	8.70
YC1400	0.03	76.81	0.60	0.39	3.50
YC1410	0.24	78.74	0.54	1.03	5.90
YC1420	0.29	78.88	0.54	1.09	9.40
YC1500	0.78	78.29	0.55	1.42	8.70
YC1510	0.99	78.05	0.56	2.22	12.10

Hydrologic Model Routing Input Summary

HMS Label	*Length*	*Slope*	*Manning's Values*			*Cross Section Table*
			Channel	*Left Bank*	*Right Bank*	
R_BC1000	12853.68	0.00080	0.05	0.07	0.07	10' width XS
R_BC1100	5721.94	0.00213	0.05	0.07	0.07	10' width XS
R_BC1200	8778.91	0.00087	0.05	0.07	0.07	10' width XS
R_BC1300	5406.82	0.00183	0.05	0.07	0.07	10' width XS
R_BC1400	10240.97	0.00293	0.05	0.07	0.07	5' width XS
R_BC1410	5735.13	0.00001	0.05	0.07	0.07	5' width XS
R_BR1000	460.87	0.00121	0.05	0.07	0.07	45' Width XS
R_BR1100	8017.78	0.00082	0.05	0.07	0.07	45' Width XS
R_BR1200	2819.10	0.00235	0.05	0.07	0.07	40' width XS
R_BR1300	609.11	0.00108	0.05	0.07	0.07	40' width XS
R_BR1400	4180.88	0.00158	0.05	0.07	0.07	40' width XS
R_BR1500	1418.26	0.00148	0.05	0.07	0.07	40' width XS
R_BR1600	4131.62	0.00148	0.05	0.07	0.07	40' width XS
R_BR1700	2339.13	0.00198	0.05	0.07	0.07	40' width XS
R_BR1800	2634.36	0.00198	0.05	0.07	0.07	40' width XS
R_BR1900	5278.04	0.00072	0.05	0.07	0.07	40' width XS
R_DD1000	5956.82	0.00218	0.05	0.07	0.07	10' width XS
R_DD1100	Modified Puls					
R_DD1200	2393.50	0.00004	0.05	0.07	0.07	10' width XS
R_DD1300	Modified Puls					
R_DD1400	5177.40	0.00004	0.05	0.07	0.07	5' width XS
R_DD1500	1867.25	0.00234	0.05	0.07	0.07	5' width XS
R_DD1510	5328.18	0.00252	0.05	0.07	0.07	5' width XS
R_DD1600	4521.14	0.00213	0.05	0.07	0.07	5' width XS
R_DD1700	5666.70	0.00529	0.05	0.07	0.07	5' width XS
R_EB1000	5498.50	0.00130	0.05	0.07	0.07	30' width XS
R_EB1100	Modified Puls					
R_EB1200	Modified Puls					
R_EB1300	5641.70	0.00106	0.05	0.07	0.07	25' width xs
R_EB1400	3577.75	0.00116	0.05	0.07	0.07	20' width XS
R_EB1500	2464.04	0.00181	0.05	0.07	0.07	20' width XS
R_EB1600	10873.47	0.00132	0.05	0.07	0.07	15' width XS
R_EB1700	Modified Puls					
R_EB1800	8749.69	0.00192	0.05	0.07	0.07	10' width XS
R_EB1900	Modified Puls					
R_EB2000	Modified Puls					
R_EB2010	Modified Puls					
R_MD1000	Modified Puls					
R_MD1100	7451.09	0.00307	0.05	0.07	0.07	10' width XS
R_MD1200	1535.96	0.00378	0.05	0.07	0.07	10' width XS
R_SG1000	2366.75	0.00304	0.05	0.07	0.07	10' width XS
R_SG1100	5084.34	0.00193	0.05	0.07	0.07	10' width XS
R_SG1200	1255.16	0.00076	0.05	0.07	0.07	5' width XS
R_SG1300	3926.47	0.00201	0.05	0.07	0.07	5' width XS
R_SG1310	2769.47	0.00405	0.05	0.07	0.07	5' width XS
R_WB1000	14730.11	0.00197	0.05	0.07	0.07	25' width xs
R_WB1100	16643.28	0.00147	0.05	0.07	0.07	25' width xs
R_WB1200	11616.82	0.00117	0.05	0.07	0.07	25' width xs
R_WB1300	7357.30	0.00135	0.05	0.07	0.07	10' width XS
R_WB1400	11553.85	0.00184	0.05	0.07	0.07	10' width XS

Hydrologic Model Routing Input Summary

HMS Label	*Length*	*Slope*	*Manning'sValues*			*Cross Section Table*
			Channel	*Left Bank*	*Right Bank*	
R_WB1500	6349.34	0.00221	0.05	0.07	0.07	5' width XS
R_WC1000	3384.04	0.00110	0.05	0.07	0.07	30' width XS
R_WC1100	8641.68	0.00128	0.05	0.07	0.07	30' width XS
R_WC1200	4970.50	0.00234	0.05	0.07	0.07	20' width XS
R_WC1300	4205.51	0.00115	0.05	0.07	0.07	20' width XS
R_WC1400	5680.25	0.00139	0.05	0.07	0.07	20' width XS
R_WC1410	7411.15	0.00309	0.05	0.07	0.07	10' width XS
R_WC1420	2233.39	0.00352	0.05	0.07	0.07	5' width XS
R_WC1500	5312.00	0.00150	0.05	0.07	0.07	15' width XS
R_WC1510	3978.72	0.00282	0.05	0.07	0.07	5' width XS
R_WC1600	7766.72	0.00245	0.05	0.07	0.07	15' width XS
R_WC1700	7090.06	0.00244	0.05	0.07	0.07	15' width XS
R_WC1800	2973.75	0.00075	0.05	0.07	0.07	15' width XS
R_WC1900	3253.67	0.00177	0.05	0.07	0.07	15' width XS
R_WC2000	9934.82	0.00251	0.05	0.07	0.07	15' width XS
R_WC2100	2545.16	0.00254	0.05	0.07	0.07	15' width XS
R_WC2200	1905.44	0.00182	0.05	0.07	0.07	10' width XS
R_WC2210	5460.67	0.00412	0.05	0.07	0.07	5' width XS
R_WC2300	7522.00	0.00118	0.05	0.07	0.07	10' width XS
R_WC2400	Modified Puls					
R_WC2500	9883.80	0.00197	0.05	0.07	0.07	5' width XS
R_WC2510	5480.72	0.00127	0.05	0.07	0.07	5' width XS
R_WC2600	2060.09	0.00669	0.05	0.07	0.07	5' width XS
R_YC1000	6842.50	0.00293	0.05	0.07	0.07	10' width XS
R_YC1100	16768.20	0.00125	0.05	0.07	0.07	5' width XS
R_YC1200	7490.66	0.00185	0.05	0.07	0.07	5' width XS
R_YC1300	7359.77	0.00383	0.05	0.07	0.07	5' width XS
R_YC1400	586.59	0.00010	0.05	0.07	0.07	5' width XS

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
BC1000	2.43	219.2	02Jan2000, 22:30	4.56
BC1100	0.58	90.3	02Jan2000, 20:30	5.25
BC1110	1.51	172.8	02Jan2000, 22:15	5.05
BC1200	1.1	158	02Jan2000, 20:45	5.24
BC1300	1.28	219.3	02Jan2000, 20:15	5.33
BC1400	1.35	225.6	02Jan2000, 20:45	5.32
BC1410	0.8	184.6	02Jan2000, 19:45	5.31
BC1420	2.28	427.8	02Jan2000, 20:45	5.17
BC1421	2.48	433.2	02Jan2000, 21:00	5.28
BC1500	2.15	328.3	02Jan2000, 21:00	5.21
BC1510	1.13	185.8	02Jan2000, 20:30	5.24
BR1100	0.88	142.8	02Jan2000, 20:30	4.81
BR1110	1.12	215.8	02Jan2000, 20:15	5.1
BR1200	0.38	86.6	02Jan2000, 19:30	4.77
BR1300	0.01	2.5	02Jan2000, 19:00	3.23
BR1310	1.45	173	02Jan2000, 22:00	4.84
BR1400	0.2	12.8	02Jan2000, 20:45	2.13
BR1500	0.09	26	02Jan2000, 19:00	4.8
BR1510	1.46	137.6	02Jan2000, 22:45	4.72
BR1600	0.49	96.7	02Jan2000, 19:45	4.73
BR1610	1.95	155.5	02Jan2000, 23:30	4.16
BR1700	0.82	154.9	02Jan2000, 20:15	5.19
BR1800	0.22	58.2	02Jan2000, 19:15	4.93
BR1810	0.4	72	02Jan2000, 19:45	4.45
BR1900	0.62	138	02Jan2000, 19:30	4.77
DD1000	0.34	69	02Jan2000, 19:45	5
DD1100	0.77	85.9	02Jan2000, 21:15	5.03
DD1200	0.26	28.5	02Jan2000, 21:00	4.96
DD1210	0.98	114.1	02Jan2000, 22:00	5.01
DD1300	0.6	116.4	02Jan2000, 20:15	5.39
DD1400	0.25	45.9	02Jan2000, 19:45	5.37
DD1410	0.71	163.3	02Jan2000, 19:45	5.38
DD1500	0.11	23.8	02Jan2000, 19:15	5.16
DD1510	0.32	59.5	02Jan2000, 20:00	5.4
DD1520	1.03	189.1	02Jan2000, 20:15	4.91
DD1600	0.64	144.2	02Jan2000, 19:45	5.26
DD1700	1.17	229.1	02Jan2000, 20:15	5.3
DD1800	1.29	195.8	02Jan2000, 20:45	4.97
EB1000	0.57	111.6	02Jan2000, 20:00	4.8
EB1100	0.37	68.1	02Jan2000, 19:45	4.75
EB1200	1.63	172.4	02Jan2000, 22:15	4.61
EB1300	1.41	203.7	02Jan2000, 20:30	5.1
EB1400	0.2	46.8	02Jan2000, 19:30	5.15
EB1410	1.01	127.8	02Jan2000, 21:00	5.18
EB1500	0.42	100.2	02Jan2000, 19:30	5.4
EB1600	1.45	221.9	02Jan2000, 20:45	5.29
EB1700	2.31	327.8	02Jan2000, 21:00	5.09
EB1710	1.03	162.7	02Jan2000, 20:45	5.34
EB1800	2	290.5	02Jan2000, 21:15	5.16

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
EB1900	0.01	2.8	02Jan2000, 19:00	5.06
EB1910	0.72	104.9	02Jan2000, 20:45	5.22
EB2000	0.96	188.9	02Jan2000, 20:00	5.06
EB2010	0.39	68.5	02Jan2000, 20:15	5.36
EB2020	1.27	212.1	02Jan2000, 20:30	5.13
EB2021	0.69	154.3	02Jan2000, 19:45	5.13
EB2100	0.43	103.8	02Jan2000, 19:30	4.91
J_BC1100	14.66	2301.6	02Jan2000, 23:45	5.12
J_BC1200	12.57	2054	02Jan2000, 23:00	5.13
J_BC1300	11.47	1923.5	02Jan2000, 21:30	5.12
J_BC1400	10.19	1714.5	02Jan2000, 21:00	5.09
J_BC1420	4.76	860.4	02Jan2000, 20:45	5.23
J_BC1500	3.28	513.5	02Jan2000, 21:00	5.22
J_BR&EB&WB	60.7	7990.3	03Jan2000, 05:30	5.03
J_BR&WC	104.36	12402.7	03Jan2000, 06:15	4.98
J_BR1100	107.08	12549.3	03Jan2000, 07:00	4.97
J_BR1110	108.2	12627.3	03Jan2000, 07:00	4.97
J_BR1200	106.2	12533.3	03Jan2000, 06:30	4.98
J_BR1300	104.37	12397.8	03Jan2000, 06:15	4.98
J_BR1310	105.82	12522.1	03Jan2000, 06:15	4.98
J_BR1400	66.95	8333.2	03Jan2000, 07:00	4.97
J_BR1500	65.29	8223.2	03Jan2000, 06:45	4.99
J_BR1510	66.75	8333.7	03Jan2000, 06:45	4.98
J_BR1600	63.25	8095.4	03Jan2000, 06:30	5.01
J_BR1610	65.2	8227.1	03Jan2000, 06:30	4.99
J_BR1700	62.76	8075.9	03Jan2000, 06:15	5.02
J_BR1800	61.54	7989.1	03Jan2000, 06:00	5.02
J_BR1810	61.94	8015.9	03Jan2000, 06:00	5.02
J_BR1900	61.32	7986.8	03Jan2000, 06:00	5.03
J_DD_DDT1	5.52	893.1	02Jan2000, 20:30	5.13
J_DD1000	8.47	1010.4	03Jan2000, 02:45	5.07
J_DD1100	8.13	979.2	03Jan2000, 02:00	5.08
J_DD1200	7.36	1024	02Jan2000, 22:15	5.09
J_DD1300	6.12	943.1	02Jan2000, 22:15	5.15
J_DD1400	4.81	736.3	02Jan2000, 20:45	5.1
J_DD1410	0.71	163.3	02Jan2000, 19:45	5.38
J_DD1500	3.21	580.5	02Jan2000, 20:30	5.15
J_DD1510	4.56	828.1	02Jan2000, 20:30	5.12
J_DD1520	1.03	189.1	02Jan2000, 20:15	4.91
J_DD1600	3.1	558.6	02Jan2000, 20:30	5.15
J_DD1700	2.46	421.7	02Jan2000, 20:30	5.13
J_DD1800	1.29	195.8	02Jan2000, 20:45	4.97
J_EB_EBT2	3.74	678.5	02Jan2000, 20:30	5.11
J_EB&MD	31.7	4386.4	03Jan2000, 02:45	5.12
J_EB&YC	22.49	3472.9	03Jan2000, 00:00	5.21
J_EB1000	32.64	4444.7	03Jan2000, 04:00	5.1
J_EB1100	32.07	4397.3	03Jan2000, 03:30	5.11
J_EB1200	27.16	3834.4	03Jan2000, 03:00	5.14
J_EB1300	25.53	3840.9	03Jan2000, 01:15	5.2
J_EB1400	24.12	3678.2	03Jan2000, 00:30	5.21
J_EB1500	22.91	3536.3	03Jan2000, 00:15	5.21

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
J_EB1600	11.26	1650.4	03Jan2000, 00:15	5.16
J_EB1700	9.81	1455.7	02Jan2000, 23:15	5.14
J_EB1800	6.47	1071.3	02Jan2000, 21:30	5.14
J_EB1900	4.47	781.8	02Jan2000, 21:00	5.12
J_EB2000	1.39	291.2	02Jan2000, 19:45	5.01
J_EB2010	2.35	402	02Jan2000, 21:45	5.16
J_EB2020	1.96	363.4	02Jan2000, 20:00	5.13
J_MD1000	4.54	610.2	02Jan2000, 22:45	5.02
J_MD1100	3.03	454.4	02Jan2000, 20:45	5.13
J_MD1200	1.55	244	02Jan2000, 20:15	5.29
J_MD1200andMD1210	2.49	369.1	02Jan2000, 20:30	5.2
J_MD1300	1.42	214	02Jan2000, 20:30	5.28
J_SG&DD	13.17	1560.8	03Jan2000, 02:15	5.12
J_SG1000	14.26	1683.3	03Jan2000, 02:15	5.09
J_SG1100	4.7	707.9	02Jan2000, 21:15	5.2
J_SG1200	4.54	674.3	02Jan2000, 21:15	5.19
J_SG1300	3.15	478.6	02Jan2000, 20:30	5.16
J_SG1310	1.28	213.5	02Jan2000, 20:00	5.06
J_SG1320	0.24	56	02Jan2000, 19:15	4.43
J_SG1400	1.12	169.4	02Jan2000, 20:30	5.27
J_WB&BC	23.31	3319.9	03Jan2000, 01:15	5.09
J_WB1000	28.06	3670.6	03Jan2000, 06:00	4.96
J_WB1100	26.58	3551.8	03Jan2000, 04:30	4.99
J_WB1200	24.36	3397	03Jan2000, 02:45	5.07
J_WB1400	4.59	743.9	02Jan2000, 21:15	5.28
J_WB1500	2.71	507.5	02Jan2000, 20:45	5.36
J_WC_WCT1	21.11	2637.5	03Jan2000, 01:00	5.03
J_WC&SG	36.14	4407.7	03Jan2000, 01:30	5.05
J_WC1000	37.41	4524.3	03Jan2000, 02:45	5.01
J_WC1100	37.07	4502.5	03Jan2000, 02:30	5.02
J_WC1200	21.88	2730.1	03Jan2000, 01:30	5.02
J_WC1300	21.39	2670.6	03Jan2000, 01:15	5.02
J_WC1400	19.33	2401.2	03Jan2000, 01:45	5.01
J_WC1410	1.78	280.3	02Jan2000, 21:00	5.29
J_WC1420	1.09	182.4	02Jan2000, 20:30	5.34
J_WC1430	1.01	164.6	02Jan2000, 20:30	5.34
J_WC1500	17.95	2236.1	03Jan2000, 01:30	5.02
J_WC1510	0.5	102.5	02Jan2000, 20:00	5.28
J_WC1520	0.35	79.8	02Jan2000, 19:45	5.28
J_WC1600	17.33	2159.7	03Jan2000, 01:00	5.02
J_WC1700	16.06	1986.8	03Jan2000, 01:00	5
J_WC1800	15.1	1854.7	03Jan2000, 00:45	4.99
J_WC1900	14.71	1805	03Jan2000, 00:30	4.98
J_WC2000	13.82	1675.3	03Jan2000, 00:45	4.96
J_WC2100	11.76	1407.1	03Jan2000, 00:45	4.93
J_WC2200	11.39	1356.8	03Jan2000, 00:30	4.93
J_WC2220	1.2	144.7	02Jan2000, 21:30	5.01
J_WC2300	9.49	1123.1	03Jan2000, 01:15	4.9
J_WC2400	8.45	1007.9	03Jan2000, 00:45	4.92
J_WC2500	4.11	626.8	02Jan2000, 20:45	4.72
J_WC2510	2.3	416.9	02Jan2000, 20:30	5.24

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
J_WC2520	1.45	297.3	02Jan2000, 20:00	5.25
J_WC2600	2.23	474.2	02Jan2000, 20:00	4.99
J_WC2700	1.35	266.6	02Jan2000, 20:00	4.92
J_WCwWCT2	18.45	2303.2	03Jan2000, 01:15	5.02
J_WCwWCT4	6.41	1043.2	02Jan2000, 20:30	4.91
J_YC_YCT2	3.49	640	02Jan2000, 20:15	5.27
J_YC1000	11.23	1822.8	03Jan2000, 00:00	5.26
J_YC1100	7.9	1358.3	02Jan2000, 23:45	5.26
J_YC1100andYC1110	10.46	1708.4	02Jan2000, 23:30	5.25
J_YC1200	4.53	843.4	02Jan2000, 20:15	5.28
J_YC1200&YC1210	5.58	1058.7	02Jan2000, 20:15	5.29
J_YC1300	2.8	505.6	02Jan2000, 20:15	5.25
J_YC1400	2.33	413.8	02Jan2000, 20:00	5.26
J_YC1500	1.77	306.6	02Jan2000, 20:15	5.24
MD1000	1.51	253.5	02Jan2000, 20:30	4.87
MD1100	0.54	86.5	02Jan2000, 20:15	4.82
MD1200	0.13	32.7	02Jan2000, 19:15	5.36
MD1210	0.94	125.5	02Jan2000, 20:45	5.05
MD1300	0.86	123.3	02Jan2000, 20:30	5.24
MD1310	0.56	90.7	02Jan2000, 20:15	5.35
Outlet	108.2	12623.7	03Jan2000, 07:00	4.97
R_BC1000	14.66	2270.5	03Jan2000, 01:45	5.1
R_BC1100	12.57	2050.7	02Jan2000, 23:45	5.12
R_BC1200	11.47	1903.7	02Jan2000, 23:00	5.12
R_BC1300	10.19	1711.1	02Jan2000, 21:45	5.09
R_BC1400	3.28	513	02Jan2000, 21:30	5.22
R_BC1410	4.76	807.8	02Jan2000, 20:45	4.91
R_BR1000	108.2	12623.7	03Jan2000, 07:00	4.97
R_BR1100	106.2	12483.7	03Jan2000, 07:15	4.97
R_BR1200	105.82	12515.9	03Jan2000, 06:30	4.98
R_BR1300	104.36	12397.8	03Jan2000, 06:15	4.98
R_BR1400	66.75	8325.5	03Jan2000, 07:00	4.98
R_BR1500	65.2	8222.5	03Jan2000, 06:45	4.99
R_BR1600	62.76	8065.1	03Jan2000, 06:30	5.02
R_BR1700	61.94	8010.9	03Jan2000, 06:15	5.02
R_BR1800	61.32	7982.4	03Jan2000, 06:00	5.02
R_BR1900	60.7	7953.5	03Jan2000, 06:00	5.03
R_DD1000	8.13	973.4	03Jan2000, 02:45	5.08
R_DD1100	7.36	902.6	03Jan2000, 02:15	5.08
R_DD1200	6.12	881.7	02Jan2000, 22:15	5.11
R_DD1300	5.52	837	02Jan2000, 22:30	5.13
R_DD1400	4.56	691.5	02Jan2000, 20:45	5.08
R_DD1500	3.1	558	02Jan2000, 20:30	5.15
R_DD1510	1.03	188.9	02Jan2000, 20:45	4.91
R_DD1600	2.46	421.2	02Jan2000, 20:45	5.13
R_DD1700	1.29	195.7	02Jan2000, 21:00	4.97
R_EB1000	32.07	4392.5	03Jan2000, 04:00	5.11
R_EB1100	31.7	4361.2	03Jan2000, 03:30	5.12
R_EB1200	25.53	3680.3	03Jan2000, 03:00	5.17
R_EB1300	24.12	3667.9	03Jan2000, 01:15	5.2
R_EB1400	22.91	3530.7	03Jan2000, 00:45	5.21

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
R_EB1500	22.49	3470.8	03Jan2000, 00:15	5.21
R_EB1600	9.81	1451.9	03Jan2000, 00:30	5.14
R_EB1700	6.47	997.3	03Jan2000, 00:00	5.13
R_EB1800	4.47	780.9	02Jan2000, 21:30	5.12
R_EB1900	3.74	675	02Jan2000, 21:00	5.11
R_EB2000	0.43	103.7	02Jan2000, 19:30	4.91
R_EB2010	1.96	336.7	02Jan2000, 22:00	5.12
R_MD1000	3.03	390.2	03Jan2000, 01:00	5.09
R_MD1100	2.49	368.7	02Jan2000, 20:45	5.19
R_MD1200	1.42	213.9	02Jan2000, 20:30	5.28
R_SG1000	13.17	1559.4	03Jan2000, 02:30	5.11
R_SG1100	4.54	673.8	02Jan2000, 21:30	5.19
R_SG1200	3.15	473.1	02Jan2000, 21:00	5.15
R_SG1300	1.12	169.2	02Jan2000, 20:45	5.27
R_SG1310	0.24	55.9	02Jan2000, 19:30	4.43
R_WB1000	26.58	3540.3	03Jan2000, 06:00	4.96
R_WB1100	24.36	3379.4	03Jan2000, 04:30	5.04
R_WB1200	23.31	3301.6	03Jan2000, 02:45	5.08
R_WB1300	4.59	732.4	02Jan2000, 23:15	5.27
R_WB1400	2.71	506	02Jan2000, 21:30	5.36
R_WB1500	1.86	380	02Jan2000, 20:45	5.38
R_WC1000	37.07	4499.9	03Jan2000, 03:00	5.02
R_WC1100	36.14	4404.3	03Jan2000, 02:45	5.04
R_WC1200	21.39	2669.9	03Jan2000, 01:45	5.02
R_WC1300	21.11	2636.2	03Jan2000, 01:30	5.03
R_WC1400	18.45	2301.2	03Jan2000, 02:00	5.02
R_WC1410	1.09	182.3	02Jan2000, 21:00	5.34
R_WC1420	1.01	164.5	02Jan2000, 20:45	5.34
R_WC1500	17.33	2157.6	03Jan2000, 01:45	5.01
R_WC1510	0.35	79.8	02Jan2000, 20:00	5.28
R_WC1600	16.06	1985.6	03Jan2000, 01:30	4.99
R_WC1700	15.1	1853.6	03Jan2000, 01:15	4.98
R_WC1800	14.71	1801.9	03Jan2000, 01:00	4.98
R_WC1900	13.82	1674.6	03Jan2000, 01:00	4.96
R_WC2000	11.76	1405.9	03Jan2000, 01:30	4.92
R_WC2100	11.39	1356.4	03Jan2000, 00:45	4.92
R_WC2200	9.49	1122.7	03Jan2000, 01:30	4.9
R_WC2210	1.2	144.6	02Jan2000, 22:00	5
R_WC2300	8.45	1006.3	03Jan2000, 01:45	4.92
R_WC2400	6.41	770.3	03Jan2000, 01:45	4.9
R_WC2500	2.23	472.7	02Jan2000, 20:30	4.99
R_WC2510	1.45	296.1	02Jan2000, 20:30	5.25
R_WC2600	1.35	266.3	02Jan2000, 20:00	4.92
R_YC1000	10.46	1706.5	03Jan2000, 00:00	5.25
R_YC1100	5.58	1046.2	03Jan2000, 00:00	5.27
R_YC1200	3.49	633	02Jan2000, 21:45	5.26
R_YC1300	2.33	413.6	02Jan2000, 20:30	5.26
R_YC1400	1.77	297.6	02Jan2000, 20:30	5.24
SC1320	0.24	56	02Jan2000, 19:15	4.43
SG1000	1.09	166.8	02Jan2000, 20:30	4.77
SG1100	0.16	41	02Jan2000, 19:15	5.38

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
SG1200	1.39	201.2	02Jan2000, 21:15	5.28
SG1300	0.75	98.2	02Jan2000, 21:00	5.15
SG1310	1.04	159.6	02Jan2000, 20:30	5.21
SG1400	1.12	169.4	02Jan2000, 20:30	5.27
WB1000	1.48	204.6	02Jan2000, 21:30	4.84
WB1100	2.22	192.1	02Jan2000, 23:15	4.49
WB1200	1.05	105.4	02Jan2000, 22:00	4.81
WB1300	1.63	225.5	02Jan2000, 21:00	5.25
WB1400	1.88	237.9	02Jan2000, 21:15	5.17
WB1500	0.85	127.8	02Jan2000, 20:30	5.32
WB1600	1.86	380.6	02Jan2000, 20:15	5.38
WC1000	0.34	75.2	02Jan2000, 19:30	4.09
WC1100	0.93	150.4	02Jan2000, 20:15	4.35
WC1200	0.49	75.8	02Jan2000, 20:30	4.86
WC1300	0.28	54.3	02Jan2000, 19:45	4.7
WC1400	0.88	122.8	02Jan2000, 20:30	4.84
WC1410	0.69	98.1	02Jan2000, 20:45	5.22
WC1420	0.08	19.9	02Jan2000, 19:15	5.38
WC1430	1.01	164.6	02Jan2000, 20:30	5.34
WC1500	0.62	104.3	02Jan2000, 20:15	5.16
WC1510	0.15	22.7	02Jan2000, 20:00	5.27
WC1520	0.35	79.8	02Jan2000, 19:45	5.28
WC1600	1.27	215	02Jan2000, 20:45	5.29
WC1700	0.96	167.5	02Jan2000, 20:30	5.22
WC1800	0.39	95.8	02Jan2000, 19:15	5.27
WC1900	0.16	42.3	02Jan2000, 19:15	5.35
WC1910	0.73	154.8	02Jan2000, 19:45	5.39
WC2000	1.05	162.8	02Jan2000, 20:45	5.06
WC2010	1.01	148.8	02Jan2000, 21:15	5.28
WC2100	0.37	64.9	02Jan2000, 20:00	5.03
WC2200	0.41	79.5	02Jan2000, 20:00	5.18
WC2210	0.29	49.9	02Jan2000, 20:00	5.27
WC2220	1.2	144.7	02Jan2000, 21:30	5.01
WC2300	1.04	131.9	02Jan2000, 21:00	4.74
WC2400	2.04	265.5	02Jan2000, 20:45	5
WC2500	1.88	160.6	02Jan2000, 22:30	4.4
WC2510	0.85	121.1	02Jan2000, 20:45	5.23
WC2515	0.92	179.6	02Jan2000, 20:15	5.22
WC2520	0.53	118.6	02Jan2000, 19:45	5.3
WC2600	0.06	17.3	02Jan2000, 19:00	5.1
WC2610	0.82	192.7	02Jan2000, 19:45	5.09
WC2700	1.35	266.6	02Jan2000, 20:00	4.92
YC1000	0.77	138	02Jan2000, 20:15	5.35
YC1100	2.32	328.4	02Jan2000, 21:30	5.22
YC1110	2.56	369.3	02Jan2000, 21:15	5.24
YC1200	1.04	225.7	02Jan2000, 20:00	5.33
YC1210	1.05	215.5	02Jan2000, 20:00	5.32
YC1300	0.47	93.1	02Jan2000, 20:00	5.25
YC1310	0.69	134.4	02Jan2000, 20:15	5.33
YC1400	0.03	8.4	02Jan2000, 19:00	5.1
YC1410	0.24	56.8	02Jan2000, 19:30	5.32

HEC-HMS Big Rock Welch Creek Final 1%-Annual-Chance Flood Discharge Results

Hydro element	Drainage Area	Peak Discharge (cfs)	Time of Peak	Volume
YC1420	0.29	54.5	02Jan2000, 19:45	5.34
YC1500	0.78	151.1	02Jan2000, 20:00	5.27
YC1510	0.99	157.1	02Jan2000, 20:45	5.21

Appendix D. Comparison of Discharge Data

Comparison 1 Percent Annual Chance Discharges

USGS Gage Regression Analysis

Stream name		*Gage Number*	*Drainage Area (sq. mi.)*	*Q100 (cfs)*		
				Freq. Anal.	*Regress.*	*Weighted*
East Branch Big Rock near Big Rock	J_EB&MD	5551900	32.6	1760	2470	1900
Welch Creek near Big Rock	approx. J_WC1400	5551930	22.1	794	1900	962

USGS Gage Frequency Analysis for Nearby Watersheds

				***USGS 100yr peak flow (cfs)*		
Stream Name	*Gage Number*	*Drainage Area (sq. mi.)*	*Est. Slope (ft/mi)*	*Frequency Analysis Flow*	*Regression Equation Results*	*Weighted frequency with regression*
Blackberry at Yorkville	5551700	70.2	5.54	2,850	4,150	2,870
Green at Amboy	5447000	201	5.10	8,280	4,860	7,960
Killbuck Creek near Monroe Center	5440500	117	7.43	9,130	5,330	8,730
Kyte River near Flagg Center	5442000	116	4.79	2,840	4,150	3,100
Coon Creek at Riley	5438250	85.1	7.07	4,370	4,470	4,380
S. Branch Kishwakee at Dekalb	5439000	77.7	2.83	3,070	2,860	3,040
S. Branch Kishwakee at Fairdale	5439500	387		15,700	7,580	15,100
Leaf River at Leaf River	5441000	103	6.44	15,100	11,000	14,500
East Branch Big Rock near Big Rock	5551900	32.6		1,760	2,470	1,900

Notes:

** Taken from "Estimating Flood-Peak Discharge Magnitudes and Frequencies for Rural Streams in Illinois”

Comparison 1 Percent Annual Chance Discharges

BLACKBERRY CREEK	Drainage Area (sq. mi.)	10%	2%	1%	0.20%
At intersection with US Highway 30	57.1	1325	2302	2808	4218
At confluence with Aurora Chain of Lakes					
Approximately 190 feet upstream of Jericho Road	52.4	1347	2373	2910	4421
Approximately 80 feet downstream of Burlington Railroad	51.4	1497	2465	2952	4286
At upstream of confluence with East Run and approximately 300 feet upstream of Galena Road	45.9	1401	2286	2742	3984
At confluence with Lake Run Approximately 1800 feet downstream of Illinois Route 56	31.9	1037	1681	2003	2875
At confluence with Prestbury Branch					
Approximately 2740 feet upstream of Illinois Route 56	27.8	995	1637	1961	2847
Approximately 140 feet upstream of Ke-De_Ka Road	25.5	1003	1675	2018	2961
Approximately 4140 feet downstream from Illinois Route 47	23.5	992	1670	2017	2976
Approximately 550 feet upstream of Scott Road, 90 feet upstream of junction with Seavey Road Run	15	719	1221	1477	2189
Approximately 240 feet upstream of InterState 88	13.4	717	1261	1545	2348
Approximately 50 feet upstream of Illinois Route 47	11.2	634	1120	1376	2097
At confluence with Elburn Run					
Approximately 3200 feet upstream of Smith Road	7	316	537	651	966
Approximately 125 feet upstream of Hughes Road	6	303	523	637	956
At intersection with a private road. The private road connects to Keslinger Road from south and at approximately 250 feet east of Deneali Road intersection	4.8	351	628	772	1174
Approximately 670 feet downstream of BCNW Railroad	3.1	326	561	677	985
At confluence with Route 38 Branch					
Approximate 1500 feet downstream of Pouley Road and southeastern to the intersection of Illinois Route 38 and Pouley Road	1	177	310	376	551

Appendix E. Work Maps

THIS IS MAP SHEET NUMBER 2 of 2

FLOODPLAIN COMPARISON MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

DATA SOURCES:

PLSS LINES - USGS DRG
FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- LETTERED XS's
- BFE
- Proposed 1% WSEL LINES (New Study)
- EFFECTIVE FEMA FLD_HAZ LINES
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

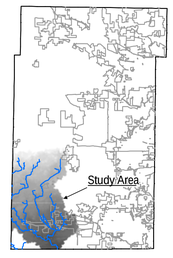
STREAM CENTERLINES

- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

Kane County, Illinois



0 135 310 620 930 1,240 Meters
0 500 1,000 2,000 3,000 4,000 Feet

1" = 1000'

ISWS

ILLINOIS STATE WATER SURVEY

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171081
KANE COUNTY	170896
KANEVILLE, VILLAGE OF	171388
SUGAR GROVE, VILLAGE OF	170333

ROUGH DRAFT

Illinois State Water Survey (ISWS)

MAP PRINTED: NOV. 26, 2008

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

MATCH TO SHEET #1

THIS IS MAP SHEET NUMBER 2 of 2

ENGINEERING WORK MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

DATA SOURCES:

PLSS LINES - USGS DRG
FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- XS (Station Number & 1% WSEL are Labeled)
- 1% WSEL LINES (New Study)
- SUBBASINS (Name, CN, & Tc are labeled)
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

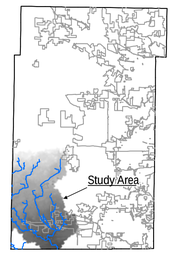
STREAM CENTERLINES

- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

Kane County, Illinois



1" = 1000'

For a high resolution version of this map, please contact the Illinois State Water Survey.

