Draft Detailed Project Report with Integrated Environmental Assessment

Little Miami River, Loveland, Ohio
Continuing Authorities Program (CAP) Section 14
Emergency Streambank Stabilization Project

Photo above shows an area experiencing slope failure along E. Kemper Road in Loveland, Ohio

June 2024

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Continuing Authorities Program (CAP)
Section 14 Emergency Streambank Stabilization Project
City of Loveland, Hamilton County, Ohio

The U.S. Army Corps of Engineers (USACE), Louisville District conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. §4321 et seq.), as amended. The Final Detailed Project Report, with Integrated Environmental Assessment (DPR/EA) dated [pending], for the Continuing Authorities Program (CAP) Hamilton County, Ohio Section 14 Emergency Streambank Stabilization Project addresses potential environmental impacts associated with the stabilization of a bank section of the Little Miami River to protect E. Kemper Road in the City of Loveland, Hamilton County, Ohio.

The Final DPR with integrated EA, incorporated herein by reference, evaluated various alternatives that would address emergency streambank erosion occurring on the bank of the Little Miami River.

The Tentatively Selected Plan is the least costly alternative compared to the cost of relocating the threatened facility. The Tentatively Selected Plan includes re-grading the bank to a stable condition in sections and placing an engineered mix of stone and soil with native plantings of riparian vegetation on the bank. This alternative is estimated to require clearing a total of approximately 0.6 acres, placing an estimated 12,616 cubic yards of riprap shot rock, and soil within the project footprint. When completed, this alternative would correct ongoing failure of the slope and stormwater infrastructure and protect 1,140 LF of streambank within the project footprint.

In addition to a "no action" plan, six action alternatives were considered. The alternatives included: (1) vegetated riprap with shot rock (the Tentatively Selected Plan), (2) wall with tieback anchors, (3) soil anchor reinforcement, (4) chemical grouting, and (5) road relocation. The alternatives are described in detail in Section 3.0 of the DPR/EA. Based upon a thorough review of the relative cost and efficacy of these alternatives, all but the Tentatively Selected Plan and the No Action Alternative were screened from further evaluation and environmental effect analysis.

Potential effects were evaluated, as appropriate, in Section 4.0 of the DPR/EA. A summary assessment of the potential effects of the Tentatively Selected Plan are listed in the table below:

	Insignificant effects	Insignificant effects as a result of mitigation	Resource unaffected by action
Air Quality	☒	☐	☐
Climate	☒	☐	☐
Greenhouse Gases	☒	☐	☐
Topography, Geology, and Soils	☒	☐	☐
Water Quality and Aquatic Resources	☒	☐	☐
Fish and Wildlife Resources	☐	☐	☒
Listed Species	☐	☐	☒
Invasive Species	☒	☐	☐
Recreational, Scenic, and Aesthetic Resources	☐	☐	☒
Cultural Resources	☒	☐	☐
Noise	☒	☐	☐
Hazardous, Toxic, and Radioactive Waste	☐	☐	☒
Socioeconomics and Environmental Justice	☐	☐	☒
Cumulative Effects	☐	☐	☒

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the Tentatively Selected Plan. Best management practices (BMPs), as detailed in the DPR/EA, will be integrated into the project plans and specifications, and implemented during construction activities to minimize impacts. Erosion control BMPs will mitigate adverse effects to aquatic resources, fish and wildlife habitat, threatened and endangered species, soils, and water quality. The establishment of native vegetation in the project area, and on the stabilized slope in particular, will mitigate aesthetic impacts by obscuring stone and mitigate invasive species impacts by denying these species disturbed, unoccupied soil. These actions are described in greater detail in Section 3.0 of the EA.

No compensatory mitigation is required as part of the Tentatively Selected Plan.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the USACE determined that the Tentatively Selected Plan will have no effect on the following federally listed species or their designated critical habitat: Indiana bat (*Myotis sodalis)*, northern long- eared bat (*Myotis septentrionalis*), the proposed endangered tri-colored bat (*Perimyotis subflavus*), and the candidate monarch butterfly (*Danaus plexippus*).

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers determined that the Tentatively Selected Plan has no potential to cause adverse effects on historic properties.

Pursuant to the Wild and Scenic River Act of 1968, the alternatives considered were evaluated for their potential to impact the values for which this section of the Little Miami River was designated under the

National Wild and Scenic Rivers System. These include the river's free-flowing condition, water quality, and outstanding remarkable values: scenic, geologic, fish and wildlife, ecologic, recreational, and historic resources. The analysis is detailed in Section 6.0 of the DPR/EA. Coordination with National Park Service related to whether the Tentatively Selected Plan can be implemented in a manner that does not threaten the protected qualities of the River is ongoing. Final scope and plans for the proposed project will be subject to further review and a Section 7 determination conducted by the National Park Service.

A 30-day public and agency review of the draft EA was completed on [*PENDING*]. All comments submitted during the public comment period will be responded to in the Final EA.

All applicable environmental laws have been considered and coordinated with appropriate agencies and officials had been completed.

All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the Tentatively Selected Plan would not significantly affect the human environment; therefore, preparation of an Environmental Impact Statement is not required.

Date	Reyn L. Mann Colonel, Corps of Engineers District Commander

Little Miami River, Loveland, Ohio
Continuing Authorities Program (CAP) Section 14
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1 INTRODUCTION

1.1 STUDY PURPOSE AND SCOPE

This Detailed Project Report with Integrated Environmental Assessment (DPR/EA) was prepared by the Louisville District of the U.S. Army Corps of Engineers (USACE) to identify the most cost effective and environmentally acceptable plan for preventing active slope failures and erosion along the Little Miami River in the City of Loveland, Ohio. The City of Loveland, Ohio, the Non-Federal Sponsor (NFS), requested Federal assistance in addressing streambank erosion issues under Section 14 of the Flood Control Act of 1962, as amended, in May 2023.

The purpose of the Loveland, Ohio CAP Section 14 Emergency Streambank Stabilization Project (the Project) is to investigate a cost effective and environmentally acceptable plan for preventing active slope failures and erosion along the Little Miami River that is threatening public infrastructure in the City of Loveland, Ohio. Specifically, the City of Loveland identified three areas of distress and movement along E. Kemper Road on the right (northwestern) bank of the Little Miami River from river mile 23.7 to 22.9, requiring the City to perform road repairs on a regular basis.

The need for the Project is to prevent the slope failures and erosion from impacting E. Kemper Road, which provides access to local residents, school buses, and emergency responders, and would negatively impact approximately 11 residences and 23 commercial businesses if the road were shut down or inaccessible. As of September 2023, the traffic count on E. Kemper Road is estimated to equal 5,985 vehicles per day (TIMS 2023). The streambank slope failures and erosion have impacted the adjacent roadway infrastructure and, as a result, is a threat to vehicle occupant safety and utility lines.

The primary purpose of the Project is to identify the sections of the streambank in immediate need of stabilization and to develop a viable solution for the prevention of active erosion.

The primary failure mechanism of the bank is the rise and fall of the Little Miami River and rapid drawdown slope stability, which occurs when flood waters recede quickly and pore water pressures within the slopes do not have sufficient time to dissipate. This creates a condition where the slopes become unstable. When the water level in the river draws down, the resisting force is removed, and saturated sand seams with low cohesion flow out of the bank. This undermines the material around where the sand seams used to be, causing the soil to collapse.

The Cincinnati area (Hamilton and Clermont counties) comprises the southwestern corner of Ohio. Erosion and unstable streambanks similar to the issue in the Project Area occurs along steep hillsides and waterways throughout the Cincinnati area and in the Project Area due to the prevalence of Kope geology. The Kope Formation is a historically unstable, pervasive formation consisting of embedded limestone and shale with sand seams. Shale accounts for approximately 80 percent or more of the formation and readily weathers, slakes, and slumps. Multiple factors contribute to erodibility of the formation including, but not limited to, human activities, low durability of bedrock, undercutting of the slope toe by stream water, and slope steepness (Glassmeyer, 2021).

1.2 LOCATION

1.2.1 Study Area

The City of Loveland is located in southwestern Ohio, 17 miles northeast of Cincinnati in Hamilton, Clermont, and Warren Counties, Ohio (Figure 1). According to the 2020 Census, the population is 13,307. Loveland is unique in that the city is in three different counties: Clermont, Hamilton, and Warren. The City of Loveland, Ohio is within the Little Miami River watershed and drains a total of 1,758 square miles flowing through all or part of 11 counties (EPA 2022).

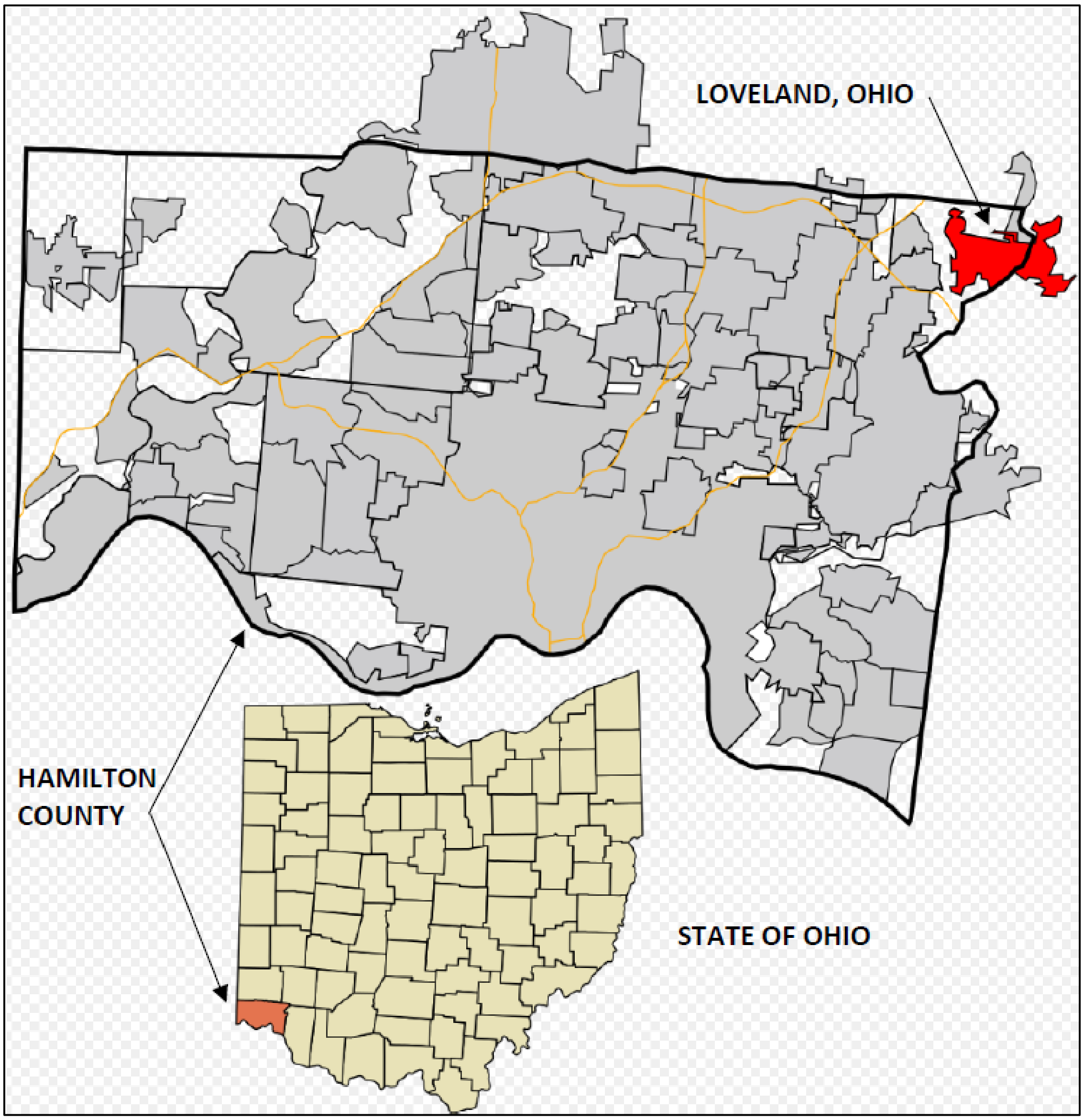


Figure 1. City of Loveland, Hamilton County and the State of Ohio

1.2.2 Wild and Scenic River Designation

1.2.2.1 Designation Background Information

In 1968, Congress passed the National Wild and Scenic Rivers Act of 1968 (WSRA) (Public Law No. 90-542 codified as 16 U.S.C. §§ 1271-1287) to provide Federal protection for our country's remaining free-flowing rivers or segments of rivers, preserving them and their immediate environments for the use and enjoyment of present and future generations.

1.2.2.2 River Classification

Section 2(b) of the WSRA (16 U.S.C. § 1273) provides definitions for the three classifications of eligible river areas, including wild, scenic, and recreational river areas. These classifications are based on the extent of development and accessibility along each segment of river existing at the time of designation. "Wild" rivers are generally inaccessible except by trail; "Scenic" rivers are largely undeveloped but are accessible in places by road; and "Recreational" rivers are readily accessible by road. The classifications are measures of the level of development along the river at the time of designation. Designation neither prohibits develop nor does it provide control over private property (National Wild and Scenic Rivers System, 2023).

Section 7(a) of the WSRA (16 U.S.C. § 1278) identifies restrictions to protect the river values from the harmful effects of water resources projects. The WSRA prohibits Federal agencies from assisting in the construction of any water resources project that would have a direct and adverse effect on the values for which such river was established as determined by the Secretary of the Interior. The WSRA does not exclude water resources projects proposed for health and safety or emergency purposes, nor does it provide a different or expedited standard of evaluation for the repair, replacement, or expansion of water resources projects that existed at the time of the River's designation.

1.2.2.3 Specific Project Site Information

In 1973, a total of 66 miles of the upper portion of the Little Miami River was designated a combination of Scenic River Area (18 miles) and Recreational River Area (48 miles) by the Secretary of the Interior. In 1981, pursuant to the authority granted to the Secretary of the Interior by Section 2 of the WSRA (16 U.S.C. § 1273), an additional 28 miles of the Lower Little Miami River from Foster, Ohio to the confluence with the Ohio River was designated a State administered National Recreational River Area in the National Wild and Scenic Rivers System (Figure 2). The 1981 Recreational River Area designation applies to the project site area in Loveland, OH. Under Section 2 of the WRSA 16 U.S.C. § 1273, recreational River Areas are "those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past."

The Little Miami River is a State-administered component of the National Wild and Scenic Rivers System (System). The Ohio Department of Natural Resources (ODNR), Division of Watercraft is charged with the day-to-day river management responsibilities. The Department of the Interior under the National Park Service (NPS) make evaluations and determinations of effect for Federally-assisted water resources projects under Section 7(a) of the WSRA (16 U.S.C. § 1278).

The Little Miami River is managed to protect and enhance its free-flowing condition, water quality, and Outstandingly Remarkable Values (ORV) designation(s). Depending on location, the Little Miami River's

ORVs include botany, fish, geology, history, prehistory, recreation, and wildlife. ODNR is charged with the day-to-day river management responsibilities.

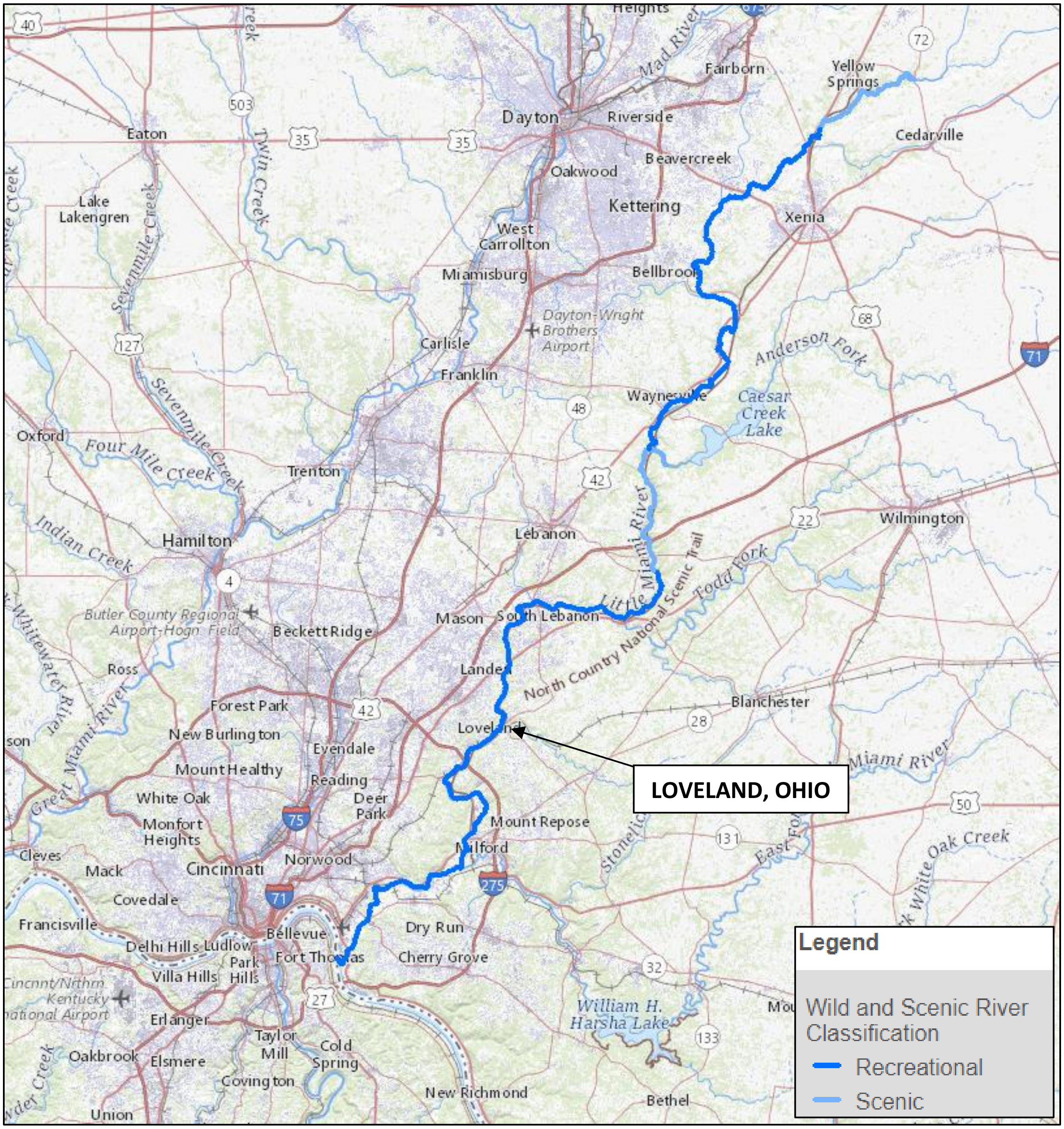


Figure 2. Wild and Scenic River Designation on the Little Miami River

1.2.3 Project Area

The Project Area is entirely within Hamilton County on E. Kemper Road along the right (northwestern) bank of the Little Miami River at approximate river mile 23.7 to 22.9 (Figure 3). The Project Area on E. Kemper Road covers a total site area of approximately 1.5 acres with three sites that cover approximately 0.5 acres each.

Slope failures occur along steep, heavily wooded slopes at the three sites immediately southeast of E. Kemper Road along the Little Miami River. At Sites 1 and 2, E. Kemper Road runs along a hillside with steep, wooded slopes to the northwest leading up to railroad tracks. Near Site 3, a structure and parking lot are located on the northwest side of E. Kemper Road with a wooded slope leading up to railroad tracks beyond. The sites are moderately to poorly drained and areas of ponded water form along the southeast side of E. Kemper Road.

A Project Area map including the three work sites and the laydown area is shown in Figure 3. Additional details regarding the laydown area can be found in Section 6.2 and Appendix D.

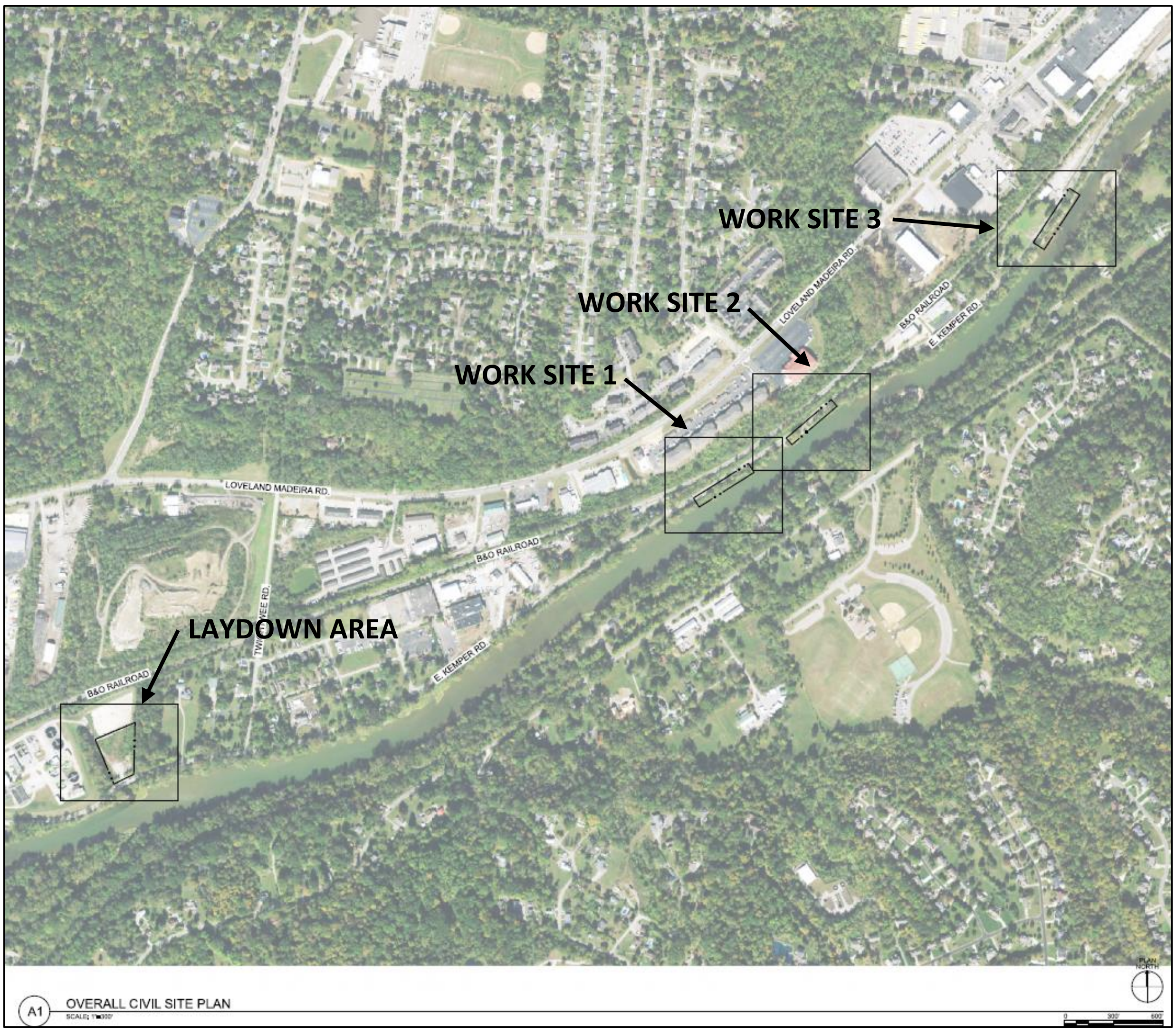


Figure 3. Project Area Map including laydown area of the proposed Loveland Bank Stabilization Project, Loveland, Ohio.

1.3 STUDY AUTHORITY

Section 14 of the Flood Control Act of 1946, as amended, authorizes the US Army Corps of Engineers (USACE) to study, design, and construct emergency streambank and shoreline works to protect public services including (but not limited to) streets, bridges, schools, water and sewer lines, National Register sites, and churches from damage or loss by natural erosion. The authority is a part of the Continuing Authorities Program (CAP), which focuses on water resource related projects of relatively smaller scope, cost, and complexity. Traditional USACE civil works projects are typically of wider scope and complexity and are specifically authorized by Congress. CAP is a delegated authority to plan, design, and construct certain types of water resource and environmental restoration projects without specific Congressional authorization.

1.4 RELEVANT PRIOR STUDIES AND REPORTS

USACE completed a Planning Assistance to States (PAS) study in the Project Area in April 2023 to study Kope geology. As part of the PAS study, a geotechnical exploration was performed in May of 2022. The PAS study utilized soil data from the geotechnical exploration to complete a slope stability analyses that determined the cause of the slope failures along E. Kemper Road. Slope stability models were utilized to complete the initial geotechnical analysis of this Project. A full survey and additional geotechnical exploration will be completed during design to further define the Tentatively Selected Plan (TSP).
The 2012 Hamilton County, Ohio and Incorporated areas, Flood Insurance Study (FIS) No. 39061CV001C was used to develop the hydraulic model for this study project. The frequency flows from the FIS were used in the hydraulic model, and the Hamilton County data shapefiles were used for calibration of the water surface elevations with the respective locations along the Little Miami River.

Caesar Creek Dam is located approximately 35 driving miles to the northeast (upstream) of the Project Area and provides for summer pool elevation of 848.4 feet NAVD88 above the dam. William H. Harsha Lake is located in southwest Ohio on the East Fork of the Little Miami River on river mile 32.6, approximately 21.3 miles upstream of the confluence with the Little Miami River. William H. Harsha Lake provides for summer pool elevation of 730.25 feet NAVD88 above the dam. The operation of these two dams has no impact on erosion in the project area.

2 AFFECTED ENVIRONMENT - EXISTING CONDITIONS

2.1 AIR QUALITY

The United States Environmental Protection Agency (USEPA), Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants, called “criteria” pollutants. They are carbon monoxide, nitrogen dioxide, ozone, lead, particulates of microns or less in size (PM-10 and PM-2.5), and sulfur dioxide. Ozone is the only parameter not directly emitted into the air, but that forms in the atmosphere when three atoms of oxygen (O3) are combined by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC, also known as ozone precursors. Strong sunlight and hot weather can cause ground-level ozone to form in harmful concentrations in the air.

As of November 2023, Hamilton County, OH was in attainment for all NAAQS (USEPA 2023a). Attainment is a designation given to areas of the United States that have met all air standards for human health by established deadlines using criteria set forth in the Clean Air Act.

2.2 CLIMATE

Several factors influence local climate conditions including latitude, elevation differences, large bodies of water, prevailing winds, the jet stream, topography, and land cover (Drum et al. 2017). Ohio's mid-latitude, interior location and the lack of surrounding mountains expose the state to incursions of very cold air masses from the Arctic during the winter and warm, humid air masses from the Gulf of Mexico in the summer months (Frankson et al. 2022). The climate in this area of Ohio is continental in character, and temperature and precipitation levels fluctuate widely. Because the prevailing winds are westerly, most of the storms cross the state in a west to east pattern. Low pressure storms that originate in the Gulf of Mexico and move in a northeasterly direction across Ohio contribute the greater proportion of precipitation received by the state. Warm, moist, tropical air masses from the Gulf predominate during the summer months when humidity levels are high. As storms move through the state, occasional hot and cold periods of short duration may be experienced. During the spring and fall, storm systems tend to be less severe and have a smaller frequency, thus resulting in less radical extremes in temperature and rainfall.

Climate data were gathered from the nearest National Oceanic and Atmospheric Administration weather station (USW00013841) in Cincinnati, Ohio, located approximately 18 miles south-southwest of the Loveland project site (U.S. Climate Data 2023). Historical weather data was obtained from 1981 through 2023. The climate of the area is generally temperate with cold winters and warm summers. The average annual high temperature is 65°F and the average annual low temperature is 44°F. The warmest month is July with a mean daily high of 87°F. The coldest average month is January, with the mean daily low being 39°F. The average yearly amount of precipitation and snowfall is 42.4 and 16 inches, respectively (NOAA 2023). The month with highest average precipitation is May (4.7 inches), and the lowest average precipitation month is February (2.6 inches).

<u>Climate Change</u>
In 2017, the USACE Huntington District, in collaboration with the Ohio River Basin Alliance, the USACE Institute for Water Resources, the USACE Great Lakes and Ohio River Division, and numerous other Federal agencies, non-government organizations, and research and academic institutions completed the Ohio River Basin Climate Change Pilot Report. This pilot study investigated potential climate change impacts to Ohio River Basin (ORB) infrastructure, including Federal facilities operated for reduction of flood damages, navigation, local protection, water supply, and hydroelectric power production, as well as the potential impacts on terrestrial and aquatic ecosystems that are influenced by operation of these infrastructure components (Drum et al. 2017). The primary purpose of the study was to identify those components of the ORB infrastructure and ecosystem resources that may be at risk from future changes in precipitation and temperature, and to formulate mitigation and adaptation strategies that may be implemented to reduce those effects.

The primary concern to water infrastructure projects is the threat of extreme weather episodes becoming more prevalent, longer, and more potent. The potential for climate and weather elements including temperature, precipitation, winds, humidity, evaporation to become less predictable and more susceptible to extreme changes suggests a need for studies on the effects of these variables on existing water management operating schemes and whether the current infrastructure design can accommodate future operational changes.

The pilot study addresses the formulation of potential adaptation strategies that could decrease the impacts associated with changes in precipitation, streamflow discharge, and temperatures across the basin. Although not prescriptive in nature, these strategies suggest potential paths forward that can be integrated into both near- and long-term infrastructure planning, structure rehabilitation, water policy analysis, and operational changes and can be useful as a management tool for streambank erosion projects throughout the ORB, including the Project Area.

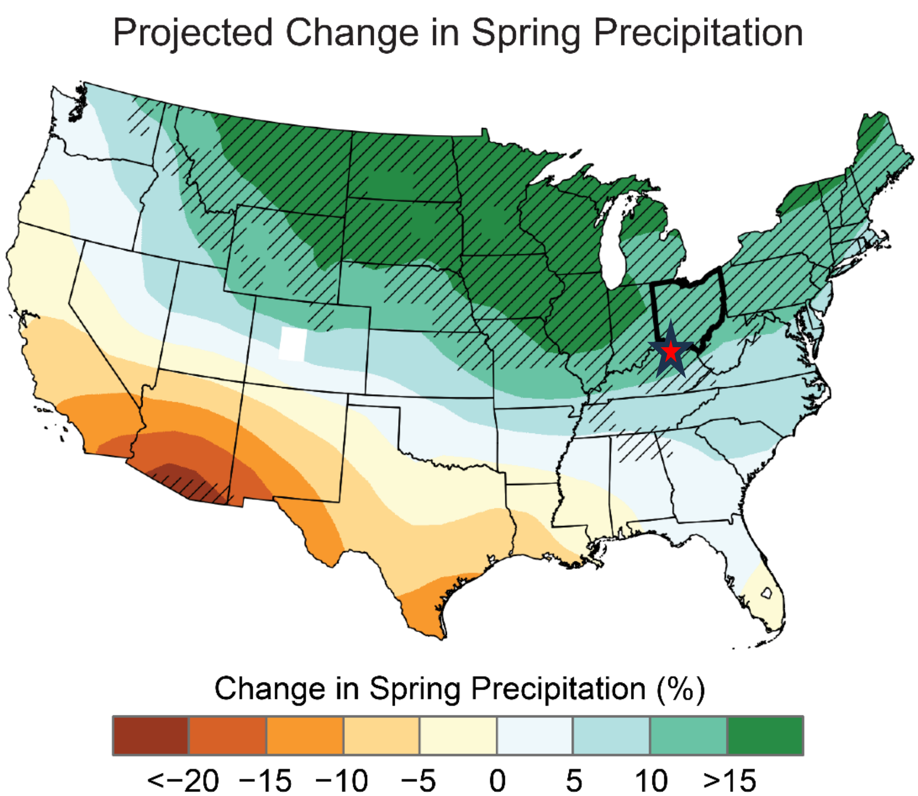


Figure 4. Projected changes in spring precipitation by the mid-century under future greenhouse emissions (Source: Frankson et al. 2023)

In general, the modeling data suggest that the more rapid changes in temperature, precipitation, and stream flows resulting from changes in regional climate may not begin within the ORB until 2040. However, modeling results also suggest a gradual increase in annual mean temperatures between 2011 and 2040 amounting to one-half degree per decade, with greater increases between 2041 and 2099 of one full degree per decade (Drum et al. 2017). The Middle Ohio River Hydrologic Unit Code (HUC)-4 region (which encompasses the Project Area) is projected to experience significant changes in annual stream flows (15–25%), spring maximums (15–35%), and slightly elevated fall minimum flows (5–15%). However, the pilot study further suggests that the region encompassing the Loveland CAP Project is not expected to experience marked hydrologic regime changes that may negatively affect the region until 2071 (Drum et al. 2017).

Additional analysis of current and future climate trends was conducted by USACE for the proposed Project. Project engineers utilized several toolsets related to climate change which indicated that historic increases in temperature have occurred and are likely to continue in the project area in the future. Increases in temperature could have a detrimental impact on vegetative plantings. However, temperature is not a high priority variable related to streambank stabilization or erosion. Both precipitation and streamflow, which more directly influence streambank stability, have increased uncertainty regarding their historic and projected trends when compared with temperature. Regarding precipitation trends, the literature review and analysis tools found increasing historical and projected trends.

While no consensus could be reached regarding streamflow trends from the literature review, and no statistically significant trend was found from the timeseries analysis of the Little Miami streamflow data, other methods of analysis predict changes in climate and/or weather patterns that have the potential to impact the Loveland project area. For example, analysis conducted via the USACE Climate Hydrology Assessment Tool (CHAT) found increasing trends for projected streamflow and precipitation within the project area and analysis conducted via USACE's Civil Works Vulnerability Assessment Tool (VA tool) shows an increase in flood risk for the region. Taken together, these results forecast increases in rainfall and storm events within the region which, coupled with projected increases in streamflow and precipitation, have the potential to exacerbate erosion or slope failure occurring at the site in the future.

A more detailed analysis and discussion of the climate of the region, and its potential effect on the proposed Loveland project is located in Appendix H.

2.3 TOPOGRAPHY, GEOGRAPHY AND SOILS

2.3.1 Topography and Geology

The topography of the Little Miami River Watershed has been influenced by glaciations which left distinctive landforms and thick deposits of silt, sand, and gravel. The northwest part of the watershed is within the Eastern Corn Belt Plains ecoregion, which is characterized by level to gently sloping land and relatively low gradient streams. The majority of the watershed lies within the Interior Plateau ecoregion which has greater relief and tributaries tend to have steeper gradients before entering the Little Miami flood plain. The valley of the mainstem through the study area is relatively narrow with steep sides.

Sections of the shoreline corresponding to the Project Area has experienced ongoing erosion resulting in unstable streambanks that pose threats to public infrastructure along the Little Miami River. This issue occurs along steep hillsides and waterways throughout the Cincinnati area due to the prevalence of Kope geology. The Kope Formation is a historically unstable, pervasive formation consisting of embedded limestone and shale with sand seams. Shale accounts for approximately 80 percent or more of the formation and readily weathers, slakes, and slumps. Multiple factors contribute to erodibility of the formation including, but not limited to, human activities, low durability of bedrock, undercutting of the slope toe by stream water, and slope steepness (Glassmeyer & Shakoor 2021).

The Cincinnati area (Hamilton and Clermont counties) comprises the southwestern corner of Ohio and is susceptible to landslides.. Most of the landslides occur in the Kope Formation and the overlying colluvial soil during late winter and early spring. Rotational and translational slides are the most frequently occurring slope movements associated with the Kope Formation and the overlying colluvial soil. Rapid earthflows, rockfalls, and complex slides (combination of rotational and translational slides), although present, are infrequent. Rotational slides are common where thick colluvium covers the bedrock. They are generally 6.6–49.2 ft (2–15 m) thick, 98.4–984.3 ft (30–300 m) wide (measured perpendicular to the direction of sliding), and 98.4–492.1 ft (30–150 m) long (measured along the direction of sliding). Many rotational slides are associated with springs or marshy areas either beneath or within the slope toes. Translational slides are common where thin colluvial soils (6.6–9.8 ft, 2–3 m thick) cover relatively steep slopes (15°–30°). They occur along the colluvium–bedrock contact, are generally 32.8–492.1 ft (10–150 m) wide and 98.4–426.5 ft (30–130 m) long and vary in shape from long and narrow to wide and short. Translational slides generally occur during spring because the slide material is almost saturated between the months of January and May. The dominant form of deformation in translational slides is longitudinal stretching resulting in a series of scarps. Complex landslides in the Cincinnati area consist of more than one layer of slide material. They are thinner near the slope crest and become thicker near the toe. Rapid earth flows in the Kope Formation (locally known as mudslides) occur on steeper slopes along the Columbia Parkway. They occur during wet periods in areas where the colluvium is less than 6.6 ft (2 m) thick and is clayey in nature. Rapid earthflows involve movement of the entire thickness of the colluvium, exposing the bedrock (Glassmeyer & Shakoor 2012).

2.3.2 Soil Associations

The USDA Soil Survey indicates that the soils within the project area are comprised entirely of the Udorthents-Urban land complex soil type. The Udorthents-Urban land complex soil type consists of moderately well drained to excessively well drained soils that have been disturbed by cuffing or filling and are generally found in areas that are covered by buildings and or pavement (USDA 2023). These soils are highly impacted and often consist of fills comprised of concrete aggregates and construction debris. This material was used to form the roadbed of E. Kemper Road and stabilize the shoreline via construction and maintenance efforts completed over the previous decades. No soils classified as prime or unique farmland are found within the project footprint.

The complete USDA Soil Survey report is provided in Appendix B.

2.3.3 Hydric Soils

Hydric soils are an indication of the likelihood for wetland to be present or the potential to develop naturally (if land is left unmanaged). Less than one percent of the soils in the Project Area are characterized as hydric (Loveland PAS 2023). Sources of water contributing to the hydric quality of soils includes the amount and frequency of flooding in an area. Flooding frequently occurs on less than two percent of the soils at the project area, while ninety-two percent typically experience no flooding. Drainage and water infiltration of soils present at a site also factor in the water holding capacity of soil profiles at a site. Over sixty percent of the soils are either well drained or moderately well drained (Loveland PAS 2023), suggesting that the project area has relatively low potential to retain water.

2.4 WATER QUALITY AND AQUATIC RESOURCES

The 602 square mile greater Little Miami watershed area encompasses all or part of 43 municipalities in Clinton, Warren, Clermont, Hamilton, and Butler counties (OEPA 2010). The watershed consists of five 10-digit HUC and twenty-five 12-digit HUC sub-watersheds. The lower Little Miami River watershed (representing 24 miles from O'Bannon Creek to Ohio River and includes the proposed project area) is located in southwest Ohio extending from Lebanon and Wilmington in the north and northwest to Cincinnati in the south.

2.4.1 Water Quality

In 2007, Ohio Environmental Protection Agency (OEPA) conducted a comprehensive physical, chemical and biological survey in the lower Little Miami River watershed excluding the East Fork of the Little Miami River in 2007. The water quality survey included monitoring of lower Little Miami River and several tributary streams. In general, the Little Miami River mainstem exhibited exceptional water quality throughout the length lower watershed during the 2007 sampling event (OEPA 2010). However, the tributaries that were surveyed showed a mix of water quality where stressors precluded the attainment of water quality standards at several locations. Impacts associated with fine sediment loading was the most widespread water quality problem within the watershed. Organic material from sewer overflows also negatively impacted water quality, especially within the lower portion of the project area. At several of the sites sampled, recreational uses were impaired due to the elevated risk for water-borne illness from pathogen contamination. This is evidenced by high concentrations of *Esherichia coli* (E. coli) bacteria associated with fecal matter.

The OEPA uses fecal coliform (FC) data collected at established monitoring stations throughout the state to assess water quality for recreational uses. Reasons for these failures include poorly treated human waste coming from home septic systems, bacteria associated with urban runoff, and ineffective wastewater treatment and system overflows (OEPA 2010). Sewage and animal waste can contain many types of disease-causing organisms which may result in severe illness if consumed. Children under five years of age, those with compromised immune systems, and the elderly are particularly susceptible.

The lower Little Miami River is currently classified as an impaired watershed and is listed as a 303(d) stream (USEPA 2023b). Impaired waters are waterbodies not fully supporting their designated uses under the Clean Water Act. Section 303(d) of the Clean Water Act (CWA) requires States, Territories, and authorized Tribes to list and prioritize waters for which technology-based limits alone do not ensure attainment of water quality standards. The CWA and the USEPA regulations require that Total Maximum Daily Loads (TMDLs) be developed for all waters on the section 303(d) lists. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that pollutant. A TMDL determines a reduction target for a pollutant and allocates load reductions necessary to the source(s) of the pollutant. Lists of 303(d) waters are made available to the public and submitted to the USEPA and the Ohio EPA. The process of formulating TMDLs for specific pollutants is a method by which impaired water body segments are identified and restoration solutions are developed. Ultimately, the goal of Ohio's TMDL process is full attainment of biological and chemical Water Quality Standards (WQS) and, subsequently, removal of water bodies from the 303(d) list.

A 2019 assessment of the biological condition of the lower Little Miami River lists the watershed as impaired for aquatic life (warmwater habitat and exceptional warmwater habitat), human health (fish consumption), and recreation (primary contact) caused by the presence of E coli (USEPA 2020). The primary causes of the impairments to aquatic life are listed as salt contamination from urban runoff and sedimentation/siltation (USEPA 2023b). Sediment loading, in part, originates from channelization and erosion from the cropland surrounding some of the problem areas. Cover crops, conservation crop rotation, improvements in tillage methods, and sediment capture areas such as filter areas or wetlands would alleviate a large proportion of the problem. Storm water runoff from surrounding urbanized areas also contribute to sediment loads and other contaminants.

2.4.2 OEPA Floodplains

Executive Order 11988 requires Federal agencies to consider the potential effects of their proposed actions to floodplains. The floodplain of the Little Miami River varies in width from a few hundred feet to one and one-half miles. Local relief ranges from a few feet to as much as 275 feet. The Little Miami River flows in a varying bed of sand, gravel, silt, and rock to its terminus at the Ohio River. The river varies in width but generally is in the 50- to 100-foot range. The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) was reviewed to determine the location of the 100-year floodplain within the project area (FEMA 2023). The floodplain of the Little Miami River covers nearly the entire project area footprint. Figure 6 includes the FIRM floodplain map for the area encompassing the three project areas adjacent to E. Kemper Road.

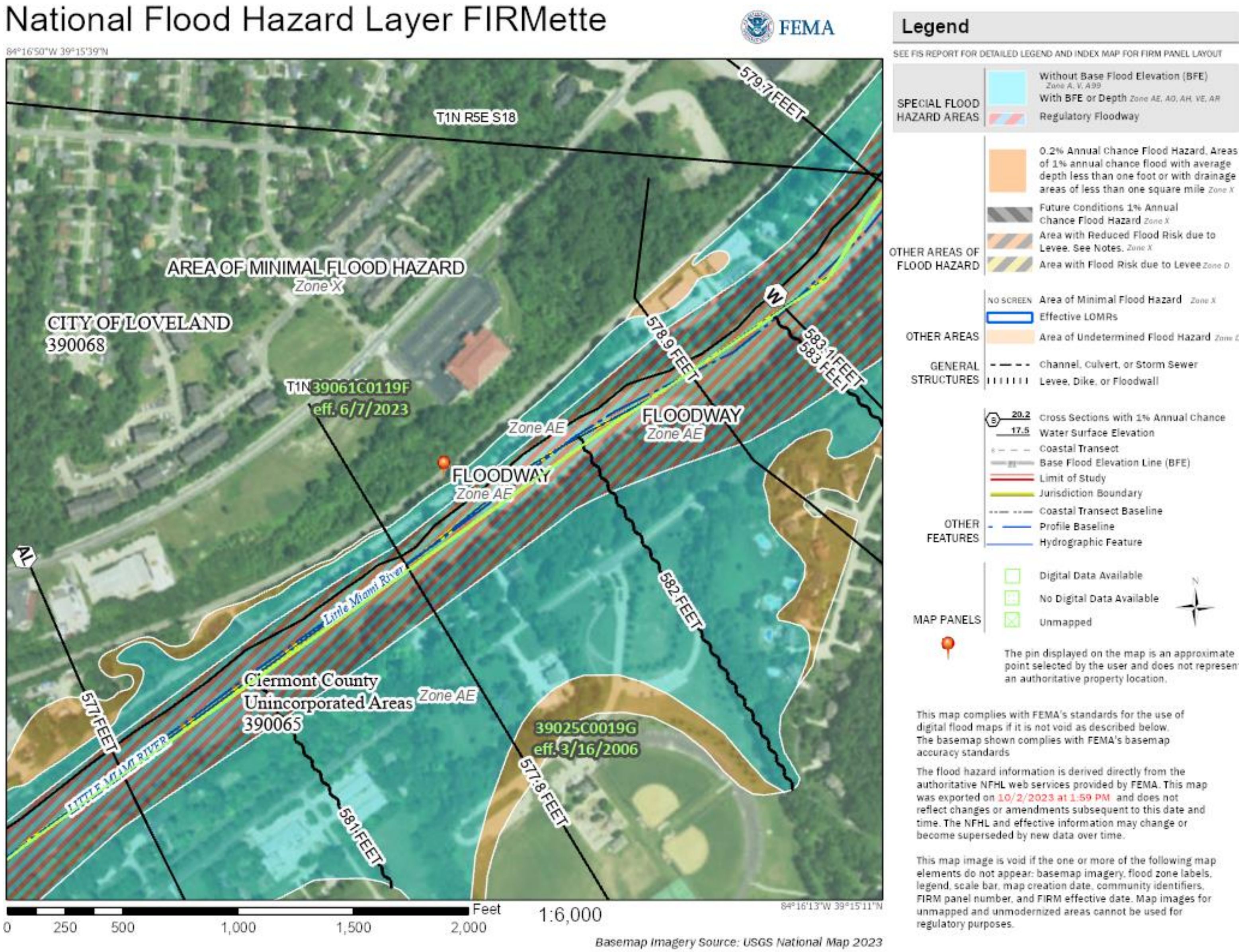


Figure 5. FIRM Floodplain Map for the Project Area

2.4.3 Wetlands

Wetlands provide a great variety of ecosystem benefits. They provide function as surge capacity buffers for floodwaters, regulate flow, purify water via the retention and/or absorption of excess nutrients and pollutants, provide habitat to wildlife, and provide recreation to people.

Analysis conducted via the United States Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) desktop application indicate that wetland habitats within the project area footprint are limited to the floodplain of the Little Miami River. Because the area surrounding the project area footprint is highly modified by urban development, wetland habitats are mostly limited to the streambed and near water margins of the Little Miami River. The NWI dataset classified the wetland habitat within this area as *R2UBH Riverine* habitat type. The riverine classification refers to stream and river environments that have flowing water and features of this habitat type are classified based on the substrate or vegetation in the channel, not what is present on the edges of the channel. Riverine wetland habitat types have three sub systems that are defined by the gradient of the stream or the frequency of the presence of surface water (USFWS 2023). The R2 riverine subsystems flow continuously and are permanently flooded. Lower perennial streams are characterized as low gradient defined by their gentle elevation change and relatively slow-moving water with sand or mud substrates. This subsystem has well-developed floodplains through which the main flow meanders if left in its natural state. Surrounding floodplain areas may be in their natural state but are often drained for agriculture. Figure 6 shows existing wetlands within the project footprint.

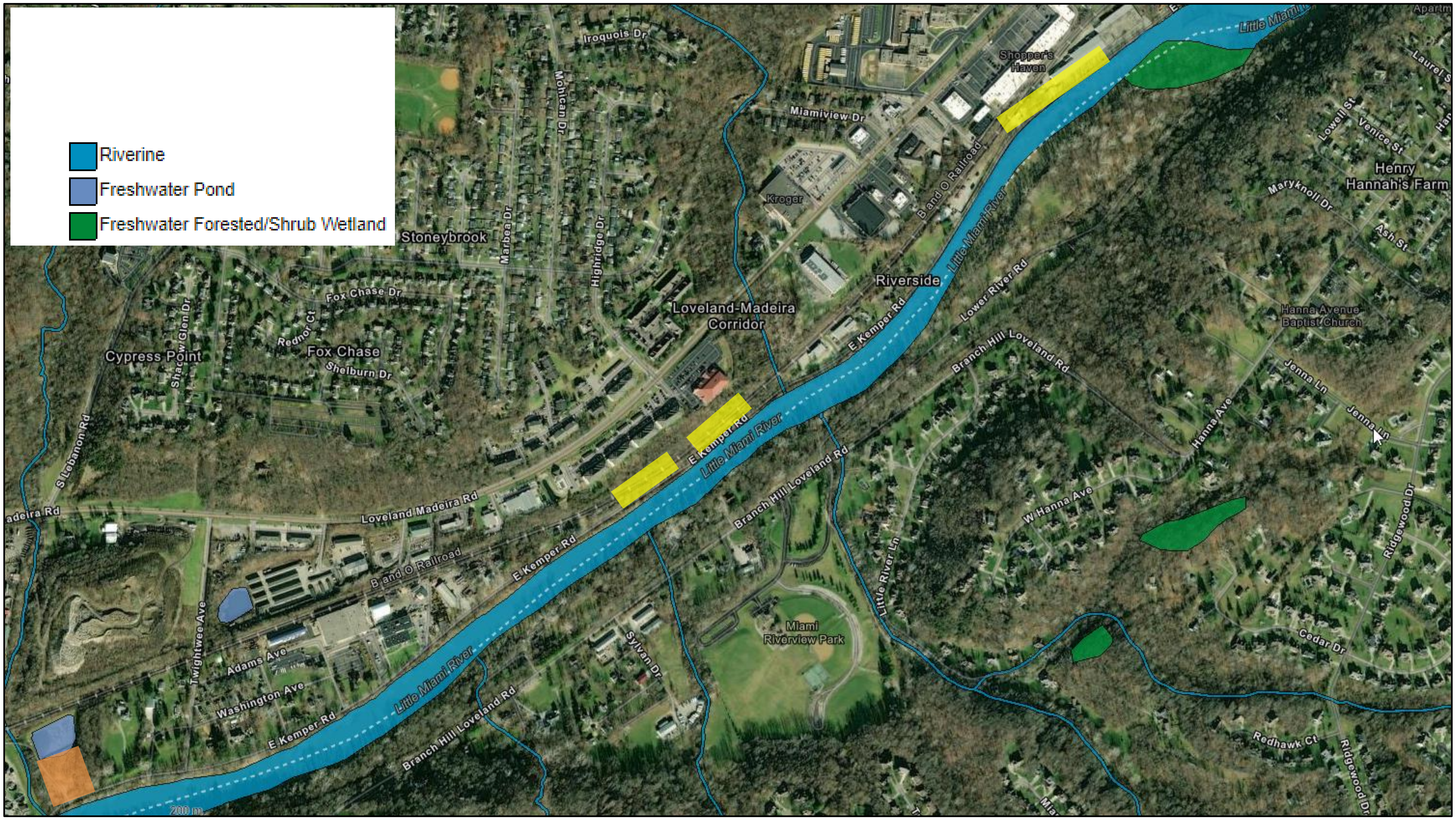


Figure 6. Wetland habitat types present on or near the proposed Loveland Shoreline Stabilization Project (Source: USEPA 2024).

2.4.4 Groundwater

Groundwater yields vary greatly in the project area with wells ranging from 25 to 500 gallons per minute depending on location. Undisturbed soil strata in the immediate area of the project footprint include sand and gravel deposits that have the potential to yield several hundred gallons per minute with the highest yields reported in where nearby streams can recharge the aquifer. In higher elevations (i.e., out of the immediate river valley), groundwater yields are much less productive. Areas in this zone that consist mostly of valley fill with thick deposits of sand and gravel are somewhat permeable but typically yield less than 100 gallons per minute (Walker 1986).

2.5 FISH AND WILDLIFE RESOURCES

2.5.1 Terrestrial and Aquatic Vegetation

Terrestrial and aquatic vegetation communities are highly impacted by urban development of the Project Area. In general, the terrestrial and aquatic vegetative communities within the project area footprint are limited to riparian areas making up the streambanks and near- and shallow, in-water sections of the banks of the Little Miami River. Typical herbaceous wetland flora of this area includes various sedges (*Carex* spp.), cattail (Typha sp.), spikerush (*Eleocharis palustris*), smartweed (*Polygonum* sp.), knotweed (Reynoutria japonica), pondweed (*Potamogeton* sp.), water willow (*Justicia americana*), and scouring rush (*Equisetum hyemale*).

Woody vegetation of the project site includes trees such as willow (*Salix* sp.), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), black walnut (*Juglans nigra*), and box elder (*Acer negundo*). These species are common in riparian areas in the project area and are prevalent in floodplains and bottomlands throughout the region.

2.5.2 Fauna

Common animals that inhabit the urban-riparian interface that comprises the Project Area include the raccoon (*Procyon lotor*), Virginia opossum (*Didelphus virginiana*), red-winged blackbird (*Agelaius phoenicus*), muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), great blue heron (*Ardea herodias*), belted kingfisher (*Megaceryle alcyon*), beaver (*Castor canadensis*), reptiles and amphibians, as well as a wide range of waterfowl.

2.5.3 Invasive Species

Invasive species are non-native species that thrive in areas where they do not naturally occur and cause economic or environmental harm, or harm to human, animal, or plant health. Invasive species degrade, change, or displace native habitats, compete with native wildlife, and are major threats to biodiversity. Invasive species are commonly introduced or spread through periodic disturbance of an area. Awareness of current and local emerging invasive species and their potential impacts can help address and limit the spread of these species.

Invasive species have the potential to negatively impact natural areas of the project area and can result in significant impacts to ecosystem function. For example, the creation of canopy gaps caused by the loss of host trees (via pests or disease) can alter soil moisture, increase incidental light striking the forest floor, and change the temperature profiles. Infestations can also alter forest stand composition and age structure, understory plant diversity, and may facilitate growth of invasive plants. These impacts to forested habitats have the potential to impact the fauna that use these areas (e.g., birds and mammals).

For example, some neotropical bird species that require larger tracts of mature, interior forests may be negatively impacted by forest fragmentation, and other species that occupy edge habitat may be favored. Loss of trees in riparian areas can adversely impact cold-loving aquatic fish and invertebrate species by increasing solar exposure to streams and increasing water temperature.

According to the University of Georgia's Center for Invasive Species and Reproductive Health, a total of 336 invasive species have been documented in Hamilton County (CISRH 2024); 20 of the most encountered invasive species are provided in Table 1. A complete list of invasive species documented in the Hamilton Cunty is provided in Appendix B.

Table 1 - Common invasive species documented in Hamilton County, Ohio (source: CISRH 2024)

Common Name	Scientific Name	Number of Records
garlic mustard	*Alliaria petiolata*	78
multicolored Asian lady beetle	*Harmonia axyridis*	74
Japanese beetle	*Popillia japonica*	58
tree-of-heaven	*Ailanthus altissima*	46
white clover	*Trifolium repens*	39
Amur honeysuckle	*Lonicera maackii*	27
common pokeweed	*Phytolacca americana*	24
red clover	*Trifolium pratense*	21
lesser celandine	*Ficaria verna*	19
Queen Anne's lace	*Daucus carota*	15
common purslane	*Portulaca oleracea*	15
eastern poison-ivy	*Toxicodendron radicans*	14
brown marmorated stink bug	*Halyomorpha halys*	12
chicory	*Cichorium intybus*	12
multiflora rose	*Rosa multiflora*	12
mugwort	*Artemisia vulgaris*	12
osage-orange	*Maclura pomifera*	11
henbit	*Lamium amplexicaule*	11
kudzu	*Pueraria montana var. lobata*	9
northern catalpa	*Catalpa speciosa*	9

2.6 LISTED SPECIES

Lists of threatened, endangered, and species of special concern are maintained by USFWS and the State of Ohio. Under the Endangered Species Act of 1973 (ESA), Pub. L. No. 93-205, 87 Stat. 884 (codified as amended at 16 U.S.C. §§ 1531, et seq.), endangered species generally are defined as any species in danger of extinction throughout all or a significant portion of its range. A threatened species is any species likely to become endangered in the foreseeable future. The ESA defines critical habitat of the above species as a geographic area that contains the physical or biological features that are essential to the conservation of a particular species and that may need special management or protection. This section also covers birds listed under the Migratory Bird Treaty Act of 1918 (MBTA), Pub. L. No. 65-186, 40 Stat. 755 (codified as amended at 16 U.S.C. § 703, et seq.) as birds of conservation concern.

2.6.1 Federally Listed Species

Based on data obtained from the USFWS Information for Planning and Consultation (IPaC) online planning tool (USFWS 2023), four Federally listed species have been or are known to occur within range of the proposed Project Area. This list includes the Federally endangered Indiana bat (M*yotis sodalis*), thenorthern long-eared bat (*Myotis septentrionalis*), the proposed endangered tri-colored bat (*Perimyotis subflavus*), and the candidate monarch butterfly (*Danaus plexippus*).

Because all three of the listed bat species have very large ranges that include the entire state of Ohio, all are considered potentially present throughout the state, even in areas in which they have not been previously documented. While their presence in the Project Area is assumed and suitable summer roosting habitat occurs in the project footprint (USFWS 2023b), no known hibernacula or maternity caves are used by the northern long-eared bat, Indiana bat, or tricolored bat occurring on or near the Project Area.

A more detailed review of the life history requirements, ranges, and pertinent distribution data of listed species is provided in Appendix B.

2.6.2 Critical Habitat

There is no known critical habitat within range of the project area footprint (USFWS 2023b).

2.6.3 Other Federally Protected Wildlife

Bald eagles (*Haliaeetus leucocephalus*) have a very large range in the continental U.S. and have the potential to utilize the Project Area for foraging or short migratory movements. While this species was formally removed from the Federal list of endangered and threatened species in 2007, bald eagles are state listed and are also protected under the Migratory Bird Treaty Act (MBTA) of 1918, Pub. L. No. 65-186, 40 Stat. 755 (codified as amended at 16 U.S.C. §§ 703, et seq.) and the Bald and Golden Eagle Protection Act, Pub. L. No. 86-70, 54 Stat. 250 (codified as amended at 16 U.S.C. §§ 668, et seq.). Bald eagles are not currently known to nest in the Project Area but transient individuals may visit or pass through the site seasonally.

The Osprey (*Pandion haliaetus*) is also protected by the MBTA and is also a potential resident or visitor of the Project Area.

2.6.4 State Listed Wildlife

The state of Ohio designates certain species as endangered, threatened, or special concern species based on their conservation status within the state (ODNR 2023). The ODNR maintains a list of documented observations for Ohio state listed species, which can be organized by county. Appendix B lists the state listed species which have been documented in Hamilton County and may therefore be present on the Project Area. This list represents a diverse array of wildlife that includes 62 taxa, including 22 species classified by the state as endangered (ODNR 2023).

No known records of state listed species are in the project area footprint, and a site visit conducted by a USACE biologist did not document listed species. Because many of the state listed species are ecological specialists that have very narrow habitat requirements and highly restricted ranges, the presence of the majority of these species can be eliminated from consideration due to the urbanized nature of the project area and the highly disturbed habitats found within the project area footprint. Transient species, those with more general life history requirements, or one or more of the fish or mussel species documented in the county may be found in the project area footprint.