MATCH TO SHEET #1

ISWS

ILLINOIS STATE WATER SURVEY

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171081
KANE COUNTY	170896
KANEVILLE, VILLAGE OF	171388
SUGAR GROVE, VILLAGE OF	170333

ROUGH DRAFT

Illinois State WATER Survey (1895)

MAP PRINTED: NOV. 26, 2008

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

THIS IS MAP SHEET NUMBER 1 of 2

FLOODPLAIN COMPARISON MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

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FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- LETTERED XS's
- BFE
- Proposed 1% WSEL LINES (New Study)
- EFFECTIVE FEMA FLD_HAZ LINES
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

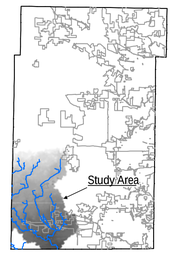
STREAM CENTERLINES

- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

Kane County, Illinois



0 155 310 620 930 1,240 Meters
0 500 1,000 2,000 3,000 4,000 Feet

1" = 1000'

ISWS

ILLINOIS STATE WATER SURVEY

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171081
KANE COUNTY	170896
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ROUGH DRAFT

Illinois State Water Survey (1895)

MAP PRINTED: NOV. 26, 2008

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

MATCH TO SHEET #2

THIS IS MAP SHEET NUMBER 1 of 2

ENGINEERING WORK MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

DATA SOURCES:

PLSS LINES - USGS DRG
FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- XS (Station Number & 1% WSEL are Labeled)
- 1% WSEL LINES (New Study)
- SUBBASINS (Name, CN, & Tc are labeled)
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

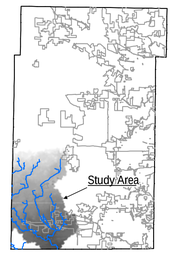
STREAM CENTERLINES

- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

Kane County, Illinois



0 155 310 620 930 1,240 Meters

0 500 1,000 2,000 3,000 4,000 Feet

1" = 1000'

For a high resolution version of this map, please contact the Illinois State Water Survey.

ILLINOIS STATE WATER SURVEY (ISWS)

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171081
KANE COUNTY	170896
KANEVILLE, VILLAGE OF	171388
SUGAR GROVE, VILLAGE OF	170333

ROUGH DRAFT

Illinois State Water Survey (ISWS)

MAP PRINTED: NOV. 26, 2008

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

Appendix F. HEC-RAS Output

HEC-RAS Version 4.0 Big Rock Creek
Plan: 1% Final - Profile PF1

Rivers=10
Hydraulic Reaches=17
River Stations = 517
Plans =1
Profiles =1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Youngs Creek	US Kesling	39778.79	PF 1	56.8	849.8	850.95		851.01	0.00614	2.06	30.8	52.86	0.4
Youngs Creek	US Kesling	39380.65	PF 1	56.8	847.61	848.72		848.77	0.005103	1.89	34.57	60.53	0.36
Youngs Creek	US Kesling	38798.34	PF 1	56.8	844.34	845.53	845.11	845.58	0.005913	1.7	33.32	51.63	0.37
Youngs Creek	US Kesling	38474.24	PF 1	56.8	840.87	841.2	841.2	841.33	0.049947	2.5	20.18	120.46	0.92
Youngs Creek	US Kesling	38112.12	PF 1	56.8	838.11	838.56	838.56	838.65	0.047066	2.95	24.93	125.56	0.93
Youngs Creek	US Kesling	37410.57	PF 1	56.8	835.66	836.82		836.82	0.000229	0.42	169.84	275.33	0.08
Youngs Creek	US Harter Trib	36853.83	PF 1	505.6	833.64	836.12		836.17	0.002004	1.97	306.92	254.28	0.26
Youngs Creek	US Harter Trib	36546.19	PF 1	505.6	831.51	835.66		835.71	0.001276	2.01	302.47	254.72	0.22
Youngs Creek	US Harter Trib	36059.1	PF 1	505.6	831.03	834.23		834.55	0.008052	5.22	130.31	144.94	0.65
Youngs Creek	US Harter Trib	35633.39	PF 1	505.6	828.09	832.19		832.3	0.004021	3.25	209.96	161.22	0.38
Youngs Creek	US Harter Trib	35096.34	PF 1	505.6	826.26	830.06		830.27	0.003733	4.25	166.62	142.92	0.47
Youngs Creek	US Harter Trib	34633.64	PF 1	505.6	824.41	828.58	828.04	828.77	0.003173	4.01	179.92	222.16	0.43
Youngs Creek	US Harter Trib	34386.42	PF 1	505.6	823.84	826.85		827.19	0.015574	5.72	134.75	223.6	0.74
Youngs Creek	US Harter Trib	34091.62	PF 1	505.6	821.82	826.27		826.38	0.001156	2.72	200.13	72.41	0.27
Youngs Creek	US Harter Trib	33805.94	PF 1	505.6	821.87	825.93		826.03	0.001238	2.8	264.46	226.9	0.26
Youngs Creek	US Harter Trib	33301.63	PF 1	505.6	823.23	825.3		825.34	0.002234	2.26	315.94	370.89	0.33
Youngs Creek	US Harter Trib	32750.37	PF 1	505.6	821.67	824.16		824.23	0.0026	2.77	250.49	211.66	0.37
Youngs Creek	US Harter Trib	32405.3	PF 1	505.6	820.55	823.26		823.35	0.004401	2.71	215.63	177.7	0.37
Youngs Creek	US Harter Trib	32001.95	PF 1	505.6	819.94	821.77		821.88	0.004725	3.11	187.57	188.35	0.47
Youngs Creek	US Harter Trib	31433.96	PF 1	505.6	815.74	819.04		819.16	0.008035	3.74	200.51	248.81	0.51
Youngs Creek	US Harter Trib	31005.42	PF 1	505.6	813.75	817.58		817.63	0.002239	2.43	332.43	337.74	0.28
Youngs Creek	US Harter Trib	30765.28	PF 1	505.6	813.08	816.45	816.45	816.83	0.010197	5.8	130.42	187.87	0.73
Youngs Creek	US Harter Trib	30691.48	PF 1	505.6	812.15	815.96		816.15	0.003084	4.16	202.96	280.54	0.43
Youngs Creek	US Harter Trib	30401.09	PF 1	505.6	811.78	815.54		815.57	0.001249	1.96	413.58	392.59	0.21
Youngs Creek	US Harter Trib	30261.52	PF 1	505.6	809.47	815.23	813.87	815.32	0.002308	3.01	291.22	386.37	0.29
Youngs Creek	US Harter Trib	29917.88	PF 1	505.6	809.03	813.18	812.97	813.7	0.012563	6.02	102.49	102.49	0.67
Youngs Creek	DSHarter_Kane	29093.56	PF 1	843.4	802.14	810.49		810.81	0.002066	4.74	248.77	209.11	0.36
Youngs Creek	DSHarter_Kane	28728.23	PF 1	843.4	801.41	809.11		809.6	0.005945	5.84	187.72	192.34	0.49
Youngs Creek	DSHarter_Kane	28089.27	PF 1	843.4	800.42	807.55		807.66	0.001715	3.41	487.07	491.26	0.27
Youngs Creek	DSHarter_Kane	27613.36	PF 1	843.4	800.14	805.99	805.93	806.29	0.005165	5.17	301.17	520.17	0.46
Youngs Creek	DSHarter_Kane	26908.75	PF 1	843.4	799.02	804.38		804.42	0.001438	2.21	580.45	493.96	0.23
Youngs Creek	DSHarter_Kane	26551	PF 1	843.4	798.24	804.37		804.38	0.000028	0.52	2230.54	1167.11	0.04
Youngs Creek	DSHarter_Kane	25600.33	PF 1	843.4	797.11	804.19		804.28	0.001473	3.22	484.95	399.29	0.25
Youngs Creek	DSHarter_Kane	24819.08	PF 1	843.4	795.88	802.61		802.82	0.002308	4.15	308.38	333.35	0.32

HEC-RAS Version 4.0 Big Rock Creek
Plan: 1% Final - Profile PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Youngs Creek	DSHarter_Kane	23887.53	PF 1	843.4	796.46	801.15	800.35	801.21	0.001369	2.68	556.68	683.86	0.24
Youngs Creek	DSHarter_Kane	23398.36	PF 1	843.4	798.01	801.07		801.08	0.000095	0.48	1573.78	691.84	0.06
Youngs Creek	DSHarter_Kane	22870.19	PF 1	843.4	793.98	801.06		801.06	0.000009	0.28	4037.63	1158.27	0.02
Youngs Creek	DSHarter_Kane	22493.31	PF 1	843.4	795.81	801.06		801.06	0.000007	0.21	4532.39	1393.85	0.02
Youngs Creek	DSHarter_Kane	22294.34	PF 1	1358.3	794.82	801.04		801.05	0.000117	1.03	1881.89	744.67	0.08
Youngs Creek	DSHarter_Kane	21886.34	PF 1	1358.3	795.33	800.81		800.92	0.001977	2.72	525.94	255.5	0.28
Youngs Creek	DSHarter_Kane	21336.45	PF 1	1358.3	794.94	799.57		799.72	0.002424	3.11	463.05	252.3	0.31
Youngs Creek	DSHarter_Kane	20667.35	PF 1	1358.3	792.84	798.41		798.51	0.001355	2.54	535.44	151.1	0.24
Youngs Creek	DSHarter_Kane	20059.17	PF 1	1358.3	792.45	796.72		797.01	0.005611	4.35	312.08	113.7	0.46
Youngs Creek	DSHarter_Kane	19704.3*	PF 1	1358.3	791.76	795.61		795.73	0.002352	2.84	482.87	221.49	0.32
Youngs Creek	DSHarter_Kane	19349.49	PF 1	1358.3	791.07	795.44		795.46	0.000312	1.3	1103.47	412.83	0.13
Youngs Creek	DSHarter_Kane	18981.47	PF 1	1358.3	790.51	795.26		795.3	0.000653	1.6	850.12	298.66	0.17
Youngs Creek	DSHarter_Kane	18894.88	PF 1	1358.3	790.13	795.17		795.23	0.001017	2.02	671.46	215	0.2
Youngs Creek	DSHarter_Kane	18568.36	PF 1	1358.3	789.71	794.77		794.85	0.001298	2.34	580.73	183.85	0.23
Youngs Creek	DSHarter_Kane	17611.33	PF 1	1358.3	788.87	793.92		793.98	0.000679	2.16	764.27	245.08	0.18
Youngs Creek	DSHarter_Kane	16899.5	PF 1	1358.3	788.11	793.46		793.52	0.000639	2.07	797.37	295.78	0.17
Youngs Creek	DSHarter_Kane	16099.94	PF 1	1358.3	787.88	792.78		792.84	0.001116	2.83	723.4	303.46	0.23
Youngs Creek	DSHarter_Kane	15257.5	PF 1	1358.3	785.62	791.93		792	0.000903	2.23	646.83	223.07	0.2
Youngs Creek	DSHarter_Kane	14715.47	PF 1	1358.3	786.05	791.16		791.33	0.001758	3.4	440.06	189.8	0.33
Youngs Creek	DSHarter_Kane	14222.84	PF 1	1358.3	784.64	790.55		790.68	0.000972	3.24	471.62	131.01	0.26
Youngs Creek	DSHarter_Kane	13603.54	PF 1	1358.3	783.92	789.81		789.94	0.00153	3.35	500.83	161.12	0.27
Youngs Creek	DSHarter_Kane	13109.88	PF 1	1358.3	784.46	788.69		788.9	0.00351	3.69	368.36	132.59	0.39
Youngs Creek	DSHarter_Kane	12363.2	PF 1	1358.3	782.16	786.62		786.81	0.002266	3.5	388.36	139.25	0.37
Youngs Creek	DSHarter_Kane	12007.82	PF 1	1358.3	781.51	785.47		785.81	0.003794	5.57	315.09	131.85	0.5
Youngs Creek	DSHarter_Kane	11760.78	PF 1	1358.3	781.17	785.1		785.23	0.001506	3.23	477.43	178.04	0.31
Youngs Creek	DSHarter_Kane	11655.44	PF 1	1358.3	781.03	784.89		785.04	0.002077	3.96	464.62	184.94	0.37
Youngs Creek	DSHarter_Kane	10957.93	PF 1	1358.3	780.25	783.22		783.41	0.003043	3.79	415.13	235.12	0.42
Youngs Creek	DSHarter_Kane	10084.22	PF 1	1358.3	779.29	782.2		782.24	0.000832	1.81	982.93	663.57	0.19
Youngs Creek	DSHarter_Kane	8751.631	PF 1	1358.3	778.79	780.86		780.89	0.001259	1.61	1061.08	821.69	0.21
Youngs Creek	DSHarter_Kane	7627.391	PF 1	1358.3	776.9	779.29		779.33	0.001602	1.63	843.64	592.14	0.23
Youngs Creek	DSHarter_Kane	6759.211	PF 1	1358.3	773.62	775.01	775.01	775.42	0.0403	5.14	264.48	331.13	1.01
Youngs Creek	DSHarter_Kane	5936.419	PF 1	1822.8	769.61	773.93		773.94	0.000123	1.09	2666.42	958.63	0.09
Youngs Creek	DSHarter_Kane	5320.022	PF 1	1822.8	769.76	773.83		773.85	0.000315	1.59	1727.54	742.49	0.14
Youngs Creek	DSHarter_Kane	4704.124	PF 1	1822.8	769.25	773.36		773.48	0.001273	3.39	677.56	240.99	0.3
Youngs Creek	DSHarter_Kane	3938.384	PF 1	1822.8	769.42	772.56		772.62	0.001006	2.47	944.25	496.82	0.25
Youngs Creek	DSHarter_Kane	3092.454	PF 1	1822.8	768.37	769.89	769.89	770.38	0.027386	6.41	328.69	344.56	0.93
Youngs Creek	DSHarter_Kane	2651.696	PF 1	1822.8	759.62	764.82		764.96	0.001108	3.36	625.61	199.84	0.28
Youngs Creek	DSHarter_Kane	2339.185	PF 1	1822.8	758.78	764.64		764.72	0.000479	2.4	860.36	213.23	0.19
Youngs Creek	DSHarter_Kane	2254.428	PF 1	1822.8	759.69	764.22		764.59	0.004425	3.67	377.93	105.63	0.4
Youngs Creek	DSHarter_Kane	1888.187	PF 1	1822.8	759.76	763.38		763.53	0.001831	2.81	582.41	178.48	0.32
Youngs Creek	DSHarter_Kane	1541.499	PF 1	1822.8	758.36	762.94		763.11	0.001484	3.76	592.26	211.41	0.32

HEC-RAS Version 4.0 Big Rock Creek
Plan: 1% Final - Profile PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Youngs Creek	DSHarter_Kane	1460.557	PF 1	1822.8	758.61	762.56		762.89	0.005436	4.76	405.29	152.87	0.47
Youngs Creek	DSHarter_Kane	722.5509	PF 1	1822.8	757.16	761.19		761.27	0.00134	2.64	797.5	289.83	0.24
Young Trib -s	out Harter Rd Trib	1840.669	PF 1	134.4	815.67	816.42		816.44	0.003717	1.18	114.15	217.91	0.29
Young Trib -s	out Harter Rd Trib	1781.296	PF 1	134.4	815.59	815.76	815.76	815.86	0.058753	1.97	52.75	255.48	0.92
Young Trib -s	out Harter Rd Trib	1711.352	PF 1	134.4	812.7	814.74	814.32	814.81	0.006673	2.1	67.43	198.74	0.41
Young Trib -s	out Harter Rd Trib	1500.313	PF 1	134.4	811.52	812.29		812.4	0.019344	3.25	56.96	152.09	0.69
Young Trib -s	out Harter Rd Trib	1098.976	PF 1	134.4	811.42	811.68		811.69	0.001057	0.29	187.3	318.21	0.13
Young Trib -s	out Harter Rd Trib	656.7638	PF 1	134.4	809.85	811.6		811.61	0.000094	0.41	424.29	377.32	0.06
Young Trib -s	out Harter Rd Trib	440.7848	PF 1	134.4	809.71	811.57		811.57	0.000166	0.55	311.22	266.72	0.07
Young Trib -n	ort Keslinger Rd Tri	2974.518	PF 1	151.1	847.43	849.71		849.78	0.00298	2.36	80.56	91.83	0.31
Young Trib -n	ort Keslinger Rd Tri	2604.75	PF 1	151.1	846.31	848.45		848.53	0.003828	2.55	76.07	103.68	0.35
Young Trib -n	ort Keslinger Rd Tri	2154.453	PF 1	151.1	845.04	846.64		846.71	0.004396	2.43	79.16	97.62	0.37
Young Trib -n	ort Keslinger Rd Tri	2065.893	PF 1	151.1	844.84	846.34		846.39	0.003028	1.99	96.72	114.01	0.3
Young Trib -n	ort Keslinger Rd Tri	1950.156	PF 1	151.1	845.16	845.87		845.92	0.00568	1.42	86.81	139.9	0.35
Young Trib -n	ort Keslinger Rd Tri	1806.406	PF 1	151.1	844.39	845.41		845.44	0.002583	1.51	119.36	159.31	0.27
Young Trib -n	ort Keslinger Rd Tri	1555.132	PF 1	151.1	843	843.59	843.59	843.79	0.048643	3.87	42.69	110.04	1.01
Young Trib -n	ort Keslinger Rd Tri	1451.097	PF 1	151.1	840.08	841.45	841.02	841.5	0.004077	2.23	92.87	213.52	0.35
Young Trib -n	ort Keslinger Rd Tri	1209.943	PF 1	151.1	838.58	839.29	839.27	839.41	0.028703	3.29	56.34	204.66	0.89
Young Trib -n	ort Keslinger Rd Tri	608.9119	PF 1	151.1	836.4	837	836.62	837.02	0.001886	0.99	145.32	346.55	0.25
Young Trib -n	ort Keslinger Rd Tri	237.9461	PF 1	306.6	834.62	836.73		836.74	0.000454	0.94	520.17	609.77	0.12
West Branch B	ig WestBranch	22780.82	PF 1	3551.8	723.14	729.68		729.71	0.000202	1.6	2697.86	759.85	0.12
West Branch B	ig WestBranch	22450.22	PF 1	3551.8	724.33	729.64		729.67	0.000186	1.52	2492.91	502.66	0.12
West Branch B	ig WestBranch	22239.41	PF 1	3551.8	724.7	729.56		729.62	0.000378	1.65	1873.16	426.93	0.16
West Branch B	ig WestBranch	21918.85	PF 1	3551.8	723.39	729.22		729.32	0.004465	2.81	1415.77	437.68	0.21
West Branch B	ig WestBranch	21697.72	PF 1	3551.8	723.66	728.96		729.04	0.0009	2.18	1657.98	451.8	0.17
West Branch B	ig WestBranch	21504.06	PF 1	3551.8	722.85	728.83		728.91	0.000776	3.28	1614.53	401.32	0.24
West Branch B	ig WestBranch	21035.01	PF 1	3551.8	724.82	728.42		728.5	0.003435	1.16	1576.72	415.62	0.15
West Branch B	ig WestBranch	20105.53	PF 1	3551.8	723.11	726.69		726.87	0.004349	2.03	1116.08	322.04	0.19
West Branch B	ig WestBranch	19674.85	PF 1	3551.8	720.92	725.69		725.85	0.001796	4.43	1227.91	352.4	0.36
West Branch B	ig WestBranch	19375.1	PF 1	3551.8	719.45	725.41		725.54	0.000996	3.72	1280.82	364.57	0.28
West Branch B	ig WestBranch	19142.57	PF 1	3551.8	721.34	725.2		725.3	0.000803	2.35	1375.51	348.74	0.23
West Branch B	ig WestBranch	18287.85	PF 1	3551.8	720.47	724.49		724.71	0.002329	3.82	968.38	332.74	0.36
West Branch B	ig WestBranch	17901.41	PF 1	3551.8	719.33	723.72		723.91	0.002333	4.45	1029.82	361.39	0.4
West Branch B	ig WestBranch	16679.17	PF 1	3551.8	718.12	722.48		722.62	0.001245	3.37	1218.12	407.74	0.29
West Branch B	ig WestBranch	16425.5	PF 1	3551.8	717.6	721.98		722.25	0.002889	4.99	869.34	335.02	0.44
West Branch B	ig WestBranch	16316.71	PF 1	3551.8	717.72	721.78		721.97	0.002266	4.49	1087.32	444.24	0.39
West Branch B	ig WestBranch	16192.65	PF 1	3551.8	717.72	721.27		721.6	0.00453	5.12	807.72	399.12	0.53
West Branch B	ig WestBranch	15335.51	PF 1	3551.8	716.02	720.56		720.63	0.000875	2.92	1825.12	787.82	0.25
West Branch B	ig WestBranch	14941.95	PF 1	3551.8	714.43	720.45		720.49	0.000561	0.94	2417.76	702.19	0.07
West Branch B	ig WestBranch	14702.56	PF 1	3551.8	714.53	720.38		720.43	0.00031	1.12	2061.02	655.48	0.08
West Branch B	ig WestBranch	14540.55	PF 1	3551.8	709.1	720.25	715.07	720.36	0.000882	2.93	1525.38	569.94	0.17

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
West Branch B	ig WestBranch	14460.25		Bridge									
West Branch B	ig WestBranch	14386.97	PF 1	3670.6	709	719.82	715.06	720.05	0.000923	4.09	1015.23	355.49	0.25
West Branch B	ig WestBranch	14336.81		Bridge									
West Branch B	ig WestBranch	14266.29	PF 1	3670.6	708.7	718.44	717.13	719.26	0.004788	8.36	662.74	398.59	0.54
West Branch B	ig WestBranch	14001.33	PF 1	3670.6	708.2	717.64	716.84	718.09	0.003108	6.63	903.3	342.61	0.43
West Branch B	ig WestBranch	13780.42	PF 1	3670.6	707.8	717.19	716.23	717.5	0.002526	5.89	1132.69	425.33	0.39
West Branch B	ig WestBranch	13306.81	PF 1	3670.6	706.8	716.44	715.3	716.68	0.002086	5.4	1303.47	479.65	0.35
West Branch B	ig WestBranch	13149.56	PF 1	3670.6	706.5	716.31		716.43	0.000978	3.95	1663.78	383.07	0.25
West Branch B	ig WestBranch	12836.18	PF 1	3670.6	705.9	716.14		716.23	0.000769	3.35	1713.7	393.07	0.21
West Branch B	ig WestBranch	12636.79	PF 1	3670.6	705.5	715.82		716.06	0.001308	4.81	1025.91	498.93	0.29
West Branch B	ig WestBranch	12588.36	PF 1	3670.6	705.4	715.65	710.29	715.99	0.001176	4.76	820.51	448.71	0.27
West Branch B	ig WestBranch	12564.2		Bridge									
West Branch B	ig WestBranch	12520.67	PF 1	3670.6	705.4	714.9		715.07	0.000799	3.87	1717.14	483.27	0.23
West Branch B	ig WestBranch	12312.65	PF 1	3670.6	704.8	714.65		714.85	0.001316	4.63	1400.45	348.79	0.29
West Branch B	ig WestBranch	11789.21	PF 1	3670.6	703.6	713.24		713.83	0.003274	7.23	1056.23	375.78	0.45
West Branch B	ig WestBranch	11468.71	PF 1	3670.6	702.9	712.56		712.91	0.002504	5.94	965.63	291.6	0.38
West Branch B	ig WestBranch	11205.32	PF 1	3670.6	702.3	712.29		712.46	0.001162	4.35	1581.67	394.7	0.27
West Branch B	ig WestBranch	11035.5	PF 1	3670.6	701.9	711.65		712.19	0.003004	6.98	1149.71	343.75	0.43
West Branch B	ig WestBranch	10689.44	PF 1	3670.6	701.1	710.98		711.28	0.002221	5.65	1219.95	300.52	0.36
West Branch B	ig WestBranch	10031.19	PF 1	3670.6	699.6	709.78		710.1	0.001779	5.56	1101.27	285.61	0.34
West Branch B	ig WestBranch	9501.056	PF 1	3670.6	698.4	708.36		708.88	0.003172	6.83	1202.09	419.74	0.44
West Branch B	ig WestBranch	8998.761	PF 1	3670.6	697.3	707.25		707.66	0.002239	6.24	983.17	318.07	0.38
West Branch B	ig WestBranch	8299.35	PF 1	3670.6	695.7	705.48		706.01	0.002867	6.93	1228.67	449.14	0.43
West Branch B	ig WestBranch	7972.055	PF 1	3670.6	694.9	705.01		705.27	0.001729	5.47	1180.91	511.44	0.33
West Branch B	ig WestBranch	7392.009	PF 1	3670.6	693.6	704.03		704.36	0.001822	5.75	1334.84	262.96	0.34
West Branch B	ig WestBranch	6929.084	PF 1	3670.6	692.5	702.45		703.18	0.003556	7.87	901.59	278.2	0.48
West Branch B	ig WestBranch	6601.64	PF 1	3670.6	691.8	701.3		702.01	0.003605	7.45	914.17	431.15	0.47
West Branch B	ig WestBranch	6276.748	PF 1	3670.6	691.1	701.03		701.19	0.001303	4.71	1572.94	493.35	0.29
West Branch B	ig WestBranch	5724.747	PF 1	3670.6	689.9	699.21		699.99	0.003904	7.77	838.05	271.21	0.49
West Branch B	ig WestBranch	4703.804	PF 1	3670.6	687.5	696.34		696.78	0.002949	6.41	929.44	356.02	0.42
West Branch B	ig WestBranch	4365.069	PF 1	3670.6	686.7	695.81		696.01	0.001568	4.7	1381.65	554.49	0.31
West Branch B	ig WestBranch	4223.354	PF 1	3670.6	686.4	695.47		695.72	0.001817	5.22	1197.41	421.4	0.33
West Branch B	ig WestBranch	4136.398	PF 1	3670.6	686.2	695.34		695.55	0.001573	4.75	1282.93	444.41	0.31
West Branch B	ig WestBranch	4087.958	PF 1	3670.6	686.1	695.35		695.46	0.000923	3.78	1685.9	527.64	0.24
West Branch B	ig WestBranch	4071.65	PF 1	3670.6	686	695.26		695.36	0.00074	3.44	1779.9	512.01	0.22
West Branch B	ig WestBranch	4028.008	PF 1	3670.6	685.9	694.94	692.91	695.24	0.001972	5.53	1142.31	472.36	0.35
West Branch B	ig WestBranch	3723.837	PF 1	3670.6	685.2	693.84	692.47	694.37	0.003875	7.21	956.36	330.25	0.47
West Branch B	ig WestBranch	3529.164	PF 1	3670.6	684.8	693.48	692.06	693.77	0.002185	5.41	1109	485.38	0.36
West Branch B	ig WestBranch	3392.068	PF 1	3670.6	684.5	692.88		693.36	0.003796	6.66	908.51	378.08	0.47
West Branch B	ig WestBranch	3077.041	PF 1	3670.6	683.8	692.23		692.49	0.002168	5.3	1180.49	463.42	0.36
West Branch B	ig WestBranch	2067.105	PF 1	3670.6	681.5	691.04		691.19	0.001125	4.24	1630.95	462.5	0.27

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
West Branch B	ig WestBranch	1802.776	PF 1	3670.6	680.9	690.79		690.95	0.000924	3.99	1306.94	361.47	0.24
West Branch B	ig WestBranch	1769.47	PF 1	3670.6	680.8	690.76		690.91	0.000923	3.98	1302.74	360.32	0.24
West Branch B	ig WestBranch	1565.623	PF 1	3670.6	680.3	690.52		690.71	0.001117	4.47	1514.8	423.09	0.27
West Branch B	ig WestBranch	903.7697	PF 1	3670.6	678.8	690.23		690.31	0.000497	3.23	2399.51	524.58	0.18
Welch Creek	USJ_BR	1069.488	PF 1	4524	652.3	665.55		665.62	0.000401	3.25	3554.73	518.04	0.16
Welch Creek	USJ_BR	558.341	PF 1	4524	651.85	665.3		665.4	0.000473	3.66	2898.68	358.08	0.18
MalgrenDrain	Tri MD Trib	2975.616	PF 1	125.5	752.27	753.47		753.48	0.001133	0.99	166.03	275.15	0.18
MalgrenDrain	Tri MD Trib	2406.345	PF 1	125.5	751.61	752.66		752.67	0.001827	1.26	140.79	257.6	0.22
MalgrenDrain	Tri MD Trib	2002.527	PF 1	125.5	750.65	752.16		752.17	0.000888	1.12	156.4	200.69	0.17
MalgrenDrain	Tri MD Trib	1382.334	PF 1	125.5	749.85	751.49		751.51	0.00132	1.38	134.87	198.13	0.2
MalgrenDrain	Tri MD Trib	730.4267	PF 1	125.5	749.2	750.44		750.46	0.002045	1.48	110.63	152.94	0.24
Malgren Drain	us trib 1	20687.75	PF 1	123.3	761.73	762.98		762.99	0.001058	1.08	164.75	261.05	0.18
Malgren Drain	us trib 1	20213.91	PF 1	123.3	761.12	762.35		762.37	0.001707	1.3	118.65	164.89	0.22
Malgren Drain	us trib 1	19792.49	PF 1	123.3	759.79	761.56	760.84	761.6	0.002027	1.76	93.32	116.61	0.25
Malgren Drain	us trib 1	19023.34	PF 1	123.3	757.98	758.93		758.98	0.006845	2.23	74.8	152.03	0.42
Malgren Drain	us trib 1	18215.33	PF 1	123.3	756.05	757.49		757.51	0.000864	1.07	160.68	225.5	0.16
Malgren Drain	us trib 1	17864.82	PF 1	123.3	756.06	757.24		757.25	0.00062	0.82	175.47	192.82	0.13
Malgren Drain	us trib 1	17709.76	PF 1	123.3	756.7	756.93		756.98	0.016049	1.15	70.44	229.66	0.49
Malgren Drain	us trib 1	17573.01	PF 1	123.3	755.56	756.35		756.36	0.00197	1.1	123.27	187.53	0.22
Malgren Drain	us trib 1	17382.61	PF 1	123.3	754.21	755.26	755.26	755.5	0.020543	4.3	36	81.08	0.88
Malgren Drain	us trib 1	17329.02	PF 1	123.3	753.16	755.05		755.07	0.001057	1.36	124.3	170.16	0.22
Malgren Drain	us trib 1	17106.27	PF 1	123.3	753.57	754.69		754.72	0.003049	1.52	93.84	163.86	0.28
Malgren Drain	us trib 1	16697.37	PF 1	244	751.23	753.81	752.89	753.88	0.001728	2.49	136.1	214.87	0.31
Malgren Drain	us trib 1	16602.29	PF 1	244	751.62	753.1	753.1	753.46	0.019126	5.33	56.19	211.01	0.91
Malgren Drain	us trib 1	16426.59	PF 1	244	749.81	751.82		751.84	0.001119	1.49	231.76	230.54	0.19
Malgren Drain	us trib 1	16342.2	PF 1	244	750.32	751.72		751.74	0.001372	1.28	228.5	286.63	0.2
Malgren Drain	us trib 1	15898.24	PF 1	244	749.24	749.81	749.81	750	0.037296	4.22	73.77	190.9	1.02
Malgren Drain	us trib 1	15691.16	PF 1	244	747.51	749.14		749.15	0.001327	1.38	302.35	598.93	0.2
Malgren Drain	us trib 1	15487.93	PF 1	244	747.01	749.02		749.03	0.000335	0.77	390.88	361.27	0.1
Malgren Drain	DS Trib1	15117.18	PF 1	454.4	746.47	748.67		748.7	0.001888	1.89	347.61	361.2	0.25
Malgren Drain	DS Trib1	14777.3	PF 1	454.4	746.08	747.87		747.93	0.003694	2.39	235.49	226.71	0.34
Malgren Drain	DS Trib1	14286.1	PF 1	454.4	745.47	746.74		746.76	0.001757	1.44	370.83	386.65	0.23
Malgren Drain	DS Trib1	14025.77	PF 1	454.4	744.22	746.29		746.32	0.001651	1.82	374.17	396.69	0.24
Malgren Drain	DS Trib1	13603.42	PF 1	454.4	742.19	745.73		745.76	0.001028	1.93	384.93	353.25	0.2
Malgren Drain	DS Trib1	13030.5	PF 1	454.4	741.9	744.69	744.17	744.77	0.003935	2.95	213.91	193.53	0.37
Malgren Drain	DS Trib1	12852.07	PF 1	454.4	741.08	743.09	743.09	743.46	0.01863	5.63	110.14	147.15	0.78
Malgren Drain	DS Trib1	12477.6	PF 1	454.4	734.6	741.6	737.8	741.7	0.001048	2.62	191.55	80.62	0.21
Malgren Drain	DS Trib1	12447.12		Bridge									
Malgren Drain	DS Trib1	12423.11	PF 1	454.4	734.4	740.99	737.68	741.14	0.00152	3.18	142.98	33.47	0.27
Malgren Drain	DS Trib1	12273.05	PF 1	454.4	734	740.77	737.98	740.89	0.001563	2.98	201.92	147.43	0.26
Malgren Drain	DS Trib1	11927.99	PF 1	454.4	733	739.88	737.65	740.09	0.003588	4.07	173.55	214.14	0.39

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Malgren Drain	DS Trib1	11386.96	PF 1	454.4	731.4	738.11		738.37	0.00281	4.08	111.73	30.31	0.36
Malgren Drain	DS Trib1	10624.91	PF 1	454.4	729.2	735.86		736.11	0.003152	4.12	129.82	87.67	0.37
Malgren Drain	DS Trib1	10176.99	PF 1	454.4	727.9	734.51		734.77	0.002879	4.05	115.33	54.96	0.36
Malgren Drain	DS Trib1	9718.892	PF 1	454.4	726.6	733.24		733.46	0.002788	3.81	134.27	138.77	0.36
Malgren Drain	DS Trib1	9250.437	PF 1	454.4	725.2	731.31		731.66	0.005569	4.76	96.63	38.92	0.49
Malgren Drain	DS Trib1	8848.583	PF 1	454.4	724	730.42		730.58	0.001481	2.79	145.23	114.34	0.25
Malgren Drain	DS Trib1	8594.259	PF 1	454.4	723.3	729.86		730.08	0.002604	3.91	149.51	119.05	0.38
Malgren Drain	DS Trib1	8251.915	PF 1	454.4	722.3	729.51		729.59	0.000795	2.47	267.79	149.25	0.2
Malgren Drain	DS Trib1	8063.206	PF 1	454.4	721.8	729.39		729.47	0.000582	2.36	260.57	130.66	0.18
Malgren Drain	DS Trib1	7883.75	PF 1	454.4	721.2	729.34	724.47	729.37	0.000291	1.73	404.34	237.04	0.13
Malgren Drain	DS Trib1	7858.115		Bridge									
Malgren Drain	DS Trib1	7836.115	PF 1	610.2	721.2	729.29		729.33	0.00036	1.97	546.03	310.48	0.14
Malgren Drain	DS Trib1	7588.193	PF 1	610.2	720.1	729.3		729.31	0.000011	0.4	1631.39	284.57	0.02
Malgren Drain	DS Trib1	7392.36	PF 1	610.2	719.2	729.3		729.3	0.000021	0.59	1242.71	291.71	0.03
Malgren Drain	DS Trib1	7072.529	PF 1	610.2	717.7	729.3		729.3	0.000003	0.28	2268.39	321.07	0.02
Malgren Drain	DS Trib1	6897.541	PF 1	610.2	716.9	729.3		729.3	0.000003	0.25	2633.71	440.27	0.01
Malgren Drain	DS Trib1	6756.535	PF 1	610.2	716.3	729.29	717.68	729.3	0.000031	0.54	1246.22	373.36	0.04
Malgren Drain	DS Trib1	6734.567		Culvert									
Malgren Drain	DS Trib1	6623	PF 1	610.2	716.2	721.17		721.37	0.002066	3.9	194.95	90.04	0.33
Malgren Drain	DS Trib1	6442.824	PF 1	610.2	715.4	720.31		720.63	0.003428	4.54	138.12	59.14	0.41
Malgren Drain	DS Trib1	6093.219	PF 1	610.2	713.8	718.6		719.09	0.005797	5.62	111.37	37.86	0.52
Malgren Drain	DS Trib1	5841.812	PF 1	610.2	712.7	717.06	715.84	717.57	0.006273	5.78	108.38	123.9	0.55
Malgren Drain	DS Trib1	5494.505	PF 1	610.2	711.1	715.09	713.95	715.53	0.005402	5.43	124.87	54.75	0.51
Malgren Drain	DS Trib1	4935.437	PF 1	610.2	708.02	713.13		713.33	0.00282	4.02	255.04	332.97	0.36
Malgren Drain	DS Trib1	4431.418	PF 1	610.2	707	712.21	710.57	712.29	0.001458	2.86	412.65	430.66	0.26
Malgren Drain	DS Trib1	4030.68	PF 1	610.2	706.2	709.84	709.54	710.84	0.01699	8.02	77.56	59.87	0.86
Malgren Drain	DS Trib1	3644.372	PF 1	610.2	705.4	709.16		709.2	0.001405	2.31	417.54	306.91	0.25
Malgren Drain	DS Trib1	3181.396	PF 1	610.2	704.5	709		709.01	0.000178	0.91	1064.96	652.24	0.09
Malgren Drain	DS Trib1	2699.885	PF 1	610.2	703.5	708.95		708.96	0.000124	0.93	1193.03	685.03	0.08
Malgren Drain	DS Trib1	2100.138	PF 1	610.2	702.3	708.82		708.84	0.000313	1.65	675.52	393.62	0.13
Malgren Drain	DS Trib1	1774.06	PF 1	610.2	701.7	708.79		708.79	0.00006	0.82	1332.91	534.98	0.06
Malgren Drain	DS Trib1	1325.935	PF 1	610.2	700.8	708.79		708.79	0.000007	0.28	3432.11	965.54	0.02
Malgren Drain	DS Trib1	995.6259	PF 1	610.2	700.1	708.78		708.79	0.000007	0.31	3842.39	1342.78	0.02
Malgren Drain	DS Trib1	542.2028	PF 1	610.2	699.2	708.78	702.33	708.78	0.000001	0.14	3691.35	1465.88	0.01
Malgren Drain	DS Trib1	234.1139	PF 1	610.2	698.6	708.78	701.96	708.78	0.000011	0.44	4092.28	1349.77	0.03
EBBR Trib2	EBBR Trib2	8083.82	PF 1	103.8	844.6	845.97		846	0.001869	1.68	104.3	248.95	0.26
EBBR Trib2	EBBR Trib2	7908.646	PF 1	103.8	843.9	845.46		845.56	0.003712	2.46	42.71	45.26	0.36
EBBR Trib2	EBBR Trib2	7604.291	PF 1	103.8	842.6	844.16		844.27	0.00481	2.75	37.74	27.35	0.41
EBBR Trib2	EBBR Trib2	7234.882	PF 1	103.8	841	842.81		842.89	0.002977	2.31	45.41	52.12	0.32
EBBR Trib2	EBBR Trib2	6679.105	PF 1	103.8	838.6	839.91		840.11	0.009958	3.58	29.03	24.79	0.58
EBBR Trib2	EBBR Trib2	6235.32	PF 1	103.8	836.7	838.39		838.43	0.001892	1.87	81.47	172.12	0.27

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EBBR Trib2	EBBR Trib2	5938.964	PF 1	103.8	835.5	838.39		838.39	0.00003	0.35	554.67	533.13	0.04
EBBR Trib2	EBBR Trib2	5732.33	PF 1	103.8	834.6	838.38	835.4	838.38	0.000037	0.46	538.06	791.07	0.04
EBBR Trib2	EBBR Trib2	5648.08		Culvert									
EBBR Trib2	EBBR Trib2	5601.265	PF 1	291.2	834.4	835.92	835.92	836.09	0.01033	4.18	122.38	352.9	0.62
EBBR Trib2	EBBR Trib2	5355.794	PF 1	291.2	833.3	835.24		835.26	0.001149	1.72	260.62	391.99	0.22
EBBR Trib2	EBBR Trib2	4986.094	PF 1	291.2	831.6	834.36		834.55	0.003882	3.61	92.65	120.32	0.41
EBBR Trib2	EBBR Trib2	4662.227	PF 1	291.2	830.2	833.8		833.88	0.00124	2.47	152.86	119.32	0.25
EBBR Trib2	EBBR Trib2	4273.45	PF 1	291.2	828.4	833.64	830.25	833.67	0.000248	1.42	288.39	166.78	0.12
EBBR Trib2	EBBR Trib2	4237.891		Culvert									
EBBR Trib2	EBBR Trib2	4194.248	PF 1	291.2	828.3	833.51		833.53	0.000201	1.3	327.62	195.12	0.11
EBBR Trib2	EBBR Trib2	4085.037	PF 1	291.2	828.1	833.49		833.51	0.000117	1.04	408.84	208.87	0.08
EBBR Trib2	EBBR Trib2	3994.851	PF 1	291.2	827.9	833.45	829.73	833.48	0.00028	1.57	298.86	360.04	0.12
EBBR Trib2	EBBR Trib2	3951.376		Culvert									
EBBR Trib2	EBBR Trib2	3888.729	PF 1	291.2	827.8	829.94		830.34	0.010394	5.11	59.31	41.88	0.66
EBBR Trib2	EBBR Trib2	3701.168	PF 1	291.2	825.7	828.05	827.48	828.45	0.009857	5.09	61.31	119.82	0.64
EBBR Trib2	EBBR Trib2	3347.157	PF 1	291.2	821.8	825.05		825.43	0.007457	4.96	58.73	24.58	0.57
EBBR Trib2	EBBR Trib2	2875.389	PF 1	291.2	819	822.26		822.54	0.005026	4.22	68.93	27.66	0.47
EBBR Trib2	EBBR Trib2	2484.29	PF 1	291.2	816.7	820.37	819.01	820.64	0.004671	4.13	70.48	26.53	0.45
EBBR Trib2	EBBR Trib2	1860.67	PF 1	291.2	812.9	817.56	815.93	817.83	0.004363	4.13	70.53	24.45	0.43
EBBR Trib2	EBBR Trib2	1619.137	PF 1	291.2	811.5	816.77		816.96	0.002886	3.54	82.35	26.17	0.35
EBBR Trib2	EBBR Trib2	906.1862	PF 1	291.2	807.3	811.14	811.14	812.2	0.026844	8.26	35.24	16.86	1.01
East Branch B	R US_Trib2	82694.48	PF 1	154.3	838.05	838.39		838.46	0.02279	2.12	76.68	264.21	0.66
East Branch B	R US_Trib2	82612.23	PF 1	154.3	837.02	837.95		837.97	0.002581	1.42	137.72	260.5	0.26
East Branch B	R US_Trib2	82558.46	PF 1	154.3	836.79	837.74		837.78	0.005297	1.64	103.66	194.77	0.36
East Branch B	R US_Trib2	82455.23	PF 1	154.3	835.72	837.18		837.25	0.005266	2.41	81.21	118.97	0.39
East Branch B	R US_Trib2	82337.25	PF 1	154.3	835.17	836.58		836.65	0.005155	2.45	81.44	111.66	0.39
East Branch B	R US_Trib2	82009	PF 1	154.3	834.17	835.83		835.86	0.001395	1.38	137.38	153.69	0.21
East Branch B	R US_Trib2	80864.91	PF 1	402	831.44	832.7		832.73	0.003852	1.41	287.83	455.96	0.3
East Branch B	R US_Trib2	80348.95	PF 1	402	828.87	830.48		830.54	0.005027	2.72	233.26	348.71	0.4
East Branch B	R US_Trib2	79927.51	PF 1	402	827.65	829.22		829.25	0.002207	1.81	297.17	333.61	0.26
East Branch B	R US_Trib2	79540.96	PF 1	402	826.49	828.11		828.16	0.004132	2.05	244.63	379.61	0.34
East Branch B	R US_Trib2	79062.96	PF 1	402	823.77	826.01		826.13	0.005296	3.36	166.66	170.76	0.43
East Branch B	R US_Trib2	78575.79	PF 1	402	821.48	823.79		823.9	0.004556	3.17	168.52	146.54	0.4
East Branch B	R US_Trib2	77907.85	PF 1	402	818.01	820.69		820.77	0.005182	3.03	218.38	314.68	0.41
East Branch B	R US_Trib2	77534.95	PF 1	402	815.6	819.02	818.74	819.07	0.004377	2.73	264.06	428.61	0.37
East Branch B	R US_Trib2	76272.23	PF 1	402	811.47	816.27		816.31	0.002036	2.31	351.58	690.88	0.26
East Branch B	R US_Trib2	75740.39	PF 1	402	810.61	815.27	814.88	815.3	0.001952	2.01	389.3	710.31	0.25
East Branch B	R US_Trib2	75191.54	PF 1	402	810.09	813.12	813.12	813.26	0.012924	4.47	190.37	531.8	0.63
East Branch B	R US_Trib2	74151.01	PF 1	402	808.2	810.49		810.49	0.000057	0.38	1212.87	1050.01	0.05
East Branch B	R US YC	73070.51	PF 1	678.5	806	810.43		810.43	0.000057	0.5	2382.81	1714.56	0.05
East Branch B	R US YC	72484.19	PF 1	1071.3	804.3	810.34		810.36	0.000228	1.45	1398.42	1223.81	0.11

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
East Branch B	R US YC	72122.29	PF 1	1071.3	803.2	810.29		810.31	0.000254	1.47	1085.72	1284.7	0.11
East Branch B	R US YC	71913.65	PF 1	1071.3	802.6	810.21	808	810.26	0.00053	2.29	814.21	1726.45	0.17
East Branch B	R US YC	71715.73		Culvert									
East Branch B	R US YC	71614.21	PF 1	1071.3	802.3	808.12	807.22	808.49	0.003731	5.44	266.94	978.77	0.44
East Branch B	R US YC	71374.04	PF 1	1071.3	801.7	807.72	806.61	807.81	0.001457	3.14	523.99	1006.98	0.26
East Branch B	R US YC	71179.57	PF 1	1071.3	801.2	807.54		807.58	0.000871	2.3	828.32	557.07	0.19
East Branch B	R US YC	70907.24	PF 1	1071.3	800.5	807.3		807.35	0.000722	2.54	736.31	380.36	0.19
East Branch B	R US YC	70672	PF 1	1071.3	799.8	807.14	803.4	807.2	0.000522	2.48	800.79	451.1	0.17
East Branch B	R US YC	70591.79		Culvert									
East Branch B	R US YC	70509	PF 1	1071.3	799.65	805.72		805.78	0.000806	2.52	716.75	414.23	0.2
East Branch B	R US YC	70372.6	PF 1	1071.3	799.4	805.59		805.64	0.001042	2.43	697.98	384.27	0.22
East Branch B	R US YC	70217.35	PF 1	1071.3	799.1	805.23		805.34	0.002531	3.67	550.22	514.51	0.33
East Branch B	R US YC	69808.44	PF 1	1071.3	798.2	804.55		804.62	0.001612	2.93	591.53	474.53	0.27
East Branch B	R US YC	69402.64	PF 1	1071.3	797.3	804.09		804.16	0.001999	3.04	547.65	335.93	0.28
East Branch B	R US YC	69106.26	PF 1	1071.3	796.6	803.38		803.49	0.003012	3.67	476.84	338.98	0.33
East Branch B	R US YC	68757.54	PF 1	1071.3	795.9	802.53	801.8	802.62	0.002095	3.39	526.18	931.46	0.3
East Branch B	R US YC	68277.67	PF 1	1071.3	794.8	801.72		801.76	0.001603	1.95	694.42	632.24	0.17
East Branch B	R US YC	67923	PF 1	1071.3	794.1	800.98		801.1	0.00351	3.51	514.51	392.62	0.29
East Branch B	R US YC	67305.04	PF 1	1071.3	792.7	798.81		799.05	0.004272	4.52	358.29	263.41	0.38
East Branch B	R US YC	66404.44	PF 1	1071.3	790.7	796.82		796.97	0.001924	3.9	485.9	317.41	0.31
East Branch B	R US YC	65723.99	PF 1	1071.3	789.2	795.67		795.8	0.00193	3.83	508.66	361.91	0.31
East Branch B	R US YC	65504.86	PF 1	1071.3	788.8	795.34		795.43	0.001426	3.29	537.27	301.1	0.26
East Branch B	R US YC	65227.61	PF 1	1071.3	788.2	795.01		795.1	0.001037	3.2	539.92	252.08	0.24
East Branch B	R US YC	65066.21	PF 1	1071.3	787.8	794.83		794.92	0.001233	3.1	560.58	276.46	0.23
East Branch B	R US YC	64931.14	PF 1	1071.3	787.5	794.66		794.76	0.00109	3.19	573.63	268.06	0.24
East Branch B	R US YC	64675.35	PF 1	1071.3	787	794.35		794.46	0.001194	3.4	644.71	313.06	0.25
East Branch B	R US YC	64426.41	PF 1	1071.3	786.4	794.26		794.29	0.000342	2.05	1360.34	898.56	0.14
East Branch B	R US YC	64352.98	PF 1	1071.3	786.3	794.23		794.25	0.000289	1.85	1380.74	789.47	0.13
East Branch B	R US YC	64007.12	PF 1	1071.3	785.5	794	789.46	794.11	0.000564	2.98	610.91	470.23	0.19
East Branch B	R US YC	63963.62		Culvert									
East Branch B	R US YC	63922.67	PF 1	1455.7	785.5	793.32		793.41	0.001076	3.32	857.93	392.71	0.23
East Branch B	R US YC	63680.41	PF 1	1455.7	785	792.85		793.01	0.002574	4.25	636.57	367.97	0.31
East Branch B	R US YC	63448.6	PF 1	1455.7	784.6	792.21		792.41	0.002668	4.74	657.16	416.37	0.35
East Branch B	R US YC	63231.37	PF 1	1455.7	784.2	791.58		791.81	0.003392	4.97	568.6	343.23	0.39
East Branch B	R US YC	63101.05	PF 1	1455.7	784	791.04		791.35	0.003562	5.57	522.8	338.34	0.43
East Branch B	R US YC	62194.81	PF 1	1455.7	782.3	789.45		789.6	0.001351	3.57	762.4	693.41	0.26
East Branch B	R US YC	61935.8	PF 1	1455.7	781.8	788.54		788.94	0.006173	6.34	449.65	490.3	0.53
East Branch B	R US YC	61455.57	PF 1	1455.7	780.9	787.87		787.91	0.000933	2.69	1233.89	1029.73	0.22
East Branch B	R US YC	61061.92	PF 1	1455.7	780.2	787.38		787.47	0.001165	3.42	1020.93	803.48	0.25
East Branch B	R US YC	60605.14	PF 1	1455.7	779.3	787.07		787.14	0.000569	2.66	1168.66	581.63	0.18
East Branch B	R US YC	60294.28	PF 1	1455.7	778.7	786.74		786.87	0.001351	3.92	796.17	420.38	0.28

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East Branch B	R US YC	59821.06	PF 1	1455.7	777.9	785.72		786.04	0.002368	5.3	448.4	246.22	0.37
East Branch B	R US YC	58972.94	PF 1	1455.7	776.3	782.83	782.58	783.28	0.005163	6.41	398.39	836.31	0.51
East Branch B	R US YC	58562.58	PF 1	1455.7	775.5	781.92		782	0.001955	3.61	982.45	1105.41	0.31
East Branch B	R US YC	57760.74	PF 1	1455.7	774	780.55		780.64	0.001622	3.53	967.88	925.24	0.28
East Branch B	R US YC	57404.63	PF 1	1455.7	773.4	780.03		780.08	0.000647	2.52	1060.75	572.75	0.19
East Branch B	R US YC	56668.67	PF 1	1455.7	772	779.37		779.46	0.001376	3.53	899.51	854.75	0.27
East Branch B	R US YC	55598.83	PF 1	1455.7	770	778.68	774.55	778.74	0.00043	2.21	1095.2	982.98	0.15
East Branch B	R US YC	55525.23		Culvert									
East Branch B	R US YC	55473.69	PF 1	1455.7	770	776.95		777.2	0.002849	5.02	586.2	559.87	0.36
East Branch B	R US YC	54775.08	PF 1	1455.7	768.23	775.93		775.98	0.001029	2.88	1072.23	783.69	0.22
East Branch B	R US YC	53962.73	PF 1	1455.7	768.03	774.89		774.97	0.001598	3.29	810.94	552.06	0.26
East Branch B	R US YC	52872.39	PF 1	1650.4	766.93	773.52		773.57	0.001083	2.75	1159.99	932.93	0.22
East Branch B	R US YC	52312.64	PF 1	1650.4	767.02	773.01		773.05	0.000789	2.32	1104.84	550.13	0.19
East Branch B	R US YC	51475.72	PF 1	1650.4	768.21	772.15		772.21	0.001486	2.7	877.96	445.44	0.26
East Branch B	R US YC	50697.24	PF 1	1650.4	765.6	771		771.07	0.001437	3.44	929.71	639.65	0.31
East Branch B	R US YC	50025.4	PF 1	1650.4	765.69	769.91		769.97	0.001928	2.67	851.03	498.27	0.27
East Branch B	R US YC	49446.02	PF 1	1650.4	762.77	768.8		768.88	0.001967	3.23	834.87	497.79	0.28
East Branch B	R US YC	48788.69	PF 1	1650.4	765.42	768.09		768.12	0.000889	1.66	1193.79	630.58	0.18
East Branch B	R US YC	48368.47	PF 1	1650.4	763.26	767.63		767.68	0.001256	2.5	974.8	497.92	0.23
East Branch B	R US YC	48176.66	PF 1	1650.4	761.97	767.39		767.44	0.001166	2.62	952.7	475.04	0.22
East Branch B	R US YC	47903.15	PF 1	1650.4	761.26	767.09		767.17	0.000999	3.23	807.36	370.9	0.26
East Branch B	R US YC	47790.39	PF 1	1650.4	764.65	766.88		766.99	0.002735	3.17	647.15	361.88	0.39
East Branch B	R US YC	47640.83	PF 1	1650.4	762.47	766.66		766.71	0.001169	2.39	1029.29	538.71	0.22
East Branch B	R US YC	47262.66	PF 1	1650.4	763.82	766.13		766.18	0.001683	1.99	855.78	441.16	0.24
East Branch B	R US YC	46548.61	PF 1	1650.4	762.85	764.81		764.88	0.002247	2.08	772.39	413.6	0.27
East Branch B	R US YC	45992.09	PF 1	1650.4	759.78	763.67		763.74	0.001897	2.84	803.64	414.09	0.28
East Branch B	R US YC	45684.87	PF 1	1650.4	759.19	763.34		763.37	0.00093	1.96	1342.89	890.21	0.19
East Branch B	R US YC	45455.26	PF 1	1650.4	758.1	763.16		763.19	0.000669	1.93	1199.06	546.01	0.17
East Branch B	R US YC	44890.81	PF 1	1650.4	755.96	762.79		762.83	0.000719	2.28	1007.47	387.5	0.18
East Branch B	R US YC	44393.41	PF 1	1650.4	757.59	762.15		762.26	0.002244	3.47	657.53	317.28	0.31
East Branch B	R US YC	44010.08	PF 1	1650.4	754.67	761.17		761.34	0.00265	4.39	581.82	264.02	0.35
East Branch B	R US YC	43567.03	PF 1	1650.4	753.85	760.73		760.79	0.000644	2.53	948.62	307.72	0.18
East Branch B	R US YC	43291.47	PF 1	1650.4	753.53	760.6		760.64	0.000465	2.05	1154.81	378.28	0.15
East Branch B	R US YC	43118.18	PF 1	1650.4	757.34	760.34		760.39	0.001318	2.02	942.85	467.12	0.22
East Branch B	R US MD incl DeKal	42607	PF 1	3536.3	756.89	759.18		759.33	0.002622	1.81	1151.66	417.32	0.28
East Branch B	R US MD incl DeKal	41515.84	PF 1	3536.3	753.35	756.92		757.02	0.002341	3	1380.76	595.13	0.3
East Branch B	R US MD incl DeKal	40855.34	PF 1	3536.3	750.93	755.66		755.76	0.001617	3.26	1450.53	511.5	0.27
East Branch B	R US MD incl DeKal	40296.98	PF 1	3678.2	749.76	754.92		755.02	0.000986	3.42	1445.54	477.55	0.27
East Branch B	R US MD incl DeKal	38830.31	PF 1	3678.2	748.13	753.39		753.54	0.002704	4.57	1258.91	478.92	0.36
East Branch B	R US MD incl DeKal	37987.55	PF 1	3678.2	747.95	752.83		752.87	0.000624	2.45	2209.13	1285.42	0.21
East Branch B	R US MD incl DeKal	36693.22	PF 1	3840.9	747.02	752.31		752.35	0.00056	0.95	2761.79	675.94	0.07

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
East Branch B	R US MD incl DeKal	36479.2	PF 1	3840.9	748.2	752.1		752.15	0.001196	0.85	2100.15	918.01	0.1
East Branch B	R US MD incl DeKal	36086.03	PF 1	3840.9	746.96	751.75		751.8	0.000685	2.31	2318.36	808.58	0.21
East Branch B	R US MD incl DeKal	35629.51	PF 1	3840.9	745.05	751.48		751.53	0.000497	2.82	2109.86	605.35	0.2
East Branch B	R US MD incl DeKal	35261.18	PF 1	3840.9	745.16	751.28		751.36	0.000455	2.51	1892.21	527.19	0.19
East Branch B	R US MD incl DeKal	35134.68	PF 1	3840.9	745.45	750.92		751.24	0.003491	5.76	966.04	522.57	0.49
East Branch B	R US MD incl DeKal	34477.76	PF 1	3840.9	743.68	749.06		749.25	0.00242	3.6	1318.6	441.55	0.28
East Branch B	R US MD incl DeKal	33605.25	PF 1	3840.9	742.62	747.62		747.71	0.001333	3.05	1636.75	562.62	0.25
East Branch B	R US MD incl DeKal	32277.12	PF 1	3840.9	741.53	745.01		745.23	0.003383	3.41	1034.81	407.15	0.36
East Branch B	R US MD incl DeKal	31815.66	PF 1	3834.4	739.42	744.44		744.53	0.001129	3.45	1648.13	531.17	0.28
East Branch B	R US MD incl DeKal	31627.49	PF 1	3834.4	739.58	743.94		744.19	0.002704	5.12	1119.37	415.53	0.43
East Branch B	R US MD incl DeKal	31465.57	PF 1	3834.4	738.83	743.63		743.83	0.002062	4.77	1101.84	420.88	0.39
East Branch B	R US MD incl DeKal	31396.59	PF 1	3834.4	738.34	743.58		743.71	0.001313	3.62	1451.79	459.43	0.3
East Branch B	R US MD incl DeKal	30808.58	PF 1	3834.4	737.84	742.29		742.47	0.006196	4.68	1385.63	464.88	0.41
East Branch B	R US MD incl DeKal	30450.1	PF 1	3834.4	737.06	741.56		741.64	0.000955	2.81	1684.07	478.86	0.25
East Branch B	R US MD incl DeKal	30099.81	PF 1	3834.4	738.06	741.25		741.33	0.000892	2.22	1726.69	588.95	0.23
East Branch B	R US MD incl DeKal	29754.2	PF 1	3834.4	736.69	740.91		741	0.001229	3.03	1594.32	701.28	0.28
East Branch B	R US MD incl DeKal	29410.74	PF 1	3834.4	737	740.44		740.59	0.00165	3.32	1242.56	427.85	0.32
East Branch B	R US MD incl DeKal	28689	PF 1	3834.4	735.16	739.4		739.62	0.002666	4.05	1064.59	407.61	0.35
East Branch B	R US MD incl DeKal	28412.73	PF 1	3834.4	734.63	738.74		738.94	0.002389	2.57	1073.21	384.1	0.29
East Branch B	R US MD incl DeKal	27653.39	PF 1	3834.4	733.47	738.06		738.17	0.000796	2.71	1448.4	369.84	0.23
East Branch B	R US MD incl DeKal	27264.59	PF 1	3834.4	733.24	737.65		737.77	0.001171	3.1	1381.63	446.4	0.28
East Branch B	R US MD incl DeKal	26581.36	PF 1	3834.4	731.61	737.31		737.37	0.000893	1.21	2238.52	561.12	0.09
East Branch B	R US MD incl DeKal	25787.37	PF 1	3834.4	731.61	736.24		736.33	0.003889	1.99	1583.28	626.81	0.18
East Branch B	R US MD incl DeKal	25342.59	PF 1	3834.4	729.78	735		735.09	0.002785	2.04	1678.22	446.91	0.16
East Branch B	R US MD incl DeKal	24916.03	PF 1	3834.4	729.43	733.55		733.65	0.005173	1.95	1534.31	425.23	0.2
East Branch B	R US MD incl DeKal	24250.29	PF 1	3834.4	728.35	731.95		732.16	0.002809	4.55	1054.89	428.86	0.43
East Branch B	R US MD incl DeKal	23611.98	PF 1	3834.4	726.83	730.64		730.85	0.002649	4.21	1039.81	389.33	0.41
East Branch B	R US MD incl DeKal	22682.24	PF 1	3834.4	724.88	729.43		729.55	0.001345	3.37	1392.1	476.22	0.3
East Branch B	R US MD incl DeKal	22255.57	PF 1	3834.4	724.2	728		728.34	0.006206	6.3	840.17	448.19	0.62
East Branch B	R US MD incl DeKal	22171.58	PF 1	3834.4	724.6	727.74		727.93	0.00292	4.21	1112.84	478.17	0.43
East Branch B	R US MD incl DeKal	21556.32	PF 1	3834.4	723.67	726.62		726.75	0.002815	1.33	1368.36	505.05	0.15
East Branch B	R US MD incl DeKal	21156.44	PF 1	3834.4	721.54	726.3		726.38	0.00065	2.62	1708.22	470.78	0.22
East Branch B	R US MD incl DeKal	20754.91	PF 1	3834.4	720.69	725.75	724.29	725.91	0.002602	4.09	1204.96	459.37	0.34
East Branch B	R US MD incl DeKal	20501.45	PF 1	3834.4	719.66	725.04		725.3	0.003053	5.7	988.15	386.17	0.47
East Branch B	R US MD incl DeKal	20206.2	PF 1	3834.4	719.12	724.5		724.66	0.002757	3.85	1257.92	526.3	0.33
East Branch B	R US MD incl DeKal	19813.28	PF 1	3834.4	719.91	722.96		723.28	0.005515	5.31	858.63	425.93	0.57
East Branch B	R US MD incl DeKal	19280.07	PF 1	3834.4	717.13	721.69		721.86	0.002505	3.29	1152.57	480.78	0.37
East Branch B	R US MD incl DeKal	18946.78	PF 1	3834.4	715.4	721.32		721.42	0.001101	3.46	1556.97	568.81	0.28
East Branch B	R US MD incl DeKal	18174.25	PF 1	3834.4	715.36	720.5		720.63	0.001507	4.08	1415.47	597.99	0.33
East Branch B	R US MD incl DeKal	17723.62	PF 1	3834.4	715.75	719.51		719.69	0.002902	1.87	1374.12	523.62	0.18
East Branch B	R US MD incl DeKal	17207.53	PF 1	3834.4	711.78	718.35		718.46	0.001863	2.42	1555.74	445	0.17