2.7 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

2.7.1 Local Resources

The Little Miami River corridor contains some of the most scenic, interesting, and diverse natural features in the State of Ohio. For much of its length, it is an aesthetically pleasing stream, flowing alternately through a deep gorge, steep wooded slopes, farmlands, and occasional small riverside communities. Even though human activities are evident along many parts of the River' s edge, the River is relatively undeveloped when compared to other Ohio streams. The Little Miami River and its immediate surroundings are of major importance for open space and natural beauty in southwestern Ohio, where urban growth is rapidly destroying the few remaining natural areas.

The principal recreational and aesthetic resource in the vicinity of the project area is the Little Miami River. While this river's recreational opportunities are typical of other rivers in the region, these opportunities are enhanced by the protections granted to them by the WSRA. Canoeing and kayaking are popular activities, and the Little Miami River provides a regionally rare opportunity to enjoy these activities in a largely undeveloped, meandering stream environment. The Little Miami River is a valuable natural resource to the residents of the greater Cincinnati area that provides substantial recreational opportunities for people living in and near Cincinnati, Dayton, Hamilton, Middletown, Springfield, and Columbus, Ohio. These areas have few river-oriented recreation developments and only small segments of river areas under protection. These recreation opportunities are distinctive, of relatively high quality, in a natural environment, and not readily available elsewhere.

. The Little Miami River's vibrant ecology provides ample opportunity to see a wide variety of mammals, birds, reptiles, amphibians, and fish. This healthy ecosystem also enhances fishing. The Little Miami River's recreational qualities are protected under the WSRA as one of the river's outstanding remarkable values. The Little Miami River boasts substantial scenic value and the aesthetic quality of this section of the river is particularly important given the urbanized nature of the surrounding area . Roads along the River are generally screened by vegetation and inconspicuous.

2.8 CULTURAL RESOURCES

Several steps were taken to identify cultural resources within the proposed Project Area. These included a background check of the National Register of Historic Places (NRHP), the Louisville District Geographic Information System, the Ohio History Connection's Ohio Archaeological Inventory, and the Ohio Historic Inventory (both available online), and previous cultural resource survey reports that have occurred within and near the vicinity of the Project Area. The purpose of this records search was to identify and locate any previously recorded cultural resources or historic properties that could be affected by the proposed Project. The online records review of the Ohio Archaeological and Historic Inventories occurred on July 3, 2023. An online request for data was sent on December 12, 2023, as well. The online search found no known prehistoric or historic archaeological sites or above ground structures within the Project area footprint. It also determined that no previously recorded historic properties listed on the NRHP are located within the Project Area. No archaeological sites were located within a 0.5-mile radius of the proposed Project. No archaeological surveys have been previously conducted within the Project area. One archaeological survey was conducted within a 0.5-mile radius of the Project Area. Three above ground structures (HAM-5191-51 [Loveland Middle School], HAM-5192-51 [Miami Supply / Howard's Supply], and HAM-5193-51 [Presto Outing Club House]) have been previously recorded within a 0.25-mile radius of the Project Area. These three above ground structures will not be affected by the proposed undertaking. The records review of the NRHP database found no evidence of any previously recorded historic properties listed on the NRHP within a 0.25-mile radius of the Project Area.

2.9 NOISE

Changes in noise are typically measured and reported in units of A-weighted decibels (dBA), a weighted measure of sound level. Sound levels within the vicinity of the project area vary based on time of day and time of year. The primary sources of noise within the Project area include everyday vehicular traffic along the adjacent roadway (typically between 50 and 60 dBA at 100 feet) and human-generated recreational activities at the Project. Noise ranging from about 10 dBA for the rustling of leaves to as much as 115 dBA (the upper limit for unprotected hearing exposure established by the Occupational Safety and Health Administration) is common in areas where there are sources of recreational activities, construction activities, and vehicular traffic.

2.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The USEPA Envirofacts database was queried to identify hazardous, toxic, and radioactive waste (HTRW) sources within one mile of the project area footprint (USEPA 2024). A total of 10 USEPA facilities were documented near the project area footprint (Figure 7). Considering the urbanized nature of the area, a relatively conservative buffer was utilized based on the scope and design of the project and it's potential to impact or be impacted by HTRWs near the site. The list of facilities placed on the USEPA facilities list include generators, transporters, treaters, storers, or disposers of HTRW materials and a number of environmental laws and regulations area in place to deal with how they are reported and managed.

There is a record of a brownfield site approximately 0.53-miles to the northeast of proposed Project Site 3. A Phase 1 Environmental Assessment of the brownfield site was conducted in 2018 and no institutional controls were in place at the time, potentially indicating that the site is stable and of little threat to the surrounding area. Another facility was classified as a toxic waste emitter, with the last recorded release (of aerosolized hydrochloric acid) in 1995 (USEPA 2024). None of the listed sites are expected to be disturbed during the demolition or construction of the proposed Project. A complete list of facilities within the 1-mile buffer is provided in Appendix B.

Figure 7. United States Environmental Protection Agency-listed facilities within 1 mile of the proposed Loveland Shoreline Stabilization Project footprint (modified from USEPA 2024).

2.11 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE

2.11.1 EO 12898 Environmental Justice

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Exec. Order No. 12898, 1994) requires that, to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.

Executive Order 13985 Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (Exec. Order No. 13985, 2021) promotes racial equity and support for underserved communities and allocation of resources to address the historic failure to invest sufficiently, justly, and equally in underserved communities, as well as individuals from those communities.

Executive Order 14008 Tackling the Climate Crisis at Home and Abroad (Exec. Order No. 14008, 2021) established the Justice40 Initiative with the goal that 40 percent of the overall benefits of certain investments, including climate change and clean water infrastructure flow to disadvantaged communities.

The USEPA EJScreen tool was utilized to evaluate the demographic and environmental justice variables for the Project Area. Table 2 shows how EJ indexes for the area around the project compare to the State of Ohio, USEPA Region 5, and the United States. This data indicates while these EJ indexes are near or below the national and state medians, the indexes related to air pollution were notably above national levels. Approximately 13% of the total population surrounding the project area is comprised of minority populations, which is substantially lower than national averages. Approximately 21% of the population surrounding the project area is classified as low- income, which is similar to state averages but lower than national averages.

Table 2 - Environmental and demographic indicators present in the Loveland Project Area (Source: USEPA 2024).

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
POLLUTION AND SOURCES					
Particulate Matter ($\mu g/m^3$)	9.83	9.18	81	8.08	88
Ozone (ppb)	68	61.4	99	61.6	89
Diesel Particulate Matter ($\mu g/m^3$)	0.264	0.261	57	0.261	61
Air Toxics Cancer Risk* (lifetime risk per million)	27	22	0	25	5
Air Toxics Respiratory HI*	0.3	0.25	51	0.31	31
Toxic Releases to Air	14,000	10,000	87	4,600	94
Traffic Proximity (daily traffic count/distance to road)	40	110	41	210	35
Lead Paint (% Pre-1960 Housing)	0.31	0.44	39	0.3	59
Superfund Proximity (site count/km distance)	0.11	0.094	80	0.13	69
RMP Facility Proximity (facility count/km distance)	0.17	0.49	44	0.43	50
Hazardous Waste Proximity (facility count/km distance)	0.17	1.3	29	1.9	31
Underground Storage Tanks (count/km^2)	2	2.9	58	3.9	59
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.092	0.47	84	22	81
SOCIOECONOMIC INDICATORS					
Demographic Index	17%	28%	38	35%	25
Supplemental Demographic Index	9%	14%	25	14%	27
People of Color	13%	24%	50	39%	27
Low Income	21%	33%	36	31%	39
Unemployment Rate	4%	6%	50	6%	48
Limited English Speaking Households	0%	1%	0	5%	0
Less Than High School Education	2%	10%	16	12%	17
Under Age 5	4%	6%	37	6%	38
Over Age 64	13%	18%	35	17%	40
Low Life Expectancy	17%	21%	14	20%	28

The Council on Environmental Quality (CEQ) created the Climate and Economic Justice Screening Tool (CEJST) to help Federal agencies identify disadvantaged communities that have been historically marginalized, underserved, and/or overburdened by pollution. The CEJST identifies these communities through publicly available nationally consistent datasets. Under the current formula, a census tract will be identified as "disadvantaged" in one or more categories of criteria if the census tract is above the threshold for one or more environmental or climate indicators and the census tract is above the threshold for the socioeconomic indicators. A search conducted via the Climate and Economic Justice Screening Tool of the area immediately surrounding the project area footprint (Census Tract #39061024303) indicates that this area is not considered disadvantaged because it does not meet any burden or socioeconomic thresholds (CEQ 2023).

2.11.2 EO 13045 Protection of Children

Under this executive order, federal agencies must identify and assess environmental health and safety risks that may disproportionately affect children as a result of the implementation of federal policies, programs, activities, and standards. The EPA's EJScreen environmental justice mapping tool and the US Census Bureau's QuickFacts website were used to assess the environmental and demographic indicators within the project region. According to EJScreen, 4% of the population within the project region is under five years of age, putting this area in the 37th percentile in Ohio and the 38th percentile in the United States. The QuickFacts website indicates 24.7% of the estimated 2023 population within Hamilton County, Ohio is under the age of 18, compared to 23.5% of the population within the nation.

3 PLAN FORMULATION

3.1 OBJECTIVES AND CONSTRAINTS

3.1.1 Planning Objectives

The planning process for this Project is to investigate a cost-effective and environmentally acceptable plan to prevent active slope failures and erosion occurring along the Little Miami River that is threatening public infrastructure in the City of Loveland, Ohio. The study being conducted will recommend the most cost effective and environmentally acceptable solution for stabilizing the Little Miami River streambank in the project area. The Project Delivery Team (PDT) identified the following objectives:

- Implement a long-term shoreline stabilization plan that protects E. Kemper Road from foreseeable slope failures and further erosion.
- Stabilization efforts should be environmentally and economically acceptable; and
- Identify the least cost alternative that meets the purpose of this study.

3.1.2 Planning Constraints and Considerations

The PDT identified the following constraint:

- The shoreline stabilization plan must protect the designation of the Little Miami River as a Recreational River Area, and the plan must be coordinated with the Ohio Department of Natural Resources (ODNR) and the National Park Service (NPS).

The project considerations pertain to avoiding negative impacts to the streambank, the habitat, and nearby utilities. The PDT identified the following considerations:

- Actions identified must minimize impacts to the streambank and in-stream habitat.
- Solutions should avoid negative impacts to public utilities along the roadway.
- Topography and geography of the shoreline limits implementation.
- A railroad line near the Project area could provide permitting or procedural obstacles and should be avoided.
- Road closures during construction may necessitate traffic control.
- Implementation may need to avoid high water.

The selected plan and any subsequent permitting process for implementation must comply with the requirements associated with the Little Miami River's designation as a Recreational River Area. NPS and ODNR are responsible for making evaluations and determinations of effect in accordance with the Wild and Scenic Rivers Act. Once submitted for consideration, the NPS and ODNR will review the plan for impacts to the Little Miami River's free flowing condition, water quality, and its ORVs.

3.2 PROBLEMS AND OPPORTUNITIES

The Kope Formation is found throughout the state of Ohio. According to the Ohio Geology Interactive Map of the Ohio Department of Natural Resources, the three erosion sites are underlain by the Kope Formation that belongs to the Ordovician Age and includes shale and limestone interbedded with an average of 75% shale and 25% limestone (Figure 8).

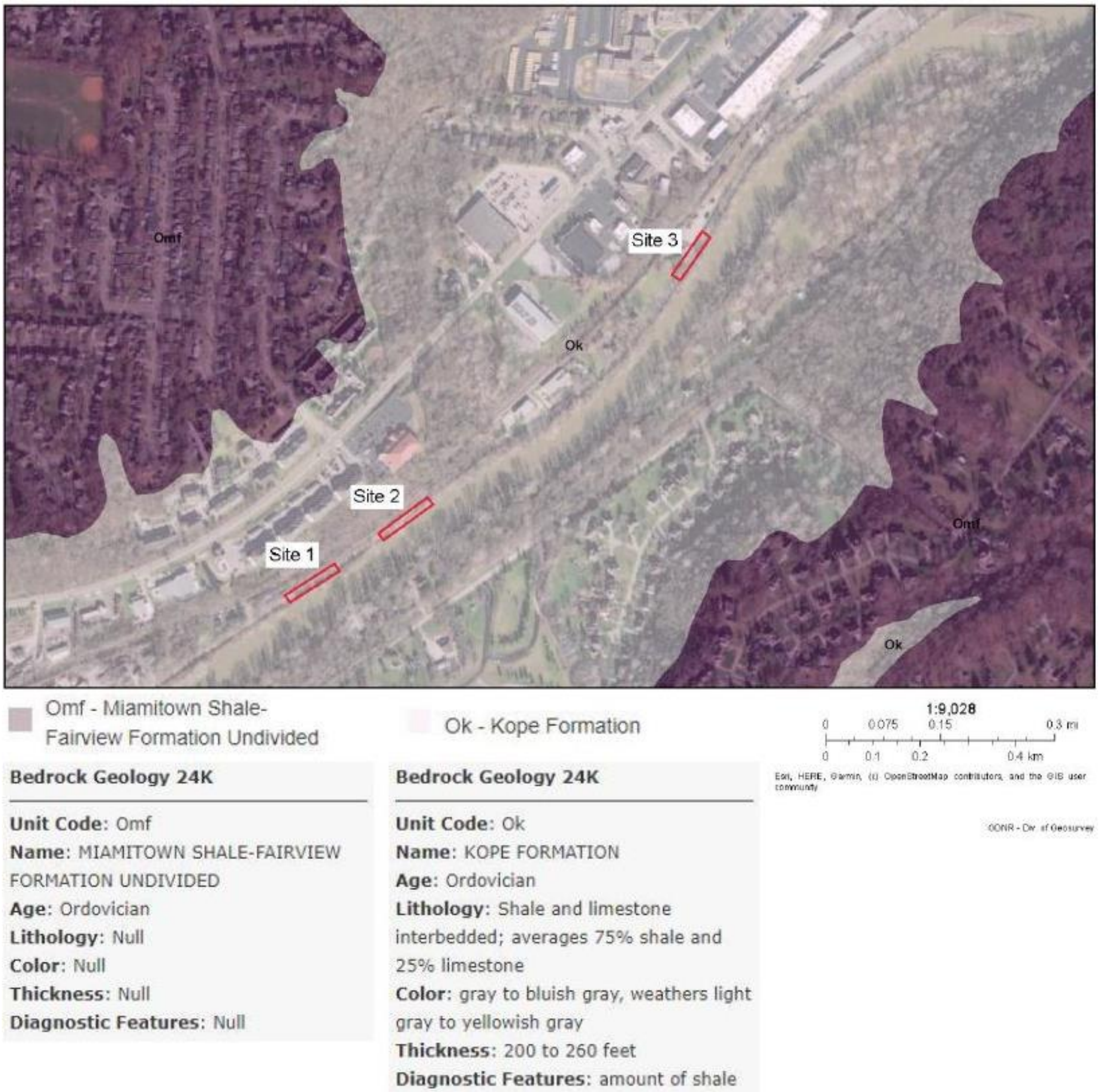


Figure 8. Bedrock Geology Map

This geology is known to create conditions that are susceptible to erosion and landslides; however, not all areas of the state are both susceptible to landslides and have high incident rates. The southwest corner of the state including Hamilton, Clermont, Brown and Adams Counties as well as small portions of Butler and Warren Counties have high susceptibility and incidence of landslides.

E. Kemper Road provides transportation for bus routes, local residents, emergency responders, and approximately 11 residences and 23 commercial businesses. The slope failures and erosion occurring in the project area will continue to negatively impact E. Kemper Road and may eventually result in failure of the road. As of September 2023, the traffic count on E. Kemper Road was 5,985 vehicles per day (TIMS 2023). The City of Loveland performs road repairs on a regular basis. Implementation of the proposed protection measures will restore stability to the streambank and prevent failure that would impact E. Kemper Road and the local community.

The following problems are seen at the project site specifically:

- Observed slope failures along the Little Miami River.
- Collapse of public infrastructure and private property along slope failure.

The following are opportunities that could result from the project:

- Stabilize the banks and protect public infrastructure.
- Repairs to the roadway may provide an opportunity to expand bike lanes to accommodate the growing recreation economy.
- Potential to provide safer access to a Recreational Wild and Scenic River.
- Potential to improve/promote aesthetics of a Recreational Wild and Scenic River.

3.3 MOST PROBABLE FUTURE WITHOUT PROJECT CONDITIONS

<u>Bank Failure Progression</u>

Without any intervention, it can be assumed that the bank will continue to experience slope failures and erode at a similar rate as has been observed over the past 10-20 years (Figure 9). The active slope failures of the streambank would continue unabated and eventually undermine the soils below E. Kemper Road. This will either result in the eventual full collapse of the highway into the Little Miami River or in the demolition of part of the highway sometime before the highway collapses into the River. In the former scenario, some form of cleanup project would be needed to remove roadway materials from the Little Miami River.

Figure 9 - Bank Failure Effect on E. Kemper Road in July 2023

<u>Climate Change</u>

The climate of the Project Area is generally temperate with cold winters and warm summers. The average annual high temperature is 65°F and the average annual low temperature is 44°F. The warmest month is July with a mean daily high of 87°F. The coldest average month is January, with the mean daily low being 39°F. The average annual precipitation and snowfall is 42.4 and 16 inches, respectively (NOAA 2023). The month with the highest average precipitation is May (4.7 inches), and the lowest average precipitation is February (2.6 inches).

Climate modeling and research gathered by USACE climate assessment suggests that increases in precipitation and flood events are expected to occur with greater intensity and frequency in the future. The failure of the outfalls and erosion at the project area would be expected to occur should the predicted climate patterns be realized, with the rate and degree of impact dependent on the frequency and intensity of local weather events.

3.4 MEASURES TO ACHIEVE PLANNING OBJECTIVES

3.4.1 Preliminary Structural and Non-Structural Measures

For Emergency Streambank Stabilization projects, non-structural measures are generally not considered to stabilize the streambank. Under Section 14 of the Flood Control Act of 1946, USACE is authorized to construct bank protection works to protect vital public facilities that are being threatened by streambank erosion. Based on the project location on the Little Miami River and the failure mechanism, the following measures were identified for consideration:

Riprap / Shot Rock Stabilization – Riprap stone protection is a method of armoring the streambank from erosion through the placement of blocky, gradated stone across its length. A toe is typically excavated to the depth of the scour. A revetment top and end protections are constructed to prevent erosion, wave action, floating debris, and water surface irregularities. Its intrusion into the stream is contingent upon the slope of the protection (i.e. 3:1 or 2:1). This measure would also include removing all debris and vegetation in the excavated area and placing material in a state approved landfill.

Wall with Tieback Anchors – Another option considered was a wall system, either post and panel or sheet pile, with tieback anchors. Sheet piling is an earth retention and excavation support technique that retains soils, using steel sheet sections with interlocking edges. Sheet piles are installed in sequence to a design depth along the planned excavation perimeter alignment. They are typically driven into the earth with a vibrator hammer. The interlocked sheet piles form a wall for permanent or temporary lateral earth support with reduced groundwater inflow. Tieback anchors can be included to provide additional lateral support if required. Tieback anchors are a horizontal wire or rod that reinforce retaining walls for stability. Tiebacks are anchored on one end to the wall and to a stable structure on the other. This measure would also include removing all debris and vegetation in the excavated area and placing material in a state approved landfill.

Launched Soil Nails with Riprap Stone Protection at Toe: Launched soil nails are long steel or fiberglass rods with a steel mesh or mat facing that are installed to reinforce or strengthen the existing ground. Soil nails are inserted using high pressure air by a launcher that can be mounted on a hydraulic excavator. The soil nails reinforce the locally unstable soil mass by transferring the nail's tensile and shear resistance through the failure plane of the sliding soil. The nails maintain the resisting force because they are anchored beyond the slip plane. Riprap stone placed in the scour area is anticipated near the toe. This measure would also include removing all debris and vegetation in the excavated area and placing material in a state approved landfill.

Chemical Grouting – Injecting chemical bonding agents into the soil matrix to stabilize the soils and provide additional strength.

Vegetated Riprap / Nature-based – Riprap integrated with nature-based solutions like vegetative plantings and woody materials.

Road Relocation – This measure would realign and relocate 3,300 linear feet of E. Kemper Road. The road would require a complete redesign moving the road into the embankment to the north of the road currently to avoid the advancing erosion and to ensure safe passage.

3.4.2 Excluded Measures

The existing and Future Without Project (FWOP) conditions were considered. A FWOP would result in continued slope failures and erosion leading to adverse impacts to E. Kemper Road. Failure to stabilize the streambank would eventually result in full collapse of the road into the Little Miami River or in the demolition of part of the road sometime before the highway collapses into the River.

No specific measures that were considered were excluded, and all measures were carried forward to develop alternatives.

3.5 FORMULATION AND COMPARISON OF ALTERNATIVE SOLUTION SETS

Each measure became a standalone alternative plan. Per USACE Engineering Pamphlet (EP) 1105-2-58 for Emergency Streambank and Shoreline Erosion Protection of Public Works and Non-Profit Public Services Projects, the least cost alternative plan is considered to be justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility. The threatened facility for this Project is E. Kemper Road. .

3.5.1 Initial Array of Alternative Plans

The streambank erosion management measures were combined to form an initial array of alternative plans. Per EP 1105-2-58, the option of relocating threatened facilities must be considered and compared with alternatives in CAP Section 14 analysis. In this case, relocation of E. Kemper Road was considered a non-structural “measure” and was the basis for cost comparison and alternative selection. The initial cost estimates include the cost of construction, as well as cultural resources and environmental mitigation, which were considered factors during initial planning of the study. In addition to No-Action, six alternatives were identified as an initial array:

Alternative Plan 1 (Riprap/Shot Rock Stabilization) - The riprap/shot rock remediation alternative would include at a minimum removing all the existing fill in the area contained within the observed slope failure and the material surrounding the damaged storm sewer to expose the underlying undisturbed clay. The failure zone (Zone A) would likely be defined as being a minimum of five feet beyond the tension crack observed along the road and extend downward at an approximate 1 horizontal to 1 vertical (1H:1V) slope until undisturbed native soils are encountered. For constructability, Zone A would likely be extended to include the materials supporting the storm sewer. The removed materials in Zone A would be replaced with riprap and shot rock to restore the slope. A 2H:1V outer slope between E. Kemper Road and Little Miami River would be created for the three sites with crushed stone consisting of riprap and shot rock properly benched into the underlying undisturbed soils (sizes of the benches will depend on the grade revealed when removing the existing fill) and the 1H:1V existing fill slope (typical benches would be 1H:1V but will be determined during the design phase). Shot rock will be used to reconstruct most of the remediated areas with riprap placed on the outer slopes along the Little Miami River. The riprap should be sized to the anticipated velocities of the Little Miami River to protect the slope from erosion. A choke stone should be placed over the shot rock to provide a working surface for the stone base course of E. Kemper Road. In utility areas, consider bedding utilities and backfilling utility trenches with controlled low-strength material (CLSM). CLSM is a low strength concrete material. Use of this as bedding and backfill of utilities reduces the risk of loss of support of the utility through material loss within the utility and into the surrounding crushed stone. Potential future failures within the underlying low strength zone of the Kope Formation would disturb the remediated stone slope. However, crushed stone such as riprap and shot rock used to initially remediate the slope should be suitable to be used to reconstruct the slope. Additionally, depending on the nature of a slope failure, the resulting slope and residual strength of the crushed stone may be sufficient that only a slight modification of the disturbed slope would be necessary to restore stability. The construction cost for riprap/shot rock at a conceptual level is estimated to be $4,370,000 (FY2024). See Figure 11 below.

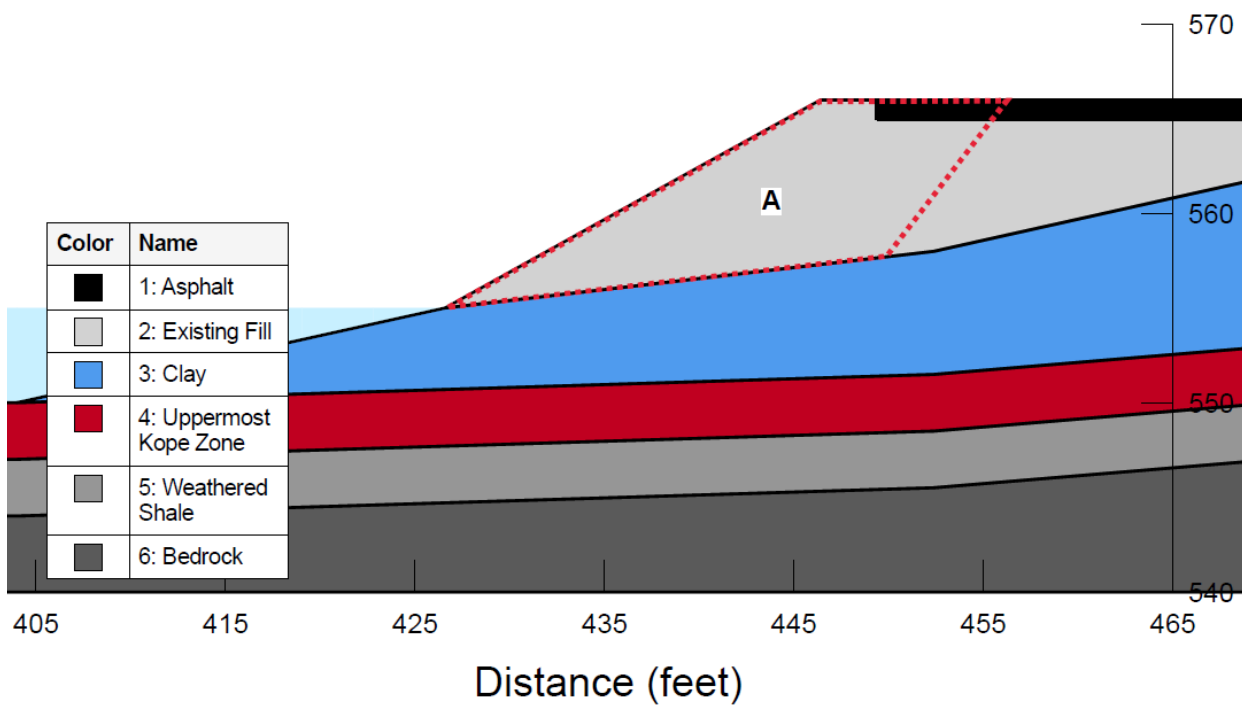


Figure 10 - Alternative 1 Riprap/Shot Rock Stabilization

A – Minimum zone of soils replaced with riprap/shot rock.

Alternative Plan 2 (Wall with Tieback Anchors) - A wall system, either post and panel or sheet pile, was considered as a potential remediation method. Several factors would impact the design of a wall system. The only soil removal and replacement for this option would be the required soil removal and replacement completed during the replacement of the damaged storm sewer. The weaker residual strength soils in Zone D would remain.

Assuming that the riverside soils in Zone C were replaced during construction, the wall design still must account for the erosional losses in Zones C and D (area included in the red dashed line), the weakened properties of Zone D, and the steep slope on the river side of the wall. This condition with the relatively thin layer of soils (approximately 10 feet of existing fill and native clay) and uppermost Kope zone (approximately 3 feet) overlying the weathered shale would likely require the wall to be reinforced with anchors. In addition, portions of the system (anchors and or sheet piles) would be susceptible to material loss over time from corrosion. This method of repair would only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope formation would damage the wall system and require reconstruction of the wall. The cost for a wall with tieback anchors at a conceptual level is estimated to be $6,150,000 (FY2024). See Figure 12 below.

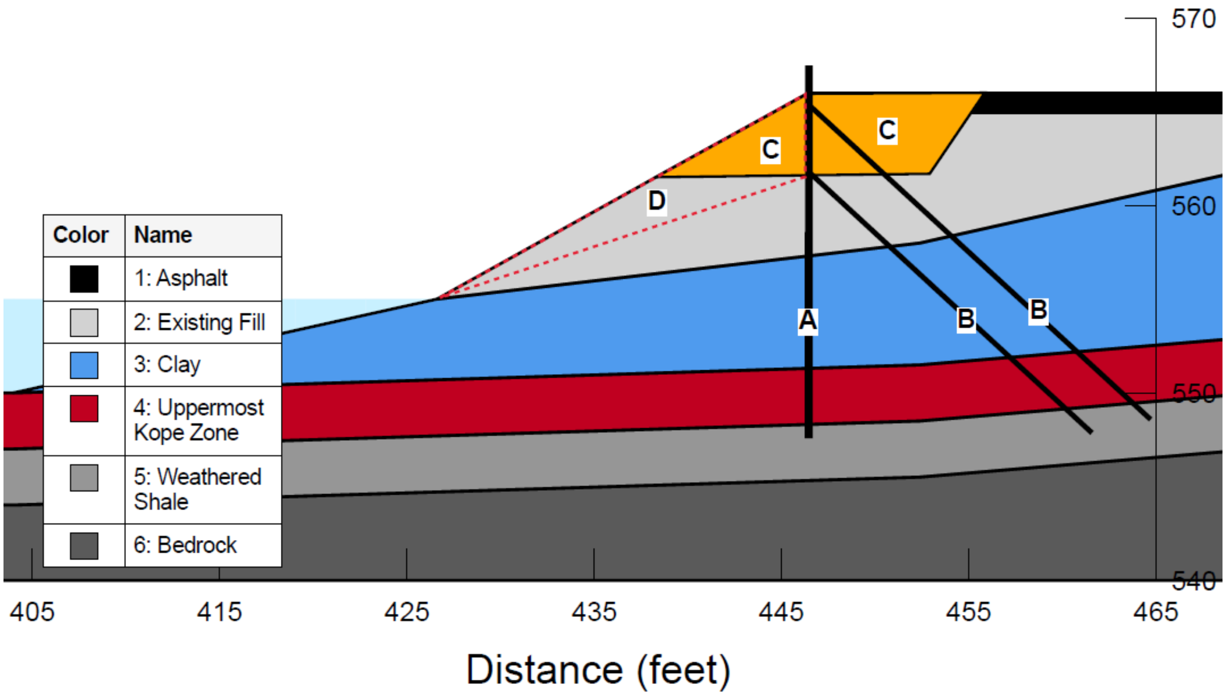


Figure 11 - Alternative 2 Wall with tieback anchors

A – Wall (sheet pile or post and panel)
B – Tieback Anchors
C – Minimum zone of material anticipated to be removed for the repair of the storm sewer
D – Weakened zone of soils in residual strength due to past failure(s)

Alternative Plan 3 (Soil Anchor Reinforcement) - A soil anchor system with a reinforcing mat was a system of remediation considered for this project. The only soil removal and replacement for this option would be the required soil removal and replacement completed during the replacement of the damaged storm sewer. The weaker residual strength soils in Zone D would remain. The anchors and reinforcing mat would be used to stabilize the soils of the upper slope. It is estimated that approximately 366 soil nails will be needed and installed in a systematic pattern to stabilize the existing bank slope. As with the wall system, portions of the system (anchors and reinforcing mat) would be susceptible to material loss over time from corrosion. This method of repair would also only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope formation would damage the anchor system and require reconstruction. The cost for soil anchor reinforcement at a conceptual level is estimated to be $4,580,000 (FY2024). See Figure 13 below.