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
East Branch B	R US MD incl DeKal	16879.42	PF 1	3834.4	710.89	717.66		717.78	0.00229	2.11	1493.07	472.25	0.15
East Branch B	R US MD incl DeKal	16374.85	PF 1	3834.4	710.95	716.59		716.66	0.003357	2.48	1822	512.54	0.18
East Branch B	R US MD incl DeKal	15631.11	PF 1	3834.4	710.33	715.25		715.37	0.001999	4.4	1571.35	453.24	0.37
East Branch B	R US MD incl DeKal	14745.15	PF 1	3834.4	710.25	713.85		713.98	0.003295	2.13	1444.91	602.27	0.2
East Branch B	R US MD incl DeKal	14258.96	PF 1	3834.4	709.64	712.6		712.67	0.003974	2.04	1809.4	589.58	0.21
East Branch B	R US MD incl DeKal	13766.58	PF 1	3834.4	707.31	711.24		711.36	0.003308	1.86	1693.82	538.27	0.17
East Branch B	R US MD incl DeKal	12717.51	PF 1	3834.4	706.02	709.26		709.32	0.003259	1.67	1991.19	939.32	0.16
East Branch B	R DS_MD	10206.23	PF 1	4397.3	696.9	708.72		708.73	0.000085	1.29	4888.65	1056.43	0.07
East Branch B	R DS_MD	10044.92	PF 1	4397.3	696.6	708.7		708.72	0.000142	1.73	4316.98	771.74	0.09
East Branch B	R DS_MD	9803.148	PF 1	4397.3	696.1	708.62		708.69	0.000287	2.54	2199.62	566.03	0.14
East Branch B	R DS_MD	9673.909	PF 1	4397.3	695.88	708.51	702.39	708.63	0.000429	3.48	1742.49	583.76	0.18
East Branch B	R DS_MD	9630.191		Bridge									
East Branch B	R DS_MD	9577.171	PF 1	4397.3	696	707.69	705.03	708.19	0.002355	7.02	895.65	219.53	0.38
East Branch B	R DS_MD	9537.469		Bridge									
East Branch B	R DS_MD	9487.779	PF 1	4397.3	696.6	704.76	704.55	705.95	0.009146	10.98	691.72	290.36	0.72
East Branch B	R DS_MD	9090.038	PF 1	4397.3	695.7	703.43	702.15	703.7	0.002705	5.84	1149.92	548.89	0.41
East Branch B	R DS_MD	8400.542	PF 1	4397.3	694.3	702.41		702.6	0.001873	4.28	1281.87	443.61	0.33
East Branch B	R DS_MD	8063.593	PF 1	4397.3	693.5	702.14		702.26	0.000586	3.2	1953.48	577.68	0.2
East Branch B	R DS_MD	7651.964	PF 1	4397.3	692.7	701.92	699.67	702.04	0.000818	3.77	1823.56	627.17	0.23
East Branch B	R DS_MD	7594.827		Bridge									
East Branch B	R DS_MD	7551.286	PF 1	4397.3	692.4	701.54		701.73	0.001946	4.83	1408.84	480.49	0.33
East Branch B	R DS_MD	7427.041	PF 1	4397.3	692.2	700.69	699.75	701.06	0.005528	7.46	1203.73	607.61	0.55
East Branch B	R DS_MD	7026.326	PF 1	4397.3	691.3	699.95		700.02	0.001214	3.42	2351.87	1024.69	0.25
East Branch B	R DS_MD	6760.327	PF 1	4397.3	690.7	699.73		699.79	0.000895	3.28	2627.11	851.93	0.22
East Branch B	R DS_MD	6058.298	PF 1	4397.3	689.2	699.53		699.58	0.00033	2.38	2863.56	888.16	0.14
East Branch B	R DS_MD	5482.864	PF 1	4397.3	688	698.1	696.73	698.9	0.004651	8.92	1223.84	989.55	0.53
East Branch B	R DS_MD	5409.797		Bridge									
East Branch B	R DS_MD	5371.703	PF 1	4444.7	688	697.43	695.53	698.38	0.004574	8.15	696.14	580.14	0.54
East Branch B	R DS_MD	4668.506	PF 1	4444.7	686.3	696.73	695.01	696.82	0.00095	3.77	2545.13	901.18	0.24
East Branch B	R DS_MD	4468.501	PF 1	4444.7	685.8	696.64	694.36	696.68	0.000579	2.72	3372.3	1005.98	0.18
East Branch B	R DS_MD	4199.346	PF 1	4444.7	685.1	696.46		696.52	0.000702	3.14	2850.07	792.51	0.2
East Branch B	R DS_MD	3634.052	PF 1	4444.7	683.7	695.82		696.06	0.002239	6.13	1788.24	442.66	0.37
East Branch B	R DS_MD	3246.288	PF 1	4444.7	682.8	694.95		695.22	0.002181	6.03	1488.82	386.24	0.36
East Branch B	R DS_MD	3147.423	PF 1	4444.7	682.5	694.4		694.93	0.003228	7.49	1175.46	324.03	0.45
East Branch B	R DS_MD	2697.236	PF 1	4444.7	681.4	694.08		694.19	0.001052	4.12	1967.25	383.75	0.25
East Branch B	R DS_MD	2093.314	PF 1	4444.7	680	692.79		693.3	0.003145	7.49	1390.06	311.67	0.44
East Branch B	R DS_MD	1413	PF 1	4444.7	678.5	691.03		691.39	0.002769	6.73	1593.23	425.35	0.41
East Branch B	R DS_MD	1045.043	PF 1	4444.7	677.4	690.19		690.47	0.002948	7.42	1828.07	478.96	0.41
East Branch B	R DS_MD	666.9187	PF 1	4444.7	676.4	689.75		689.88	0.001078	4.43	2402.95	598.01	0.25
East Branch B	R DS_MD	452.57	PF 1	4444.7	675.9	689.52		689.65	0.001106	4.51	2329.25	569.97	0.26
East Branch B	R DS_MD	77.20041	PF 1	4444.7	675	689.43		689.47	0.00025	2.4	3722.04	775.47	0.13

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Big Rock Cree	k USJ_WelchCk	31307.57	PF 1	7986.8	675	688.88		689.11	0.001097	5.65	3207.54	564.08	0.28
Big Rock Cree	k USJ_WelchCk	30359.14	PF 1	7986.8	674.3	688.68		688.75	0.00027	2.82	4008.79	647.23	0.14
Big Rock Cree	k USJ_WelchCk	29972.07	PF 1	7986.8	674	688.26		688.54	0.001077	5.65	2305.63	541.68	0.27
Big Rock Cree	k USJ_WelchCk	29666.92	PF 1	7986.8	673.8	688.03		688.22	0.000855	4.53	2788.58	626.2	0.24
Big Rock Cree	k USJ_WelchCk	29170.4	PF 1	7986.8	673.5	687.34		687.71	0.001755	6.6	2699.23	772.92	0.33
Big Rock Cree	k USJ_WelchCk	28805.6	PF 1	7986.8	673.2	686.62		687.11	0.002074	6.62	1783.56	621.83	0.34
Big Rock Cree	k USJ_WelchCk	28342.63	PF 1	7986.8	672.9	685.77		686.19	0.001901	6.36	2827.26	819.6	0.35
Big Rock Cree	k USJ_WelchCk	27931.11	PF 1	7986.8	672.6	685.31		685.57	0.001941	5.82	2665.12	873.62	0.33
Big Rock Cree	k USJ_WelchCk	27621.47	PF 1	7986.8	672.4	684.88		685.08	0.001811	5.34	2702.23	877.05	0.31
Big Rock Cree	k USJ_WelchCk	26955.57	PF 1	7986.8	671.9	683.66		683.93	0.002202	5.69	2159.54	864.32	0.33
Big Rock Cree	k USJ_WelchCk	26617.3	PF 1	7986.8	671.1	683.29	676.66	683.72	0.000215	5.33	1628.87	648.83	0.28
Big Rock Cree	k USJ_WelchCk	26567.3		Bridge									
Big Rock Cree	k USJ_WelchCk	26487.3	PF 1	7989.1	671.6	682.86	677.18	683.31	0.001194	5.73	1563.93	708.09	0.3
Big Rock Cree	k USJ_WelchCk	26139.64	PF 1	7989.1	670.9	682.58		682.85	0.001047	5.07	2332.34	560.03	0.27
Big Rock Cree	k USJ_WelchCk	25638.57	PF 1	7989.1	670.1	682.2		682.4	0.000817	4.51	2701.39	583.62	0.24
Big Rock Cree	k USJ_WelchCk	25125.96	PF 1	7989.1	669.3	681.62		681.91	0.001287	5.52	2556.76	691.46	0.3
Big Rock Cree	k USJ_WelchCk	24056.53	PF 1	7989.1	667.5	679.98	677.99	680.37	0.002098	6.94	2062.08	466.89	0.38
Big Rock Cree	k USJ_WelchCk	23587.23	PF 1	8075.9	666.8	679.12		679.55	0.002203	7.03	1997.92	522.47	0.39
Big Rock Cree	k USJ_WelchCk	23008.95	PF 1	8075.9	665.8	678.3		678.6	0.001429	5.81	2387.8	627.23	0.31
Big Rock Cree	k USJ_WelchCk	22538.47	PF 1	8075.9	665	678		678.1	0.000637	3.8	3724.94	792.54	0.21
Big Rock Cree	k USJ_WelchCk	22163.11	PF 1	8075.9	664.4	677.49		677.76	0.001314	5.53	2439.73	622.59	0.3
Big Rock Cree	k USJ_WelchCk	21782.22	PF 1	8075.9	663.8	677.28	669.23	677.59	0.0002	4.52	1882.47	735.5	0.22
Big Rock Cree	k USJ_WelchCk	21749.47		Bridge									
Big Rock Cree	k USJ_WelchCk	21707.66	PF 1	8095.4	663.8	676.73	670.74	677.34	0.001508	6.42	1485.06	764.92	0.33
Big Rock Cree	k USJ_WelchCk	20579.16	PF 1	8095.4	662.3	674.56		674.98	0.003173	7.32	2131.1	590.41	0.42
Big Rock Cree	k USJ_WelchCk	20234.6	PF 1	8095.4	661.9	673.42		673.85	0.003078	7.41	2552.51	907.42	0.44
Big Rock Cree	k USJ_WelchCk	19454.48	PF 1	8095.4	663.21	672.77		672.92	0.000613	4.13	2952.2	553.05	0.26
Big Rock Cree	k USJ_WelchCk	18390.62	PF 1	8095.4	659.47	672.28		672.44	0.000566	4.44	2966.51	624.65	0.25
Big Rock Cree	k USJ_WelchCk	17322.2	PF 1	8223.2	658.1	671.75		671.88	0.000454	3.4	3069.6	468.74	0.17
Big Rock Cree	k USJ_WelchCk	16772.19	PF 1	8223.2	657.4	671.52		671.62	0.000443	3.36	3375.34	486.89	0.17
Big Rock Cree	k USJ_WelchCk	16036.67	PF 1	8333.2	656.5	671.14		671.27	0.000495	3.92	3361.86	551.54	0.19
Big Rock Cree	k USJ_WelchCk	15889.48	PF 1	8333.2	656.3	671.08		671.19	0.000477	3.61	3303.2	496.51	0.18
Big Rock Cree	k USJ_WelchCk	15585.2	PF 1	8333.2	655.9	670.67		670.94	0.001581	6.48	3227.89	439.98	0.33
Big Rock Cree	k USJ_WelchCk	15028.62	PF 1	8333.2	655.2	669.71		670.09	0.001463	6.74	2613.68	328.16	0.33
Big Rock Cree	k USJ_WelchCk	14904.22	PF 1	8333.2	655.1	669.47	665.76	669.89	0.001728	7.24	2418.04	324.52	0.35
Big Rock Cree	k USJ_WelchCk	14721.52	PF 1	8333.2	654.9	666.76	666.76	669.03	0.010146	14.75	1096.2	233.67	0.82
Big Rock Cree	k USJ_WelchCk	14518.78	PF 1	8333.2	654.6	666.19	665.02	667.07	0.000298	2.72	1436.87	1877.62	0.14
Big Rock Cree	k USJ_WelchCk	14330.3	PF 1	8333.2	654.4	666.36	663.11	666.93	0.00023	2.5	1632.14	1879.36	0.13
Big Rock Cree	k USJ_WelchCk	13926.25	PF 1	8333.2	653.7	665.46		666.64	0.000389	3.23	1301.03	678.19	0.17
Big Rock Cree	k USJ_WelchCk	13538.82	PF 1	8333.2	652.9	665.43		666.21	0.002431	8.44	1698.29	354.31	0.43
Big Rock Cree	k USJ_WelchCk	13247.9*	PF 1	8333.2	652.35	665.29		665.59	0.001152	5.89	2592.52	606.39	0.29

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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Big Rock Cree	k USJ_WelchCk	12957.15	PF 1	8333.2	651.8	665.32		665.37	0.000247	2.8	5615.04	1131.82	0.14
Big Rock Cree	k DSJ_WelchCk	12361.04	PF 1	12397.8	650.6	665.24	657.81	665.26	0.000137	1.68	12312.4	2124.92	0.08
Big Rock Cree	k DSJ_WelchCk	11961.65	PF 1	12397.8	649.8	665.22	657.42	665.23	0.000069	1.34	16662.34	2347.87	0.06
Big Rock Cree	k DSJ_WelchCk	11220.33	PF 1	12533.3	648.4	665.1	657.24	665.17	0.000307	2.69	6654.96	1311.17	0.12
Big Rock Cree	k DSJ_WelchCk	10001.87	PF 1	12533.3	646	664.73	657.08	664.8	0.000576	3.58	7123.33	1564.3	0.15
Big Rock Cree	k DSJ_WelchCk	9401.219	PF 1	12533.3	644.8	664.15		664.33	0.000971	4.59	4651.17	393.39	0.19
Big Rock Cree	k DSJ_WelchCk	9188.212	PF 1	12533.3	644.4	663.95		664.13	0.000901	4.55	4522.38	423.36	0.19
Big Rock Cree	k DSJ_WelchCk	9040.269	PF 1	12533.3	644.1	663.4	652.91	663.91	0.000714	5.91	2916.8	486.43	0.25
Big Rock Cree	k DSJ_WelchCk	8998.507		Bridge									
Big Rock Cree	k DSJ_WelchCk	8966.977	PF 1	12549.3	644.1	661.95		662.61	0.001234	7.18	3034.55	398.26	0.31
Big Rock Cree	k DSJ_WelchCk	8794.831	PF 1	12549.3	643.9	661.9		662.32	0.000753	5.8	3495.62	349.54	0.24
Big Rock Cree	k DSJ_WelchCk	8472.034	PF 1	12549.3	643.6	660.57		661.81	0.003113	10.62	2151.18	320.44	0.47
Big Rock Cree	k DSJ_WelchCk	7994.756	PF 1	12549.3	643.1	659.97		660.65	0.001508	7.79	3139.92	435.96	0.34
Big Rock Cree	k DSJ_WelchCk	7510.75	PF 1	12549.3	642.6	659.14		659.75	0.002287	8.51	3291.54	513.57	0.38
Big Rock Cree	k DSJ_WelchCk	6717.615	PF 1	12549.3	641.8	658.66		658.85	0.000659	4.89	4366.55	683.61	0.22
Big Rock Cree	k DSJ_WelchCk	6210.249	PF 1	12549.3	641.3	658.18		658.5	0.000824	5.56	3324.15	553.3	0.24
Big Rock Cree	k DSJ_WelchCk	5788.143	PF 1	12549.3	640.9	657.65		658.09	0.001165	6.48	4169.84	691.96	0.29
Big Rock Cree	k DSJ_WelchCk	5245.664	PF 1	12549.3	640.3	656.86		657.36	0.001696	7.44	3774.49	610.9	0.34
Big Rock Cree	k DSJ_WelchCk	4697.597	PF 1	12549.3	639.8	656.02		656.59	0.001562	7.33	3465.64	492.53	0.33
Big Rock Cree	k DSJ_WelchCk	4051.343	PF 1	12549.3	639.1	654.25		655.16	0.004687	10.83	2479.18	522.16	0.53
Big Rock Cree	k DSJ_WelchCk	3406.749	PF 1	12549.3	638.4	651.78		652.75	0.003488	9.83	2435.03	623.81	0.49
Big Rock Cree	k DSJ_WelchCk	2816.447	PF 1	12549.3	637.8	650.73		651.25	0.001938	7.25	3365.48	766.13	0.37
Big Rock Cree	k DSJ_WelchCk	1498.676	PF 1	12623.7	636.5	649.13		649.49	0.001391	6.17	4060.65	1091.87	0.31
Big Rock Cree	k DSJ_WelchCk	1336.95	PF 1	12623.7	636.4	648.93		649.24	0.001373	6.06	4187.13	1151.07	0.31
Big Rock Cree	k DSJ_WelchCk	654.5444	PF 1	12623.7	635.7	648.38		648.53	0.000956	4.92	6194.3	1643.12	0.25
Big Rock Cree	k DSJ_WelchCk	141.7052	PF 1	12623.7	635.1	648.13		648.19	0.000429	3.43	8685.72	1919.81	0.17
Big Rock Cree	k DSJ_WelchCk	-83	PF 1	12623.7	635	648.08		648.12	0.000236	2.56	10490.88	1903.85	0.13
Big Rock Cree	k DSJ_WelchCk	-806.9	PF 1	12623.7	633	647.91		647.97	0.000251	2.87	8223.1	1199.68	0.13
Big Rock Cree	k DSJ_WelchCk	-2181.4	PF 1	12623.7	629.6	647.42		647.55	0.000433	4.31	6563.81	739.41	0.18
Big Rock Cree	k DSJ_WelchCk	-3181.4	PF 1	12623.7	627.1	645.89	637.21	646.74	0.000977	7.68	1849.93	611.74	0.32
Big Rock Cree	k DSJ_WelchCk	-3232.2		Bridge									
Big Rock Cree	k DSJ_WelchCk	-3325.3	PF 1	12623.7	627	644.74	638.39	645.86	0.001503	9.05	1658.31	603.58	0.39

HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

Rivers=9
Hydraulic Reaches=17
River Stations=371
Plans =1
Profiles =1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
WelchCreekTrib1	Trib1	18420.13	PF 1	165	751.58	752.49		752.51	0.002721	1	164.83	327.2	0.25
WelchCreekTrib1	Trib1	17945.3	PF 1	165	749.86	750.51		750.54	0.006939	1.83	133.58	399.02	0.4
WelchCreekTrib1	Trib1	17622.56	PF 1	165	749.22	749.41		749.41	0.001921	0.43	289.62 1	19	0.17
WelchCreekTrib1	Trib1	17412.52	PF 1	165	747.31	748.75	748.59	748.81	0.006182	2.75	115.6	325.41	0.43
WelchCreekTrib1	Trib1	17023.56	PF 1	165	745.44	746.03		746.06	0.008271	1.74	130.54	454.4	0.43
WelchCreekTrib1	Trib1	16833.86	PF 1	165	744.92	745.67		745.68	0.000843	0.62	292.92	670.89	0.14
WelchCreekTrib1	Trib1	16435.55	PF 1	165	743.73	745.24		745.26	0.001376	1.4	179.55	252.37	0.21
WelchCreekTrib1	Trib1	16053.24	PF 1	165	742.97	743.85		743.96	0.019937	3.61	70.65	190.85	0.71
WelchCreekTrib1	Trib1	15593.93	PF 1	165	740.91	741.93		741.94	0.001851	1.26	191.54	367.66	0.22
WelchCreekTrib1	Trib1	15172.56	PF 1	165	739.83	740.76		740.79	0.004543	1.84	121.45	224.26	0.35
WelchCreekTrib1	Trib1	14660.48	PF 1	165	738.46	739.52		739.54	0.001679	1.21	158.08	200.81	0.21
WelchCreekTrib1	Trib1	14264.67	PF 1	165	736.62	738.03		738.15	0.00975	3.02	63.78	95.08	0.52
WelchCreekTrib1	Trib1	13874.93	PF 1	165	734.64	736.62		736.66	0.00216	2.01	113.32	117.86	0.27
WelchCreekTrib1	Trib1	13566.25	PF 1	165	733.67	736		736.04	0.00207	1.71	117.68	148.06	0.25
WelchCreekTrib1	Trib1	13232.94	PF 1	165	734.19	734.93		734.98	0.005939	1.77	96.39	169.13	0.38
WelchCreekTrib1	Trib1	12977.65	PF 1	165	731.68	733.38		733.46	0.005994	2.91	82.42	123.92	0.43
WelchCreekTrib1	Trib1	12758.57	PF 1	165	729.58	730.84	730.84	731.22	0.02298	5.17	34.39	47.32	0.97
WelchCreekTrib1	Trib1	12675.38	PF 1	165	727.66	729.49		729.53	0.001914	2.18	114.44	126.9	0.29
WelchCreekTrib1	Trib1	12377.83	PF 1	165	727	728.59		728.67	0.005249	2.74	78.55	98.08	0.4
WelchCreekTrib1	Trib1	12141.15	PF 1	165	725.99	727.42	726.94	727.48	0.004792	2.5	88.7	113.13	0.38
WelchCreekTrib1	Trib1	11819.25	PF 1	165	723.81	724.75	724.6	724.9	0.015919	3.58	57.89	96.26	0.65
WelchCreekTrib1	Trib1	11325.2	PF 1	165	720.3	722.03		722.09	0.002876	2.54	123.4	300.8	0.37
WelchCreekTrib1	Trib1	11075.85	PF 1	165	719.67	721.2		721.25	0.003907	2.33	116.54	259.87	0.35
WelchCreekTrib1	Trib1	10675.37	PF 1	165	718.33	720.15	719.4	720.18	0.001917	1.62	139.32	207.13	0.24
WelchCreekTrib1	Trib1	10202.16	PF 1	165	716.82	717.53	717.53	717.7	0.04114	3.36	52.63	167.83	0.92
WelchCreekTrib1	Trib1	9798.384	PF 1	165	712.99	715.27	714.38	715.29	0.001089	1.58	198.82	337.66	0.19
WelchCreekTrib1	Trib1	9473.013	PF 1	165	711.81	713.58	713.25	713.76	0.010041	3.88	59.44	287.5	0.56
WelchCreekTrib1	Trib1	9021.453	PF 1	182	711.21	712.16		712.17	0.001791	1.1	196.14	323.36	0.21
WelchCreekTrib1	Trib1	8576.981	PF 1	182	709.59	710.91		710.96	0.004888	1.76	113.25	220.18	0.35
WelchCreekTrib1	Trib1	8048.06	PF 1	182	708.14	709.23		709.24	0.002277	0.9	202.18	399.71	0.22
WelchCreekTrib1	Trib1	7392.726	PF 1	182	706.88	707.65	707.25	707.67	0.002508	0.98	185.04	430.05	0.24
WelchCreekTrib1	Trib1	7223.836	PF 1	182	706.52	707.16		707.19	0.003234	1.31	141.06	330.77	0.34
WelchCreekTrib1	Trib1	7029.384	PF 1	98	703.98	706.18		706.35	0.008415	3.36	33.01	58.78	0.5
WelchCreekTrib1	Trib1	6791.379	PF 1	98	703.82	705.59		705.61	0.001494	1.4	90.6	125.98	0.21
WelchCreekTrib1	Trib1	6596.626	PF 1	98	703.44	705.22		705.26	0.002095	1.87	74.08	98.58	0.26

HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S.	WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
WelchCreekTrib1	Trib1	5978.366	PF 1	98	702.88		703.95		703.97	0.002142	1.31	118.92	329.91	0.24
WelchCreekTrib1	Trib1	5759.5	PF 1	98	702.64		703.42		703.43	0.002624	1.23	120.86	325.56	0.25
WelchCreekTrib1	Trib1	5248.621	PF 1	98	701.78		703.32		703.32	0.000071	0.33	428.66	500.91	0.05
WelchCreekTrib1	Trib1	4723.469	PF 1	98	701.34		703.19	702.25	703.21	0.002955	0.88	118.68	175.66	0.14
WelchCreekTrib1	Trib1	4169.156	PF 1	98	700.59		701.11		701.13	0.004872	1.28	90.95	275.01	0.32
WelchCreekTrib1	Trib1	3687.764	PF 1	98	699.81		700.9		700.9	0.000169	0.38	293.5	477.74	0.07
WelchCreekTrib1	Trib1	3282.419	PF 1	98	699.84		700.78		700.79	0.000623	0.56	206.22	423.68	0.12
WelchCreekTrib1	Trib1	2761.839	PF 1	98	699.09		699.73		699.83	0.022596	3.07	38.54	93.51	0.72
WelchCreekTrib1	Trib1	2256.19	PF 1	98	696.13		697.31		697.33	0.002116	1.4	96.82	188.71	0.24
WelchCreekTrib1	Trib1	1740.007	PF 1	98	694.41		695.52		695.56	0.006077	2.24	68.56	174.6	0.4
WelchCreekTrib1	Trib1	1096.614	PF 1	98	693.5		695.52		695.52	0.000011	0.15	854.33	671.28	0.02
WelchCreekTrib 4	T4	10395.8	PF 1	119	833.59		835.03	835.03	835.26	0.02446	4.06	36.15	99.83	0.79
WelchCreekTrib 4	T4	9838.853	PF 1	119	826.52		828.43		828.47	0.002628	1.93	86.02	218.9	0.28
WelchCreekTrib 4	T4	9202.265	PF 1	119	823		824.33	824.33	824.71	0.023432	5.13	24.86	34.52	0.97
WelchCreekTrib 4	T4	8561.599	PF 1	119	816.71		817.9		817.96	0.00487	2.22	67.15	97.06	0.37
WelchCreekTrib 4	T4	7917.99	PF 1	119	811.69		812.5	812.41	812.59	0.01721	2.92	53.72	149.33	0.64
WelchCreekTrib 4	T4	7355.692	PF 1	119	806.91		808.14		808.22	0.004701	2.58	60.43	117.66	0.45
WelchCreekTrib 4	T4	6766.205	PF 1	119	802.62		803.44	803.3	803.5	0.015576	2.36	65.42	197.8	0.58
WelchCreekTrib 4	T4	6172.213	PF 1	119	797.97		798.38		798.39	0.0052	0.89	133.96	504.08	0.3
WelchCreekTrib 4	T4	5483.573	PF 1	119	797.63		797.96		797.97	0.000224	0.13	319.62	637.91	0.06
WelchCreekTrib 4	T4	4649.023	PF 1	417	792.08		797.31		797.35	0.001393	2.2	464.19	1 21.97	0.23
WelchCreekTrib 4	T4	4048.344	PF 1	417	790.99		796.58		796.65	0.001001	2.33	342.48	658.75	0.21
WelchCreekTrib 4	T4	3215.659	PF 1	417	790.4		796.05		796.07	0.000488	1.59	598.71	800.8	0.14
WelchCreekTrib 4	T4	2119.289	PF 1	417	788.45		795.92		795.92	0.000066	0.67	1606.20	1 754.66	0.05
WelchCreek Trib2	Trib 2	9531.655	PF 1	80	732.84		733.99	733.79	734.13	0.012758	3.26	29.42	48.64	0.59
WelchCreek Trib2	Trib 2	8789.649	PF 1	80	725.5		726.37		726.41	0.008509	1.81	50.38	132.72	0.44
WelchCreek Trib2	Trib 2	7970.498	PF 1	80	720.01		720.82		720.84	0.005536	1.05	86.87	191.62	0.23
WelchCreek Trib2	Trib 2	7140.673	PF 1	80	716.06		716.92		716.94	0.004052	1.15	80.24	275.45	0.29
WelchCreek Trib2	Trib 2	6277.77	PF 1	80	712.28		713.33	713.04	713.35	0.004302	1.24	69.45	170.26	0.31
WelchCreek Trib2	Trib 2	5751.915	PF 1	80	710.25		710.83		710.86	0.005129	1.41	56.94	186.2	0.43
WelchCreek Trib2	Trib 2	5357.034	PF 1	80	708.99		709.82		709.84	0.001626	1.29	86.44	188.27	0.25
WelchCreek Trib2	Trib 2	5100.615	PF 1	80	708.96		709.38		709.39	0.001821	0.83	114.66	330.07	0.22
WelchCreek Trib2	Trib 2	4759.703	PF 1	80	708.51		709.16		709.16	0.000335	0.39	224.64	470.5	0.09
WelchCreek Trib2	Trib 2	4359.953	PF 1	80	708.2		708.68		708.75	0.026176	2.82	40.67	190.94	0.74
WelchCreek Trib2	Trib 2	4074.791	PF 1	80	707.36		708.1		708.1	0.000822	0.41	174.56	445.26	0.12
WelchCreek Trib2	Trib 2	3972.885	PF 1	80	707.59		707.98		707.99	0.000629	0.37	181.13	499.32	0.11
WelchCreek Trib2	Trib 2	3869.548	PF 1	103	707.16		707.91		707.91	0.000727	0.62	236.49	601.38	0.13
WelchCreek Trib2	Trib 2	3664.84	PF 1	103	707.2		707.73		707.74	0.001464	0.59	183.68	548.16	0.17
WelchCreek Trib2	Trib 2	3132.572	PF 1	103	706.28		707.37		707.37	0.000404	0.45	230.11	392.11	0.1
WelchCreek Trib2	Trib 2	2530.997	PF 1	103	705.43		706.33	706.33	706.57	0.032987	4.44	28.94	62.66	0.91
WelchCreek Trib2	Trib 2	2047.355	PF 1	103	702.04		703.05		703.06	0.001169	0.98	159.06	328.49	0.18
WelchCreek Trib2	Trib 2	1700.831	PF 1	103	701.39		702.52		702.54	0.002051	1.33	100.53	177.4	0.24

HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S.	WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)		Top Width (ft)	Froude # Chl
WelchCreek Trib2	Trib 2	1241.258	PF 1	103	701.09		702		702.01	0.000782	0.76	151.62		207.45	0.14
WelchCreek Trib2	Trib 2	823.38	PF 1	103	700.23		700.88	700.88	701.03	0.044359	3.09	33.38		107.71	0.98
WelchCreek	US reach	91314.7	PF 1	193	818.1		822.69		822.97	0.005731	4.24	45.52		17.21	0.46
WelchCreek	US reach	90888.34	PF 1	193	815.7		820.96		821.15	0.003238	3.5	55.06		17.55	0.35
WelchCreek	US reach	90555.62	PF 1	193	813.9		820.5		820.57	0.00097	2.21	87.44		23.39	0.2
WelchCreek	US reach	90449.99	PF 1	474	813.3		819.16		820.06	0.01269	7.59	62.48		16.49	0.69
WelchCreek	US reach	90033.17	PF 1	474	811		817.58		817.82	0.002575	3.99	127.33		40.94	0.35
WelchCreek	US reach	89680.13	PF 1	474	809		816.29		816.62	0.004542	4.68	101.34		28.15	0.43
WelchCreek	US reach	89536.31	PF 1	474	808.2		815.4		815.89	0.005602	5.61	84.55		20.2	0.46
WelchCreek	DSTrib5	89238.64	PF 1	627	806.6		814.34	811.93	814.66	0.00314	4.6	138.49		69.16	0.39
WelchCreek	DSTrib5	89174.22 Kesling	r Rd.	Br	idge										
WelchCreek	DSTrib5	89127.06	PF 1	627	806.2		813.31	810.85	813.62	0.00285	4.47	147.35		66.98	0.38
WelchCreek	DSTrib5	89053.17	PF 1	627	805.8		813.18	809.96	813.3	0.003365	2.78	229.73		397.51	0.24
WelchCreek	DSTrib5	88661.03	PF 1	627	804.4		810.74	809.51	811.33	0.007751	6.18	101.86		174.22	0.59
WelchCreek	DSTrib5	88209.21	PF 1	627	802.9		809.2		809.45	0.002365	4.21	169.29		52.35	0.35
WelchCreek	DSTrib5	87615.85	PF 1	627	800.8		807.15		807.56	0.004491	5.21	126.62		47.67	0.46
WelchCreek	DSTrib5	86622.6	PF 1	627	797.4		803		803.3	0.00404	4.74	162.23		107.58	0.44
WelchCreek	DSTrib5	85762.06	PF 1	627	795.7		803.01	800.18	803.01	0.000077	0.84	2239.14	2	210.01	0.06
WelchCreek	DSTrib5	85023.32	PF 1	627	794.2		802.72		802.86	0.001068	3.17	304.93		682.02	0.24
WelchCreek	DSTrib5	84045.35	PF 1	627	792.3		800.95		801.2	0.003096	4.07	157.39		99.17	0.37
WelchCreek	DSTrib5	83349.71	PF 1	627	790.9		798.14		798.54	0.004753	5.23	129.27		38.03	0.47
WelchCreek	DSTrib5	82618.3	PF 1	627	789.4		797.43		797.47	0.000558	1.96	521.52		276.38	0.16
WelchCreek	DSTrib5	82124.15	PF 1	627	788.4		796.96		797.08	0.001048	3.12	338.76		390.88	0.23
WelchCreek	DSTrib5	81584.35	PF 1	627	787.3		795.65	792.66	796.07	0.00395	5.21	125.79		107.83	0.41
WelchCreek	DS Trib4	81309.06	1	8	787.05		795.62	790.3	795.64	0.000681	1.72	1157.60	1	888.41	0.16
WelchCreek	DS Trib4	1264.04 Rowe (n	rth)	Mult	Open										
WelchCreek	DS Trib4	81229.37	1	8	786.9		795.55		795.58	0.000596	2.22	948.91	1	529.91	0.17
WelchCreek	DS Trib4	79444.38	1	8	784.6		794.18		794.32	0.000854	3.43	547.37		875.87	0.22
WelchCreek	DS Trib4	79364.18	1	8	784.6		794.07	790.4	794.23	0.00123	3.69	468.38	1	27.05	0.25
WelchCreek	DS Trib4	9305.02 Rowe (s	uth)	Br	idge										
WelchCreek	DS Trib4	79232.55	1	8	784.6		793.68		793.83	0.00101	3.56	501.61	1	85.16	0.24
WelchCreek	DS Trib4	79053.84	1	8	784.6		793.51		793.63	0.001042	3.34	548.61	1	426.66	0.24
WelchCreek	DS Trib4	78562.64	1	8	784.4		793.16		793.23	0.000629	2.82	799.2		841.51	0.19
WelchCreek	DS Trib4	77735.27	1	8	783.7		793.01		793.02	0.00012	1.28	1887.59	1	212.39	0.08
WelchCreek	DS Trib4	77068.42	1	8	783.1		793		793	0.000011	0.39	4950.48	1	713.12	0.02
WelchCreek	DS Trib4	76265.39	1	8	782.3		792.99	787.91	792.99	0.000006	0.31	6050.08	2	199.41	0.02
WelchCreek	DS Trib4	75815.75	1	8	781.9		792.99	787.27	792.99	0.000007	0.31	5463.54	2	291	0.02
WelchCreek	DS Trib4	75219.32	1	8	781.3		792.97		792.98	0.000054	0.83	2262.41	1	852	0.05
WelchCreek	DS Trib4	74944.31	1	8	780.9		792.94	784.6	792.96	0.000092	1.3	1253.13	2	135.33	0.07
WelchCreek	DS Trib4	74796.81 I-88		Cul	vert										
WelchCreek	DS Trib4	74582.14	1	8	780.7		792.42	784.29	792.44	0.00007	1.18	1222.01	2	734.21	0.07
WelchCreek	DS Trib4	74380.07	1	123	780.8		792.41	786.64	792.42	0.000091	1.12	1592.78	2	757.48	0.07

HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S.	WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
WelchCreek	DS Trib4	73355.4	1	123	780.7		792.15	786.56	792.22	0.000562	2.71	866.09 1	143.28	0.17
WelchCreek	DS Trib4	72556.36	1	123	780.5		791.45		791.64	0.000909	3.77	372.9	83.3	0.23
WelchCreek	DS Trib4	71582.32	1	123	780.3		790.6		790.79	0.000836	3.65	435.54	193.24	0.23
WelchCreek	DS Trib4	71081.75	1	123	780.3		789.83		790.17	0.001844	4.89	292.68	114.2	0.32
WelchCreek	DS Trib4	70244.41	1	123	780.1		788.45		788.75	0.001544	4.65	340.27	129.88	0.31
WelchCreek	DS Trib4	69089.84	1	123	779.9		787.37		787.41	0.000807	2.46	753.1	364.22	0.2
WelchCreek	DS Trib4	68253.4	1	123	779.8		786.69		786.73	0.00081	2.55	922.24	654.06	0.2
WelchCreek	DS Trib4	67968.18	1	123	779.7		786.52	783.63	786.56	0.000443	2.3	769.81	435.35	0.16
WelchCreek	DS Trib4	67870.11 Harter R	d.	Br	idge									
WelchCreek	DS Trib4	67792.61	1	123	779.3		785.96	783.43	786	0.000531	2.3	774.05	312.67	0.16
WelchCreek	DS Trib4	67699.66 Daubern	n (north	Br	idge									
WelchCreek	DS Trib4	67620.46	1	123	778.7		785.09	782.17	785.24	0.001487	3.57	441.01	698.85	0.27
WelchCreek	DS Trib4	67002.09	1	357	776.8		783.97	782.76	784.1	0.002092	4.19	691.46	374.74	0.32
WelchCreek	DS Trib4	66359.63	1	357	774.8		782.18		782.39	0.00332	4.81	559.83	334.57	0.39
WelchCreek	DS Trib4	65272.32	1	407	771.5		778.62		778.88	0.002942	5.06	460.51	255.57	0.38
WelchCreek	DS Trib4	64960.1*	1	407	770.55		778.11		778.24	0.001211	3.53	634.97	295.83	0.26
WelchCreek	DS Trib4	64647.92	1	407	769.6		778.02		778.05	0.000235	1.75	1375.96	529.53	0.12
WelchCreek	DS Trib4	63837.37	1	407	767.1		777.85		777.86	0.00016	1.62	1610.77	492.37	0.1
WelchCreek	DS Trib4	63717.79	1	407	768.15		777.69	773.35	777.8	0.000751	3.62	1005.04	606.65	0.22
WelchCreek	DS Trib4	63664.44 Main St.		Br	idge									
WelchCreek	DS Trib4	63621.36	1	407	767.62		775.76		776.02	0.001959	4.29	356.56	462.82	0.32
WelchCreek	DS Trib4	63515.24	1	675	767.2		774.91		775.57	0.005083	7.16	313.15	380.31	0.51
WelchCreek	DS Trib4	62643.39	1	675	764.3		771.44		771.75	0.004013	5.79	572.61	378.34	0.44
WelchCreek	DS Trib4	62078.37	1	675	762.4		769		769.36	0.004318	6.08	509.89	318.44	0.47
WelchCreek	DS Trib4	61657.61	1	675	761		767.22		767.59	0.005379	6.13	440.14	263.1	0.51
WelchCreek	DS Trib4	60882.46	1	675	759.2		764.86		765.05	0.002291	4.74	593.8	268.11	0.39
WelchCreek	DS Trib4	60231.1	1	675	757.7		763.99		764.05	0.001105	2.85	1041.34	503.14	0.23
WelchCreek	DS Trib4	59718.72	1	675	756.5		763.53		763.59	0.000843	2.87	996.57	429.53	0.21
WelchCreek	DS Trib4	59198.47	1	675	755.3		762.73		762.99	0.003205	5.28	565.09	366.14	0.39
WelchCreek	DS Trib4	58371.96	1	675	753.3		760.02		760.19	0.003495	4.77	590.57	325.94	0.36
WelchCreek	DS Trib4	57679.46	1	675	751.7		757.03		757.29	0.005092	5.29	513.04	338.49	0.49
WelchCreek	DS Trib4	57178.06	1	675	750.5		755.26		755.38	0.002845	4.11	698.78	423.21	0.37
WelchCreek	DS Trib4	56519.08	1	675	749		754.1		754.16	0.001489	2.89	939.25	510.54	0.25
WelchCreek	DS Trib4	55864.48	1	675	747.8		753.55		753.61	0.001242	2.78	920.99	426.48	0.24
WelchCreek	DS Trib4	54963.23	1	675	746.2		752.29		752.37	0.001516	3.21	829.97	379.67	0.27
WelchCreek	DS Trib4	54152.83	1	805	744.8		750.96		751.07	0.001749	3.84	873.24	482.31	0.3
WelchCreek	DS Trib4	53200.03	1	805	743.1		749.55		749.66	0.00177	3.9	910.93	465.2	0.3
WelchCreek	DS Trib4	52293.92	1	805	741.5		747.83		747.99	0.002923	4.73	787.3	514.51	0.37
WelchCreek	DS Trib4	51053.94	1	805	739.3		746.69		746.73	0.000771	2.66	1241.95	528.38	0.2
WelchCreek	DS Trib4	50282.68	1	855	738		746.08		746.17	0.001073	3.36	1092.7	522.05	0.24
WelchCreek	DS Trib4	48815.99	1	855	735.4		744.71		744.83	0.001191	3.7	893.06	390.31	0.25
WelchCreek	DS Trib4	48119.3	1	855	734.1		743.89		744.04	0.001082	3.99	777.82	242.77	0.25

HEC-RAS Version 4 Welch Creek Output
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River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S.	WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
WelchCreek	DS Trib4	48050	1	855	733.98		743.89	740.18	743.97	0.000568	2.84	983.27	310.26	0.18
WelchCreek	DS Trib4	7981.81 Lasher	d.	Br	idge									
WelchCreek	DS Trib4	47915	1	855	733.51		742.66		742.85	0.001531	4.39	652.16	273.23	0.3
WelchCreek	DS Trib4	47792.39	1	987	733.2		742.32		742.6	0.002287	5.3	676.96	257.14	0.35
WelchCreek	DS Trib4	47251.8	1	987	732		740.96		741.29	0.002643	5.71	695.95	258.81	0.38
WelchCreek	DS Trib4	46444	1	987	730.3		738.52		738.93	0.003683	6.34	688.15	319.57	0.44
WelchCreek	DS Trib4	45959.85	1	987	729.2		737.1		737.38	0.002989	5.6	841.6	316.88	0.4
WelchCreek	DS Trib4	45145.52	1	987	727.4		735.8		735.92	0.001328	3.66	851.1	275.38	0.26
WelchCreek	DS Trib4	44666.1	1	987	726.3		735.01		735.24	0.002131	4.94	715.33	300.4	0.34
WelchCreek	DS Trib4	43011.72	1	987	722.7		731.53		731.85	0.00302	5.71	631.69	297.51	0.39
WelchCreek	DS Trib4	42157.77	1	987	720.8		729.87		730.02	0.001567	4.18	780.87	268.67	0.28
WelchCreek	DS Trib4	41357.34	1	987	719		728.28		728.55	0.002376	5.22	640.7	287.62	0.35
WelchCreek	DS Trib4	41048.66	1	987	718.4		727.41		727.73	0.00293	5.68	653.4	362.68	0.38
WelchCreek	DS Trib4	40979	1	987	718.24		727.53	724.9	727.58	0.000472	2.61	1251.68	487.17	0.16
WelchCreek	DS Trib4	40861.07 Scott		Br	idge									
WelchCreek	DS Trib4	40600	1	987	717.89		725.98	724.08	726.35	0.003124	5.57	468.23	388.09	0.42
WelchCreek	DS Trib4	40563.66	1	160	717.8		725.93	724.91	726.19	0.002846	5.34	658.69	327.18	0.38
WelchCreek	DS Trib4	39948.62	1	160	716.3		724.46		724.73	0.002976	5.56	745.33	341.75	0.39
WelchCreek	DS Trib4	39518.03	1	160	715.2		723.06		723.42	0.004092	6.19	594.9	265.23	0.45
WelchCreek	DS Trib4	39108.07	1	160	714.2		721.62		721.88	0.00389	5.66	693.84	367.95	0.43
WelchCreek	DS Trib4	38832.32	1	160	713.6		720.84		721.07	0.003809	5.39	700.53	348.12	0.42
WelchCreek	DS Trib4	38162.25	1	160	711.9		719.67		719.82	0.001918	4.46	900.22	418.28	0.32
WelchCreek	DS Trib4	37595.4*	1	160	710.5		717.01		718.04	0.011005	9.62	409.69	335.42	0.75
WelchCreek	DS Trib4	37028.67	1	160	709.1		716.3		716.4	0.001485	3.99	1423.55	1 142.97	0.29
WelchCreek	DS Trib4	36372.94	1	160	707.5		715.17		715.37	0.002617	5.1	969.98	787.96	0.37
WelchCreek	DS Trib4	35936.28	1	160	706.5		713.87		714.11	0.003569	5.57	828.29	658.49	0.42
WelchCreek	DS Trib4	34698.94	1	160	703.4		710.81		710.94	0.001882	4.15	992.68	596.93	0.31
WelchCreek	DS Trib4	33701	1	160	701		709.74		709.81	0.000903	3.23	1218.3	508.35	0.22
WelchCreek	DS Trib4	33220.9*	1	160	699.83		709.2		709.32	0.001247	3.95	1149.52	600.59	0.26
WelchCreek	DS Trib4	33043.33	1	160	699.4		709.01		709.11	0.001058	3.67	1183.21	628.15	0.24
WelchCreek	DS Trib4	32860	1	160	698.89		708.89	705.89	708.98	0.00097	3.82	1300.82	710.18	0.24
WelchCreek	DS Trib4	32800.03 Wheeler		Br	idge									
WelchCreek	DS Trib4	32716	1	160	698.92		707.62	705.66	707.67	0.000682	2.64	1406.8	637.25	0.19
WelchCreek	DS Trib4	32059.55	1	236	697.7		706.7	705.99	706.91	0.00276	4.97	815.9	411.95	0.36
WelchCreek	DS Trib4	31048.2	1	236	695.9		704.61		704.79	0.001921	4.7	877.88	415.76	0.32
WelchCreek	DS Trib4	30684.17	1	236	695.3		704		704.17	0.001893	4.46	875.51	445.52	0.31
WelchCreek	DS Trib4	29814.74	1	236	693.8		703.39		703.46	0.000676	3.03	1252.43	410.83	0.19
WelchCreek	DS Trib4	28867.7*	1	236	692.18		702.93		703.04	0.000317	1.94	1152.74	457.17	0.13
WelchCreek	DS Trib4	28781.29	1	236	691.9		702.84		703	0.000583	2.61	887.33	475.24	0.18
WelchCreek	DS Trib4	28719.43	1	236	691.9		702.75	698.29	702.94	0.000952	4.04	760.43	457.19	0.24
WelchCreek	DS Trib4	3659.74 Daubernn (south		Br	idge									
WelchCreek	DS Trib4	28606.79	1	236	691.65		701.18	698.36	701.85	0.003549	6.76	372.88	364.77	0.45

HEC-RAS Version 4 Welch Creek Output
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WelchCreek	DS Trib4	28526.03	1	236	691.5		701.13	699.59	701.44	0.002399	5.37	595.41	390.69	0.36
WelchCreek	DS Trib4	28136.47	1	236	691.1		700.52	699.17	700.67	0.001578	4.23	877.21	455.2	0.28
WelchCreek	DS Trib4	27672.6	1	236	690.5		699.86		699.96	0.001358	3.72	1145.43	512.31	0.25
WelchCreek	DS Trib2	27374.9	1	401	690.2		699.42		699.54	0.001442	3.92	1021.32	350.72	0.27
WelchCreek	DS Trib2	26136.16	1	401	688.7		698.01		698.16	0.001269	4.25	1045.57	391.54	0.27
WelchCreek	DS Trib2	25468.67	1	401	688		697.23		697.38	0.001261	4.17	1042.92	367.85	0.26
WelchCreek	DS Trib2	24714.19	1	401	687.1		696.1		696.38	0.002101	5.53	836.95	379.34	0.34
WelchCreek	DS Trib2	24142.06	1	401	686.4		695.7		695.8	0.00063	2.94	959.53	411.96	0.18
WelchCreek	DS Trib1	23444.65	1	671	686		695.11	690.84	695.25	0.000963	3.57	1693.97	995.71	0.24
WelchCreek	DS Trib1	23380.15 US 30		Mult	Open							1		
WelchCreek	DS Trib1	23292.47	1	671	685.94		694.28	690.68	694.43	0.000923	3.56	1121.75	680.17	0.23
WelchCreek	DS Trib1	23215 Railroad		Mult	Open							1		
WelchCreek	DS Trib1	23159.23	1	671	686.05		693.31		693.6	0.003028	5.12	699.78	753.44	0.41
WelchCreek	DS Trib1	21281.27	1	671	683.1		691.29		691.35	0.000918	3.2	1659.4	670.87	0.22
WelchCreek	DS Trib1	20387.22	1	671	682		690.85		690.91	0.000723	3.12	1745.65	682.61	0.2
WelchCreek	DS Trib1	19926.98	1	671	681.5		690.69		690.72	0.000368	2.27	2468.83	828.86	0.14
WelchCreek	DS Trib1	19366.99	1	671	680.8		690.49		690.56	0.000779	3.34	2198.69	726.33	0.21
WelchCreek	DS Trib1	18791	1	671	680.4		690.04	686.93	690.21	0.001263	4.55	1550.35	462.82	0.28
WelchCreek	DS Trib1	18647.79	1	671	680		689.78	687.13	690.03	0.001454	4.93	1078.73	571.25	0.3
WelchCreek	DS Trib1	8599.25 Grannart		Br	idge									
WelchCreek	DS Trib1	18530	1	671	680.85		689.38	686.13	689.4	0.00025	1.92	2264.91	542.52	0.12
WelchCreek	DS Trib1	18150.28	1	671	679.4		689.23		689.29	0.000487	2.86	1598.37	404.06	0.17
WelchCreek	DS Trib1	17534.98	1	730	678.6		688.99		689.06	0.000569	3.03	1528.16	406.68	0.18
WelchCreek	DS Trib1	17097.29	1	730	678.1		687.93	687.25	688.5	0.003767	7.16	667.4	374.96	0.44
WelchCreek	DS Trib1	7071.96 Camp Dn (north		Cul	vert									
WelchCreek	DS Trib1	16979.04	1	730	677.9		686.2		686.33	0.001368	4.21	1156.78	436.59	0.27
WelchCreek	DS Trib1	16644.31	1	730	677.2		685.45		685.74	0.002484	5.55	802.52	333.25	0.37
WelchCreek	DS Trib1	16259.81	1	730	676.3		684.57		684.84	0.002804	5.56	935.73	465.95	0.38
WelchCreek	DS Trib1	15721.64	1	730	675.2		683.22		683.46	0.002244	5.16	955.96	417.02	0.36
WelchCreek	DS Trib1	15429.65	1	730	674.5		682.99		683.06	0.000793	3.19	1535.64	470.27	0.21
WelchCreek	DS Trib1	14637.02	1	730	672.8		681.82	680.11	682.22	0.00253	6.02	782.93	372.64	0.39
WelchCreek	DS Trib1	13594.73	1	730	670.5		679.35		679.74	0.002713	6.06	835.92	351.49	0.4
WelchCreek	DS Trib1	13033.49	1	730	669.3		677.68		678.16	0.003303	6.61	664.5	249.49	0.44
WelchCreek	DS Trib1	12430.8	1	730	668		677.38		677.44	0.00053	2.71	1491.63	369.87	0.17
WelchCreek	DS SGB	11726.34	1	503	666.5		676.29		676.6	0.0023	6.31	1976.76	527.04	0.36
WelchCreek	DS SGB	11296.89	1	503	665.5		675.72		675.86	0.001222	4.66	2482.31	555.66	0.26
WelchCreek	DS SGB	10594.29	1	503	664		674.75		674.97	0.001531	5.35	2099.68	568.99	0.3
WelchCreek	DS SGB	9730.736	1	503	662.1		673	671.2	673.42	0.002298	6.6	1342.65	440.86	0.36
WelchCreek	DS SGB	9678		Bridge										
WelchCreek	DS SGB	9312.346	1	503	661.6		672.36	670.12	672.54	0.001388	4.97	2057.81	573.14	0.28
WelchCreek	DS SGB	8677.546	1	503	660.8		671.46		671.68	0.001479	5.24	2161.1	575.29	0.3
WelchCreek	DS SGB	7955.854	1	503	660		670.34		670.62	0.001897	5.8	1914.85	507.98	0.33

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WelchCreek	DS SGB	7383.208	1	503	659.3		669.69		669.84	0.001171	4.52	2251.01	665.38	0.26
WelchCreek	DS SGB	6969.825	1	503	658.8		669.4		669.51	0.000897	4.09	2366.9	609.49	0.23
WelchCreek	DS SGB	6282.201	1	503	658		668.93		669.02	0.000627	3.49	2629.27	629.14	0.2
WelchCreek	DS SGB	5494.234	1	503	657.1		668.41		668.54	0.000918	4.3	2270.24	514.34	0.23
WelchCreek	DS SGB	4948.424	1	503	656.4		668.18		668.23	0.00045	2.96	4019.6	825.88	0.16
WelchCreek	DS SGB	3937.579	1	503	655.2		667.91		667.95	0.000246	2.52	4779.52	853.49	0.13
WelchCreek	DS SGB	3289	1	524	654.51		667.68	662.27	667.76	0.000473	3.57	3131.51	578.44	0.18
WelchCreek	DS SGB	160.209 Camp Dn (south		Br	idge									
WelchCreek	DS SGB	3076	1	524	655.17		667.34		667.41	0.00034	2.91	3032.72	489.05	0.16
WelchCreek	DS SGB	2439.729	1	524	653.6		666.78		667.01	0.001083	4.94	1839.58	283.82	0.26
WelchCreek	DS SGB	2253.151	1	524	653.4		666.5		666.78	0.001291	5.4	1720.92	294.86	0.28
WelchCreek	DS SGB	1889.928	1	524	653.1		666.12		666.36	0.000987	5.14	2116.47	377.88	0.26
WelchCreek	DS SGB	1538.375	1	524	652.8		665.98		666.09	0.000552	3.84	2932.02	453.64	0.19
WelchCreek	DS SGB	1069.488	1	524	652.3		665.82		665.88	0.00036	3.12	3696.26	521.13	0.16
WelchCreek	DS SGB	558.341	1	524	651.85		665.6	659.44	665.69	0.000426	3.53	3004.76	359.77	0.17
Welch Creek T6	Trib6	7117.937	PF 1	267	848.51		850.13	849.76	850.23	0.01104	2.64	101.29	130.97	0.53
Welch Creek T6	Trib6	6544.912	PF 1	267	844.27		845.5		845.57	0.006381	2.17	134.67	180.86	0.41
Welch Creek T6	Trib6	5524.681	PF 1	267	838.36		839.57		839.62	0.007	2.06	159.68	324.48	0.42
Welch Creek T6	Trib6	4214.131	PF 1	267	830.11		832.99		833.05	0.003933	2	155.24	214.59	0.33
Welch Creek T6	Trib6	3498.693	PF 1	267	828.53		829.97	829.71	829.99	0.005376	1.38	217.04	658.44	0.34
Welch Creek T6	Trib6	2403.362	PF 1	267	823.61		826.13		826.17	0.002933	1.73	200.03	344.76	0.29
Welch Creek T6	Trib6	1478	PF 1	267	820.08		822.07		822.16	0.007906	2.86	126.7	239.78	0.47
Welch Creek T6	Trib6	963	PF 1	267	817.9		820.29		820.34	0.00205	1.89	169.96	171.79	0.26
Welch Creek T6	Trib6	721	PF 1	267	818.01		819.59	819.04	819.65	0.003922	2.21	144.43	163.54	0.34
Welch Creek T6	Trib6	505	PF 1	267	816.67		817.38	817.38	817.61	0.047545	3.9	68.66	150.15	1.01
Sugar Grove	ds east run 1	4675.549	PF 1	674	674.6		680.98	678.79	681.09	0.001374	3.05	315.52	182.05	0.26
Sugar Grove	ds east run 1	4589.303		Bridge										
Sugar Grove	ds east run 1	4514.851	PF 1	674	674.4		680.1	678.33	680.41	0.003293	4.62	174.93	108.59	0.4
Sugar Grove	ds east run 1	4090.173	PF 1	674	673.8		680.19		680.21	0.000038	0.55	588.1	275.47	0.04
Sugar Grove	ds east run 1	3786.016	PF 1	674	673.3		679.88		680.15	0.002583	4.36	229.59	207.4	0.36
Sugar Grove	ds east run 1	3405.203	PF 1	674	672.8		678.85		679.12	0.002853	4.47	243.13	203.73	0.38
Sugar Grove	ds east run 1	2941.217	PF 1	674	672.2		678.98		678.98	0.000035	0.66	1081.02	232.89	0.05
Sugar Grove	ds east run 1	2639.007	PF 1	674	671.7		678.9		678.95	0.000599	2.3	571.54	304.37	0.18
Sugar Grove	ds east run 1	2480	PF 1	674	671.5		678.83	674.15	678.88	0.000321	1.96	546.71	485.08	0.14
Sugar Grove	ds east run 1	2434.339	C	ulvert										
Sugar Grove	ds east run 1	2415	PF 1	674	671.5		678.29		678.52	0.001802	3.84	175.47	26.7	0.26
Sugar Grove	US WC	2234.817	1	561	671.2		678.4		678.42	0.000114	1.26	1525.37	515.64	0.09
Sugar Grove	US WC	1985.598	1	561	670.7		678.2		678.34	0.001828	4.16	732.49	458.19	0.31
Sugar Grove	US WC	1615.322	1	561	670		677.53		677.69	0.001939	4.29	656.88	354.87	0.32
Sugar Grove	US WC	808.5454	1	561	668.4		677.02		677.08	0.00051	2.62	1116.67	389.68	0.17
Sugar Grove	US WC	724	1	561	668.3		677.05		677.06	0.000025	0.7	2456.5	383.53	0.04
Sugar Grove	US WC	647	1	561	668.1		676.99		677.05	0.000285	2.02	938.79	299.81	0.13

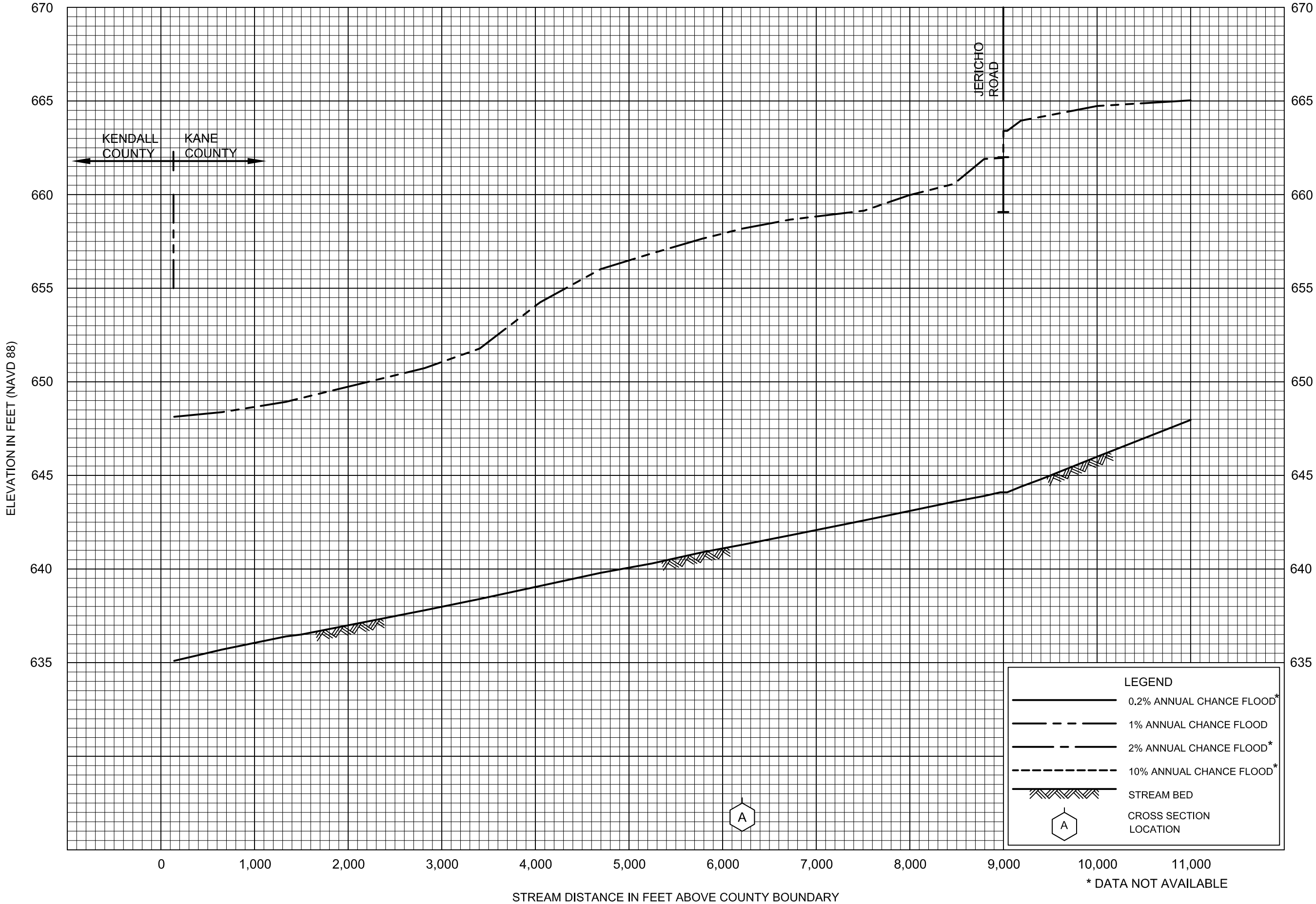
HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S.	WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Sugar Grove	US WC	547.0551	1	561	667.9		677		677.02	0.000069	1.18	1617.33	288.63	0.07
Sugar Grove	US WC	442	1	561	667.7		676.98		677.01	0.000171	1.79	1473.01	431.82	0.11
Sugar Grove	US WC	360.6642	1	561	667.6		676.99		677	0.000046	0.96	2157.84	482.48	0.06
Sugar Grove	US WC	223.9368	1	561	667.3		676.97		676.99	0.000169	1.47	1865.23	560.7	0.1
Duffin Drain	US reach	31506.91	PF 1	421	754.69		757.07		757.19	0.004946	3.4	165.76	141.82	0.42
Duffin Drain	US reach	30887.37	PF 1	421	750.29		752.65		752.91	0.010317	4.67	116.53	106.04	0.59
Duffin Drain	US reach	30413.45	PF 1	421	747.34		750.1		750.21	0.003584	3.1	182.55	154.4	0.36
Duffin Drain	US reach	29581.53	PF 1	421	743.49		746.02		746.18	0.006494	3.93	169.57	222.02	0.48
Duffin Drain	US reach	28613.8	PF 1	421	738.47		740.8	740.33	740.9	0.005087	3.19	190.6	204.49	0.41
Duffin Drain	US reach	27997.72	PF 1	421	736.31		737.47		737.51	0.005976	1.69	248.78	393.41	0.38
Duffin Drain	US reach	27642.29	PF 1	421	734.6		736.17		736.19	0.002581	1.85	370.81	607.63	0.28
Duffin Drain	US reach	26975.77	PF 1	421	733.43		735.19		735.21	0.001003	1.32	395.74	365.72	0.18
Duffin Drain	US reach	26679.12	PF 1	421	733.08		734.26		734.43	0.015898	3.4	133.7	258.06	0.72
Duffin Drain	US reach	26527.76	PF 1	559	729.67		733.08		733.21	0.005238	3.74	231.44	244	0.43
Duffin Drain	US reach	26159.43	PF 1	559	727.95		731.96		732.01	0.00212	2.55	326.46	259.01	0.28
Duffin Drain	US reach	25364.01	PF 1	559	724.25		728.14	728.14	728.45	0.014841	5.49	167.63	296.22	0.7
Duffin Drain	US reach	24345.59	PF 1	559	720.73		725.12		725.13	0.001018	1.6	631.95	767.33	0.19
Duffin Drain	US reach	23608.11	PF 1	559	719.46		723.39		723.55	0.006647	4.12	226.3	291.4	0.48
Duffin Drain	US reach	22939.2	PF 1	559	718.4		721.69		721.71	0.00148	1.65	469.92	456.07	0.22
Duffin Drain	US Trib1	21977.18	PF 1	580	717.67		719.42		719.5	0.004001	2.96	301.2	355.11	0.41
Duffin Drain	US Trib1	21278.83	PF 1	580	715.42		717.47		717.53	0.00209	2.04	301.57	272.45	0.31
Duffin Drain	US Trib1	20710.81	PF 1	580	714.2		715.8		715.86	0.004442	2.65	290.82	336.47	0.4
Duffin Drain	US Trib1	20378.38	PF 1	736	712.64		715.12		715.16	0.001291	2.05	463.02	306.24	0.26
Duffin Drain	US Trib1	20240.18	PF 1	736	711.35		714.87		714.94	0.001794	2.79	370.86	289.07	0.32
Duffin Drain	US Trib1	20129.98	PF 1	736	710.99		714.41		714.64	0.003825	4.76	233.61	210.25	0.49
Duffin Drain	US Trib1	19910.08	PF 1	736	710.19		713.96		714.06	0.001856	3.28	333.01	247.09	0.34
Duffin Drain	US Trib1	19600.91	PF 1	736	709.63		713.12		713.23	0.004197	3.63	330.21	318.42	0.4
Duffin Drain	US Trib1	18959.63	PF 1	736	707.63		710.16		710.26	0.004823	3.36	315.15	284.88	0.41
Duffin Drain	US Trib1	18162.04	PF 1	736	705.99		707.53		707.58	0.002814	1.66	436.91	406.16	0.28
Duffin Drain	US Trib1	17234.4	PF 1	736	704.17		706.46		706.48	0.00074	1.26	827.78	730.75	0.16
Duffin Drain	US Trib1	16474.59	PF 1	736	703.18		704.68	704.68	704.88	0.025545	5.38	236.74	514.87	0.86
Duffin Drain	US SG	15034.42	PF 1	943	698.97		704.17		704.18	0.00011	0.67	2048.10	1 185.62	0.07
Duffin Drain	US SG	14784.35	PF 1	943	699.26		704.15		704.16	0.000067	0.65	2110.99	948.56	0.06
Duffin Drain	US SG	14081.44	PF 1	943	698.57		704.07		704.08	0.000199	1.2	1304.9	615.3	0.1
Duffin Drain	US SG	13650.91	PF 1	943	700.83		704.02		704.03	0.000083	0.58	1948.55	820.95	0.06
Duffin Drain	US SG	13031.22	PF 1	943	697.8		703.95		703.96	0.000141	0.97	1759.28	993.72	0.08
Duffin Drain	US SG	12822.51	PF 1	943	695		703.7	699.02	703.85	0.000907	3.47	442.74	809.56	0.23
Duffin Drain	US SG	12787.46		Bridge										
Duffin Drain	US SG	12741.64	PF 1	943	695		702.35	698.88	702.38	0.000356	1.84	1014.78	680.97	0.13
Duffin Drain	US SG	12647.33	1	24	694.9		702.26		702.31	0.001315	2.64	707.12	533.82	0.24
Duffin Drain	US SG	12090.15	1	24	694		701.64		701.68	0.000905	2.26	837.87	597.31	0.2
Duffin Drain	US SG	11424.74	1	24	697.61		701.41		701.42	0.000206	1.04	1800.95	1 251.16	0.1

HEC-RAS Version 4 Welch Creek Output
Plan: 1%final Profile: PF1

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. WS Elev (ft)	Crit. WS (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Duffin Drain	US SG	10782.24	1	24	694.8	701.38		701.39	0.000022	0.49	3148.09	931.39	0.04
Duffin Drain	US SG	10244.16	PF 1	979	694.57	701.38		701.38	0.000011	0.35	4290.05 1	226.5	0.03
Duffin Drain	US SG	9838.587	PF 1	979	694.72	701.37		701.37	0.000014	0.4	3503.93	889.16	0.03
Duffin Drain	US SG	9206.963	PF 1	979	694.95	701.36		701.36	0.000023	0.52	2691.75	684.25	0.04
Duffin Drain	US SG	8425.444	PF 1	979	693.36	701.34		701.34	0.000023	0.6	3326.12 1	236.51	0.04
Duffin Drain	US SG	7885.491	PF 1	979	692.82	701.33		701.33	0.00001	0.4	3818.98	958.42	0.03
Duffin Drain	US SG	7428.556	PF 1	979	691.62	701.33		701.33	0.000009	0.42	3954.82	905.22	0.02
Duffin Drain	US SG	6837.075	PF 1	979	690.47	701.32		701.32	0.000009	0.45	3560.34	710.95	0.03
Duffin Drain	US SG	6270.968	PF 1	979	689.87	701.32		701.32	0.000009	0.47	3492.28	668.35	0.03
Duffin Drain	US SG	6109.319	PF 1	979	685.2	701.31	688.98	701.32	0.000012	0.67	3707.24 1	51.75	0.03
Duffin Drain	US SG	6044.26	C	ulvert									
Duffin Drain	US SG	6000.711	PF 1	979	685.35	701.27	691.56	701.31	0.000143	1.86	1178.82 2	395.09	0.09
Duffin Drain	US SG	5966.567	C	ulvert									
Duffin Drain	US SG	5921.865	1	10	684.4	693.73		693.87	0.000645	3.17	468.96	228.94	0.19
Duffin Drain	US SG	5829.948	1	10	684.3	693.31		693.69	0.002526	4.99	237.82	176.99	0.36
Duffin Drain	US SG	5271.408	1	10	683.9	690.97	689.61	691.59	0.006283	6.61	214	173.34	0.55
Duffin Drain	US SG	4788.296	1	10	683.5	690.33		690.5	0.000991	3.48	365.78	89.57	0.25
Duffin Drain	US SG	4639.084	1	10	683.4	690.35		690.39	0.000276	1.96	658.82	116.67	0.13
Duffin Drain	US SG	4481.848	1	10	683.6	690.08	686.78	690.3	0.000838	4.21	351.5	104.37	0.29
Duffin Drain	US SG	4429.834		Bridge									
Duffin Drain	US SG	4385.079	1	10	683.3	689.48	687.3	690.02	0.004448	6.07	190.42	227.38	0.47
Duffin Drain	US SG	4260.533	1	10	682.9	689.26	688.09	689.47	0.002292	4.41	367.37	235.15	0.35
Duffin Drain	US SG	3604.541	1	10	680.8	687.59	686.24	687.85	0.002913	4.79	328.94	150.92	0.39
Duffin Drain	US SG	3054.314	1	10	679.1	686.11		686.33	0.002745	4.54	394.6	226.66	0.37
Duffin Drain	US SG	2157.394	1	10	676.3	684.44		684.59	0.001673	3.83	472.18	234.46	0.29
Duffin Drain	US SG	1341.157	1	10	673.7	681.91		682.48	0.005309	6.19	199.29	102.66	0.49
Duffin Drain	US SG	1257.177	1	10	673.4	682.19		682.19	0.000013	0.48	2121.83	269.09	0.03
Duffin Drain	US SG	1161.362	1	10	673.1	682.19		682.19	0.000019	0.56	1859.68	263.21	0.03
Duffin Drain	US SG	1117.192	1	10	673	681.68		682.07	0.004275	5.42	261.77	172.76	0.44
Duffin Drain	US SG	955.4905	1	10	672.5	681.02	678.26	681.44	0.003673	5.48	256.86	169.35	0.42
Duffin Drain	US SG	861.4218	1	10	672.2	680.83	677.91	681.05	0.002614	4.41	377.74	244.64	0.34
Duffin Drain	US SG	843.3753	C	ulvert									
Duffin Drain	US SG	816.8823	1	10	672.1	678.57	678.57	680.27	0.025502 1	0.47	96.44	28.22	1
DD Trib1	Trib1	3024.062	PF 1	163	711.63	713.23		713.28	0.002898	2.03	108.8	144.11	0.3
DD Trib1	Trib1	2740.103	PF 1	163	709.91	711.18	711.18	711.38	0.029266	4.2	52.05	331.93	0.85
DD Trib1	Trib1	2234.066	PF 1	163	707.16	708.71		708.73	0.001388	1.03	170.45	212.3	0.19
DD Trib1	Trib1	1716.96	PF 1	163	704.21	706.82	706.82	707.04	0.014267	4.42	58.22	291.09	0.64
DD Trib1	Trib1	1068.21	PF 1	163	703.05	705.58		705.59	0.000435	0.77	269.33	308.63	0.11
DD Trib1	Trib1	566.4439	PF 1	163	704.13	704.74	704.74	704.91	0.053032	3.37	48.34	139.74	1.01
DD Trib 2	DD Trib 2	1666.293	PF 1	189	725.61	727.54	726.69	727.56	0.001949	1.24	152.49	166.02	0.23
DD Trib 2	DD Trib 2	1053.181	PF 1	189	723.55	724.27	724.27	724.49	0.044088	4.43	52.98	132.71	1.01
DD Trib 2	DD Trib 2	523.3078	PF 1	189	719.82	721.76		721.78	0.001627	1.16	187.69	295.59	0.21