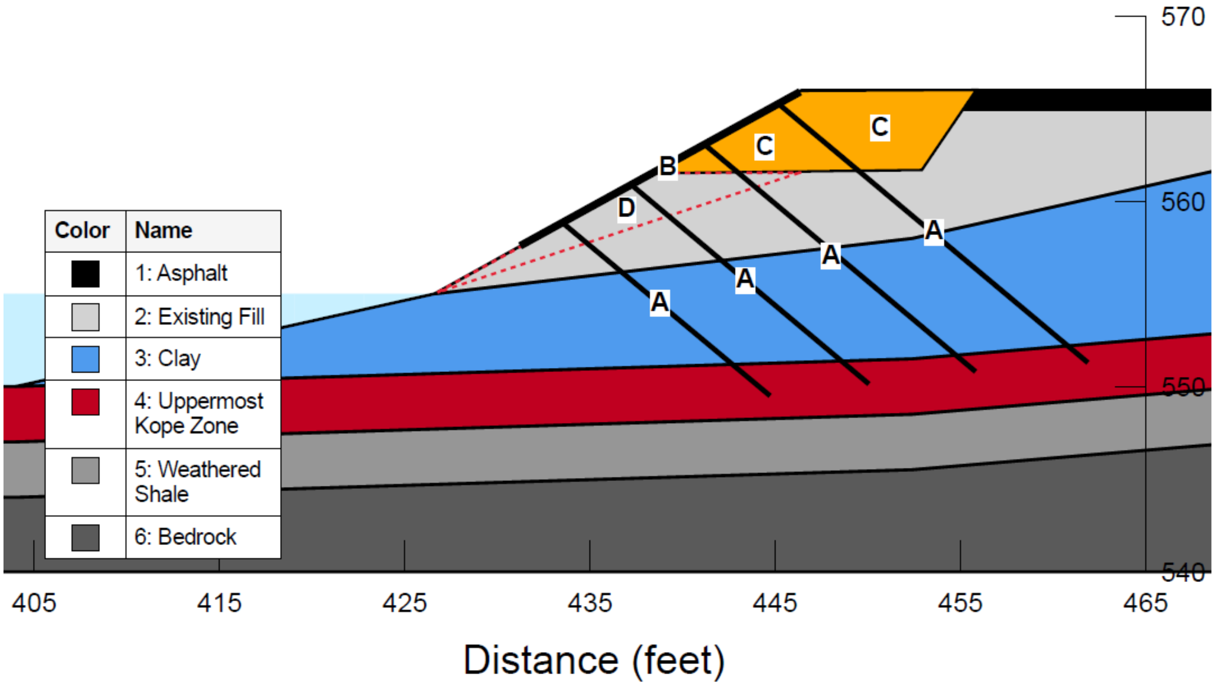


Figure 12 - Alternative 3 Soil Anchor reinforcement

A – Soil Anchor
B – Reinforcing Mat
C – Minimum zone of material anticipated to be removed for the repair of the storm sewer
D – Weakened zone of soils in residual strength due to past failure(s)

Alternative Plan 4 (Chemical Grouting) - Chemical grouting is a method of slope remediation that injects chemical bonding agents into the soil matrix to stabilize the soils and provide additional strength. Chemical grouting requires a specialty contractor with a high level of experience for a successful application. For the existing fill soils underlying the road, the grouting process is anticipated to be difficult due to the variability in the soil composition (clay/silt, with sand and gravel).

The only soil removal and replacement for this option would be the required soil removal and replacement completed during the replacement of the damaged storm sewer. The weaker residual strength soils and the remaining existing fill in Zone A would remain. The soils in Zone A would be later chemically stabilized to improve the overall slope stability. This method of repair would also only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope Formation would likely damage the matrix of the chemically grouted soils and require additional chemical grouting or other remediation methods to restore the stability of the slope. The cost for chemical grouting at a conceptual level is estimated to be $9,500,000 (FY2024). See Figure 14 below.

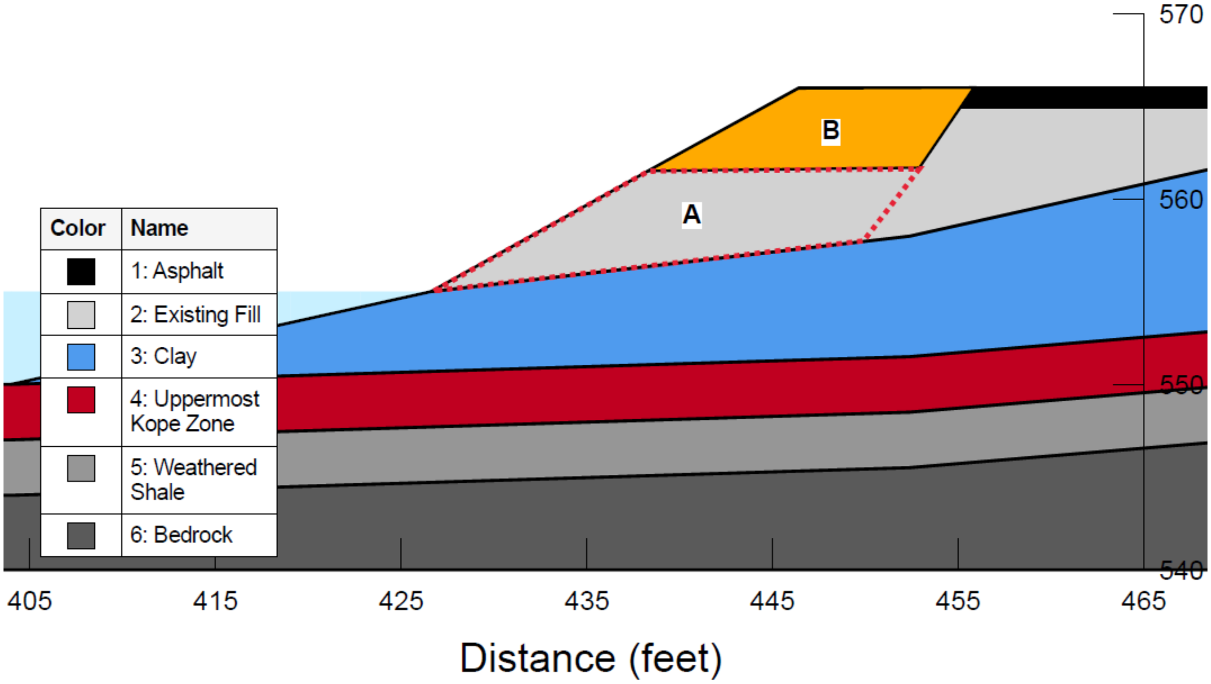


Figure 13 - Alternative 4 Chemical Grouting

A – Chemically Grouted Soils
B – Minimum zone of material anticipated to be removed for the repair of the storm sewer.

Alternative Plan 5 (Road Relocation): Re-aligning E. Kemper Road by moving away from the area of distress does not resolve the erosion issue but it would provide residents with an alternative means of ingress and egress when slope failures and erosion impact E. Kemper Road in its current location. Constructing a new road alignment would be challenging because of the surrounding topography, the Little Miami River to the south, steep slopes and a railroad to the north, and other roads and utilities in the area. The PDT formulated costs based on construction of a conceptual road approximately 3,300 linear feet in length and 19 linear feet in width, which would require clearing of 3.3 acres as well as relocation of all utilities in the vicinity. The cost for relocation at a conceptual level is estimated to be $9,830,000 (FY2024).

Alternative Plan 6 (Vegetated Riprap): Vegetated riprap would be the same as the riprap/shot rock remediation alternative, but with the addition of vegetation. After placement of the riprap, slurry comprised of a mixture of water and topsoil will be pumped into the surface voids of the riprap. After placement of the slurry, topsoil will be placed to create a smooth surface that will support vegetative growth. The topsoil will be hydroseeded with native grasses and plants suitable for the application and site conditions. The cost for vegetated riprap at a conceptual level is estimated to be $4,227,000 (FY2024).

No Action Alternative (NAA): The "No Action" Alternative would result in continued slope failures and erosion leading to adverse impacts to E. Kemper Road. Failure to stabilize the streambank would eventually result in full collapse of the road into the Little Miami River or in the demolition of part of the road sometime before the highway collapses into the River. In the former scenario, some form of cleanup project would be needed to remove roadway materials from the Little Miami River. Without the USACE funded project, the NFS would have to fix the slope failure problem themselves, continue making road surface repairs, relocate E. Kemper Road, realign the current roadways to provide substitute ingress and egress, buy out the properties (or a combination of these activities), or take no action. Under the no action alternative, no other projects would occur in the area in the foreseeable future.

3.5.2 Alternative Evaluation and Screening

Alternative Plans 1-6 were evaluated against the planning objectives and constraints (Section 3.2), based on a three-tiered rating scale (Table 3):

- Fully meets objectives / avoids constraint (2)
- Partially meets objectives / partially avoids constraint (1)
- Does not meet objectives / does not avoid constraint (0)

The PDT then assigned each measure a 2, 1 or 0 rating on how well it met the criteria.

Table 3 - Evaluation of Alternatives Against Objectives and Constraint

	OBJECTIVES			CONSTRAINT	SCORE
ALTERNATIVE	**1**	**2**	**3**	**1**	
1. Rip Rap	2	1	2	1	**6**
Justification	Partially meets objective 2, fully meets objectives 1 and 3.			Partially avoids constraint	
2. Wall with Tieback Anchors	1	1	1	1	**4**
Justification	Partially meets all objectives.			Partially avoids constraint	
3. Soil Anchor Reinforcement	1	1	1	1	**4**
Justification	Partially meets all objectives.			Partially avoids constraint	
4. Chemical Grouting	1	1	0	1	**3**
Justification	Partially meets objectives 1 and 2, does not meet objective 3.			Partially avoids constraint	
5. Road Relocation	2	0	0	2	**4**
Justification	Does not meet objectives 2 and 3, fully meets objective 1.			Fully avoids constraint	
6. Vegetated Riprap / Shot Rock	2	2	1	2	**7**
Justification	Fully meets objectives 1 and 2, partially meets objective 3.			Fully avoids constraint	

Alternative 6 received the highest evaluation/score across the objectives and constraints.

Finally, other factors relevant to the screening of measures were discussed which begin to incorporate the Principles & Guidelines alternative selection criteria of Completeness, Effectiveness, Efficiency and

Acceptability (Table 4). These criteria are defined in the USACE Engineering Regulation (ER) 1105-2-100 Planning Guidance Notebook as different measures of the extent to which each alternative plan achieves its goal of meeting the planning objectives.

- Completeness: A measure of the extent to which the necessary investments and actions, both Federal and Non-Federal, have been considered and provided for.
- Effectiveness: The extent to which each alternative plan contributes to achieving the planning objectives.
- Efficiency: A measure of the cost effectiveness of each alternative to meet the project objectives.
- Acceptability: The extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies.

Table 4 - Principles & Guidelines Alternative Screening

Alternative	Complete	Effective	Efficient	Acceptable
No Action Alternative	HIGH	LOW	HIGH	LOW
1. Riprap / Shot Rock	HIGH	HIGH	HIGH	MED
2. Wall with Tieback Anchors	HIGH	MED	LOW	MED
3. Soil Anchor Reinforcement	HIGH	MED	MED	MED
4. Chemical Grouting	HIGH	LOW	LOW	MED
5. Road Relocation	LOW	HIGH	LOW	MED
6. Vegetated Riprap / Shot Rock	HIGH	HIGH	MED	HIGH

LOW = Low score

MED = Medium score

HIGH = High score

EP 1105-2-103 Policy for Conducting Civil Works Planning Studies provides direction on the comprehensive assessment and documentation of benefits in the conduct of USACE water resources development project planning. In compliance with this memorandum, USACE also conducted an evaluation of alternatives (Table 5) based on National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ) and Other Social Effects (OSE). The costs included on this table are construction costs.

- The NED account for Section 14 identifies the least cost environmentally acceptable plan, which is less than relocation cost of the facility; in the following table, NED is calculated by subtracting the cost of the alternative from the cost of the road relocation plan.
- The RED account registers changes in the distribution of regional economic activity that result from each alternative plan.
- The EQ account displays non-monetary effects on significant natural and cultural resources.
- The OSE account registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

Table 5 - Four Accounts of Focused Array of Alternatives

Alternative (Construction Cost)	National Economic Development (NED) (Relocation – Implementation)	Regional Economic Development (RED)	Environmental Quality (EQ)	Other Social Effects (OSE)
No Action Alternative	N/A	N/A	Continued slope failure along E. Kemper Road equates to discharge of sediment into the Little Miami River.	Increased risk of reduced access to emergency services for 11 residences and 23 commercial businesses in the event of complete road failure. Safety issues remain with potential road failures and damages to road surface.
1 – Riprap / Shot Rock (4,370,000) (FY2024)	-$5,463,000	Comparatively this alternative will require the least amount of trades and laborers. Quarries are located in the vicinity and yield sufficient stone with minimal processing. Regional and local economic impacts are considered negligible given the scale of the project.	Sediment discharge mitigated. Rock habitat preferrable over other alternatives as sediment will accumulate in rock voids and revegetate with non-invasive herbaceous plants.	Moderate visual degradation of shoreline as viewed from E. Kemper Road, the Little Miami River and the opposite bank. Temporary traffic delays during construction.
2 – Wall with Tieback Anchors ($6,150,000) (FY2024)	-$3,683,000	The limited volume of tieback anchors and wall materials would result in a negligible regional economic impact. Specialized equipment and laborers are available in the local area.	Sediment discharge mitigated. Limited opportunities for shoreline habitat.	High visual degradation of streambank as viewed from E. Kemper Road, the Little Miami River and the opposite bank. Temporary traffic delays during construction.

3 – Soil Anchor Reinforcement ($4,579,000) (FY2024)	-$5,254,000	The limited volume of soil anchors would result in a negligible regional economic impact. Specialized equipment and laborers are available in the local area.	Sediment discharge mitigated. Limited opportunities for shoreline habitat.	High visual degradation of streambank as viewed from E. Kemper Road, the Little Miami River and the opposite bank. Temporary traffic delays during construction.
4 - Chemical Grouting ($9,495,000 (FY2024)	-$338,000	Regional and local economic impacts are considered negligible given the scale of the project.	Sediment discharge mitigated. Limited opportunities for shoreline habitat. Comparatively more negative environmental effects.	High visual degradation of shoreline as viewed from E. Kemper Road, the Little Miami River and the opposite bank. Temporary traffic delays during construction.
5 - Road Relocation ($9,833,000) (FY2024)	$0	It is expected that a comparatively larger and diverse group of trades will be required. The production of required asphalt will have a negligible benefit that extends beyond local impact area.	Environmental impacts would very likely be incurred by the construction of a new roadway.	Road relocation would require extensive, ongoing traffic disruptions and would create access issues for local businesses and residents along E. Kemper Road, which could result in decreased revenue and/or emergency access. Temporary traffic delays during construction.
6 – Vegetated Riprap / Shot Rock (4,227,000) (FY2024)	-$5,606,000	Comparatively this alternative will require the least amount of trades and laborers. Quarries are located in the vicinity and yield sufficient stone with minimal processing. Regional and local economic impacts are considered negligible given the scale of the project.	Sediment discharge mitigated. Rock habitat preferrable over other alternatives as sediment will accumulate in rock voids and revegetate with non-invasive herbaceous plants. Additionally, intentional vegetated plantings/seeding will increase habitat. Project will preserve the toe where possible.	Moderate visual degradation of shoreline as viewed from E. Kemper Road, the Little Miami River and the opposite bank. Mitigation with vegetative plantings at project site. Temporary traffic delays during construction.

Based on the alternatives evaluation and screening, Alternative 6 – Vegetated Riprap / Shot Rock was identified as the Tentatively Selected Plan (TSP) as the cost is less than the cost to relocate the threatened facility (E. Kemper Road). The $5,606,000 difference in cost between Alternative 6 and the road relocation alternative (Alternative 5) provides economic justification for the TSP. Alternative 6 (Tentatively Selected Plan) is the least costly and most environmentally acceptable plan. It is important to note that at the time of the Four Systems of Accounts, only a Rough Order of Magnitude estimate was available at the time and had not been refined yet through an Abbreviated Risk Analysis (ARA). Only the TSP went through an ARA, not all alternatives. If cultural resources and environmental mitigation (along with other refined costs) were added on to all alternatives, the TSP would still be the least cost, environmentally acceptable alternative.

Alternative 6 is the most environmentally acceptable plan because the rock habitat is preferable over the other alternatives, as sediment will accumulate in rock voids and revegetate with non-invasive herbaceous plants. Additionally, intentional vegetated plantings/seeding will increase habitat. Coordination with NPS indicates Alternative 6 is the most likely to fulfill the Wild and Scenic River aesthetic and visual requirements and will be most likely to receive a permit. Additionally, Alternative 6 is the most sustainable plan as it provides the easiest and most efficient repair and maintenance in case of future failure of the underlying Kope formation or potential damage to the Project from outside influences such as unwanted vegetative growth in the riprap. Of all the alternatives, riprap is the most efficient and least technical repair.

Alternatives 1-5 were excluded from further consideration as none of these plans were less expensive or more environmentally acceptable than Alternative 6, per Table 5. Alternative 6 and the NAA were moved on to the final array of plans for this project. The full cost breakdown for Alternative 6 is included in Appendix C. Section 3.6 further describes the TSP.

3.5.3 Risk and Uncertainty

The risks and uncertainties for this Project are discussed in more detail in the risk register and the Cost Engineering ARA in Appendix C. Based on Louisville District's previous experience with CAP Section 14 projects, the following items were identified for monitoring as the project progresses:

- Compatibility of design with Wild & Scenic River requirements,
- Possible mitigation for Federal and state listed species,
- Risk of Kope failure,
- Extreme weather causes a significant slope failure event,
- Timing of survey work,
- Work below the OHWM, and
- $5M federal limit on CAP 14 projects.

Early coordination and outreach with the NPS indicated that the plan should include methods to mitigate negative visual effects to the Little Miami River corridor in the Project area. The TSP includes a vegetated component which will reduce negative visual effects of the Project.

Early coordination with both ODNR and USFWS determined that a mussel survey will need to be conducted within the project footprint. The mussel survey will be performed during Design & Implementation (D&I) phase. Because all native mussels are protected in the State of Ohio (Title 15 Ohio

Revised Code Section 1533.24), the discovery of mussels within the project footprint would likely result in a mussel relocation effort. Assuming no listed mussels are documented, a mussel salvage and relocation can occur concurrent to the mussel survey itself.

Assuming the area of removed forested habitat remains less than 5 acres in size, potential impacts to resident bats may be avoided via a seasonal harvest restriction which limits the removal of trees to between October 1 and March 31.

Due to a lack of initial investigations and surveys, construction material quantity development is reduced. The risk associated with the amount of materials quantities is low. The Project Area is relatively small, and contingency has been added to the estimated area, so any materials adjustments that could arise would have low impact. Quantities are developed based on current assumptions. Additional quantity development will be gathered during the D&I phase and will contain some level of conservatism. Due to the relative simplicity of the Project, USACE is willing to accept these risks and evaluate quantities in more detail during the D&I phase.

In addition to the contingency applied to the cost, an abbreviated risk analysis has been performed in order to develop the most accurate cost. Additionally, the PDT expects to reduce the project area footprint after a land survey during D&I, which will reduce materials quantities and the total project cost.

Work below the OHWM may increase environmental mitigation costs because risk to federal and state listed species would be higher, and environmental permits would be required. During the development of plans and specifications, survey work can be completed, project area limits can be further identified, and not constructing during the wet season can alleviate the mitigation associated with high water. The risk of potential modification or claim is generally a risk on any construction project. The risk associated with unknown water elevation is low. Potential environmental permits are included in the total project cost estimate in the event that they are required.

3.6 TENTATIVELY SELECTED PLAN

Alternative 6 (Vegetated Riprap / Shot Rock) is recommended for implementation as the least cost and most environmentally acceptable plan. Alternative 6 is the Tentatively Selected Plan (TSP).

3.6.1 Tentatively Selected Plan Description

Using riprap and shot rock to reconstruct the upper slope is the TSP for the three areas of slope failure and erosion included in this Project Area (Figures 15 and 16). It is assumed that during the remediation of the slopes that the significant joint separations and damage to the storm sewer lines underneath E. Kemper Road would be repaired as part of the remediation. The cost for repairing utilities lines is the responsibility of the NFS and is included in the total project cost as “Relocations” (Section 3.6.2). Depending on the extent of the repair areas, additional utility relocations may be required. It is anticipated that remediation may extend under E. Kemper Road. The NFS would be responsible for any repairs necessary to address the threatened facility.

The removed region of material from the slope and under the road (assumed to consist of existing fill based on the boring data) would begin beyond the observed tension cracks (typically 5 feet in most cases but must be confirmed during the design phase) and include the vertically and laterally displaced areas observed along E. Kemper Road. The removed region of the existing fill would be cut to a 1H:1V slope to a depth to expose the underlying undisturbed soils. A 2H:1V outer slope between E. Kemper Road and Little Miami River would be created for the three sites with crushed stone consisting of riprap and shot rock properly benched into the underlying undisturbed soils (sizes of the benches will depend on the grade revealed when removing the existing fill) and the 1H:1V existing fill slope (typical benches would be 1H:1V but will be determined during the design phase). Shot rock will be used to reconstruct most of the remediated areas with riprap placed on the outer slopes along the Little Miam River. The riprap should be sized to the anticipated velocities of the Little Miami River to protect the slope from erosion. A choke stone should be placed over the shot rock to provide a working surface for the stone base course of E. Kemper Road. In utility areas, consider bedding utilities and backfilling utility trenches with controlled low-strength material (CLSM). CLSM is a low strength concrete material. Use of this as bedding and backfill of utilities reduces the risk of loss of support of the utility through material loss within the utility and into the surrounding crushed stone. Refer to the GeoStudio models in Appendix A, Attachment K for the example cross sections.

Implementation of the TSP must comply with the requirements associated with the Little Miami River's designation as a Recreational River Area. Vegetated riprap was chosen to accomplish this by limiting the visibility of the riprap and preserving the aesthetic value of the Project Area. After placement of the riprap, slurry comprised of a mixture of water and topsoil will be pumped into the surface voids of the riprap. After placement of the slurry, topsoil will be placed to create a smooth surface that will support vegetative growth. The topsoil will be reseeded with native grasses and plants and reseeding techniques suitable for the application and site conditions. As part of ongoing operations and maintenance of the Project, large trees will not be allowed to establish in the riprap as this would compromise the integrity of the Project (Section 6.4).

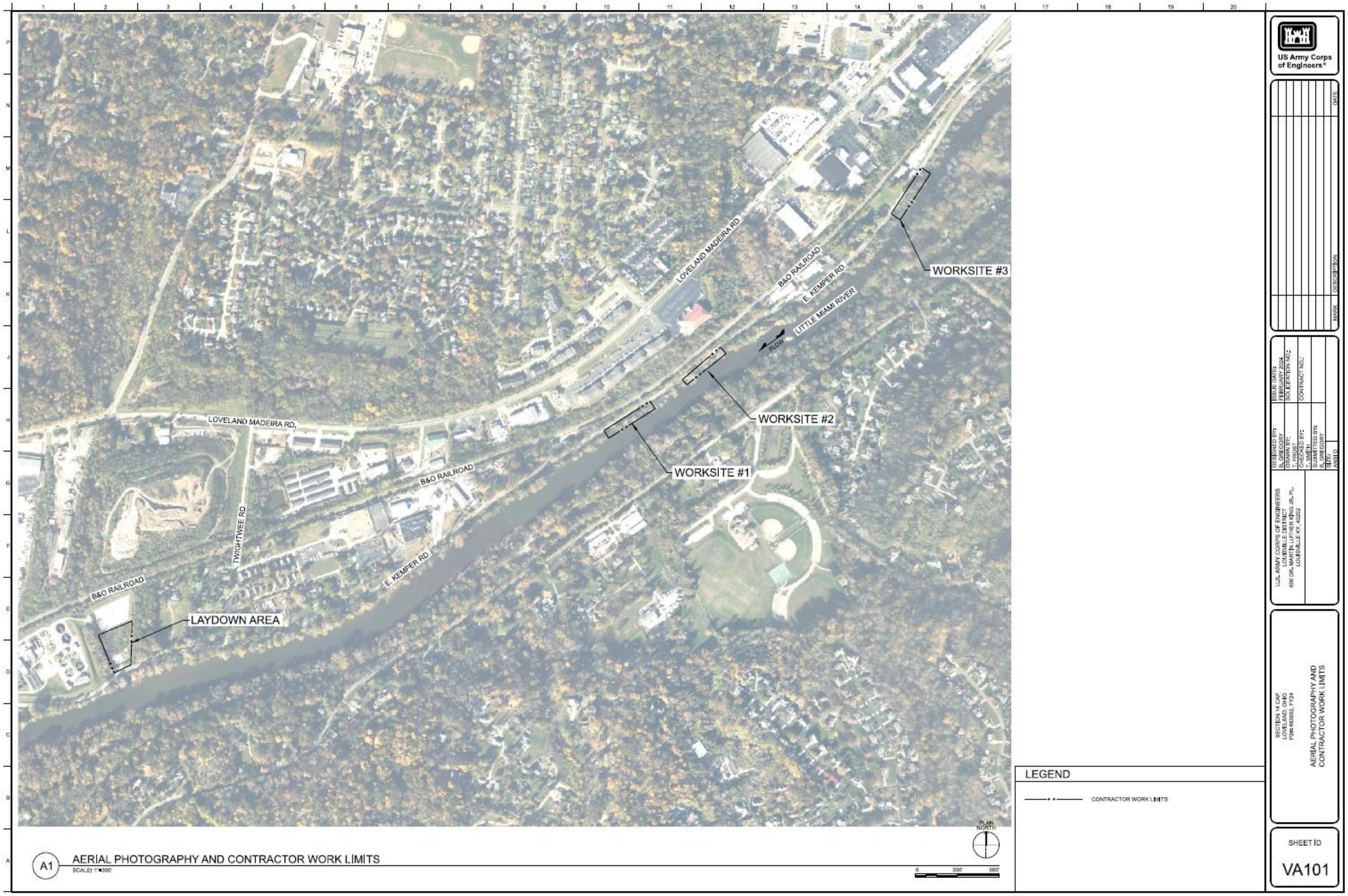
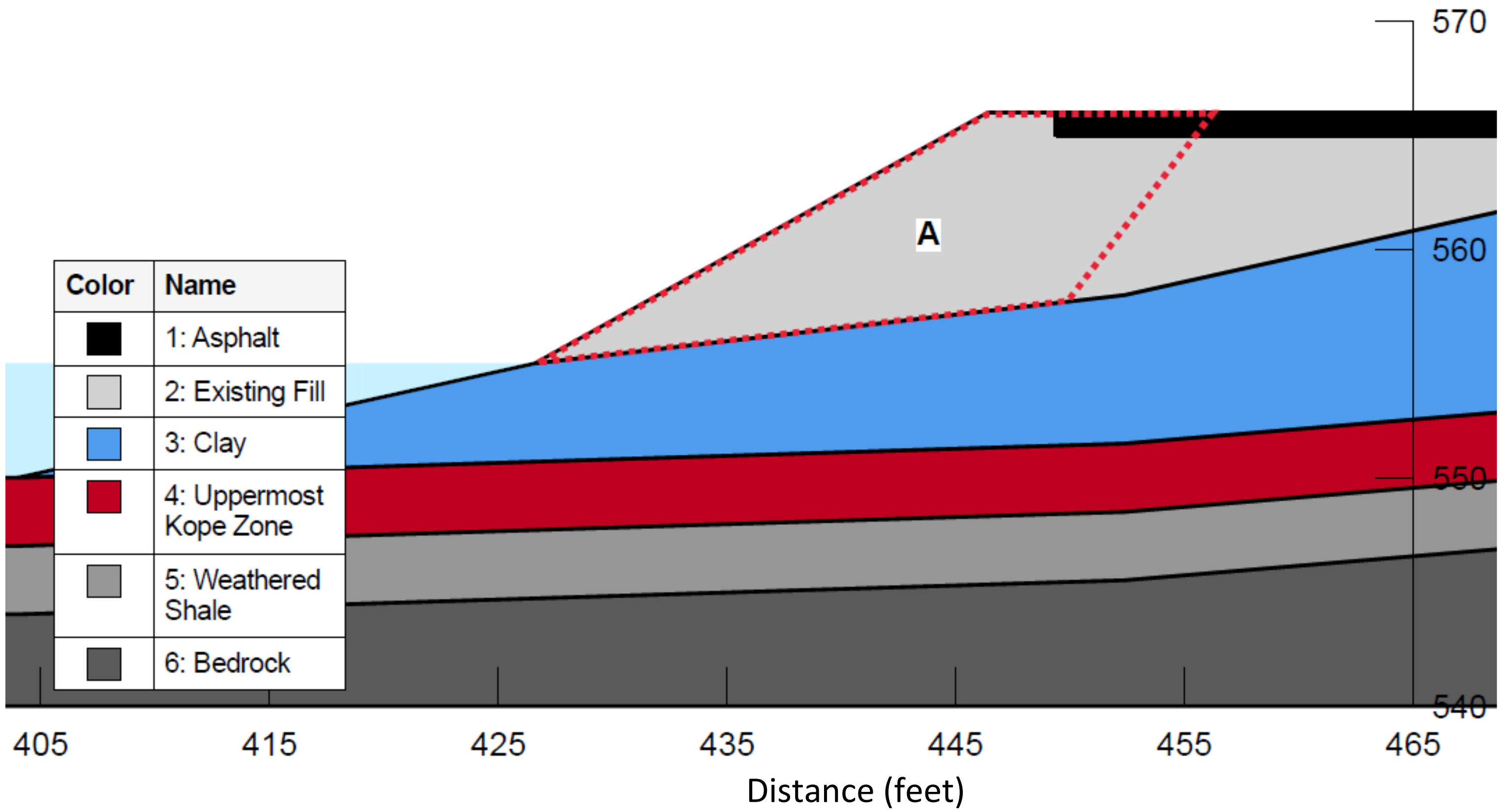


Figure 14. Aerial Photography and Contractor Work Limits of the proposed Loveland Shoreline Stabilization Project.