Appendix G. Stream Profiles

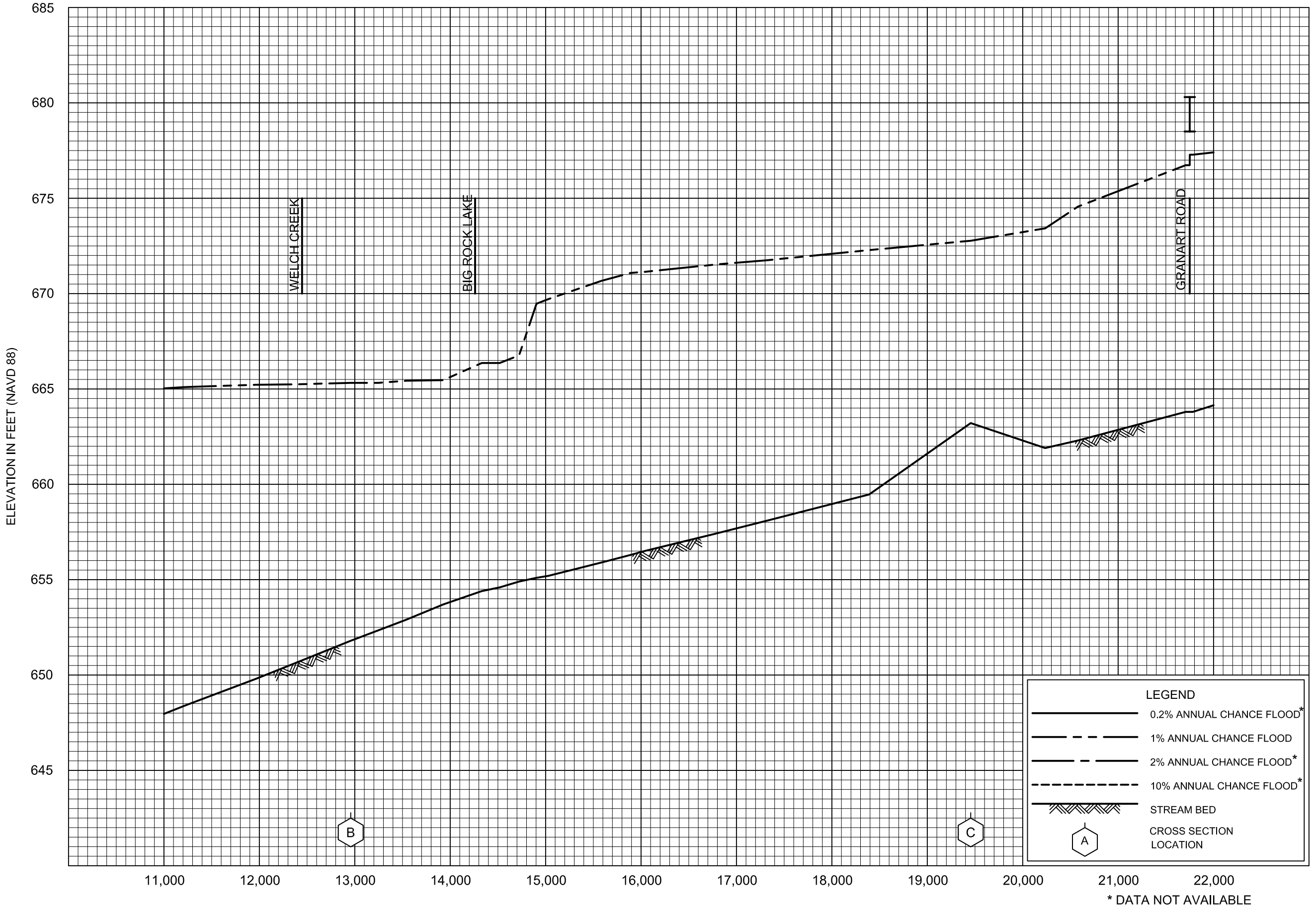


FLOOD PROFILES

BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

01P

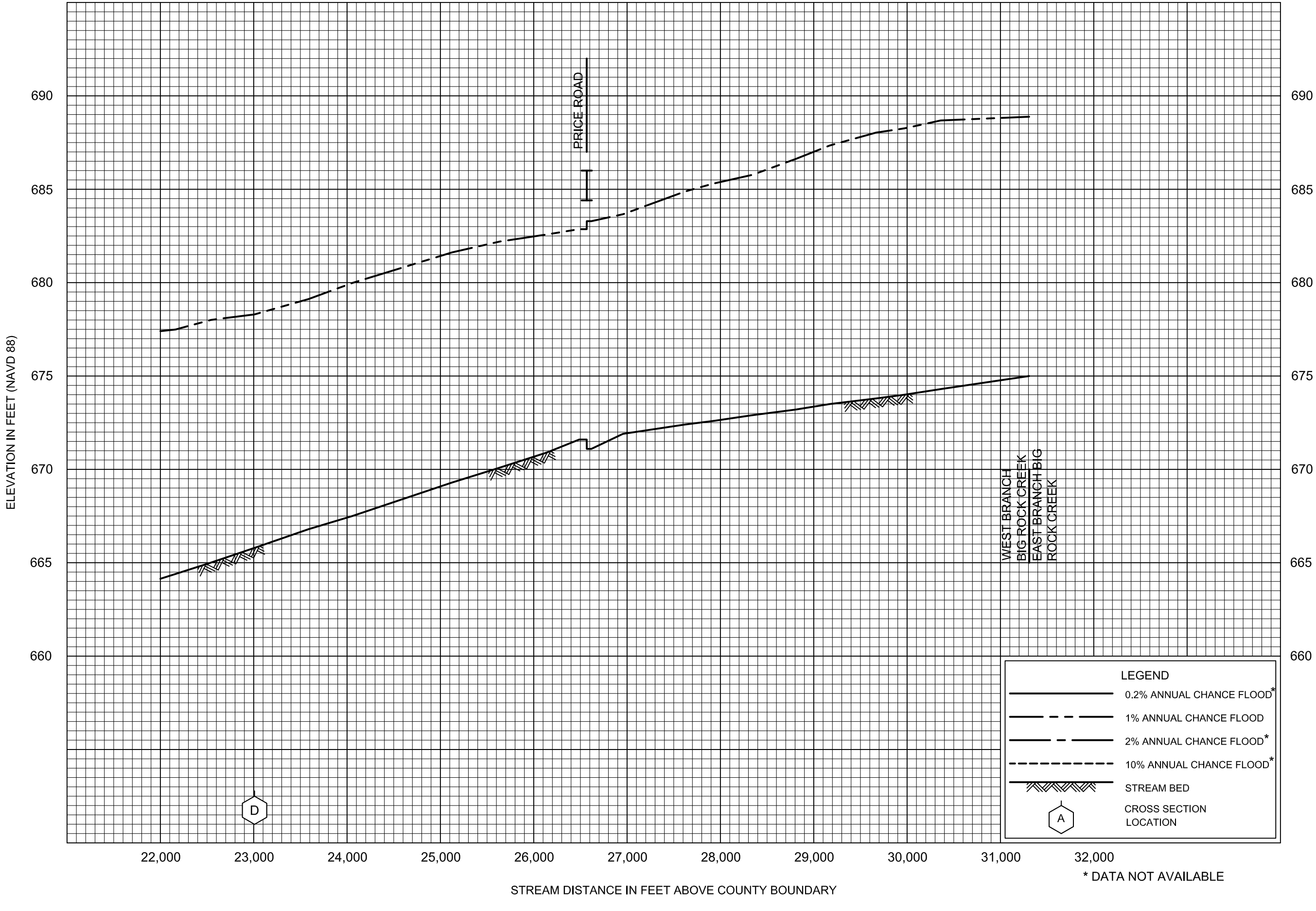


FLOOD PROFILES

BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

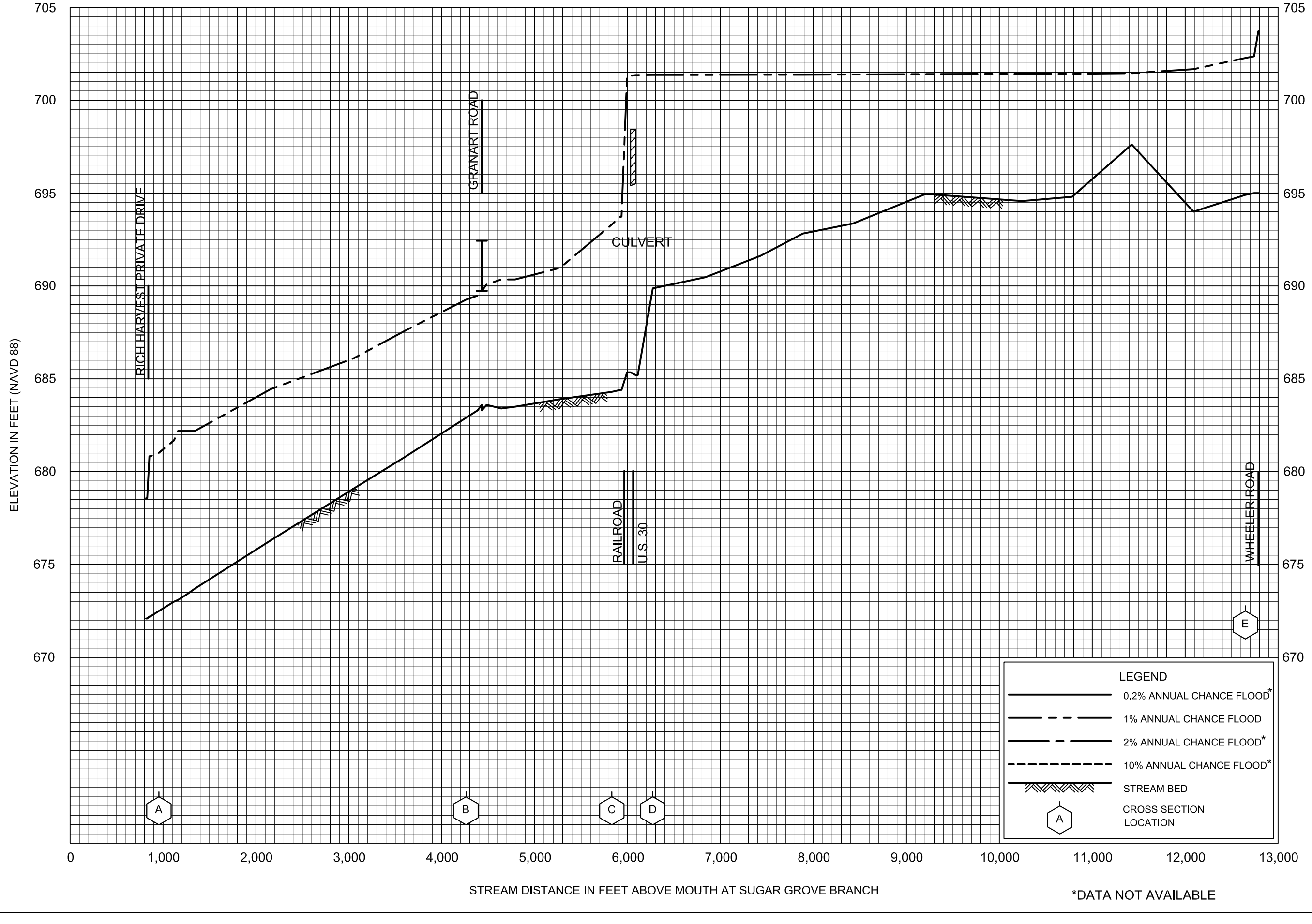
02P



FLOOD PROFILES

BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

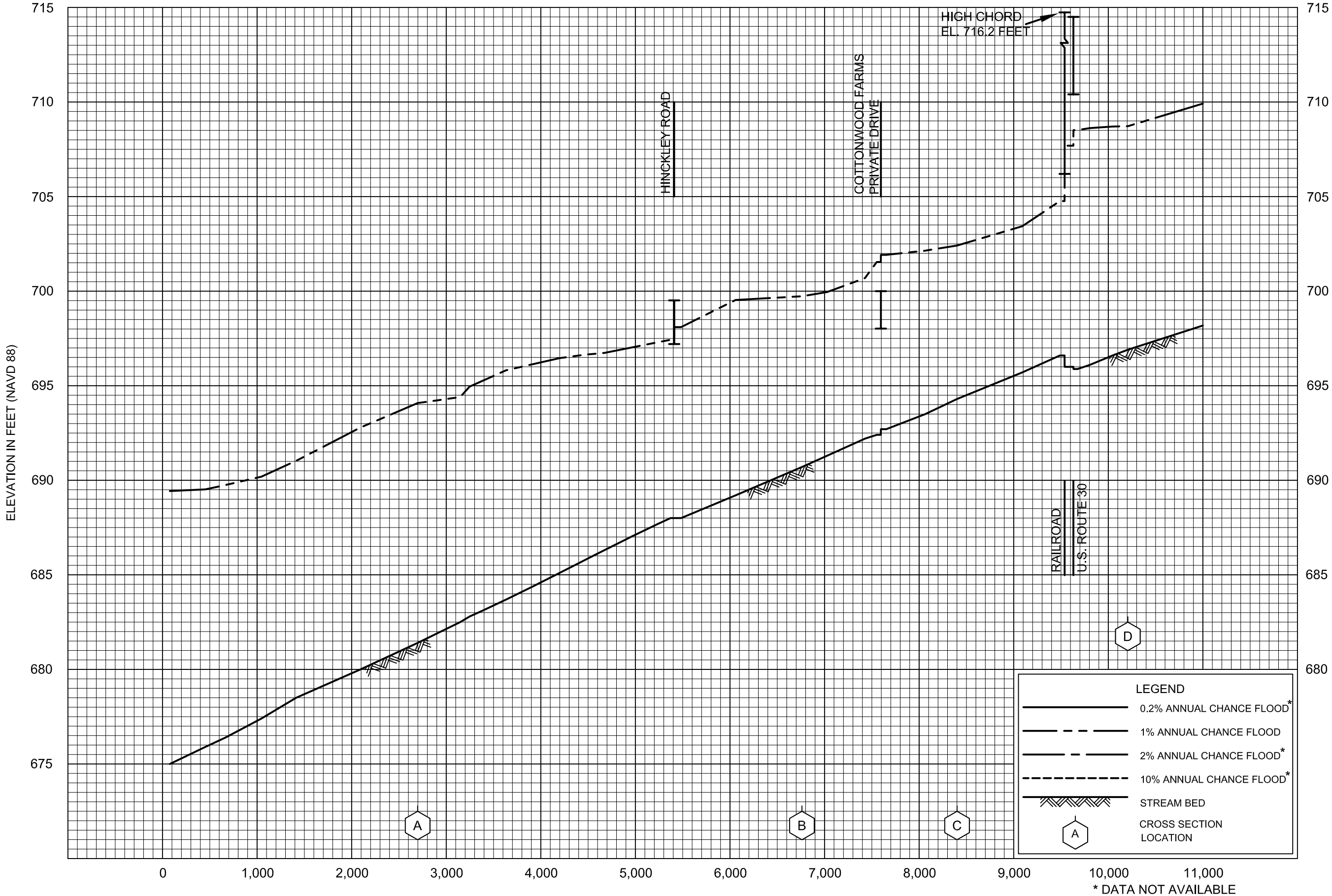


FLOOD PROFILES

DUFFIN DRAIN

KANE COUNTY, IL
AND INCORPORATED AREAS

01P

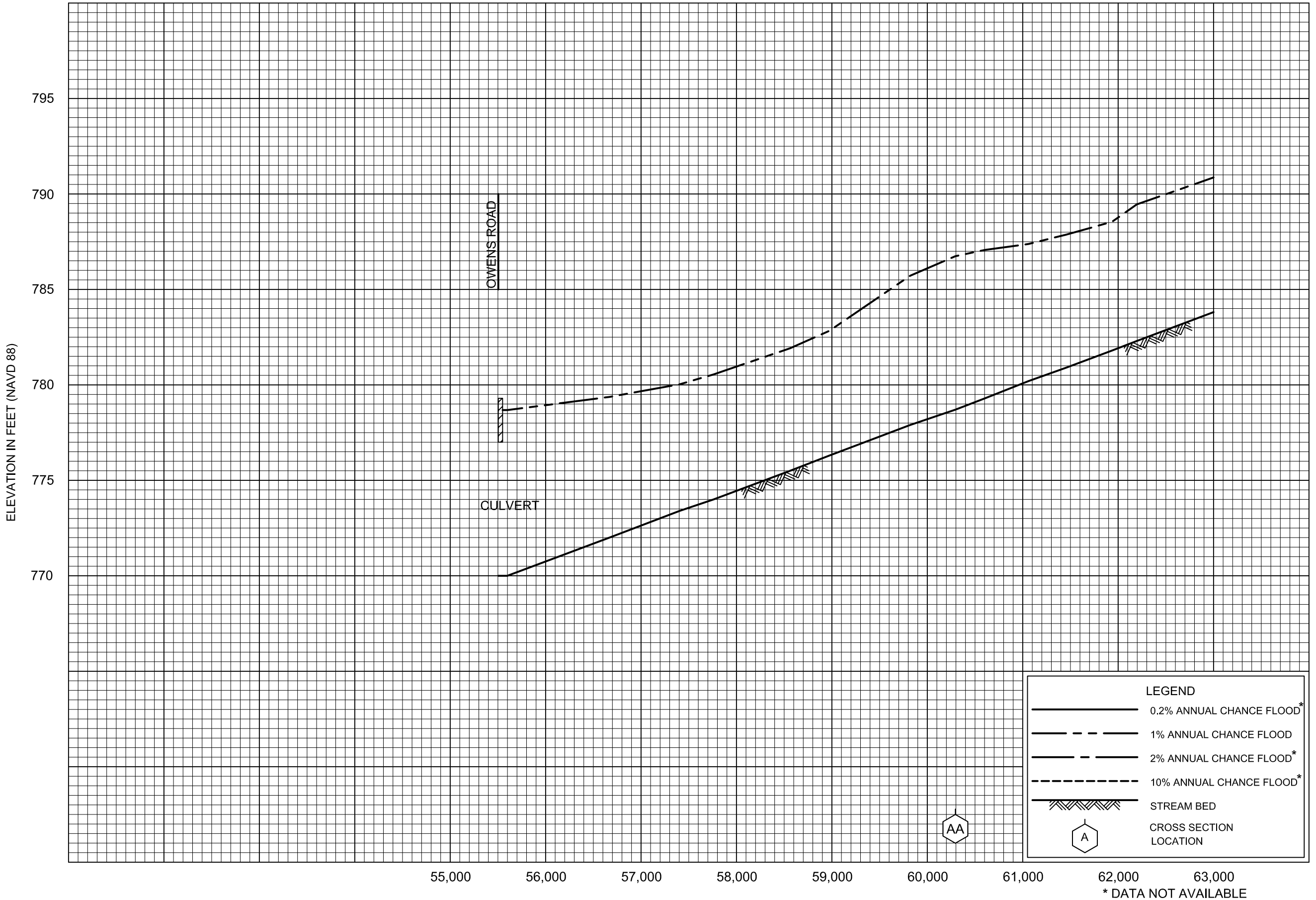


FLOOD PROFILES

EAST BRANCH BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

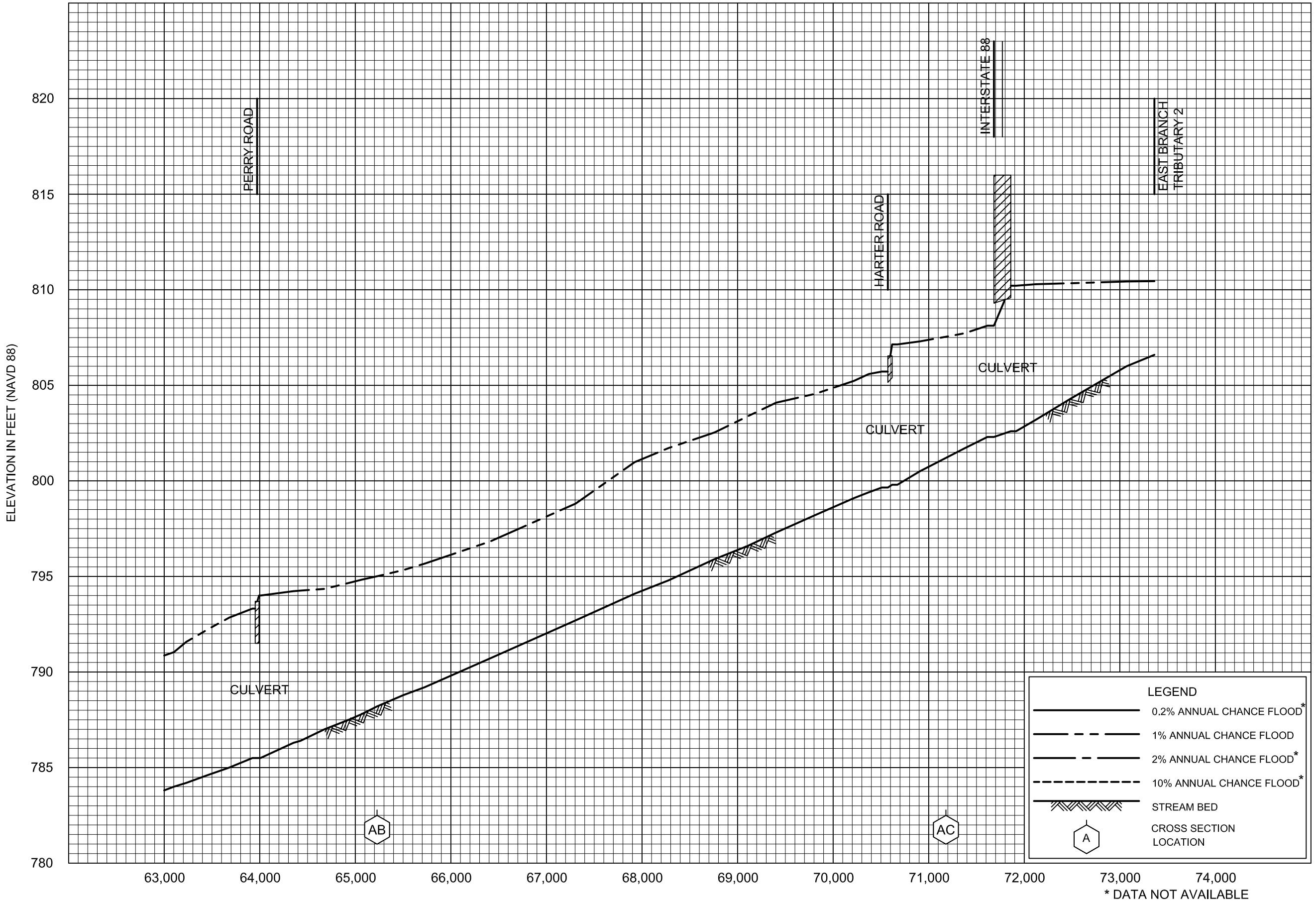
01P



FLOOD PROFILES

EAST BRANCH BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

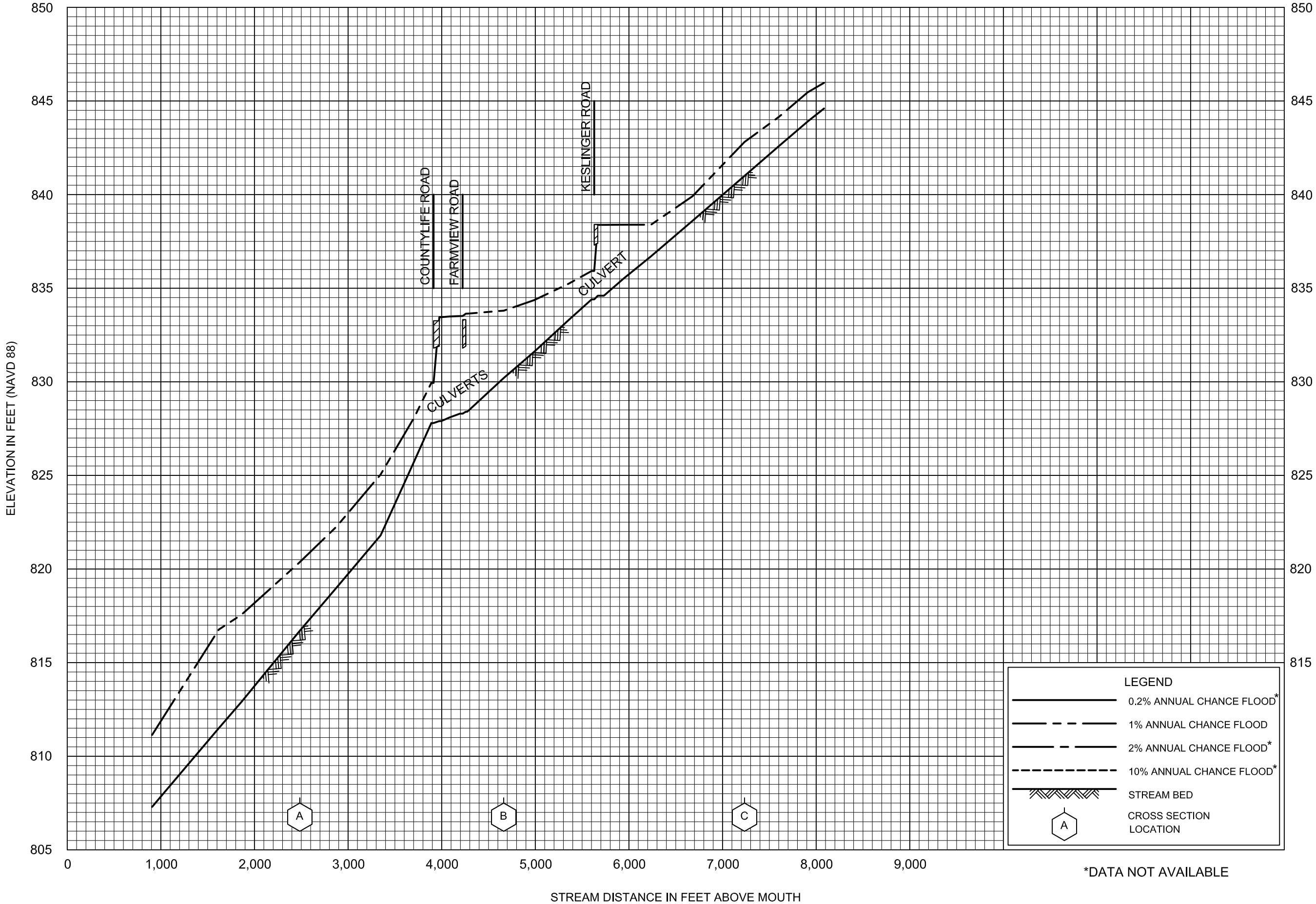


FLOOD PROFILES

EAST BRANCH BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

03P



FLOOD PROFILES

EAST BRANCH TRIBUTARY 2

KANE COUNTY, IL

AND INCORPORATED AREAS

01P

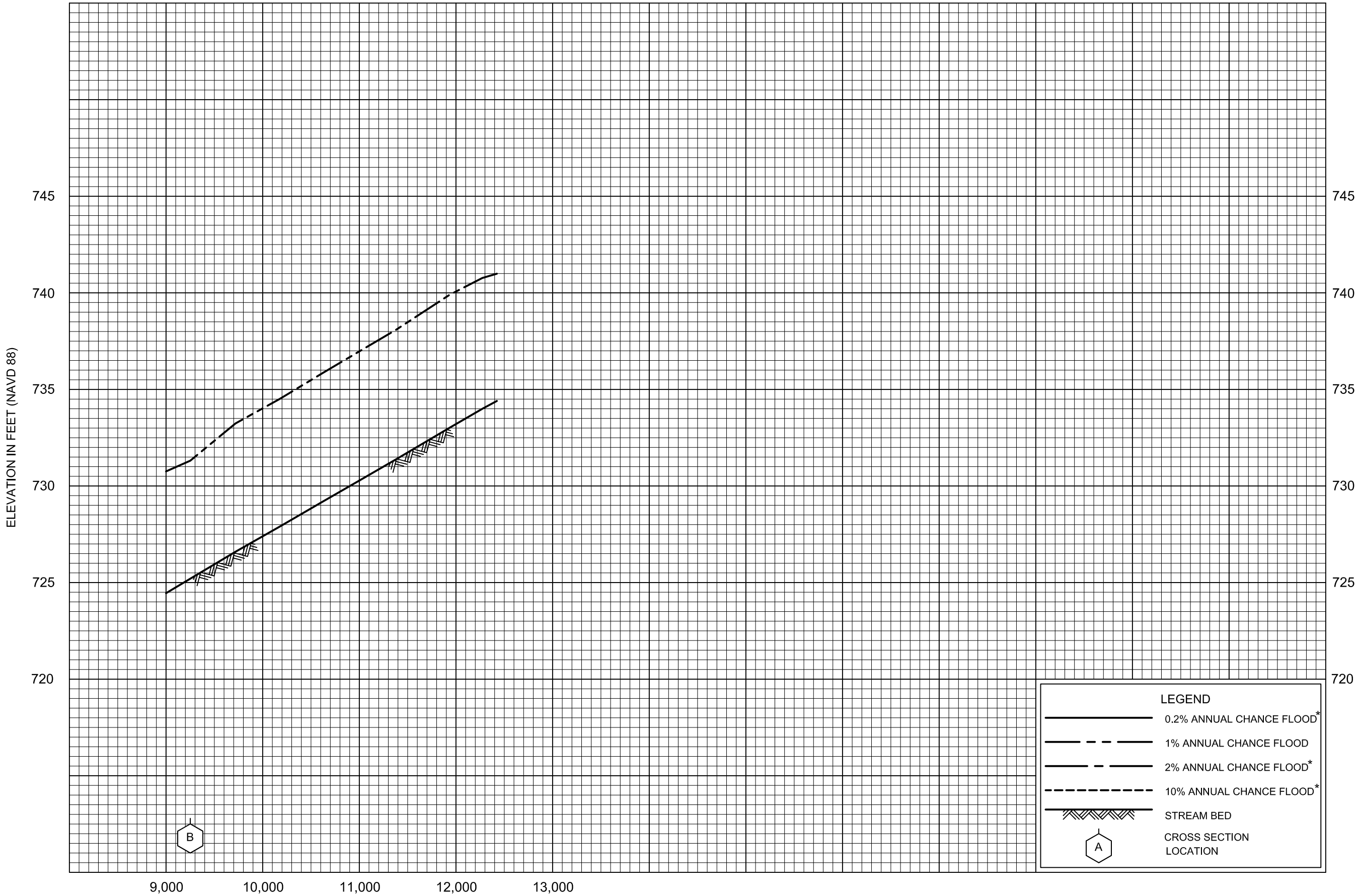
*DATA NOT AVAILABLE

FLOOD PROFILES

MALGREN DRAIN

KANE COUNTY, IL
AND INCORPORATED AREAS

01P



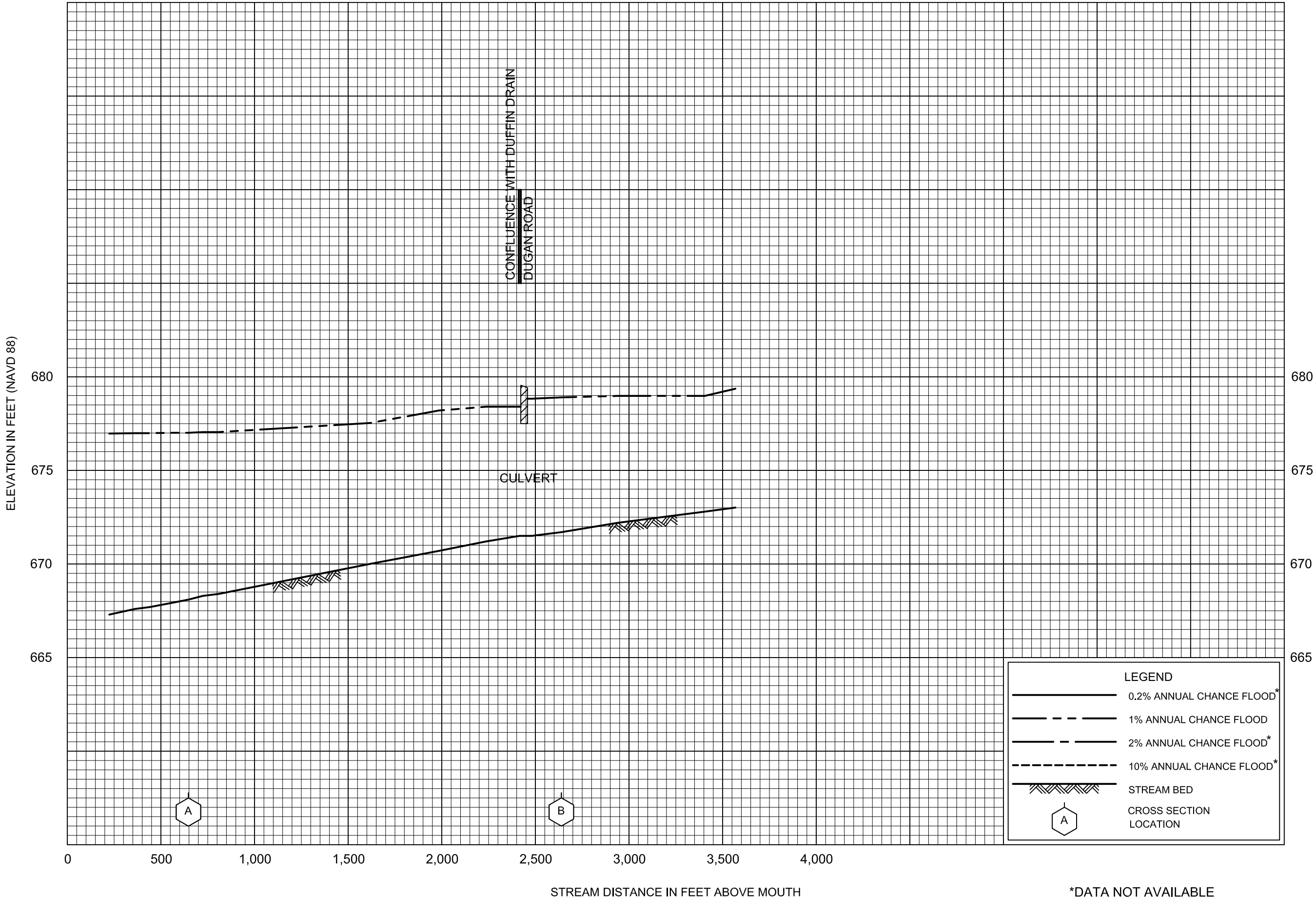
*DATA NOT AVAILABLE

FLOOD PROFILES

MALGREN DRAIN

KANE COUNTY, IL
AND INCORPORATED AREAS

02P



FLOOD PROFILES

SUGAR GROVE BRANCH

KANE COUNTY, IL
AND INCORPORATED AREAS

01P

ELEVATION IN FEET (NAVD 88)