A – Minimum zone of soils replaced with riprap/shot rock.

Figure 15. Cross-Section of the Riprap/Shot Rock Alternative

Appendix A includes engineering diagrams, work limits, extents and typical cross sections. Table 6 below includes line-item quantities for the tentatively selected plan. The design and implementation cost will be further refined and broken out in the design and implementation phase of the project.

Table 6 - Estimated Quantity Summary Table

Estimated Quantity Summary Table		
Work Item	Unit	Quantity
Clearing and Grubbing		
Work Site 1	0.23	Acre
Work Site 2	0.15	Acre
Work Site 3	0.24	Acre
Erosion and Sediment Control		
Work Site 1	400	LF
Work Site 2	300	LF
Work Site 3	400	LF
Topsoil Stripping		
Work Site 1	184	CuYd
Work Site 2	123	CuYd
Work Site 3	194	CuYd
Rip Rap Stone		
Work Site 1	1473	CuYd
Work Site 2	984	CuYd
Work Site 3	1152	CuYd
Shot Rock		
Work Site 1	3111	CuYd
Work Site 2	2344	CuYd
Work Site 3	3051	CuYd
Vegetative Treatment		
Plantings	6,765	EA
Seeding	27,060	Sq ft
*Utilities		
Electrical		
40 ft wooden post	3	EA
Distribution cable	0.5	mi
Telecom		
30 ft wooden post	2	EA
Fiber optic cable	805	LF
Storm Sewer		
12” RCP	1,140	LF

18” RCP	805	LF
Concrete headwall	6	EA
Catch basins	8	EA
Manholes	8	EA
Sanitary Sewer		
20” HDPE pipe	1,140	LF
Manholes	10	EA

* Utilities costs and quantities are rough estimates as they are the responsibility of the NFS

3.6.2 Estimated Project Costs and Schedule

Since the feasibility phase of the CAP Section 14 project for the City of Loveland was completed in Fiscal Year (FY) 2024 within the $100,000 limit, a Federal Cost Share Agreement (FCSA) was not required. The total cost for Alternative 6 was further developed after the Abbreviated Risk Analysis (ARA), and the construction cost was reduced. Table 7 presents a breakdown of the estimated Total Project Cost in FY2024 dollars. Table 8 presents the estimated first cost and apportionment for design and construction. The Cost Certification in Appendix C provides a breakdown of project costs.

Table 7 - Estimated Project Costs

Feature	Total Project Cost ($ in thousands)
Relocations	$1,045
Fish & Wildlife Facilities	$113
Bank Stabilization	$4,979
Cultural Resource Preservation	$0
Lands and Damages	$45
Planning Engineering & Design	$820
Construction Management	$348
TOTAL PROJECT COST (FY2024)	**$7,350**
TOTAL Federal (65%)	**$4,778**
TOTAL Non-Federal (35%)	**$2,573**

Table 8 - Estimated Project Costs and Apportionment for the proposed Loveland Shoreline Stabilization Project.

Little Miami River, Loveland, Ohio, CAP Section 14, Project Cost (fully funded), Price Level Date 31 May 2024						
	FY2023	**FY2024**	**FY2025**	**FY2026**	**FY2027**	**TOTAL**
Feasibility Study Costs*						
FED share	$ 24,700	$ 75,300				$ 100,000
Non-FED	$ -					$ -
Design & Implementation Costs						
Design Analyses, Plans & Specs			$ 1,068,000			$ 1,068,000
Construction and Construction Management Costs				$ 5,987,000	$ 250,000	$ 6,237,000
LERRDs				$ 45,000		$ 45,000
TOTAL PROJECT COST						**$ 7,350,000**
FED share (65%)			$ 694,200	$ 3,920,800	$ 162,500	$ 4,777,500
Non-FED (35%)			$ 373,800	$ 2,111,200	$ 87,500	$ 2,572,500
Non-FED Cash**			$ 373,800	$ 2,066,200	$ 87,500	$ 2,527,500
Non-FED LERRD				$ 45,000		$ 45,000

* Feasibility cost is not included in Total Project costs

**No projected WIK

Total Project cost is $7,350,000. Cost share is 65 (Fed)/35 (Non Fed)

65% of cost is $4,777,500

35% of cost is $2,572,500 of which $45,000 is LERRDS

Remainder due in Cash $2,527,500 - Non Fed Portion

The total project cost (fully Funded) $7,350,000 which includes the total project first costs as well as escalation to the mid-point of construction

3.6.3 Project Schedule

Execution of the Project Partnership Agreement (PPA) and completion of subsequent project phases are contingent upon available funding. Design is expected to take six months, with contract award occurring two months after Design is complete. Implementation is expected to be completed in one construction season. Table 9 provides the actual and future estimated schedule for the remaining key milestones for the project, with TBD meaning To Be Determined.

Table 9 - Project Schedule

Activity	Milestone	Scheduled Start (Current)	Actual
Initiate Feasibility Phase	CW140	03 Apr 2023	16 Mar 2023
Federal Interest Determination	CW170	06 Sep 2023	06 Sep 2023
Feasibility Scoping Meeting	CW050	04 Oct 2023	04 Oct 2023
TSP Decision Meeting	CW262	22 Apr 2024	22 Apr 2024
TOTAL FEASIBILITY CONTINGENCY	**66 Days**		
DQC Review		23 Apr 2024	31 May 2024
Public Review		18 Jun 2024	TBD
ATR		18 Jun 2024	TBD
Policy and Legal Compliance Review (MSC)		19 Jun 2024	TBD
Final DQC		24 Jul 2024	TBD
Final ATR		21 Aug 2024	TBD
Approval of Final DPR	CW170	10 Dec 2024	TBD
District Executes PPA	CW130	Mar 2025	TBD
TOTAL D&I CONTINGENCY	**90 Days**		
Preliminary Plans and Specs Complete		Mar 2026	TBD
Certify Real Estate Receipt	CW360	Oct 2027	TBD
Approve CAP Plans and Specs	CW330	Mar 2028	TBD
Contract RTA	CW400	Mar 2028	TBD
Construction Contract Award	CC800	May 2028	TBD
Project Physically Complete	CW450	Mar 2029	TBD
Project Fiscally Complete	CW470	May 2029	TBD

3.6.4 Non-Federal Sponsor Responsibilities

The City of Loveland, Ohio, the NFS, expresses continued interest in participating in the proposed project and has acknowledged their responsibilities as outlined below.

The NFS will perform all necessary steps to complete and execute a PPA for the design and implementation phase of the project. In addition, the NFS will provide the required Non-Federal contribution. The NFS is working to secure Non-Federal cost share funds from grants and loans. The NFS is also working to clarify potential in-kind contribution opportunities.

The NFS actively participated in the development of alternatives and the selection of the Tentatively Selected Plan. Louisville District has actively reached out to the NFS throughout the duration of the feasibility phase. In addition, the NFS met with representatives from USACE Louisville District at the project site to discuss alternatives.

The NFS is responsible for providing all Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas (LERRDs) required for project implementation. The Project will require the NFS to make four acquisitions from four private landowners along the bank of the Little Miami River totaling approximately 0.67 acres of shoreline. The standard estate Bank Protection Easement will be used for the acquisitions along the bank. The NFS owns sufficient real estate interests in the remaining project land to support Project construction, operation, and maintenance without further acquisitions. The NFS owns and maintains the right-of-way of E. Kemper Road. They also own the laydown area in fee. The laydown area is located on E. Kemper Road approximately 0.75 miles southwest from Worksite 1. It is an approximately 1.31-acre open field adjacent to a municipal water treatment plant with direct access to E. Kemper Road. The estimated cost for Project LERRDs is approximately $45,000, including estimated utility relocations.

Once the project has been completed, the NFS will accept the project, along with their O&M responsibilities, including monitoring and performing routine maintenance to maintain its function.

The total project cost for design and construction of the project will be shared 65% Federal and 35% Non-Federal, as presented in the estimated costs in Table 9 above. Additionally, during the design and implementation phase, the NFS shall:

• Provide all lands, easements, rights-of-way, relocations and disposal areas.

• Provide, during construction, any additional costs as necessary to make the total Non-Federal contributions equal to 35% of the total project costs. The NFS may provide work in-kind during final design and construction. The Non-Federal share is estimated at $2,572,500 which does not include the estimated value of the LERRDs.

• Operate, maintain, repair, replace, and rehabilitate the completed project or functional portion of the completed project at no cost to the Federal Government, in accordance with the applicable Federal and State laws and any specific directions prescribed by the Federal Government for so long as the project is authorized.

• Hold and save the Federal Government harmless from damages due to the construction and operation and maintenance of the project, except where such damages are due to the fault or negligence of the Federal Government or its contractors.

• Grant the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon land which the NFS owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purposes of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

• Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs for a minimum of three years after completion of the project construction for which such books, records, documents, and other evidence are required.

• Perform, or cause to be performed, any investigations for hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, as amended, that may exist in, on, or under lands, easements, or rights-of-way necessary for construction, operation, and maintenance of the project; except that the NFS shall not perform such investigations on lands, easements, or rights-of-way that the Federal Government determines to be subject to the navigation servitude without prior specific written direction by the Federal Government.

• Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA-regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines are necessary for construction, operation, and maintenance of the project.

• Agree that, as between the Federal Government and the NFS, the NFS shall be the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

• Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the streambank restoration, hinder its operation and maintenance, or interfere with the proper function such as any new development on project lands or the addition of facilities that would degrade the benefits of the project.

• Not use Federal funds to meet the NFS's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

• Assume the financial responsibility for the construction, operation, maintenance, repair, replacement, and rehabilitation of the completed betterments outside of the project area.

4 ENVIRONMENTAL EFFECTS

The National Environmental Policy Act (NEPA) and the Council on Environmental Quality's NEPA Implementing Regulations require that an EA identify the likely environmental effects of a proposed project and that the agency determine whether those impacts may be significant. Effects (or impacts) are changes to the human environment from the Proposed Action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed alternatives (40 C.F.R. § 1508.1(g)). Effects may include ecological, aesthetic, historic, cultural, economic, social, or health effects, and can be either beneficial or adverse.

The determination of whether an impact significantly affects the quality of the human environment must consider the action's potential to affect the environment and the degree of the impacts of an action (40 C.F.R. § 1501.3(b)). Significance varies with the setting of the proposed action, and agencies should consider the specific affected area and its resources where the proposed action is to occur. This includes a consideration of the short-term effects, long-term effects, effects on public health and safety, and effects that would violate Federal, state, tribal, or local law protecting the environment.

The potentially affected environment refers to the area in which the Proposed Action (or other alternatives) would take place and the potentially affected resources of the area . The affected environment includes reasonably foreseeable environmental trends and planned actions in the area, if applicable (40 C.F.R. § 1502.15). The degree of the effects of the Proposed Action generally refers to the magnitude of change that would result if the Proposed Action or alternatives were implemented.

All potentially relevant resource areas were initially considered for analysis in this DPR/EA. The discussion of some resource topics is limited in scope, due to the lack of anticipated effect from the Proposed Action on the resource or because that resource is not located within the Project Area. Please note that the existing conditions for each resource analyzed in the following section is described in detail in Chapter 2.

This section presents the adverse or beneficial environmental effects of the Proposed Action and the NAA. The section is organized by resource topic, with the effects of alternatives discussed under each resource topic. Impacts are quantified whenever possible. Qualitative descriptions of impacts are explained by accompanying text where used.

Qualitative definitions/descriptions of impacts as used in this section of the EA include:

<u>Degree:</u>

- No Effect, or Negligible – a resource would not be affected, or the effects would be at or below the level of detection, and changes would not be of any measurable or perceptible consequence;
- Minor – effects on a resource would be detectable, although the effects would be localized, small, and of little consequence to the sustainability of the resource. Mitigation measures, if needed to offset adverse effects, would be simple and achievable;
- Moderate – effects on a resource would be readily detectable, localized, and measurable. Mitigation measures, if needed to offset adverse effects, would be extensive and likely achievable; and
- Significant – effects on a resource would be obvious and would have substantial consequences. The resource would be severely impaired so that it is no longer functional in the project area. Mitigation measures to offset the adverse effects would be extensive, and success of the mitigation measures would not be guaranteed.

<u>Duration:</u>

- Short term – temporary effects caused by the construction and/or implementation of a selected alternative; and
- Long term – caused by an alternative and remain after the action has been completed and/or after it is in full and complete operation.

4.1 AIR QUALITY

4.1.1 No Action Alternative

The NAA would likely have negligible effects on air quality in the long-term. Potential future projects undertaken as a result of this alternative (i.e., road maintenance required as a result of the ongoing failure of the slope under E. Kemper Road) would have short-term construction related emissions similar to those described under the TSP. The potential closure of E. Kemper Road to conduct maintenance in the impacted area would require vehicles to use less efficient detours, thereby increasing travel times and vehicle emissions that could impact air quality. However, given the relatively low amounts of traffic typically for rural areas, any long-term impacts to air quality under this alternative would most likely be negligible.

4.1.2 Tentatively Selected Plan

The TSP would be expected to have short-term, negligible adverse effects on local air quality. Potential sources of these impacts include emissions from heavy equipment operation which include diesel fuel fumes and exhaust that would be temporary and localized. Demolition of E. Kemper Road and the laying of rip rap on the shoreline is expected to generate fugitive dust which may become airborne during project construction. Because the TSP would not require around the clock construction, the equipment downtime and the relatively small footprint of the proposed project would allow for dispersion of any fumes or fugitive dust generated during construction.

4.2 CLIMATE

4.2.1 No Action Alternative

Implementation of the NAA is anticipated to result in negligible effects to climate over the long-term. Climate modeling and research suggests that increases in precipitation and flood events are expected to occur with greater intensity and frequency in the future. The failure of the outfalls and erosion at the project sites would be expected to occur following should the predicted climate patterns be realized, with the rate and degree of impact dependent on the frequency and intensity of local weather events.

The site has a history of repair efforts designed to correct the subsidence of the road and surrounding slope. The continued maintenance and repair of E. Kemper Road may result in minimal and localized emission of greenhouse gasses that would have negligible impact on local or regional climate. However, the cumulative effect of the continued maintenance of this section of the road may require commuters to use less efficient detours, thereby increasing travel times and associated vehicle emissions. As such, the No Action Alternative has the potential to result in higher greenhouse gas emissions in the project area than the TSP. A more detailed analysis of existing climate conditions and future trends may be found in Appendix F.

4.2.2 Tentatively Selected Plan

The implementation of the TSP is anticipated to have a negligible effect on local or regional climate. While there may be short-term greenhouse gas emissions associated with the use of heavy equipment used in the construction of the project, the emissions will be localized and temporary in nature and not of the quantity to have a significant impact local or regional climate.

Climate modeling suggests that increased precipitation and flood events are expected to occur with greater intensity and frequency in the future. Analysis of predictive modeling related to climate change indicate that historic and projected future increases in temperature have occurred and are likely to continue in the project area. These events have the potential to exacerbate the subsidence of the slope in the project area and may further degrade the underlying roadbed and stormwater infrastructure. The TSP is designed to improve streambank stability via the use of riprap and shot rock to reconstruct the upper slope of the streambank. These stabilization measures are designed to accommodate modest increases in precipitation, runoff, and streamflow and are resilient to future weather conditions that are predicted for the project area. As such, increases in precipitation, such as those which may occur due to climate change modeling, would not result in failure of the bank protection.

It is possible that modest potential increases in temperature predicted could have a detrimental impact on vegetative plantings. To the extent possible, efforts will be made to include species resilient to climate change in seed mixes or plantings. To limit the impact of high temperatures and periods of dry weather, it may be advisable to implement a watering routine at least until plantings are established.

4.3 TOPOGRAPHY, GEOLOGY, AND SOILS

4.3.1 No Action Alternative

The NAA would have no effect on topography and geology of the project footprint. The ongoing subsidence of the slope underlying E. Kemper Road erosion is not anticipated to affect bedrock, and the scale of the subsidence is too small to have a measurable impact on the area's physiography on the landscape level. However, because the NAA would not correct the subsidence of the slope underlying the impacted areas, the potential exists for the continued movement of the impacted areas which may lead to active soil erosion as the areas of the shoreline are eroded by the nearby Little Miami River. While the continued subsidence and failures of sections of the roadway are not a certainty, the long-term impact to soils may be significant, at least within the areas of E. Kemper Road impacted by the failure of the outfalls and subsidence of the surrounding slope.

4.3.2 Tentatively Selected Plan

Implementation of the TSP would be expected to have a negligible effect on local topography and geology. The excavation of the streambank to a gentler slope is not anticipated to cause deep enough impacts that could affect bedrock, and the small scale of the project would prevent any measurable impact to the area's general topography.

Adverse impacts to soils resulting from disturbance occurring during project construction would be minor and short-term. No soils classified as prime or unique farmlands occur in the project footprint. Much of the soil strata underlying the project footprint are classified as Urban land-Udorthents complex, which consist of soils that have been highly disturbed by cuffing resulting in a highly modified soil profile consisting of fill comprised of concrete aggregates and debris that were used during construction of E. Kemper Road and during subsequent efforts to stabilize the roadbed and shoreline over the preceding decades.

All appropriate erosion control measures and construction best management practices would be used to mitigate erosion and other potential adverse effects to surrounding soils that may occur during project construction. Current and future loss of soils or caused by subsidence and bank erosion along this section of the Little Miami River would be halted or reduced via the implementation of the Tentatively Selected Plan. As such, the net effect of adopting the TSP would be a beneficial effect to the long-term stability and retention of soils underlying the project footprint.

4.4 WATER QUALITY AND AQUATIC RESOURCES

4.4.1 No Action Alternative

Under the NAA, subsidence of surrounding slope and potential erosion of the streambank would be expected to continue following current trends. While the continued subsidence or failure of the slope in the impact area is not a certainty, the potential failure of the slope and shoreline has the potential to cause minor, short-term adverse impacts to water quality in the form of sedimentation and increased turbidity occurring via the failure of the stormwater infrastructure and potential shoreline erosion. The degree and extent of these impacts would be dependent on prevailing weather patterns. Over the long-term, the effects of implementing the NAA would likely be localized and will result in minor adverse impacts to the water quality of the Little Miami River.

The NAA would be expected to have a negligible impact on local hydrology, floodplain, and wetland habitats.

4.4.2 Tentatively Selected Plan

The TSP would have minor, short-term adverse effects on surface waters due to ground disturbance associated with construction activities. Depending on water levels, there may be a localized, temporary increase in sedimentation and turbidity in the Little Miami River during project construction. These affects will be minimized via appropriate erosion control measures and construction best management practices (e.g., silt fences) employed during construction. Revegetation of disturbed ground with native plants would minimize erosion of soils during and after construction activities.

When viewed over the long-term, implementation of the TSP has the potential to benefit water quality, as the repair of existing stormwater infrastructure and use of rip rap in the regrading of the work areas is designed to stabilize the area and prevent failure of the slope.

During the feasibility phase of this project, USACE coordinated with OEPA and has determined that several water quality permits may need to be obtained prior to the onset of construction. The Clean Water Act (CWA) (33 USC § 1251 et seq, as amended) is the regulatory environment in which compliance with water quality regulations is assessed for Federal projects. There are three CWA permit programs which concern construction projects that effect waters of the U.S. (WOTUS). These include:

- Section 404 --Discharge of dredged or fill material
- Section 401 -- State certification of water quality
- Section 402 -- National Pollutant Discharge Elimination System (NPDES)

The section 404 program is applicable when dredged or fill material is placed below the ordinary high water mark (OHWM) of streams and/or within wetlands that are considered WOTUS. The section 401 program is applicable when a 404 permit is needed. It is the process by which the state reviews and authorizes federal licenses and permits and affirms that discharges to WOTUS will not violate state water quality standards. The section 402 program is applicable for construction projects when the project will be disturbing more than one acre of land and has the potential to discharge pollutants into WOTUS.

Given the footprint of ground disturbance for the proposed streambank stabilization, it is likely that a Section 401 Individual Water Quality Certification and a National Pollutant Discharge Elimination System (NPDES) permit will be required. Final decisions regarding the need for these permits will made during the design and implementation phase of the TSP. Preliminary estimates of fill required by the TSP include a worst-case estimate of approximately 12,616 cubic yards of riprap shot rock and soil below the ordinary high-water mark (OHWM). As the regulatory authority of Section 404 of the CWA, the USACE has completed a section 404(b)(1) evaluation document that analyzes the potential impact of the TSP on the waters of the U.S. This document is provided in Appendix B.

Any subsequent modification made to the scope or design in the Design Phase of the project will be assessed for their potential to impact the WOTUS before the start of construction. If development of detailed designs results in the potential for increases in adverse effects to water quality, additional effects analysis will be carried out, supplemental NEPA documentation may be developed, and compliance with the CWA will be ensured, as needed.

Due to the design and limited scope of the proposed project area, the TSP would have no impact on local hydrology, floodplain, or wetland habitats. An eight-step floodplain evaluation can be found in Appendix B. The Recommended Plan would result in the correction of factors leading to the failure of the slope underlying East Kemper Road and will protect the site from future erosion of the stream bank within the project footprint, thereby, also protecting the floodplain from future impacts. The TSP would also ultimately correct ongoing stormwater infrastructure deficiencies. The TSP would not result in future development of the floodplain, as the Little Miami River's designation under the Wild and Scenic Rivers System greatly restricts any development within the project area. The NFS would be responsible for acquiring a floodplain construction permit coverage for the work occurring on East Kemper Road. USACE anticipates permit coverage for construction of roadway and the stabilized streambank within the floodplain will be granted by the ODNR.

4.5 FISH AND WILDLIFE RESOURCES

4.5.1 No Action Alternative

The NAA would have negligible short-term adverse impacts to terrestrial and aquatic resources. While the continued subsidence of the slope in the impacted areas is not a certainty, the continued movement of the slope and failure of the stormwater infrastructure has the potential to negatively impact terrestrial and aquatic habitats over the long-term. The movement of the slope could cause localized erosion and siltation of substrate in impacted areas.

4.5.2 Tentatively Selected Plan

The TSP would have a moderate adverse effect to terrestrial habitat over the short- and long-term. An estimated 0.3 acres of forested habitat would be removed in the project area footprint during construction activities and replaced by the installation of riprap used to stabilize the slope. The long-term effect of the TSP may be beneficial to the surrounding habitats as the project is designed to stabilize the slope within the work areas. Currently, the streambank in the project area consists primarily of mixed-mesophytic forest with an understory of bush honeysuckle and other woody shrubs and saplings. Sections of this forested habitat will be lost as a result of implementing the TSP and would be replaced by plantings of willow stakes and herbaceous plugs within the vegetated riprap areas. Once the planted vegetation is established, positive impacts to the impacted areas would be realized as the native vegetation matured.

The TSP is anticipated to have minor adverse effects to aquatic benthic habitats over the short- and long-term. In total, a worst-case estimated of 15,708 ft^2 (0.4 acres) of nearshore, benthic habitat will be covered by the placement of riprap and shot rock in nearshore areas of the three worksites under the TSP. While a habitat evaluation has not been conducted within the project area footprint, it is likely that much of the nearshore habitat along this section of the Little Miami River has been impacted by the placement of construction debris and fill over the previous decades. This type of habitat is considered low quality and is generally unsuitable for all but the most disturbance-tolerant species. The placement of riprap within the Little Miami River will change the character of the substrate within the impacted zones over the short-term. However, these areas will return to a more natural state as the interstitial spaces between the riprap fill with sediment and are colonized by benthic macroinvertebrates and aquatic vegetation.

Best management practices will be implemented to control sedimentation and minimize impacts to the Little Miami River. Potential BMPs include the use of silt fences and revegetation of disturbed land, limiting vegetation removal to the minimum extent practicable, quickly reseeding any disturbed areas, proper use and maintenance of equipment to reduce erosion and impact from equipment as much as possible. The stabilization of the subsiding slope and repair of the stormwater infrastructure and outfalls completed as a result of the Loveland Shoreline Stabilization Project has the potential to prevent or reduce sedimentation and turbidity over the long-term. No indirect effects would be expected from implementation of the TSP.

Best management practices will be implemented to control sedimentation and minimize impacts to the Little Miami River. The stabilization of the subsiding slope and repair of the stormwater infrastructure and outfalls completed as a result of the Project has the potential to prevent or reduce sedimentation and turbidity over the long-term. No indirect effects would be expected from implementation of the TSP.

Preliminary coordination with the NPS was conducted. As a result, the study design and scope of the TSP were modified to reduce impacts to surrounding resources and improve the proposed Action’s aesthetic value by including native vegetation in the riprap and reducing the footprint of the riprap channel protection when applicable. Pursuant to the WSRA, details of the final scope and design will be submitted to the NPS for a Section 7(a) determination to determine the design’s potential impacts to the Little Miami River’s ecological value. These plans will be subject to further review by NPS and a full Section 7(a) coordination effort will be conducted, including effect determination by USACE and concurrence by the NPS at this time.

The TSP would be expected to have a negligible effect on resident wildlife, which would disperse during construction activities, and would likely return to the sites quickly upon completion of the project.

In general, invasive species have a great capacity to colonize newly disturbed areas. However, the use of native seed mixes in the revegetation of the impacted areas will limit the impact of the TSP as it relates to the spread and establishment of invasive species.

4.6 THREATENED AND ENDANGERED SPECIES

4.6.1 No Action Alternative

The NAA would be expected to have no effect on threatened and endangered species. While the continued subsidence of the underlying slope of E. Kemper Road is not a certainty, the degradation or failure of the underlying stormwater infrastructure has the potential to adversely impact water quality in the area over the short- and long-term. Increased sedimentation and turbidity may negatively affect resident mussels and other aquatic flora/fauna via siltation of the benthic habitats. However, it is important to note that no known listed mussels are known from the project area and their existence within the project footprint is considered unlikely. As such, listed species would likely be unaffected by continued by the implementation of the NAA. There are no designated critical habitats within the area impacted by the NAA.

No impacts to listed bats are expected as a result of implementing the NAA.

No bald eagles or osprey are known to nest in the project area and the NAA is not expected to impact resident state listed species.

4.6.2 Tentatively Selected Plan

The TSP is anticipated to have no effect on Federally listed species. The USFWS IPaC consulting tool identified no Federally listed mussel species within range of the project and no listed mussels are anticipated to be within the area impacted by the TSP. However, because all native mussels are protected in the State of Ohio (Section 1533.324 of the Ohio Revised Code), impacts to resident mussels will be avoided via an agency-approved mussel survey and relocation effort conducted prior to the onset of construction activities. Should native mussels be documented during this effort, USACE will initiate coordination with USFWS and ODNR, as needed.

Any material placed within the Little Miami River or otherwise escaping into the stream has the potential to bury or suffocate mussels located within this zone of impact. To the greatest extent possible, project activities occurring near the stream will be confined to the nearshore areas, which substantially reduces potential impacts to resident mussels. Fencing around the construction footprint will be installed to intercept any material falling down the slope, preventing mussels within the project footprint from being crushed by debris or construction material. Additional best management practices (e.g., silt fences and straw or hay bales) will be utilized to prevent further increases in sedimentation and turbidity to reduce downstream impacts caused by siltation/sedimentation.

The implementation of the TSP has the potential to have a negligible adverse effect on Federally listed bat species. While there are no documented records of listed bats in the Project Area, these species have a very large range that includes the entire state of Ohio and their presence is assumed by USFWS even in areas that have no documented occurrences. The removal of forested habitat (incurred as a result of the implementation of the TSP) has the potential to negatively impact resident bats in the form of lost current and future roosting habitat and is generally classified as take by USFWS. The implementation of the Tentatively Selected Plan will result in the removal of an estimated 0.5 acres of forested habitat, which includes trees that are suitable for summer roosting by listed bats. It should be noted that the USFWS regards forested impacts of less than five acres in Ohio as insignificant. Because all tree clearing activities will occur between 1 November and 31 March, potential direct impacts to listed bat species will be avoided.

This EA represents the assessment and findings regarding the project and serves as the Biological Assessment with a determination of may affect not likely to adversely affect the Indiana bat, northern long-eared bat, and gray bat. The draft DPR with integrated EA will be provided to the USFWS for comment. Any comments provided by the USFWS, or other agencies will be included in Appendix B of the Final DPR document. Because no listed mussels were identified on the IPaC as being within range of the Action, no determination has been made for mussels. However, because Ohio state statute require that any mussel resources be accounted for prior to implementation of the project, a final effect determination has been withheld, pending the results of the pending mussel survey. Should a Federally listed species be documented during the mussel survey, coordination with USFWS and ODNR will be initiated.

There are no designated critical habitats within the project area impacted by the TSP.

The TSP will result in the removal of forested habitat along the stream margins of Little Miam River that may be used by the bald eagle, osprey, and other Federally protected wildlife. While nests of these bald eagles and osprey are fairly easy to locate and nesting adults are conspicuous in their behavior, no adult individuals or nests were observed during a site visit conducted on 10 August 2023. As such, the TSP would have no effect on these species.

Because the TSP will result in the removal of forested habitat and the laying of riprap on the adjacent slope and in the near shoreline areas of the Little Miami River, the proposed project has the potential to impact state listed species and/or their habitats. However, there are no known occurrences of state listed species in the project footprint and a cursory search of the project footprint documented no listed species. In addition, many of the state listed species are ecological specialists that have very narrow habitat requirements. The presence of many of these species can be precluded from consideration due to the urbanized nature of the project area and the highly disturbed habitats found withing the project footprint. It is possible that some of the transient or highly mobile species or those with more general habitat requirements may be found in the project footprint. State listed mussels or fishes also have the potential to be found in the project footprint. The proposed mussel survey of the site will be conducted prior to project implementation will provide a final determination on the presence of state listed mussels at the site. Based on the relatively limited scope of the project, coupled with the poor quality of the habitat found in the project footprint, the TSP would be expected to have a negligible impact on state listed species.

4.7 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

4.7.1 No Action Plan

The NAA would be expected to have negligible effect on recreational, scenic, and aesthetic resources of the project area. Under this alternative, the Little Miami River would retain its utility for kayaking and other recreational activities. However, the potential closure of E. Kemper Road for maintenance and repair work would likely require some commuters to use lengthier detours in order to reach local recreational features. No immediate change to aesthetics would occur under the NAA.

4.7.2 Tentatively Selected Plan

The TSP would have minor short-term adverse effects on recreational resources. Movement through this section of the Little Miami River by recreational users may be somewhat restricted during project construction. However, because project activities will be limited to one streambank, the movement of personal watercraft along the opposite side of the river will be not impeded. The proposed project under the Tentatively Selected Plan is too small in scale to directly affect regional recreational features, but the temporary closure of E. Kemper Road may require some users to take detours during project construction.

The TSP would have moderate short-term adverse effect and minor long-term adverse effect on scenic and aesthetic character of the project area. The City of Loveland is a mixed urban-suburban interface comprised of sections of residential and commercial development interspersed with areas of forested habitat. The aesthetic and scenic character of the areas corresponding to the riprap will be permanently altered. The larger trees removed as a result of the project will be replaced by a mix of herbaceous and woody trees and shrubs. The planting of herbaceous seed mix and willow stakes within the riprap will obscure the presence of installed riprap rock over the long-term. Disturbed soils will be revegetated with native species to restore the site's aesthetics and prevent the spread of invasive species. In an effort to protect the stability of the riprap areas, the ultimate size of the woody vegetation will be limited by manual culling of trees that exceed 2-inch diameter at breast height (dbh). Due to the relatively small size of the project footprint and the use of planted vegetation utilized in the riprap areas, the long-term impact to the site's aesthetic and scenic character will be ameliorated.

Pursuant to the WSRA, final plans detailing the scope and design of the project must be submitted to the NPS for a Section 7(a) determination of the design's potential impacts to the recreational, scenic, and aesthetic values of the Little Miami River.

4.8 CULTURAL RESOURCES

4.8.1 No Action Alternative

Under the NAA, repairs to E. Kemper Road would continue to be made. Potential future projects undertaken as a result of the NAA may include roadway maintenance actions designed to repair sections of E. Kemper Road impacted by subsidence of the underlying strata. These effects would not impact historic properties.

4.8.2 Tentatively Selected Plan

Based on the results of the cultural resources survey of the Project Area, USACE has determined that no historic properties listed in or recommended for listing in the NRHP would be affected by the TSP. USACE, in accordance with 36 C.F.R. Part 800.4(d)(1) of the National Historic Preservation Act (NHPA), has reached a determination of no effect.

4.9 NOISE

4.9.1 No Action Alternative

Noise impacts under the NAA would be expected to be negligible and within normal background levels. Potential future projects undertaken as a result of the NAA may include roadway maintenance actions designed to repair sections of E. Kemper Road impacted by subsidence of the underlying strata. These adverse effects would be temporary and localized.

4.9.2 Tentatively Selected Plan

Noise associated with the TSP would be limited to noise generated during construction. The noise associated with construction would only occur during daylight hours. Noise is measured as Day Night average noise levels (DNL) in "A-weighted" decibels to which the human ear is most sensitive (dBA). No federal standards exist for allowable noise levels. The Federal Aviation Administration (FAA) denotes a DNL of about 65 dBA as the level of significant noise impact. Several other agencies, including the Federal Energy Regulatory Commission, use a DNL criterion of 55 dBA as the threshold for defining noise impacts in suburban and rural residential areas. The USACE Safety and Health Requirements Manual (USACE 2014) provides criteria for temporary permissible noise exposure levels (Table 10), the consideration of hearing protection, or the need to administer sound reduction controls.

Table 10 - Permissible temporary noise exposures (USACE 2014)

Exposure Duration/Day (Hours)	Noise Level (dBA)
8	90
6	92
4	95
3	97
2	100
1.2	102
1	105

Construction noise would be similar to heavy traffic and other machinery that are commonly encountered in the vicinity of the project. Common equipment likely to be used during construction (e.g., backhoe) generally emit noise levels around 85 dBA at 45 feet. Because construction equipment would be operated during daylight hours only, exposure times are not anticipated to exceed permissible levels. Noise generated by construction would be somewhat muffled by the onsite typography and surrounding woodlands most of the project site. These factors taking together will work to ameliorate the adverse effects of noise on the surrounding environment. While aerial imagery shows a small number of private residences occurring near the project work areas, most of these are located on the opposite bank of the Little Miami River. Due to the limited operating times of construction crews, the muffling effects of the area's topography and woodlands, and the relative project's distance from the nearest residences, and the high ambient soundscape present in the impact area, noise impacts to the surrounding environment would be expected to be minor and limited to the relatively short construction window.

4.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

4.10.1 No Action Alternative

Because no HTRW substances are known to occur at the project footprint, the USACE anticipates negligible impacts to the surrounding environment as a result of implementing the NAA. It is possible that small amounts of contaminants like motor oil and road salt located on the roadway, could find their way into the surrounding soils and waterway as a result of the failing stormwater system and outfalls. Future projects undertaken as a result of the failure of stormwater infrastructure and subsidence of E. Kemper Road would have similar equipment-related risks concerning HTRW substances as the Tentatively Selected Plan. It can be reasonably expected that these potential future projects would employ the same best management practices described above. As such, USACE anticipates the NAA would result in negligible short- and long-term adverse effects on the environmental and HTRW substances.

4.10.2 Tentatively Selected Plan

The TSP would not generate HTRW substances or have an effect on existing HTRW substances. While a number of USEPA listed HTRW facilities are located in the project area, all are located outside of the area potential impacted by construction or staging activities.

Best management practices would be employed to prevent and/or minimize any impact from spills of oils, petroleum, or coolants related to the use of heavy equipment to be employed at the site, including:

- Any equipment or vehicles driven and/or operated near the stream channel or basin should be checked and maintained daily, to prevent leaks.
- All maintenance of equipment will occur in a designated offsite area.
- Materials for the containment of spills (i.e., absorbent materials, silt fencing, filter fabric, coir rolls) will be identified and be available onsite prior to commencement of construction or maintenance activities.

Therefore, USACE anticipates the TSP would have a negligible, short-term adverse impact on the environment from hazardous and toxic substances associated with heavy equipment.

4.11 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE

4.11.1 No Action Alternative

The NAA would have a minor long-term adverse impact on the area's socioeconomics. While the continued subsidence and/or failure of the underlying slope and E. Kemper Road is not a certainty, the NAA has the potential to impact commercial traffic, civil services, and the surrounding community in the future incurred as a result of roadway maintenance. No significant adverse effects to demographics or environmental justice are anticipated under this alternative. The implementation of this alternative would not incur disproportionate adverse impacts to minority or low-income populations.

4.11.2 Tentatively Selected Plan

The TSP would be expected to have minor, short-term adverse effects on socioeconomics because E. Kemper Road, which services the area's commercial traffic, would be temporarily closed under this alternative and commuters would be required to use detours during project construction. However, the long-term effect of the TSP on local travel patterns and commerce would be expected to be beneficial, as it is designed to stabilize the failing slope and roadbed. Similarly, while the TSP would be expected to have minor short-term effects on the living environment for the area's residents (in form of civil services like school buses and emergency response vehicles), the long-term effect of this alternative is beneficial because it protects the ability of these vehicles to continue to use this route in lieu of less efficient detours.

No adverse effects to demographics or environmental justice are anticipated under this alternative. Population demographics of the local area do not indicate little potential for the project to have cause an undue burden on disadvantaged or minor populations.

4.12 CUMULATIVE EFFECTS

NEPA requires a federal agency to consider not only the direct and indirect impacts of a proposed action, but also the cumulative impact of the action. A cumulative impact is defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or Non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. (40 C.F.R. § 1508.1(g)). These actions include on- or off-site projects conducted by government agencies, businesses, or individuals that are within the spatial and temporal boundaries of the actions considered.

The cumulative effects analysis is based on the potential effects of the proposed project when added to similar impacts from other projects in the project area. An inherent part of the cumulative effects analysis is the uncertainty surrounding actions that have not yet been fully developed. The CEQ regulations provide for the inclusion of uncertainties in the analysis and states that "when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment...and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking" (40 C.F.R. § 1502.21).

Temporal and geographical limits for this project must be established in order to frame the analysis. These limits can vary by the resources that are affected. Because of the design and limited scope of the project, the limits of cumulative effects are framed within the 1.5 miles of E. Kemper Road bracketed by the project work sites or within the 1-mile buffer zone used in the analysis of project resources. Under NEPA, the evaluation of cumulative impacts requires considering the temporal limits that define the timeframe over which environmental effects are assessed. These temporal limits include past, present, and/or reasonably foreseeable future actions.

4.12.1 No Action Alternative

The NAA has the potential to contribute to cumulative impacts to the environment of the project area. While there are no additional construction projects known in the Loveland area, heavy machinery used during the future road maintenance activities would have the potential for minor cumulative effects to local air quality, noise, and hazardous and toxic substances. In addition, the NAA has the potential to involve temporary closings of one or more lanes of E. Kemper Road, which would require local commuters to use less efficient detours that result in greater greenhouse gas emissions that have the potential to contribute to impacts to local and regional air quality of Loveland and the greater Cincinnati area.

While the continued subsidence of the slope underlying the project footprint is not a certainty, failure to correct the situation has the potential to incur both short- and long-term adverse impacts to local resources. In the long-term, the NAA has the potential to contribute to cumulative effects to soils and surface water, aquatic habitat, and aquatic fauna if the hillside should collapse into the nearby Little

Miami River. While this is a worst-case scenario, it has the potential to involve significant environmental and economic impacts to the surrounding community.

4.12.2 Tentatively Selected Plan

There is the potential for cumulative effects of the TSP on these resources when added to the impacts of other past, present, and reasonably foreseeable future actions in the project area. However, the effects of the Tentatively Selected Plan, as discussed herein, are localized and minor. In scoping cumulative effects issues, no resources were identified as having a potential to be significantly affected. Only minor and temporary adverse impacts to environmental resources would be sustained with the implementation of the TSP. Most of the effects incurred as a result of completing the proposed project would cease or abate when project construction is completed.

Any future development or construction in the area, (by USACE or any other entity) has the potential to produce some temporary and minor construction-related adverse effects (e.g., noise, fugitive dust, vehicle emissions, etc.). However, because the project is designed to eliminate the need for future maintenance to E. Kemper Road (related to the subsidence of the slope) and will repair the underlying stormwater infrastructure and outfalls, the project would be expected to have a long-term beneficial effect to local resources including air and water quality. Potential impacts related to the local economy will also be realized as a consequence of the repair and long-term stabilization of E. Kemper Road, as future and cumulative impacts to traffic patterns would be minimized or eliminated.

5 MITIGATION OF ADVERSE EFFECTS

Section 4.0 documents the existing environmental resources and potential environmental effects incurred as a result of implementing of the TSP. As previously discussed herein, it is anticipated that the proposed Project area will have no effect or negligible effects on the following resource types: climate; surface water and other aquatic resources; fish and wildlife resources; surface water hydrology, groundwater, threatened and endangered species, other Federally protected wildlife, state listed species, demographics and environmental justice, recreation and visitation, cultural resources, and HTRW materials. The proposed project is expected to have minor adverse impact on the aesthetics and scenic resources, noise, and soils within the project footprint.

No significant adverse effects to the natural or human environment are expected as a result of implementing the TSP. Due to the urbanized nature of the project site, the presence of Federally listed species is highly unlikely and impacts to listed species and their habitats are limited in scope and project design. Listed bat species would not be directly affected because no caves would be disturbed and the removal of forested habitat (that may be utilized by roosting bats during the summer reproductive season) will occur between 1 November to 31 March. Surveys and habitat assessments for native mussels will all be performed prior to construction. In the unlikely event that native mussels are found within the project footprint, coordination with state and Federal agencies would be undertaken and a relocation effort would be implemented.

The implementation of construction BMPs would be utilized, including the use of silt fences and revegetation of disturbed land, limiting vegetation removal to the minimum extent practicable, reseeding any areas disturbed with native herbaceous plants, and properly using maintenance equipment to reduce erosion and impacts from equipment. Clearing of seasonal nuisance vegetation (e.g., Japanese knotweed, Johnson grass, purple loosestrife) will be required in areas of backfill placement.

In an attempt to ameliorate the impacts of the removal of riparian habitat within the project footprint, USACE will incorporate nature-based solutions into several elements of construction design. The Tentatively Selected Plan alternative consists of utilizing soil-filled riprap to simultaneously armor and vegetate the degraded streambank. It includes regrading the bank to a stable condition, followed by placement of an engineered mix of stone and soil. The soil-filled mix acts both as an armoring layer and growing substrate for establishing vegetation that should be resilient to the flow velocities expected at this side of the river. Native plantings of riparian vegetation will also be included in the final design. Revegetation of the riprap areas will work to speed the return of the impacted area to a more natural state and minimize impacts to the aesthetic values of the site.

Though unlikely, if the footprint of the project were to change, the new footprint and associated impacts would be evaluated under NEPA, and coordination would be initiated as appropriate.

6 IMPLEMENTATION REQUIREMENTS

6.1 PROJECT PARTNERSHIP AGREEMENT

The first $100,000 of the feasibility phase for a Section 14 project is funded at full Federal expense and the balance is cost shared 50-50 with the NFS. Given the feasibility phase for the CAP Section 14 project for the City of Loveland is expected to be completed within the $100,000 limit, a Federal Cost Share Agreement (FCSA) will not be executed at this time.

The City provided a Letter of Intent in May 2023 requesting Federal assistance under the Section 14 authority. The Letter of Intent is included in Appendix G. The Louisville District is scheduled to start development of the Project Partnership Agreement (PPA) in late 2024 or early 2025 following approval of the Detailed Project Report and approval from Great Lakes and Ohio River Division to execute the PPA. Following the execution of the PPA, all efforts related to design and implementation will be cost shared 65% Federal and 35% Non-Federal.

6.2 LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS AND DISPOSAL AREAS

The Project will require the NFS to make four acquisitions from four private landowners along the bank of the Little Miami River totaling approximately 0.67 acres of shoreline. The standard estate Bank Protection Easement will be used for the acquisitions along the bank. The NFS owns sufficient real estate interests in the remaining project land to support Project construction, operation, and maintenance without further acquisitions. The NFS owns and maintains the right-of-way of E. Kemper Road. They also own the laydown area in fee. The laydown area is located on E. Kemper Road approximately 0.75 miles southwest from Worksite 1. It is an approximately 1.31-acre open field adjacent to a municipal water treatment plant with direct access to E. Kemper Road.

One lane of E. Kemper Road will be closed during construction with periodic closings of the entire road when construction requires. As the road is the public facility being protected by this Project, the NFS is not entitled to LERRD credit for its value. While the NFS owns the laydown area in fee, they will only be entitled to LERRD credit for the value of a temporary work area easement over the site.

Several utilities will likely be impacted by project construction, particularly underground storm water and sanitary sewer lines as well as overhead electric and telecom lines. At this time, utility relocations are not expected to require acquisition of additional real estate.

The estimated costs for Lands, Easements, Rights-of-Way, Relocations and Disposal Areas (LERRDs) is $938k, which includes the estimated cost to physically relocate the utilities (see Appendix D for additional real estate information).

6.3 MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and Adaptive Management is not applicable for projects under the CAP Section 14 authority.

6.4 OPERATION, MAINTENANCE, REPAIR, REPLACEMENT AND REHABILITATION

Local sponsor operation and maintenance responsibilities required to assure the continued functionality of the recommended treatment will include inspecting the project annually and after high water events and correcting adverse conditions such as loss of as-constructed stone geometries, repairing areas which have been vandalized, ensuring the vegetation is growing successfully, and removing large woody trees that would compromise the integrity of the riprap. An Operation and Maintenance Manual will be developed by USACE at the completion of construction and all operation and maintenance responsibilities will be given to the NFS in perpetuity after completion of construction. The NFS should reserve $6,000 yearly for the continued maintenance of the project to be used on an as-needed basis with the assumption that this amount exceeds the cost of typical yearly maintenance. Any surplus should be reserved in case of future larger repairs. The project site should be maintained in accordance with Chapter 3 of the Flood Control Operations & Maintenance Policies (ER-1130-2-350).

6.5 REGULATORY REQUIREMENTS

The TSP is in full compliance with all local, state, and Federal statutes as well as Executive Orders. No local zoning laws or public planning ordinances are in place in the project area that would impact the TSP. Compliance is documented below in Table 11.

Table 11 - Environmental Compliance Status

Statute/Executive Order	Full	Partial	N/A
National Environmental Policy Act (considered partial until the FONSI is signed)*		X	
Fish and Wildlife Coordination Act*		X	
Endangered Species Act*		X	
Clean Water Act*		X	
National Historic Preservation Act*			
Archeological Resources Protection Act			
Wild and Scenic Rivers Act		X	
Clean Air Act	X		

Comprehensive, Environmental Response, Compensation and Liability Act	X		
Bald and Golden Eagle Protection Act	X		
Migratory Bird Treaty Act	X		
Resource Conservation and Recovery Act	X		
Toxic Substances Control Act	X		
Quiet Communities Act	X		
Farmland Protection Act	X		
Executive Order 11988 Floodplain Management**		X	
Executive Order 11990 Protection of Wetlands	X		
Executive Order 12898 Environmental Justice in Minority Populations and Low-Income Populations	X		
Executive Order 13045 Protection of Children from Environmental Health Risks and Safety Risks	X		
Executive Order 13122 Invasive Species		X	
Executive Order 14008 Tackling the Climate Crisis at Home and Abroad	X		

* Completed coordination and effect determination will be completed prior to execution of the FONSI
** Completed coordination and all necessary permits will be obtained prior to construction

7 PUBLIC INVOLVEMENT

7.1 PUBLIC VIEWS AND COMMENTS

The DPR/EA and FONSI was made available for public review and comment for a period of 30 days beginning on June 21, 2024. All Federal, state, and local agencies, as well as non-governmental organizations (NGO's), and Tribes contacted for public review are listed in Table 7 of Appendix E.

Table 12 - Stakeholders Contacted for Public Review.

Stakeholder Type	Stakeholder
Federal	U. S. Fish and Wildlife Service, Ohio Field Office
	U. S. Environmental Protection Agency, Region 5 Office
	U. S. Geological Survey, Ohio Water Science Center
	National Resource Conservation Service, Ohio Office
	Senator J. D. Vance
	Senator Sherrod Brown
	National Park Service
State	Ohio Department of Natural Resources, Office of Environmental Review
	Ohio Environmental Protection Agency
	Ohio Department of Transportation
	Ohio Division of Surface Water
Local	City of Loveland Engineer City of Loveland Manager
NGO	The Nature Conservancy of Ohio
	Ohio Environmental Council

7.2 STAKEHOLDER AGENCY COORDINATION

USACE coordination with Federal resource agencies in conjunction with the preparation of the Draft DPR/EA. Initial scoping letters were sent to Federal agencies on June 21, 2024. Federal agencies were contacted again for review of the Draft DPR/EA and FONSI on June 21, 2024 (Appendix E).

7.2.1 Federal Agencies

Coordination with Federal resource agencies will be conducted in conjunction with the preparation of the Section 14 Emergency Streambank Protection, Draft DPR and EA, City of Loveland, Ohio. All correspondence letters can be found in Appendix E. The U.S. Fish & Wildlife Service (USFWS) was contacted for comment on potential resource impacts.

7.2.2 State Agencies

Coordination with State resource agencies was conducted in conjunction with the preparation of the Section 14 Emergency Streambank Protection, Draft DPR and EA, City of Loveland, Ohio. All correspondence letters can be found in Appendix E.

USACE initiated consultation under Section 106 of the NHPA with the Ohio State Historic Preservation Officer (OH-SHPO) in a letter dated July 27, 2023. The OH-SHPO responded in a letter dated August 22, 2023, stating they agreed with the project area as presented and asked that USACE would also examine any additional temporary workspaces, access roads, staging, and/or laydown areas needed for the project. USACE coordinated the results of the cultural resources survey of the Tentatively Selected Plan and USACE's determination of no affect to historic properties with the OH-SHPO in an email on January 25, 2024. The OH-SHPO responded in a letter dated February 21, 2024, that the Tentatively Selected Plan would have no effect on historic properties and that the TSP can proceed as planned. See Appendix E for correspondence from the OH-SHPO.

7.2.3 Local Agencies

Local Agencies will be contacted for public review during the Public Review period, which began June 21, 2024.

7.2.4 Non-Governmental Organizations

Non-Governmental Organizations (NGOs) will be contacted for public review during the Public Review period, which began June 21, 2024.

7.2.5 Federally Recognized Indian Tribes

USACE initiated consultation under Section 106 of the NHPA with the federally recognized Indian tribes in a letter dated July 27, 2023. The Forest County Potawatomi Community (FCPC) responded in an email dated July 27, 2023, that no historic properties significant to the FCPC would be affected. The Match-E-Be-Nash-She-Wish Band of Pottawatomi responded in a letter dated August 2, 2023, that they will provide no additional comments. The Seneca Nation responded in an email dated Augst 7, 2023 they have no concerns or comments on the project. The Miami Tribe of Oklahoma in a letter dated August 14, 2023, that they offered no objection to the project. The Nottawaseppi Huron Band of the Potawatomi in an email dated August 17, 2023, stated they have no objection to the project. USACE coordinated the results of the cultural resources survey of the Tentatively Selected Plan and USACE's determination of no affect to historic properties with the federally recognized Indian tribes in an email on January 25, 2024. The Shawnee Tribe responded in an email dated February 12, 2024, that they have no issues or concerns with the project. See Appendix E for correspondence to and from the federally recognized Indian tribes.

Table 13 - Federally Recognized Indian Tribes Consulted Under Section 106 of the NHPA

Miami Tribe of Oklahoma	Fon du lac Band of Chippewa
Absentee-Shawnee Tribe of Oklahoma	Bois Forte Band of Chippewa
Eastern Shawnee Tribe of Oklahoma	Grand Portage Band of Lake Superior Chippewa
Shawnee Tribe of Oklahoma	Leech Lake Band of Ojibwe
Citizen Potawatomi Nation	Mille Lacs Band of Ojibwe
Forest County Potawatomi	Grand Traverse Band of Ottawa and Chippewa
Hannahville Indian Community	Little River Band of Ottawa
Gun Lake Tribe	Ottawa Tribe of Oklahoma
Nottawaseppi Huron Band of Potawatomi	Little Traverse Bay Band of Odawa
Pokagon Band of Potawatomi	Peoria Tribe of Oklahoma
Saginaw Chippewa Indian Tribe of Michigan	Sac and Fox Tribe of Mississippi in Iowa
Lac Vieux Desert Band of Lake Superior	Sac and Fox Nation of Oklahoma
Lac du Flambeau Band of Lake Superior	Oneida Nation of New York
Sault Ste Marie Tribe of Chippewa	Oneida Nation of Wisconsin
Bad River Band of Lake Superior Chippewa	Delaware Nation of Oklahoma
Keweenaw Bay Indian Community	Delaware Tribe of Indians Oklahoma
Lac Courte Oreilles Band of Chippewa	Wyandotte Nation of Oklahoma
Red Cliff Band of Lake Superior Chippewa	Osage Nation
Red Lake Chippewa	Seneca Nation
St. Croix Chippewa Community	

8 RECOMMENDATION

After considering the engineering, economic, environmental, and social aspects relative to the construction of the proposed emergency bank stabilization project in the City of Loveland, Ohio at approximate river mile 23.7 to 22.9, I approve this report and recommend that the selected plan be authorized and constructed as a Federal project under the authority of Section 14 of the 1946 Flood Control Act (P.L. 79-526), as amended.

The estimated fully funded total project cost in FY2024 price levels is $7,350,000 (not including feasibility costs). The estimated Federal share of 65% is $4,777,500 and the Non-Federal 35% share is $2,572,000. Approximately $45,000 in creditable in-kind contributions is estimated for Non-Federal Sponsor LERRDs work. I further recommend that the project be funded and constructed subject to cost-sharing and financing arrangements acceptable to the Chief of Engineers and the Secretary of the Army.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the national civil works construction program nor the perspective higher review levels within the Executive Branch. Consequently, these recommendations may be modified before implementation. However, the Non-Federal Sponsor, the State, interested Federal agencies, and other parties would be advised of any modifications and would be afforded an opportunity to comment further.

____________________________	____________________________________
Date	L. Reyn Mann Colonel, U.S. Army District Commander

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City of Loveland, Ohio
Continuing Authorities Program Section 14
Feasibility Study

Appendix A
Engineering

June 2024

Table of Contents

1. Appendix A1 Hydraulics Engineering

1.1. General Information

The Project is in the Little Miami River watershed, which encompasses a total of 1,758 square miles drains all or part of 11 counties of southwest Ohio. Loveland, Ohio is located along the Little Miami River from approximate River Mile 24.7 to 22.7. The Project sites are located on the right bank along approximate River Mile 23.7 to 22.9 on E. Kemper Road.

The Project area has experienced unstable streambanks that are threatening public infrastructure along the Little Miami River. This issue occurs along the steep hillsides and waterways throughout Cincinnati and southern Ohio due to the prevalence of Kope geology. This study evaluates river bank stability, potential impact on an existing public road and the most cost effective method for stabilizing the river bank.

1.2. FEMA Flood plain

The Project site is located within the 1% annual exceedance probability (AEP) (also commonly referred to as the 1/100 probability or "100-year") floodplain of the Little Miami River, and within zone AE as defined by the Federal Emergency Management Agency (FEMA). Most of the bank protection would be placed in within the regulatory floodway (see Attachment A: FIRM for the FEMA Flood Insurance Rate Map (FIRM) of the project area).

Immediately upstream of the Project and the town of Loveland at the confluence of O'Bannon Creek, the drainage area of 1,148 square miles produces a peak discharge of 54,900 cfs for the 1% AEP. Table 1 give the annual exceedance probability peak discharges for the Little Miami River at the confluence of O'Bannon Creek from the 2023 FEMA Flood Insurance Study (FIS). Attachment B: FEMA FIS contains the 2023 FEMA FIS.

Table 1: FEMA FIS Hydraulic Information

Flooding Source	Location	Drainage Area (SQMI)	Peak Discharge (CFS)				
			10% AEP	4% AEP	2% AEP	1% AEP	0.2% AEP
Little Miami River	At Confluence of O'Bannon Creek	1,148	31,350	39,575	46,770	54,900	77,935

1.3. Hydraulic Evaluation of Streambank Stability/Erosion

High water on the Little Miami River is a significant factor in the bank failure at each respective site. The rise of high water surface elevation and the typically short duration it takes to recede causes a rapid drawdown condition to occur.

A detailed survey of the area would be necessary to update the hydraulic model and to accurately calculate material quantities. However, since detailed mapping is not available, the 2023 approximate hydraulic model from the Project Assistance to States study was used. See Attachment C: Hydrologic Model for the Hydrologic Model setup excerpt from the 2023 Loveland, OH PAS study.

The Hydraulic Design RipRap Calculator in the Hydraulic Engineering Center's River Analysis System (HEC-RAS) version 6.3.1 was used to determine stone sizes. The following subsections discuss the development of required variable inputs for the Hydraulic Design Riprap tool.

1.3.1. Flood Profiles

The profile selected was the 1% AEP flood profile from the 2023 PAS hydraulic model. Note that it is recommended to run a full range of frequency profiles to select the most critical design condition with informed user choices for risk tolerance. But due to limited funding and lack of detailed survey, this will be considered during the design phase.

1.3.2. Stream Alignment Radius of Curvature

The radius of curvature was approximated using Google Earth Pro. Note that there were no fractal or compound curves noted for each respective site. A single radius of curvature was selected for each site.

1.3.3. Design and Reference Upstream Cross Section

The design cross sections from the hydraulic model were selected for each respective site from the 2023 PAS hydraulic model. The reference upstream cross section was selected based on a straight section of the stream that appeared symmetrical upstream of the bend.

1.3.4. Assumptions

At the time of this study, local quarry stone data was not available. The assumptions below were made for the input data.

- The unit weight of the stone was assumed to be 150 pounds per cubic foot, which is anticipated to be conservative.
- The angle of repose was assumed to be 40 degrees.
- The rock type selected was angular rock. Note that rounded rock requires approximately 25% larger in diameter stone.