670 675 680 685 690 695 700

3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500 8,000

STREAM DISTANCE IN FEET ABOVE MOUTH AT WELCH CREEK

LIMIT OF DETAILED STUDY

FAY'S LANE

RAILROAD

U.S. ROUTE 30/
GRANART ROAD

C

D

E

LEGEND

0.2% ANNUAL CHANCE FLOOD

1% ANNUAL CHANCE FLOOD

2% ANNUAL CHANCE FLOOD

10% ANNUAL CHANCE FLOOD

STREAM BED

A
CROSS SECTION
LOCATION

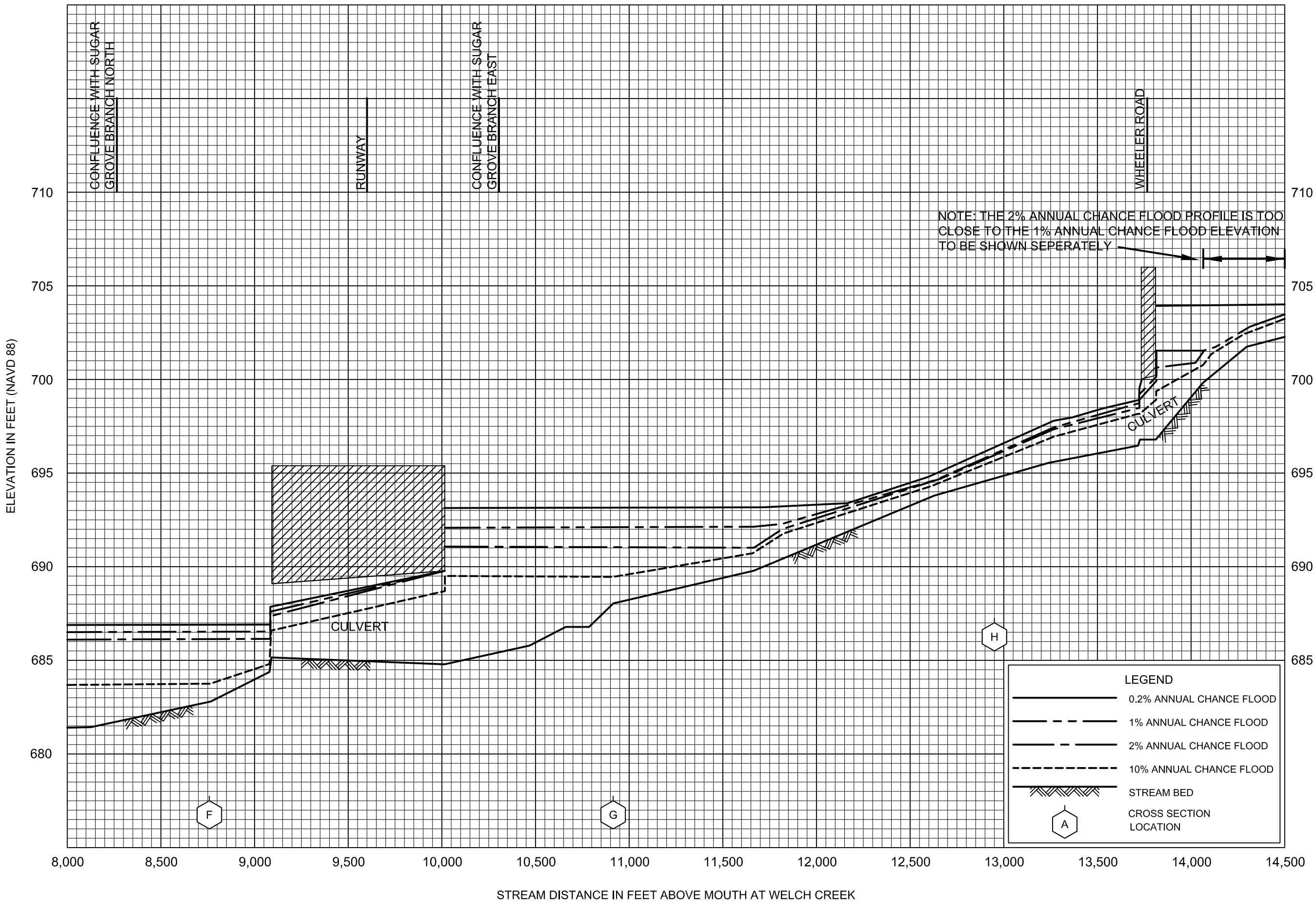
680 685 690 695 700

02P

KANE COUNTY, IL
AND INCORPORATED AREAS

FLOOD PROFILES

SUGAR GROVE BRANCH

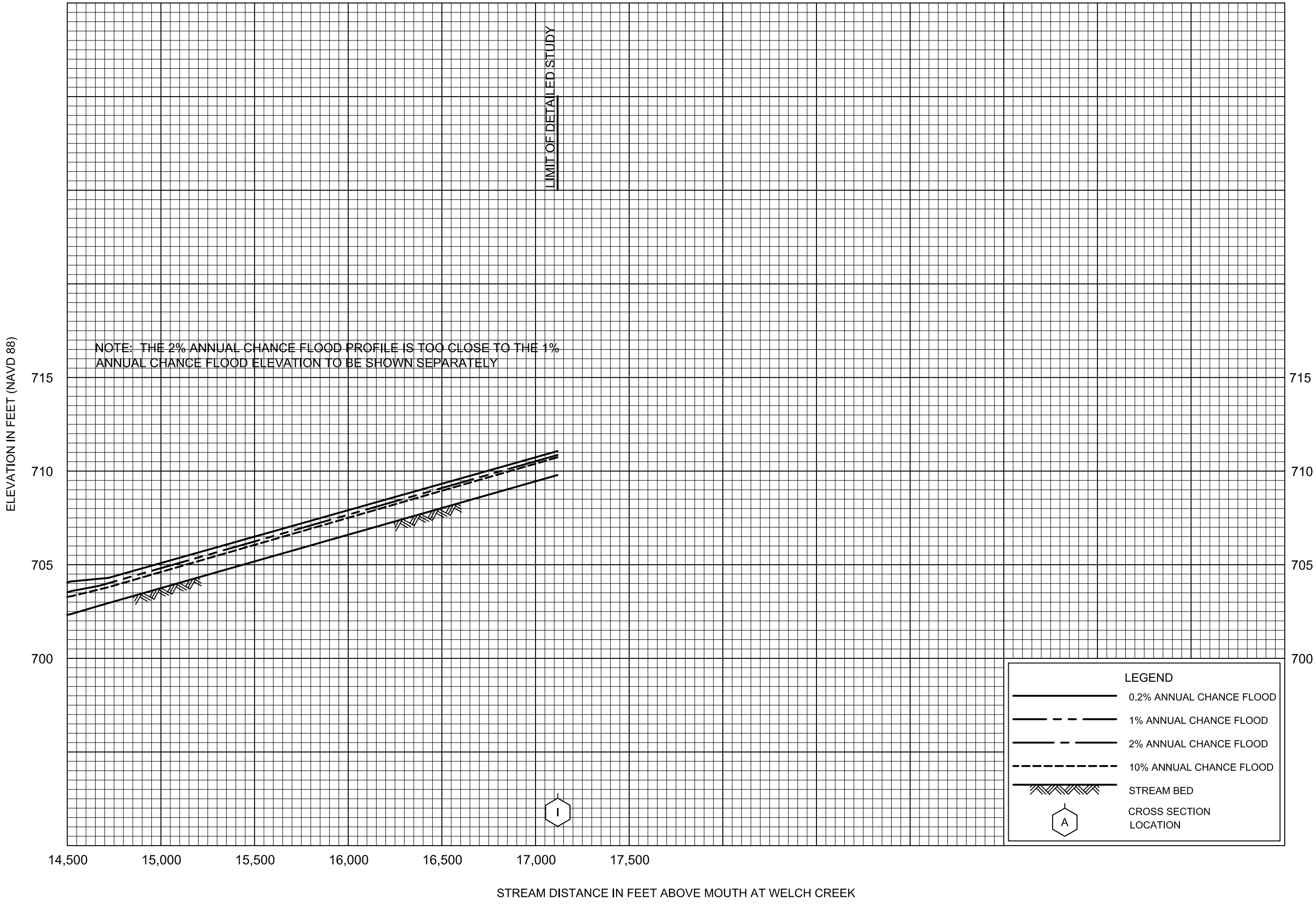


FLOOD PROFILES

SUGAR GROVE BRANCH

KANE COUNTY, IL
AND INCORPORATED AREAS

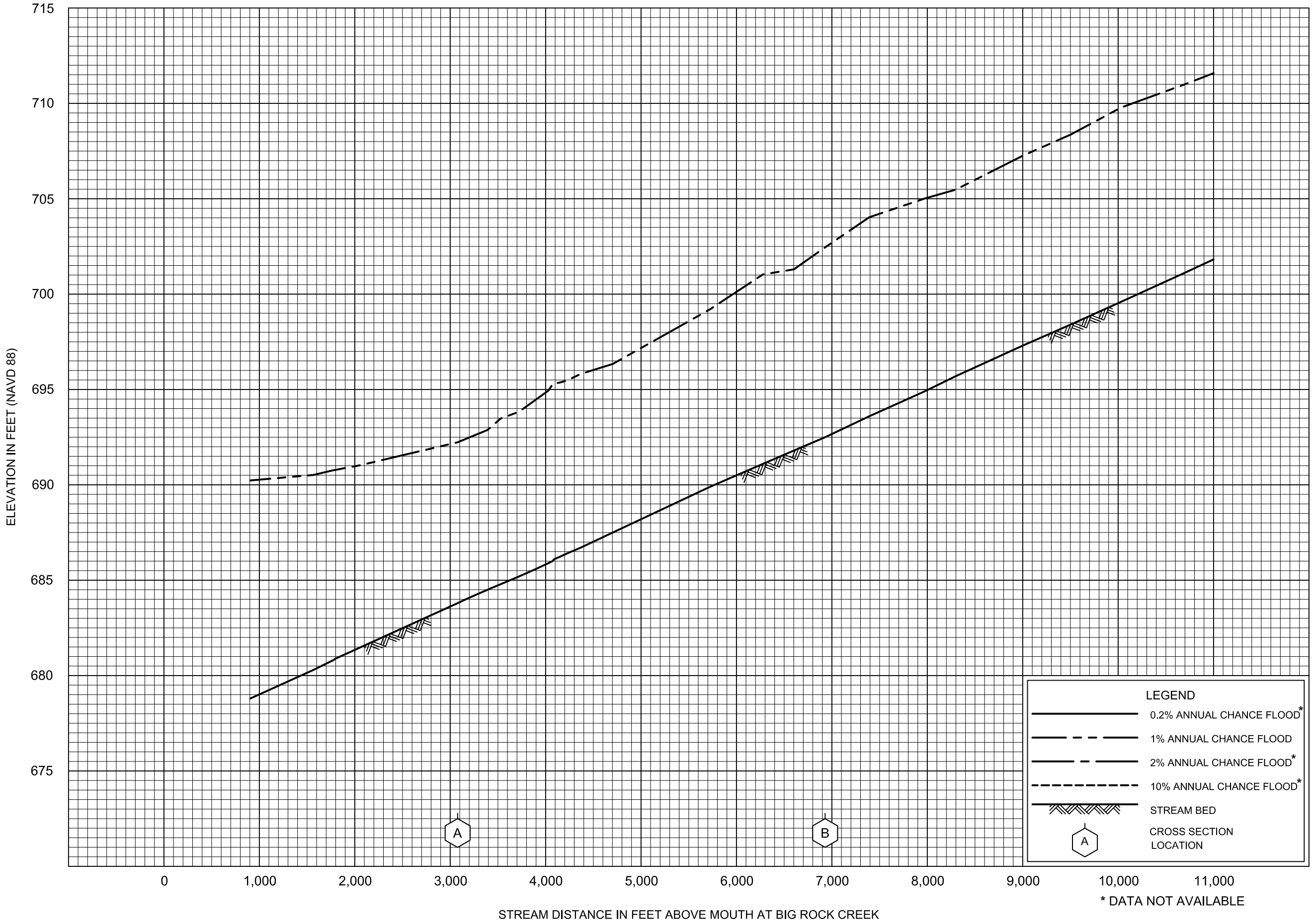
03P



FLOOD PROFILES

SUGAR GROVE BRANCH

KANE COUNTY, IL
AND INCORPORATED AREAS

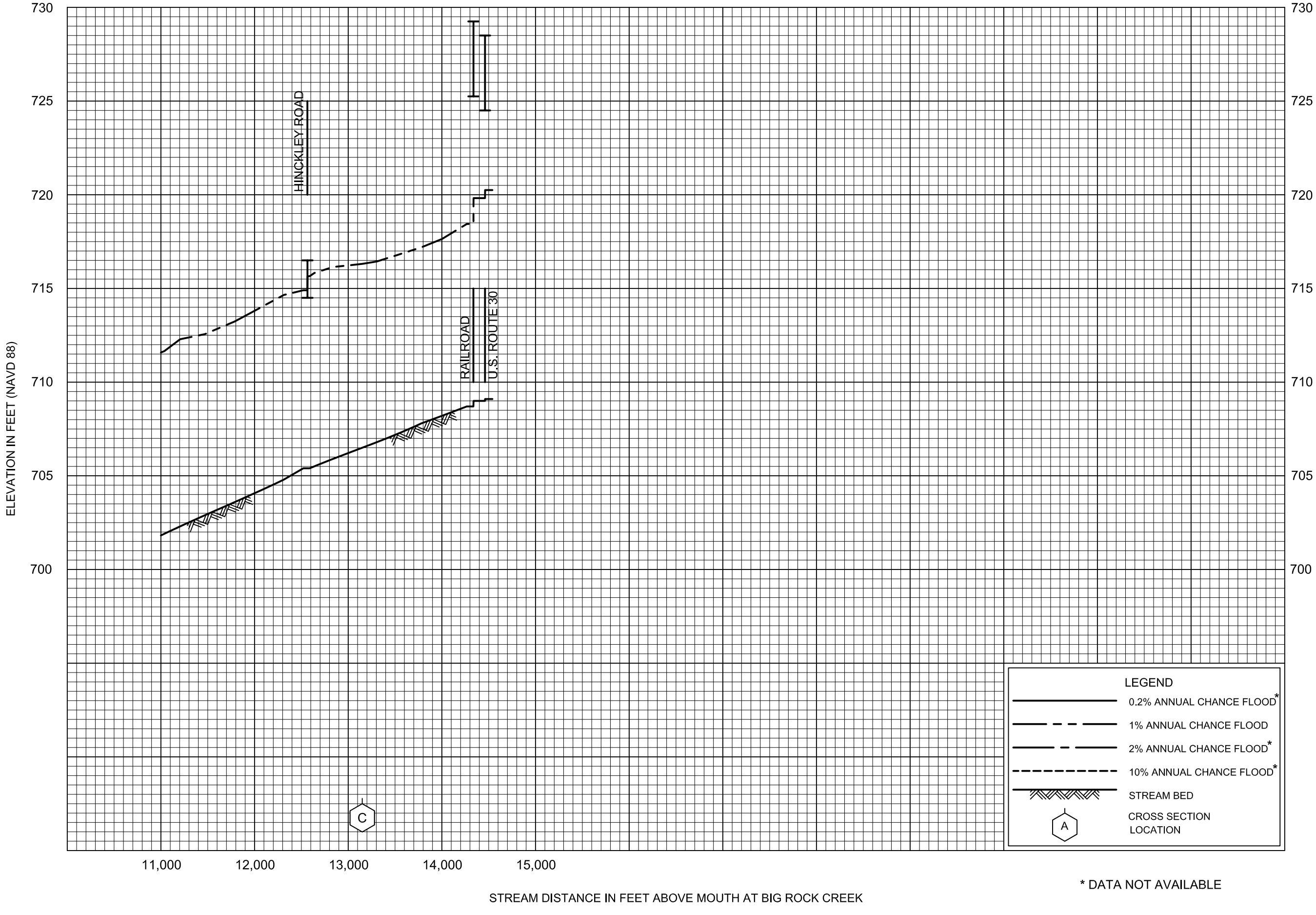


FLOOD PROFILES

WEST BRANCH BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

01P



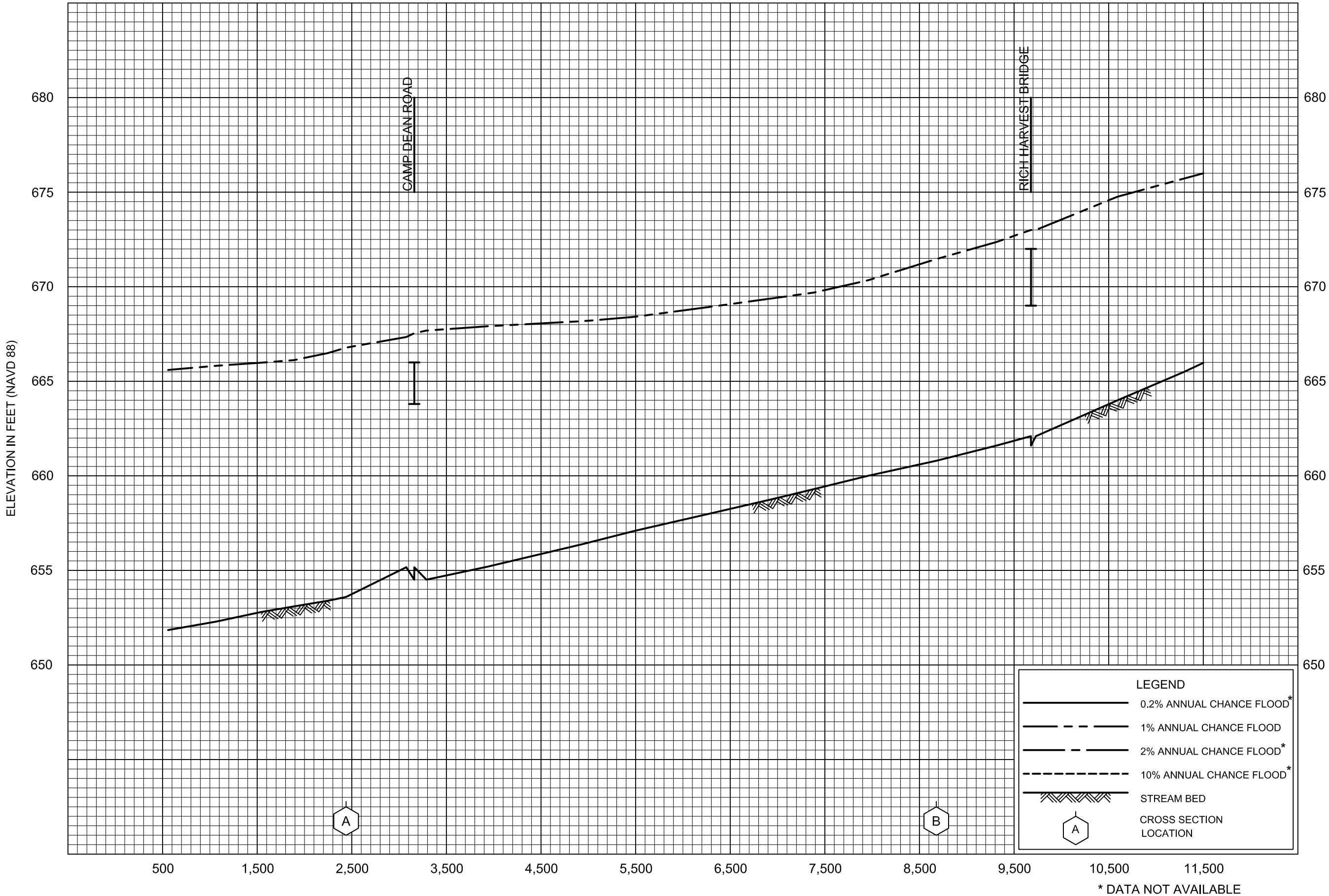
* DATA NOT AVAILABLE

FLOOD PROFILES

WEST BRANCH BIG ROCK CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

02P

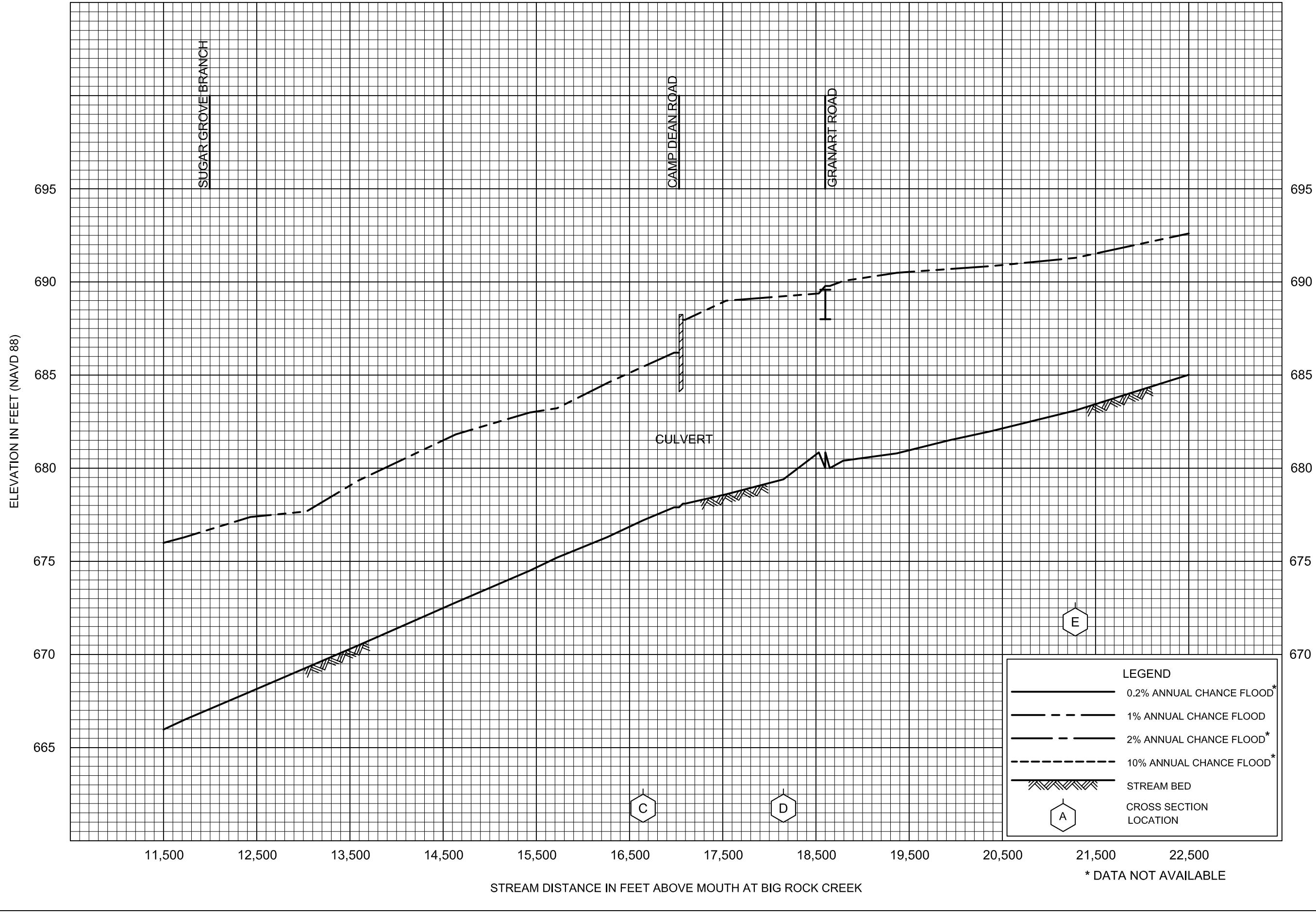


FLOOD PROFILES

WELCH CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

01P

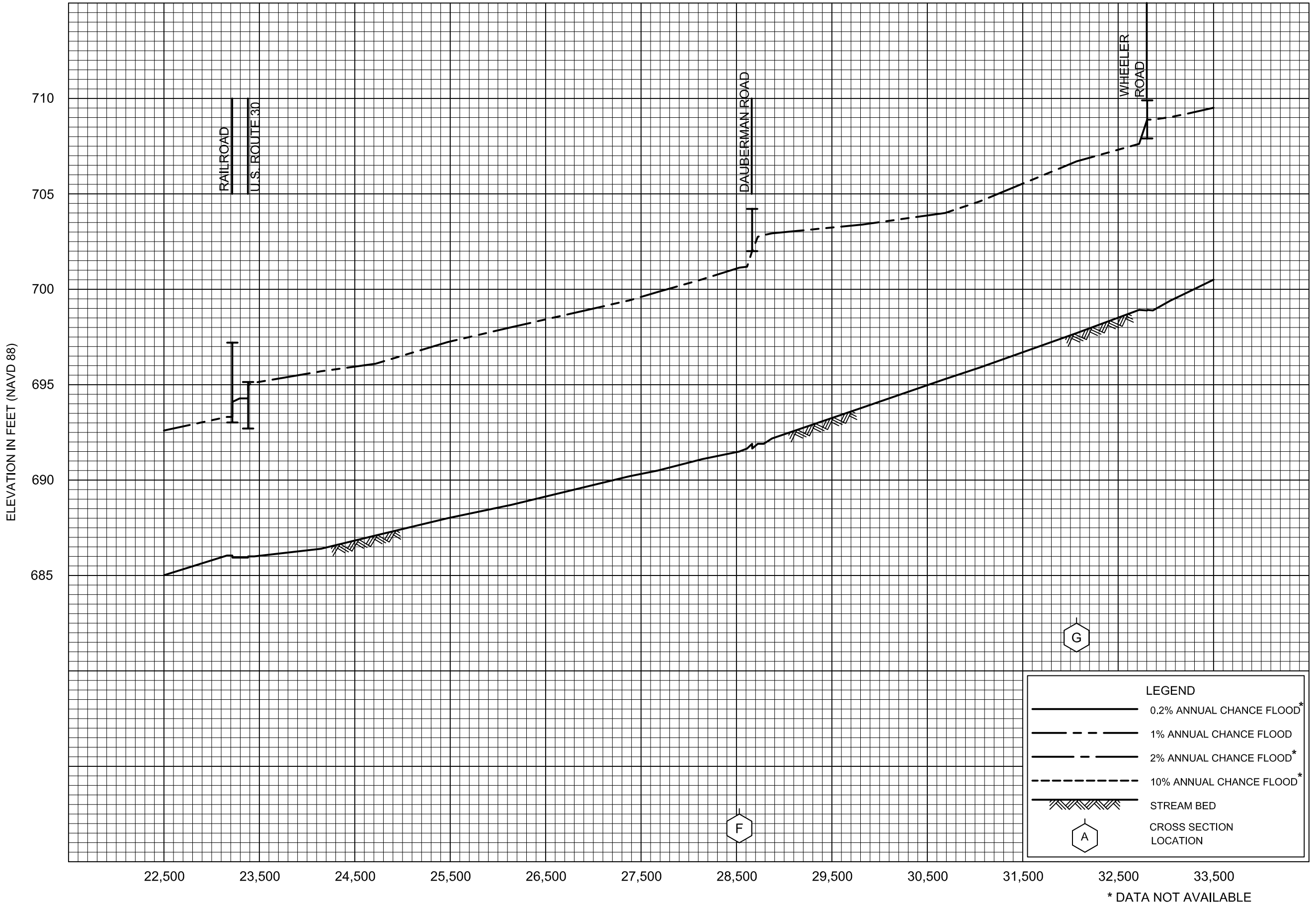


FLOOD PROFILES

WELCH CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

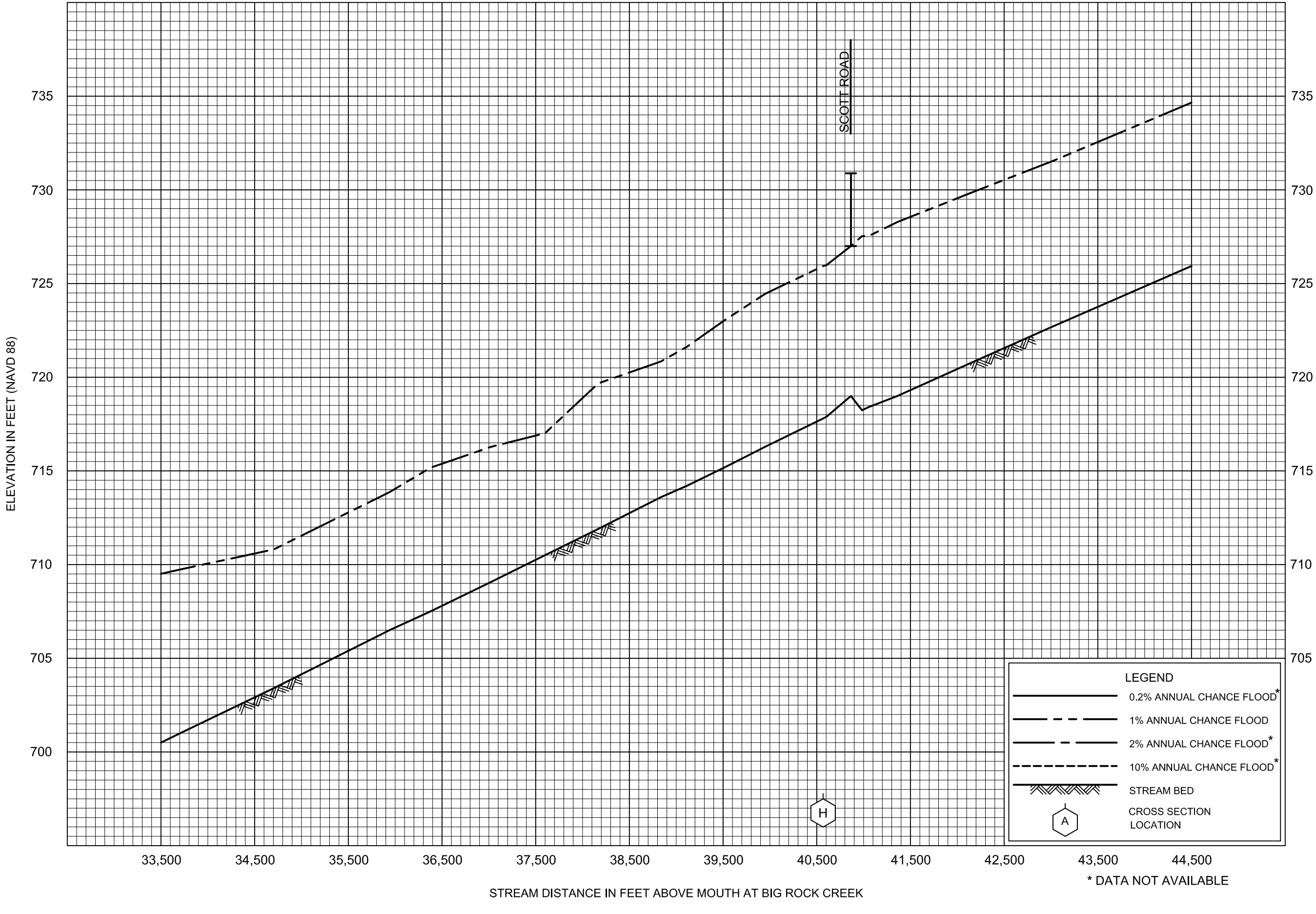
02P



FLOOD PROFILES

WELCH CREEK

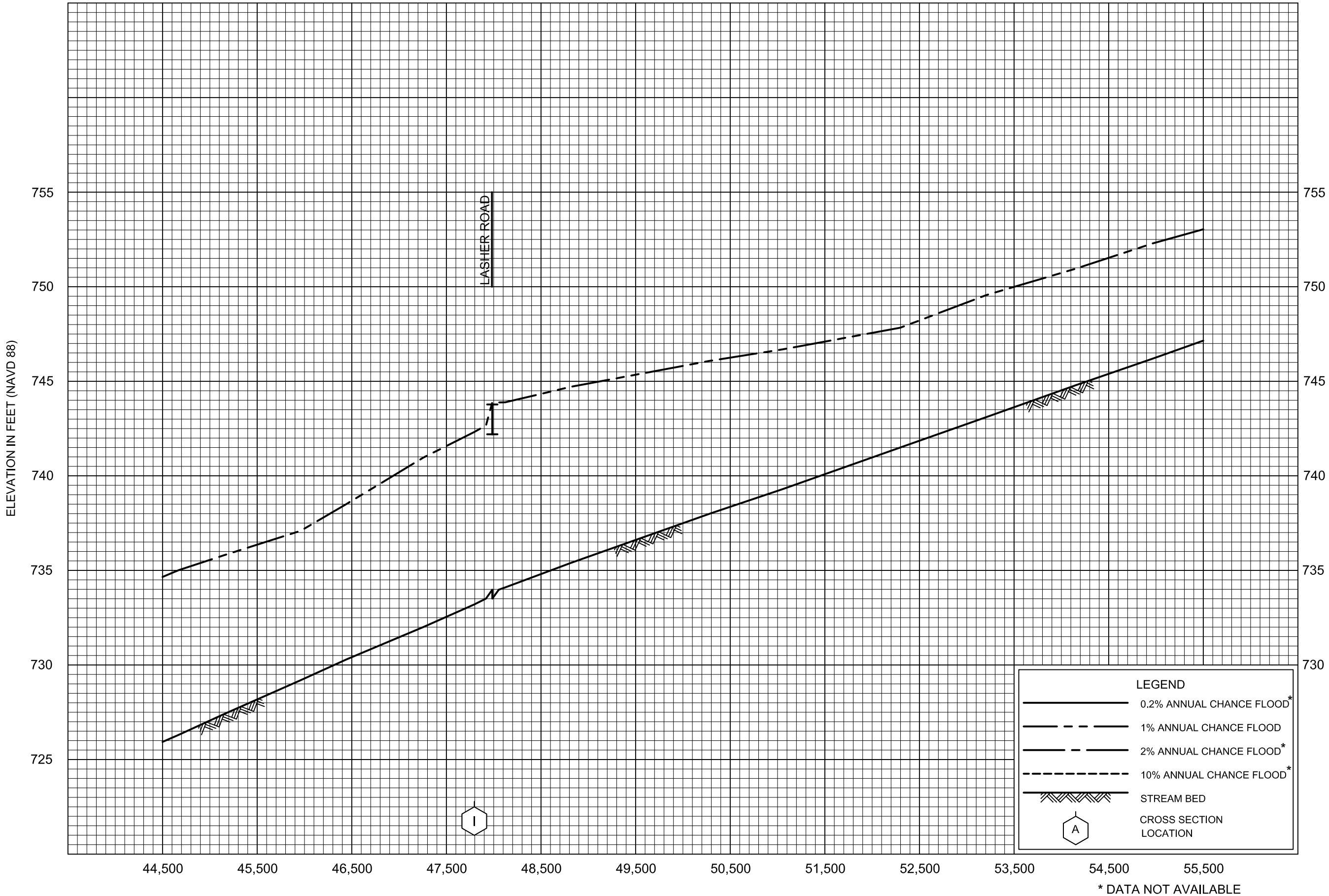
KANE COUNTY, IL
AND INCORPORATED AREAS



FLOOD PROFILES

WELCH CREEK

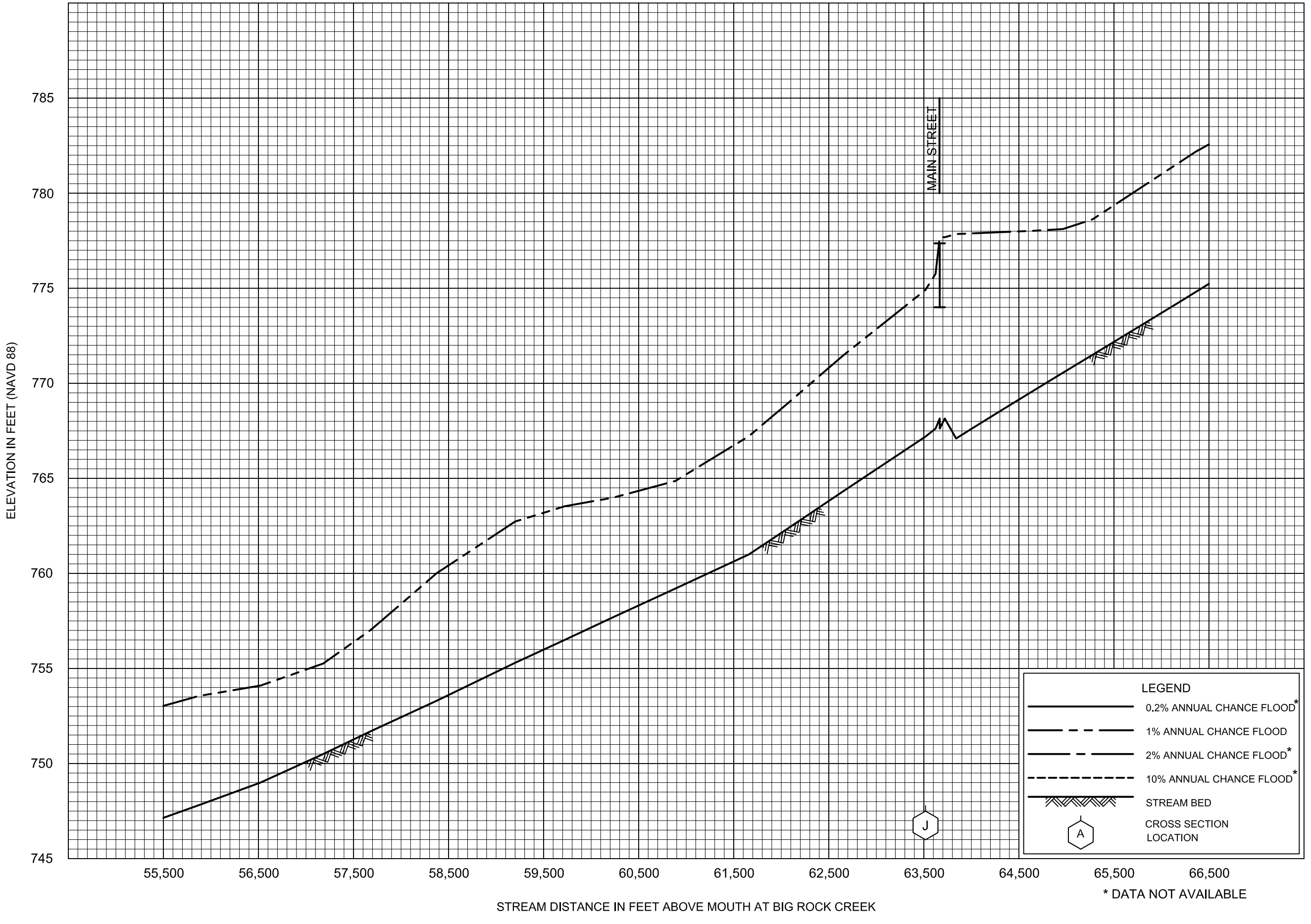
KANE COUNTY, IL
AND INCORPORATED AREAS



FLOOD PROFILES

WELCH CREEK

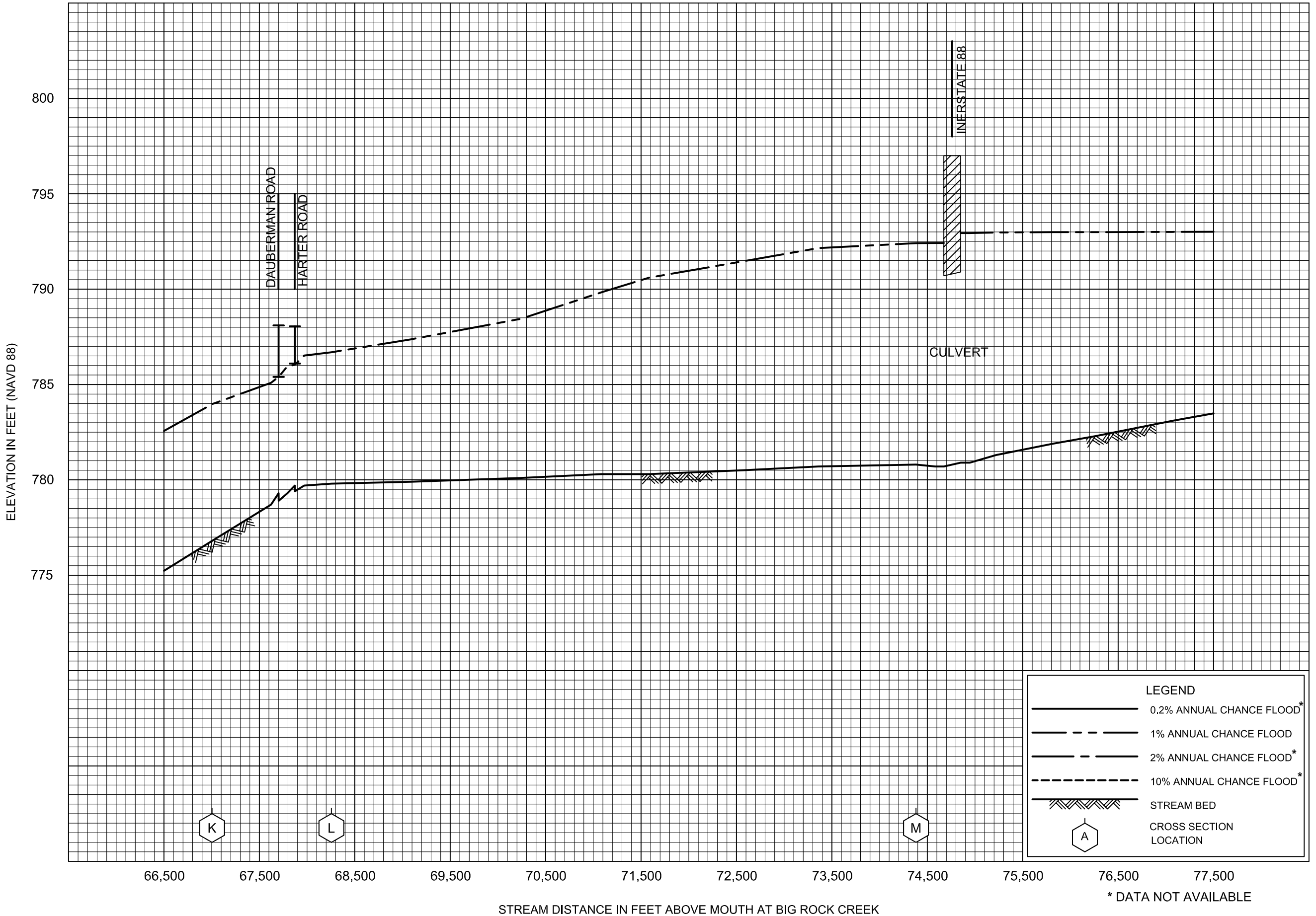
KANE COUNTY, IL
AND INCORPORATED AREAS



FLOOD PROFILES

WELCH CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

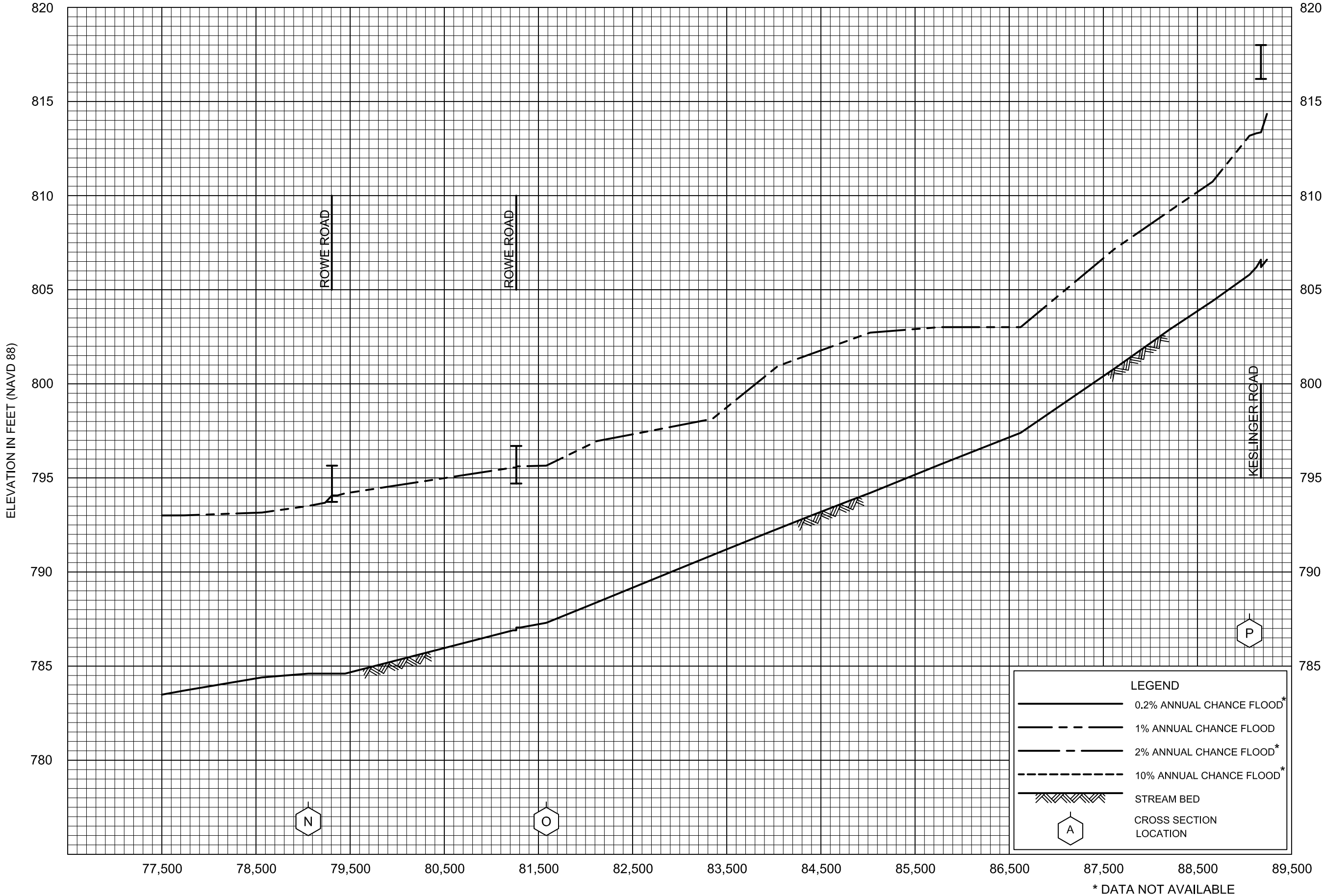


FLOOD PROFILES

WELCH CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

07P



FLOOD PROFILES

WELCH CREEK

KANE COUNTY, IL
AND INCORPORATED AREAS

08P

Appendix H. Floodplain Maps

MATCH TO SHEET #2

THIS IS MAP SHEET NUMBER 1 of 2

PROPOSED 1% WSEL FLOODPLAIN MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

DATA SOURCES:

PLSS LINES - USGS DRG
FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- LETTERED XS's
- BFE
- Proposed 1% WSEL LINES (New Study)
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

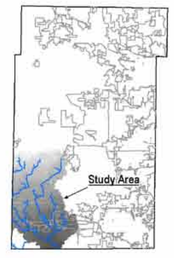
STREAM CENTERLINES

- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

Kane County, Illinois



1" = 1000'

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171081
KANE COUNTY	170896
KANEVILLE, VILLAGE OF	171388
SUGAR GROVE, VILLAGE OF	170333

ROUGH DRAFT

The technical content of the map is the responsibility of the authors. The user assumes all liability for the interpretation and use of the map.

Illinois State WATER Survey (ISWS)

MAP PRINTED: FEB. 12, 2009

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

ILLINOIS STATE WATER SURVEY

For a high resolution version of this map, please contact the Illinois State Water Survey.

PROPOSED 1% WSEL FLOODPLAIN MAP

The area shown on map sheet number 1 and map sheet number 2 covers the southwestern corner of Kane County as shown on Study Area graphic below. The two major streams modeled in this area are Big Rock Creek and Welch Creek for which an Approximate Study and Limited Detail Study were conducted. The results of the model were used to map the floodplain shown and will be submitted to FEMA for approval for inclusion as the 1% Annual Chance floodplain boundary on the Flood Insurance Rate Map.

DATA SOURCES:

PLSS LINES - USGS DRG
FIRM PANELS - Derived from USGS 7.5 Minute Quads
POLITICAL BOUNDARIES - Kane County GIS Technology
STREAM CENTERLINES - Kane County GIS Technology
STREET NAMES - Kane County GIS Technology
AERIAL PHOTOGRAPHY - USGS 2005
SUBBASINS - Illinois State Water Survey
CONTOUR LINES - Kane County GIS Technology
XS - Illinois State Water Survey
PROPOSED 1% WSEL Lines - Illinois State Water Survey

MAP LEGEND

- LETTERED XS's
- BFE
- Proposed 1% WSEL LINES (New Study)
- PLSS Lines
- FIRM Panels (Effective Panel Labeled in Gray)

STREAM CENTERLINES

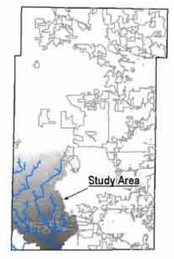
- < 1Sq Mi Approximate Study
- < 1Sq Mi Effective AE Study
- < 1Sq Mi Limited Study
- < 1Sq Mi No Effective Zone A
- Approximate Study
- Effective AE Study
- Effective Zone A
- Limited Study

POLITICAL LINES

- CORPORATE
- COUNTY
- FOREST

For a high resolution version of this map, please contact the Illinois State Water Survey.

Kane County, Illinois



1" = 1000'

ISWS

PANELS: 0225, 0250, 0290, 0295, 0300, 0305, 0315, 0355, 0360, 0380

BIG ROCK & WELCH CREEK

NEW STUDY (1% WSEL)

KANE COUNTY, ILLINOIS

AND INCORPORATED AREAS

(SEE PANEL INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NAME	COMMUNITY IDENTIFICATION NUMBER
BIG ROCK, VILLAGE OF	171091
KANE COUNTY	170896
KANEVILLE, VILLAGE OF	171388
SUGAR GROVE, VILLAGE OF	170333

ROUGH DRAFT

Illinois State Water Survey (1905)

MAP PRINTED: FEB. 12, 2009

Only Flood Hazard Information for BIG ROCK and WELCH CREEK(s) has been shown on this map. See Effective FIRM for information on other Special Flood Hazard Areas.

MATCH TO SHEET #1