1.3.5. Selected Minimum Stone Sizes

The local quarry stone data was not available so sizes were approximated using stone sizes from Engineering Manual 1110-2-1601 (EM 1601). Table 2 summarizes the computed stone sizes for the 30th percentile diameter (d_{30}) and the 100th percentile diameter (d_{100}) stone sizes. Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6 show the RipRap calculator stone sizes computed for the respective cross section.

Table 2: Computed Minimum Stone Sizes

Site	Design Cross Section	Upstream Cross Section	Radius of Curvature (FT)	Bed Results		Side Slope Results	
				d_{30} (IN)	d_{100} (IN)	d_{30} (IN)	d_{100} (IN)
1	22.96084	23.46213	14,381	6.1	9	6.5	24
	22.99993	23.46213	14,381	6.1	9	6.5	24
2	23.223	23.46213	2,434	6.6	9	11.2	24
	23.2709	23.46213	2,434	6.6	9	11.2	24
3	23.6	23.79068	1,025	4.5	9	11.6	24
	23.68	23.79068	1,025	4.5	9	11.6	24

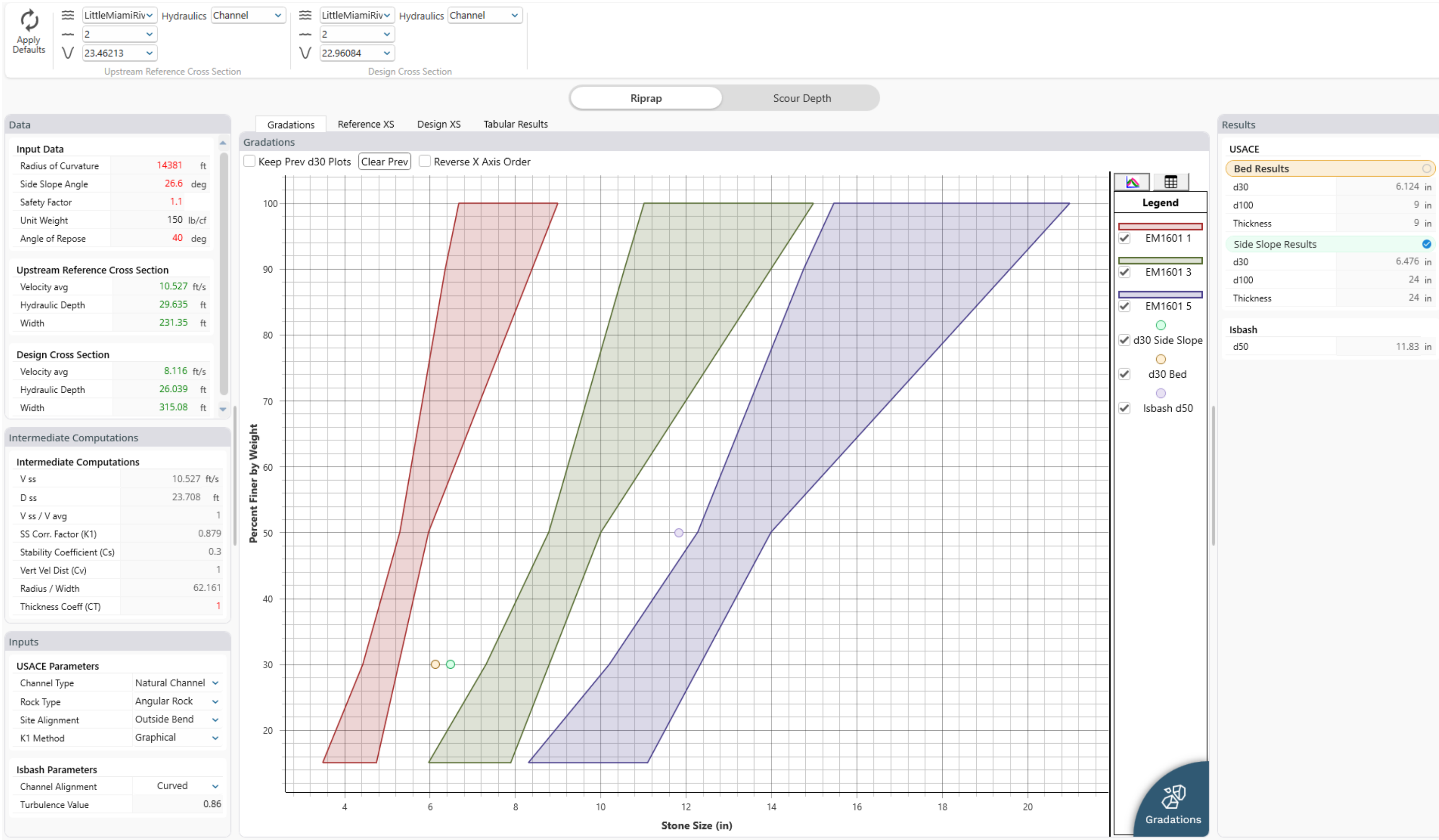


Figure 1: Site 1 - Cross Section 22.96084 - Computed Stone Size

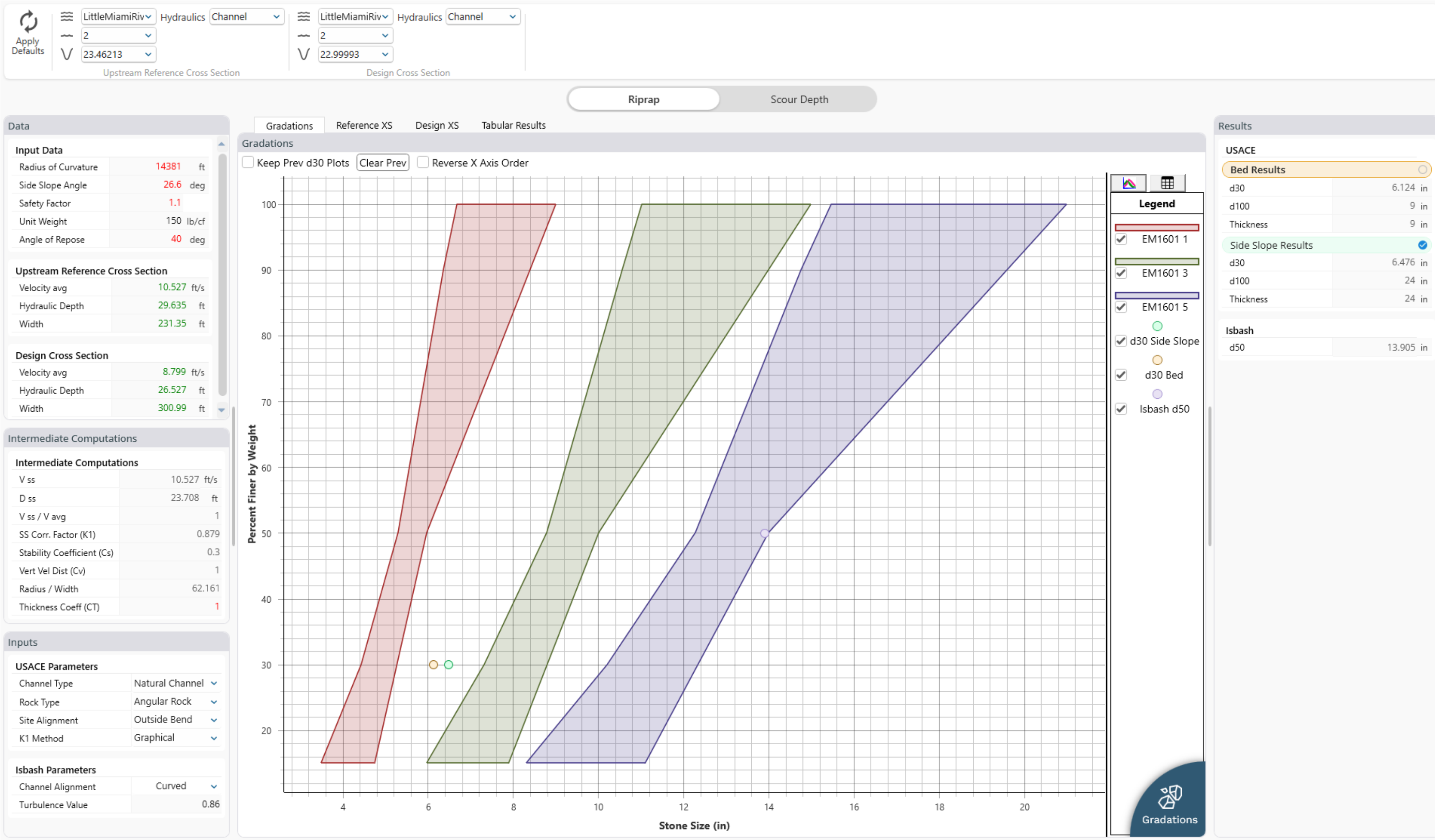


Figure 2: Site 1 - Cross Section 22.99993 - Computed Stone Size

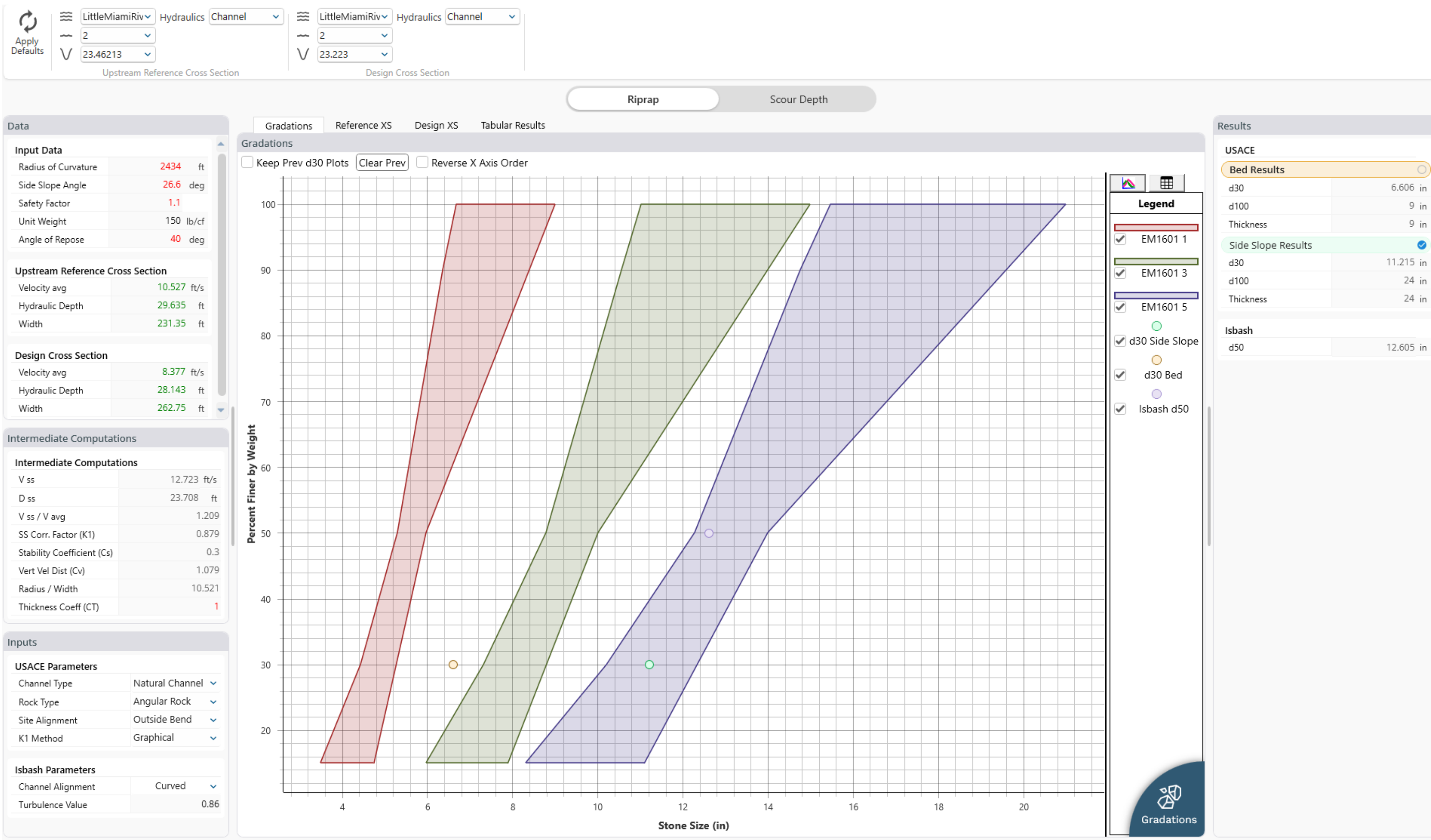


Figure 3: Site 2 - Cross Section 23.223 - Computed Stone Size

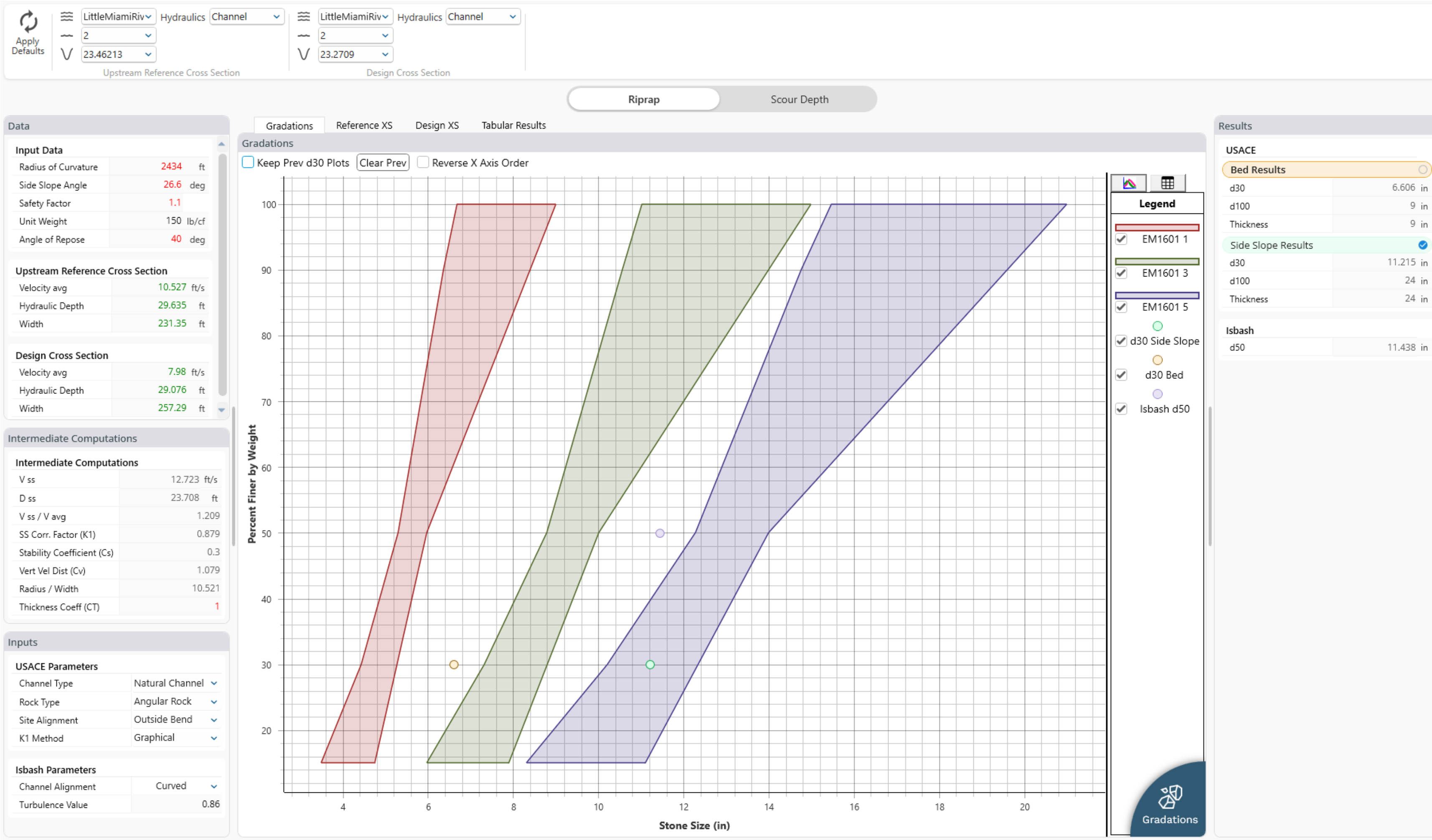


Figure 4: Site 2 - Cross Section 23.2709 - Computed Stone Size

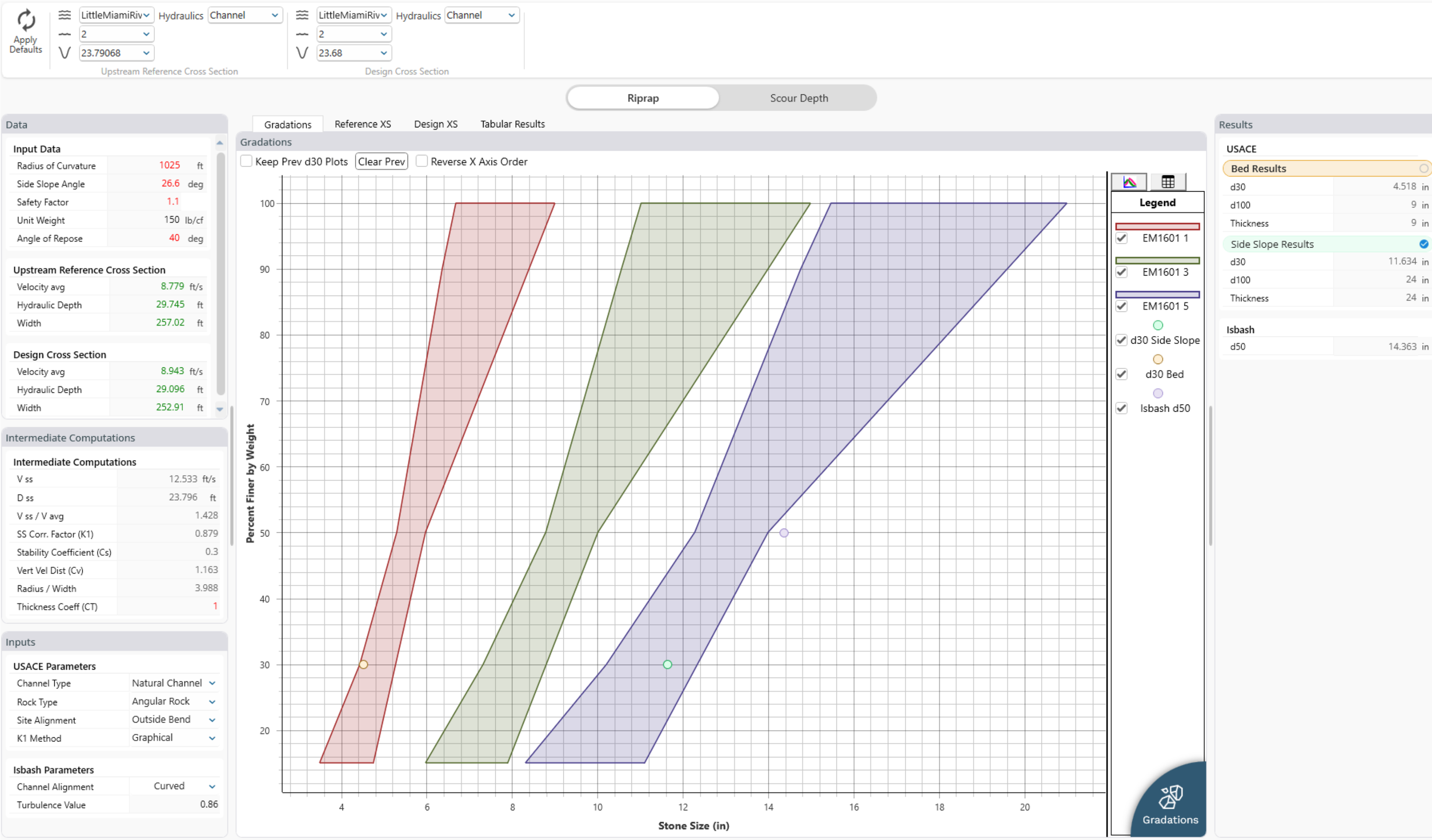


Figure 5: Site 3 - Cross Section 23.6 - Computed Stone Size

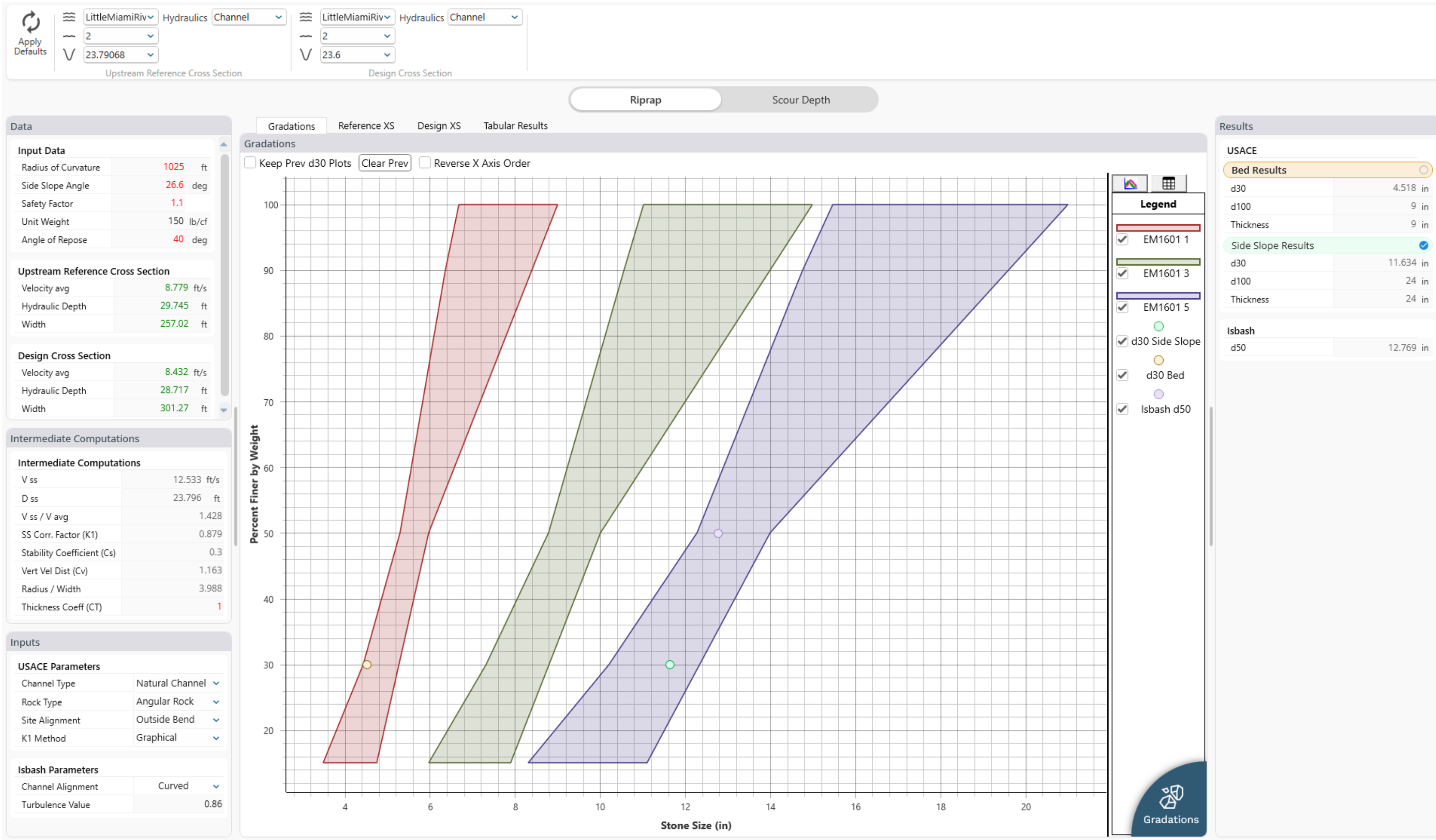
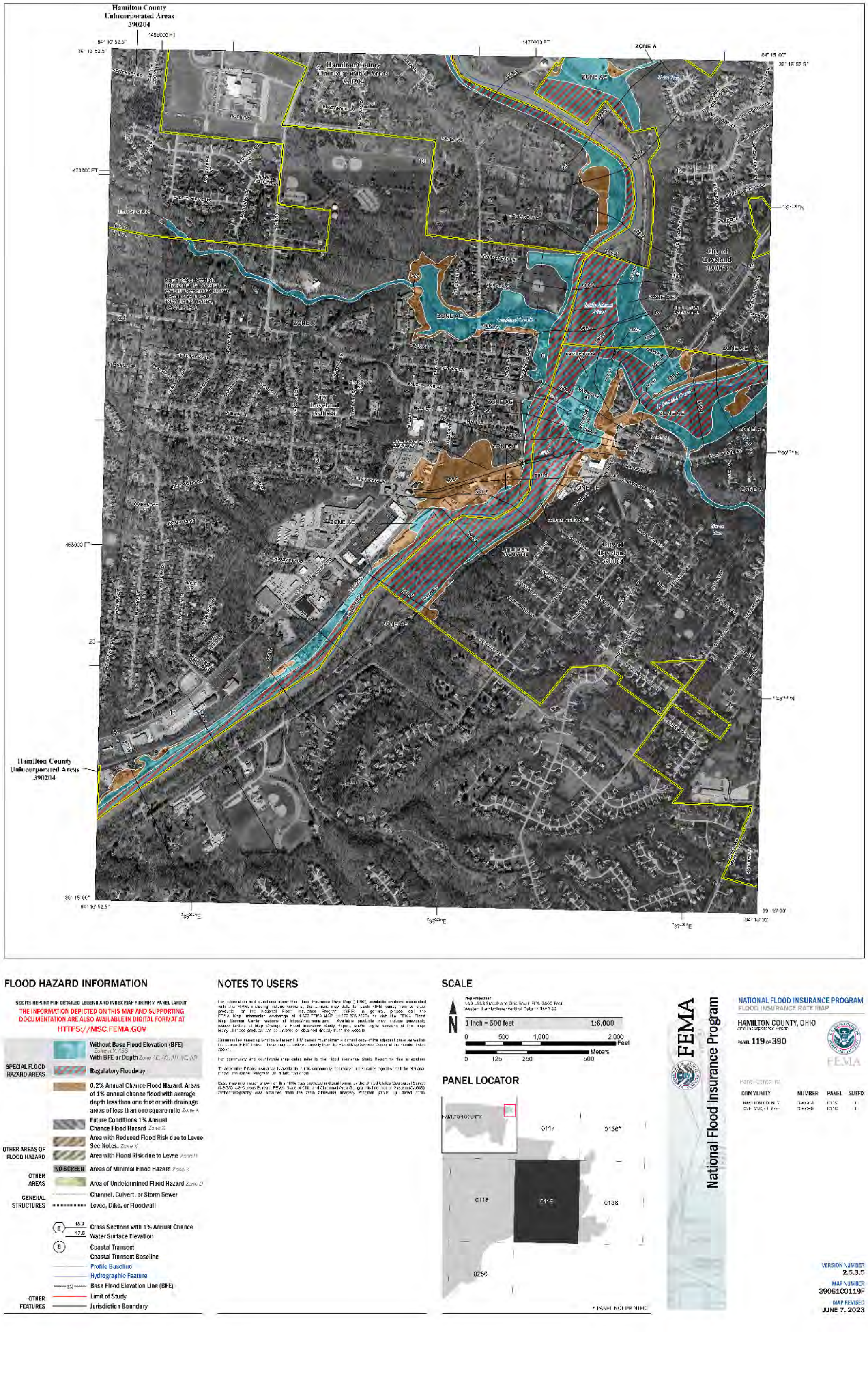


Figure 6: Site 3 - Cross Section 23.68 - Computed Stone Size

1.4. Water Operations Technical Support (WOTS)

The Louisville District requested technical assistance from the USACE Engineering Research and Development Center (ERDC) through the Water Operations Technical Support (WOTS) Program with regard to assessing the overall stream stability and potential effects that may result from improvements at select localized areas as opposed to a more comprehensive approach. A site visit was completed on August 10th, 2023 along the Little Miami River at the project sites including an ERDC Coastal & Hydraulics Lab (CHL) representative. Initial inspection was to take place by navigating the river by kayaks, but due to localized rain in the area the night before, water levels rose and were deemed unsafe due to high velocities, therefore all inspections was performed land side. At the time of inspection, the importance of the Kope Formation as a slope failure mechanic was not a detail known during the site visit. The WOTS draft report, included as Attachment D: WOTS Draft Report, had insightful recommendations regarding the slope failure from erosion that the PDT considered but ultimately did not incorporate due to the importance of the Kope formation on the geotechnical processes. It should be noted that due to limited access and visibility due to high water and vegetation, the project work site locations in the WOTS trip report are incorrectly identified and do not match the sites previously defined by the PAS study and this project.

1.5. Attachment A: FIRM



1.6. Attachment B: FEMA FIS

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 3

HAMILTON COUNTY, OHIO

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
ADDYSTON, VILLAGE OF	390205	LOVELAND, CITY OF	390068
AMBERLEY, VILLAGE OF	390206	MADEIRA, CITY OF	390225
ARLINGTON HEIGHTS, VILLAGE OF	390207	MARIEMONT, VILLAGE OF	390226
BLUE ASH, CITY OF	390208	MONTGOMERY, CITY OF	390228
CHEVIOT, CITY OF*	390209	MOUNT HEALTHY, CITY OF	390229
CINCINNATI, CITY OF	390210	NEWTOWN, VILLAGE OF	390230
CLEVES, VILLAGE OF	390211	NORTH BEND, VILLAGE OF	390231
DEER PARK, CITY OF*	390212	NORTH COLLEGE HILL, CITY OF	390232
ELMWOOD PLACE, VILLAGE OF	390213	NORWOOD, CITY OF*	390233
EVENDALE, VILLAGE OF	390214	READING, CITY OF	390234
FAIRFAX, VILLAGE OF	390215	SHARONVILLE, CITY OF	390236
FOREST PARK, CITY OF	390216	SILVERTON, CITY OF*	390237
GLENDALE, VILLAGE OF	390217	SPRINGDALE, CITY OF	390877
GOLF MANOR, CITY OF*	390218	ST. BERNARD, CITY OF	390235
GREENHILLS, VILLAGE OF	390219	TERRACE PARK, VILLAGE OF	390633
HAMILTON COUNTY, UNINCORPORATED AREAS	390204	THE VILLAGE OF INDIAN HILL, CITY OF	390221
HARRISON, CITY OF	390220	WOODLAWN, VILLAGE OF	390239
LINCOLN HEIGHTS, VILLAGE OF*	390222	WYOMING, CITY OF	390240
LOCKLAND, VILLAGE OF	390223		

*No Special Flood Hazard Areas Identified

REVISED:

JUNE 7, 2023

FLOOD INSURANCE STUDY NUMBER

39061CV001D

Version Number 2.5.3.5

FEMA

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FLOOD INSURANCE STUDY REPORT
HAMILTON COUNTY, OHIO

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the federal government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60, *Criteria for Land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the federal government.

Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) Report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum federal requirements. Contact your State NFIP Coordinator to ensure that any higher state standards are included in the community’s regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Hamilton County, Ohio.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the United States Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC-8) sub-basins affecting each, are shown in Table 1. The FIRM panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Addyston, Village of	390205	05090203	39061C0188F, 39061C0189F, 39061C0302F	
Amberley, Village of	390206	05090203	39061C0229E, 39061C0231E, 39061C0233E	

Table 1: Listing of NFIP Jurisdictions (*continued*)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Arlington Heights, Village of[1]	390207	05090203	39061C0227E, 39061C0229E	
Blue Ash, City of	390208	05090202, 05090203	39061C0094E, 39061C0113F, 39061C0231E, 39061C0232E[2], 39061C0234E[2], 39061C0251F, 39061C0253F	
Cheviot, City of[1]	390209	05080002, 05090203	39061C0194E, 39061C0211E[2], 39061C0213E[2]	
Cincinnati, City of	390210	05090201, 05090202, 05090203	39061C0189F, 39061C0204E, 39061C0208E, 39061C0209E, 39061C0211E[2], 39061C0212E, 39061C0213E[2], 39061C0214E[2], 39061C0216F, 39061C0217F, 39061C0218F, 39061C0219E[2], 39061C0226E, 39061C0228E, 39061C0229E, 39061C0233E, 39061C0234E[2], 39061C0236E, 39061C0237E[2], 39061C0238E[2], 39061C0239E[2], 39061C0241F, 39061C0242F, 39061C0243F, 39061C0244F, 39061C0263F, 39061C0302F, 39061C0306F, 39061C0307F, 39061C0309F, 39061C0326E, 39061C0327E[2], 39061C0328F, 39061C0329F, 39061C0331F, 39061C0332F, 39061C0333F, 39061C0334F, 39061C0355G, 39061C0356G, 39061C0357F, 39061C0358G, 39061C0359E[2], 39061C0366F, 39061C0376F, 39061C0378F	
Cleves, Village of	390211	05080002, 05090203	39061C0167E, 39061C0169F, 39061C0186E, 39061C0188F	
Deer Park, City of[1]	390212	05090202, 05090203	39061C0233E, 39061C0234E[2]	

[1] No Special Flood Hazard Areas Identified

[2] Panel Not Printed

Table 1: Listing of NFIP Jurisdictions (*continued*)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Elmwood Place, Village of[1]	390213	05090203	39061C0228E, 39061C0236E	
Evendale, Village of	390214	05090202, 05090203	39061C0089E, 39061C0093E, 39061C0094E, 39061C0227E, 39061C0231E, 39061C0232E[2]	
Fairfax, Village of	390215	05090202	39061C0244F	
Fairfield, City of[3]	390038	05080002	N/A	Butler County FIS Report 2018 (39017C)
Forest Park, City of	390216	05080002, 05090203	39061C0065E, 39061C0066E, 39061C0067E[2], 39061C0068E, 39061C0069E, 39061C0086E, 39061C0088E	
Glendale, Village of	390217	05090203	39061C0088E, 39061C0089E	
Golf Manor, City of[1]	390218	05090203	39061C0229E, 39061C0237E[2]	
Greenhills, Village of[1]	390219	05090203	39061C0068E, 39061C0069E	
Hamilton County, Unincorporated Areas	390204	05080002, 05080003, 05090201, 05090202, 05090203	39061C0015E, 39061C0019E, 39061C0020E, 39061C0036E, 39061C0037E, 39061C0038E, 39061C0039E, 39061C0041E, 39061C0042E, 39061C0043E, 39061C0044E, 39061C0065E, 39061C0066E, 39061C0067E[2], 39061C0068E, 39061C0069E, 39061C0088E, 39061C0092E, 39061C0111E, 39061C0112F, 39061C0113F, 39061C0114F, 39061C0116E[2], 39061C0117F, 39061C0118F, 39061C0119F, 39061C0152E, 39061C0154E[2], 39061C0156E, 39061C0157E, 39061C0158E, 39061C0159E, 39061C0162E, 39061C0164E, 39061C0166E, 39061C0167E, 39061C0168E, 39061C0169F, 39061C0176E, 39061C0177E,	

[1] No Special Flood Hazard Areas Identified

[2] Panel Not Printed

[3] Area Not Included

Table 1: Listing of NFIP Jurisdictions (*continued*)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Hamilton County Unincorporated Areas	390204	05080002, 05080003, 05090201, 05090202, 05090203	39061C0178E, 39061C0179E, 39061C0185E, 39061C0186E, 39061C0187E[2],39061C0188F, 39061C0189F, 39061C0191E, 39061C0192E, 39061C0193E, 39061C0194E, 39061C0201E, 39061C0202E, 39061C0203E, 39061C0204E, 39061C0206E, 39061C0207E, 39061C0208E, 39061C0209E, 39061C0211E[2], 39061C0212E, 39061C0213E[2], 39061C0226E, 39061C0228E, 39061C0229E, 39061C0231E, 39061C0232E[2], 39061C0233E, 39061C0234E[2], 39061C0237E[2], 39061C0241F, 39061C0242F, 39061C0244F, 39061C0251F, 39061C0252F, 39061C0253F, 39061C0256F, 39061C0258F, 39061C0259F, 39061C0263F, 39061C0264F, 39061C0266F, 39061C0268F, 39061C0277F, 39061C0281F, 39061C0282F, 39061C0302F, 39061C0306F, 39061C0307F, 39061C0309F, 39061C0326E, 39061C0327E[2], 39061C0328F, 39061C0329F, 39061C0356G, 39061C0357F, 39061C0358G, 39061C0359E[2], 39061C0366F, 39061C0367F, 39061C0376F, 39061C0377F, 39061C0378F, 39061C0379F, 39061C0385E[2], 39061C0390F	
Harrison, City of	390220	05080003	39061C0015E, 39061C0019E, 39061C0020E, 39061C0152E, 39061C0156E, 39061C0157E	
Lincoln Heights, Village of[1]	390222	05090203	39061C0089E, 39061C0227E	

[1] No Special Flood Hazard Areas Identified

[2] Panel Not Printed

Table 1: Listing of NFIP Jurisdictions (*continued*)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Lockland, Village of	390223	05090203	39061C0227E, 39061C0229E	
Loveland, City of	390068	05090202	39061C0116E[2], 39061C0117F, 39061C0118F, 39061C0119F, 39061C0136E[2], 39061C0138F	
Madeira, City of	390225	05090202	39061C0234E[2], 39061C0242F, 39061C0253F, 39061C0261F	
Mariemont, Village of	390226	05090202	39061C0244F, 39061C0263F	
Milford, City of[3]	390227	05090202	N/A	Clermont County FIS Report, 2006 (39025C)
Montgomery, City of	390228	05090202, 05090203	39061C0113F, 39061C0114F, 39061C0118F, 39061C0251F, 39061C0252F	
Mount Healthy, City of	390229	05090203	39061C0206E	
Newtown, Village of	390230	05090202	39061C0263F, 39061C0264F, 39061C0376F, 39061C0377F	
North Bend, Village of	390231	05080002, 05090203	39061C0169F, 39061C0186E, 39061C0188F	
North College Hill, City of	390232	05090203	39061C0202E, 39061C0204E, 39061C0206E, 39061C0208E	
Norwood, City of[1]	390233	05090202, 05090203	39061C0236E, 39061C0237E[2], 39061C0238E[2], 39061C0239E[2], 39061C0241F	
Reading, City of	390234	05090203	39061C0227E, 39061C0229E, 39061C0231E, 39061C0233E	
Sharonville, City of	390236	05090202, 05090203	39061C0087E, 39061C0089E, 39061C0091E, 39061C0092E, 39061C0093E, 39061C0094E, 39061C0111E, 39061C0113F	
Silverton, City of[1]	390237	05090202, 05090203	39061C0233E, 39061C0234E[2], 39061C0241F, 39061C0242F	

[1] No Special Flood Hazard Areas Identified

[2] Panel Not Printed

[3] Area Not Included

Table 1: Listing of NFIP Jurisdictions (*continued*)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Springdale, City of	390877	05080002, 05090203	39061C0067E[2], 39061C0086E, 39061C0087E, 39061C0088E, 39061C0089E	
St. Bernard, City of	390235	05090203	39061C0217F, 39061C0236E	
Terrace Park, Village of	390633	05090202	39061C0262E[2], 39061C0264F, 39061C0266F, 39061C0268F	
The Village of Indian Hill, City of	390221	05090202	39061C0114F, 39061C0242F, 39061C0244F, 39061C0251F, 39061C0252F, 39061C0253F, 39061C0254F, 39061C0256F, 39061C0258F, 39061C0261F, 39061C0262E[2], 39061C0263F, 39061C0264F, 39061C0266F	
Woodlawn, Village of	390239	05090203	39061C0088E, 39061C0089E, 39061C0226E, 39061C0227E	
Wyoming, City of	390240	05090203	39061C0207E, 39061C0209E, 39061C0226E, 39061C0227E, 39061C0228E, 39061C0229E	

[2] Panel Not Printed

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages state and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1-percent-annual-chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report.

Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 30, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

- The initial Countywide FIS Report for Hamilton County became effective on May 17, 2004. Refer to Table 27 for information about subsequent revisions to the FIRMs.

- The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at www.fema.gov/national-flood-insurance-program-community-rating-system or contact your appropriate FEMA Regional Office for more information about this program.

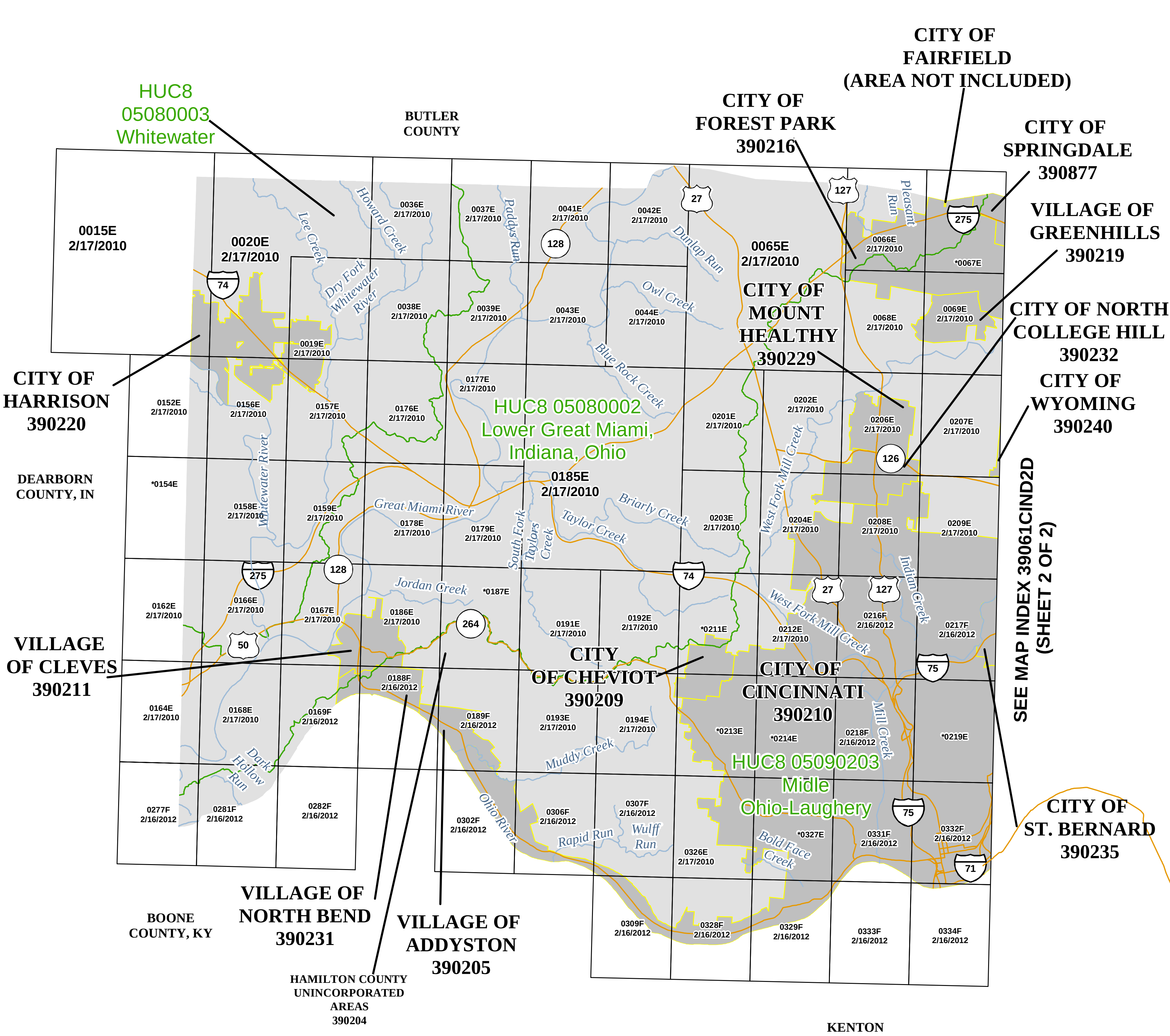
- Previous FIS Reports and FIRMs may have included levees that were accredited as reducing the risk associated with the 1-percent-annual-chance flood based on the information available and the mapping standards of the NFIP at that time. For FEMA to continue to accredit the identified levees, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

  Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 8 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE National Levee Database (nld.usace.army.mil). For all other levees, the user is encouraged to contact the appropriate local community.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at www.fema.gov/online-tutorials.

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Hamilton County, and also displays the panel number and effective date for each FIRM panel in the county. Other information shown on the FIRM Index includes community boundaries, flooding sources, watershed boundaries, and USGS HUC-8 codes.

Figure 1: FIRM Index (Page 1 of 2)



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before June 7, 2023.

1 inch = 13,333.33 feet — 1:160,000

0 — 6,250 — 12,500 — 25,000 feet

Map Projection:
NAD 1983 StatePlane Ohio South FIPS 3402 Feet
North American Datum of 1983

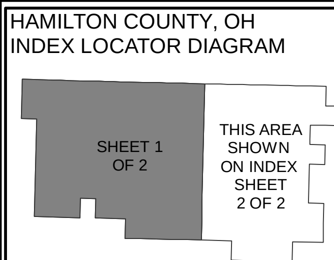
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
HTTPS://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

COUNTY LOCATOR

HAMILTON COUNTY, OH
INDEX LOCATOR DIAGRAM



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX
(SHEET 1 OF 2)

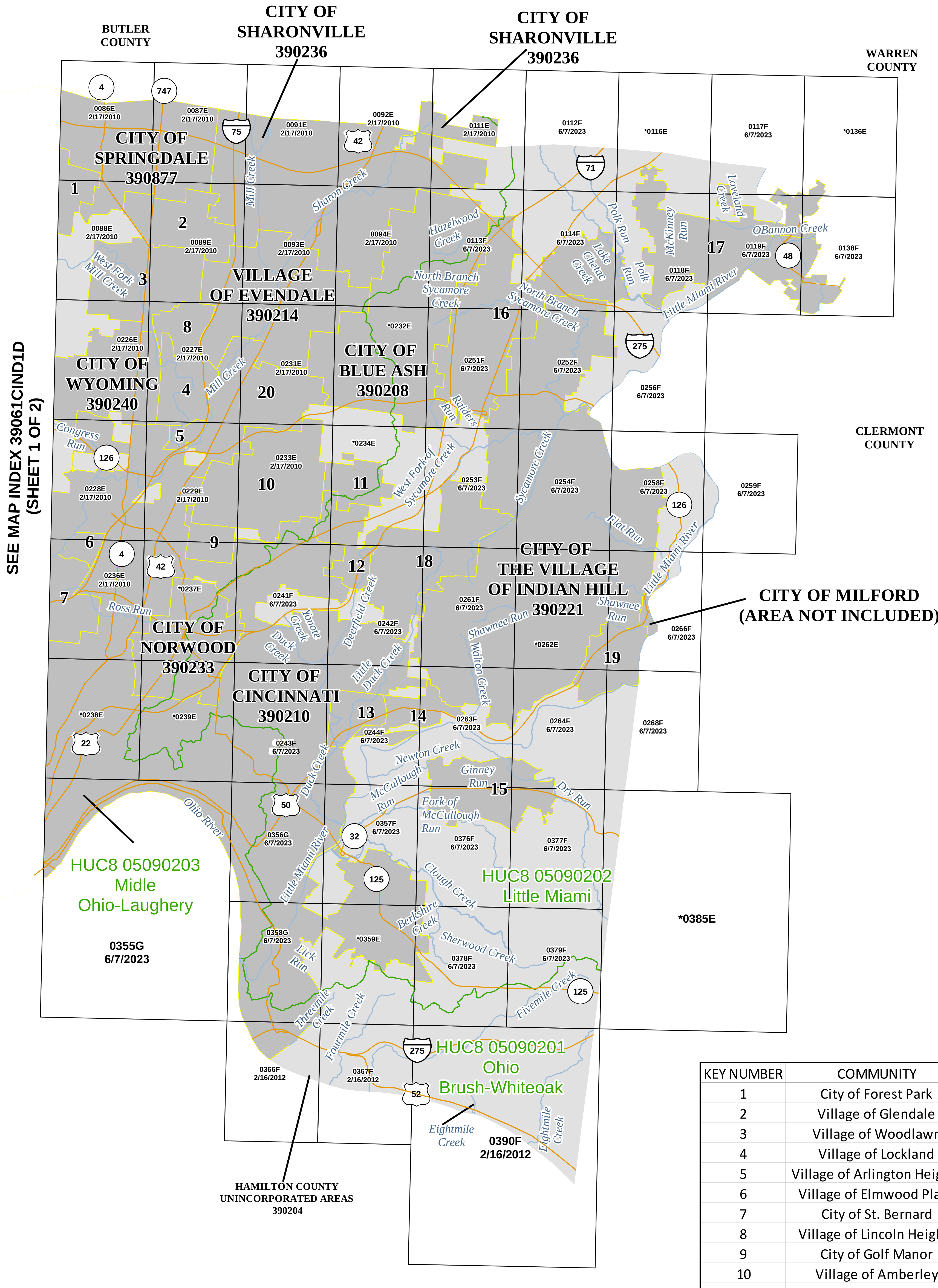
HAMILTON COUNTY, OHIO and Incorporated Areas

PANELS PRINTED:
0015, 0019, 0020, 0036, 0037, 0038, 0039, 0041, 0042, 0043, 0044, 0065, 0066, 0068, 0069, 0152, 0156, 0157, 0158, 0159, 0162, 0164, 0166, 0167, 0168, 0169, 0176, 0177, 0178, 0179, 0185, 0186, 0188, 0189, 0191, 0192, 0193, 0194, 0201, 0202, 0203, 0204, 0206, 0207, 0208, 0209, 0212, 0216, 0217, 0218, 0277, 0281, 0282, 0302, 0306, 0307, 0309, 0326, 0328, 0329, 0331, 0332, 0333, 0334

FEMA

MAP NUMBER
39061CIND1D

MAP REVISED
JUNE 7, 2023



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before June 7, 2023.

KEY NUMBER	COMMUNITY	CID
1	City of Forest Park	390216
2	Village of Glendale	390217
3	Village of Woodlawn	390239
4	Village of Lockland	390223
5	Village of Arlington Heights	390207
6	Village of Elmwood Place	390213
7	City of St. Bernard	390235
8	Village of Lincoln Heights	390222
9	City of Golf Manor	390218
10	Village of Amberley	390206
11	City of Deer Park	390212
12	City of Silverton	390237
13	Village of Fairfax	390215
14	Village of Mariemont	390226
15	Village of Newtown	390230
16	City of Montgomery	390228
17	City of Loveland	390068
18	City of Madeira	390225
19	Village of Terrace Park	390633
20	City of Reading	390234

1 inch = 10,000 feet 1:120,000

0 5,000 10,000 20,000 feet

Map Projection:
NAD 1983 StatePlane Ohio South FIPS 3402 Feet
North American Datum of 1983

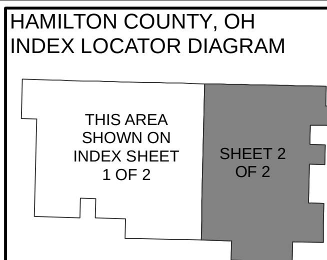
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
HTTPS://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

COUNTY LOCATOR

HAMILTON COUNTY, OH
INDEX LOCATOR DIAGRAM



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP INDEX
(SHEET 2 OF 2)

HAMILTON COUNTY, OHIO and Incorporated Areas

PANELS PRINTED:
0086, 0087, 0088, 0089, 0091, 0092, 0093, 0094, 0111, 0112, 0113, 0114, 0117, 0118, 0119, 0138, 0226, 0227, 0228, 0229, 0231, 0233, 0236, 0241, 0242, 0243, 0244, 0251, 0252, 0253, 0254, 0256, 0258, 0259, 0261, 0263, 0264, 0266, 0268, 0355, 0356, 0357, 0358, 0366, 0367, 0376, 0377, 0378, 0379, 0390

FEMA

MAP NUMBER
39061CIND2D

MAP REVISED
JUNE 7, 2023

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 2 contains the full list of these notes.

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 27 in this FIS Report.

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

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Non-Coastal Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

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

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 “Non-Levee Flood Protection Measures” of this FIS Report for information on flood control structures for this jurisdiction.

Figure 2: FIRM Notes to Users *(continued)*

PROJECTION INFORMATION: The projection used in the preparation of the map was Ohio State Plane South FIPS 3402 Feet. The horizontal datum was the North American Datum of 1983 NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov.

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 30 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided in digital format by the United States Geological Survey (USGS), US Census Bureau, FEMA, State of Ohio and Cincinnati Area Geographic Information System (CAGIS). Orthophotography was obtained from the Ohio Statewide Imagery Program (OSIP III), dated 2018. For information about base maps, refer to Section 6.2 "Base Map" in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

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

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Hamilton County, OHIO, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 27 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before June 7, 2023.

Figure 2: FIRM Notes to Users *(continued)*

SPECIAL NOTES FOR SPECIFIC FIRM PANELS This Notes to Users section was created specifically for Hamilton County, Ohio, effective June 7, 2023. ACCREDITED LEVEE: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit www.fema.gov/national-flood-insurance-program**.**
FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Hamilton County.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Figure 3: Map Legends for FIRM *(continued)*

Symbol	Description
	Regulatory Floodway determined in Zone AE.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood. See Notes to Users for important information.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir

Figure 3: Map Legends for FIRM *(continued)*

	Levee, Dike, or Floodwall
Bridge	Bridge
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway

Figure 3: Map Legends for FIRM *(continued)*

234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Hamilton County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1-percent-annual-chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent-annual-chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 22), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1- and 0.2-percent-annual-chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1-percent-annual-chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. Figure 3 “Map Legend for FIRM”, describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Hamilton County, respectively.

Table 2, “Flooding Sources Included in this FIS Report,” lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 12. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent-annual-chance floodplain corresponds to the SFHAs. The 0.2-percent-annual-chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Bares Run	Loveland, City of	Approximately 25 feet downstream from the crossing of E Loveland Avenue	Approximately 2,905 feet upstream from the crossing of E Loveland Ave	05090202	0.6	N	A	09/30/2016
Berkshire Creek	Hamilton County, Unincorporated Areas	Confluence with Clough Creek	Approximately 110 feet upstream from Stanley Road	05090202	1.5	N	A	September 2018
Brookwood Creek	Amberley, Village of	Approximately 450 feet downstream of Fair Oaks Drive	Fair Oaks Drive	05090203	0.2	Y	AE	December 1978
Clough Creek	Cincinnati, City of; Hamilton County, Unincorporated Areas	Confluence with Little Miami River	Approximately 645 feet upstream from State Road	05090202	5.1	Y	AE	March 1979
Congress Run	Cincinnati, City of; Hamilton County, Unincorporated Areas; Wyoming, City of	Confluence with Mill Creek	Approximately 580 feet upstream of North Hill Lane	05090203	2.8	Y	AE	March 1979
Dry Fork of The Whitewater River	Hamilton County, Unincorporated Areas	Confluence with Whitewater River	Approximately 160 feet upstream of Marion Road	05080003	12.0	Y	AE	March 1979
Dry Run	Hamilton County, Unincorporated Areas; Newtown, Village of	Approximately 650 feet downstream from Railroad	Approximately 95 feet upstream from Whiting Way	05090202	1.5	N	A	September 2018
Duck Creek	Cincinnati, City of; Fairfax, Village of	Confluence with Little Miami River	Approximately 1,200 feet upstream of Red Bank Road	05090202	3.2	Y	AE	02/22/2007
Duck Creek	Cincinnati, City of	Approximately 1,200 feet upstream of Red Bank Road	Approximately 957 feet upstream from Ridge Ave	05090202	2.4	Y	AE	09/20/2013

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
East Fork Mill Creek	Sharonville, City of	Confluence with Mill Creek	Crescentville Road	05090203	0.8	Y	AE	July 2009
Fork of McCullough Run	Hamilton County, Unincorporated Areas; Newtown, Village of	Confluence with McCullough Run	Ragland Road	05090202	0.7	Y	AE	March 1979
Great Miami River	Cleves, Village of; Hamilton County, Unincorporated Areas	Confluence with Ohio River	Approximately 0.9 miles upstream of State Route 126	05080002	26.0	Y	AE	March 1979
Hazelwood Creek	Blue Ash, City of	Kenwood Road	Cornell Road	05090203	0.9	Y	AE	December 1978
Howard Creek	Hamilton County, Unincorporated Areas	Confluence with Whitewater River	Oxford Road	05080003	1.1	Y	AE	March 1979
Lake Chetac Creek	Hamilton County, Unincorporated Areas; Montgomery, City of	Confluence with Polk Run	Corporate limits of City of Montgomery	05090202	0.8	Y	AE	September 2018
Lake Chetac Creek	Hamilton County, Unincorporated Areas; Montgomery, City of	Corporate limits of City of Montgomery	Fields Ertel Road and Hamilton/Warren County Boundary	05090202	2.2	N	A	September 2018
Left Fork Section Road Creek	Amberley, Village of	Confluence with Section Road Creek	Aracoma Forest Drive	05090203	0.7	Y	AE	December 1978
Little Duck Creek	Fairfax, Village of	Confluence with Duck Creek	Approximately 500 feet downstream from Red Bank Road	05090202	0.2	Y	AE	02/22/2007
Little Duck Creek	Cincinnati, City of; Fairfax, Village of	Approximately 500 feet downstream from Red Bank Road	Approximately 100 feet upstream of Murray Road	05090202	1.4	Y	AE	September 2018
Little Duck Creek	Cincinnati, City of; Hamilton County, Unincorporated Areas; Madeira, City of	Approximately 100 feet upstream of Murray Road	Approximately 780 feet upstream from Dawson Road	05090202	3.4	N	A	September 2018

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Little Miami River	Cincinnati, City of; Hamilton County, Unincorporated Areas; Loveland, City of; Mariemont, Village of; Newtown, Village of; Terrace Park, Village of; The Village of Indian Hill, City of	Confluence with Ohio River	Northern Hamilton/Warren County Boundary	05090202	26.1	Y	AE	September 2018
Loveland Creek	Hamilton County, Unincorporated Areas; Loveland, City of	Confluence with Little Miami River	Approximately 1800 feet upstream of Rich Road	05090202	1.3	N	A/AE	September 2018
McCullough Run	Hamilton County, Unincorporated Areas; Newtown, Village of	Confluence with Little Miami River	Turpin Lane	05090202	1.9	Y	AE	March 1979
Mill Creek	Arlington Heights, Village of; Cincinnati, City of; Elmwood Place, Village of; Evendale, Village of; Hamilton County, Unincorporated Areas; Lockland, Village of; Reading, City of; Sharonville, City of; St. Bernard, City of	Barrier Dam	E Sharon Rd	05090203	16.4	Y	AE	04/20/2000
Mill Creek	Sharonville, City of	E Sharon Rd	Just upstream of Crescentville Road	05090203	2.1	Y	AE	July 2009
Muddy Creek	Addyston, Village of; Cincinnati, City of; Hamilton County, Unincorporated Areas	Confluence with Ohio River	0.2 miles upstream of Sidney Road	05090203	6.6	Y	AE	March 1979

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Newton (Clear) Creek	Hamilton County, Unincorporated Areas	Confluence with Little Miami River	Railroad	05090202	1.4	Y	AE	September 2018
North Branch Sycamore Creek	Montgomery, City of	Approximately 1,880 feet upstream of Carriage Trail	I-71 Highway	05090202	2.1	Y	AE	September 2018
North Branch Sycamore Creek	The Village of Indian Hill, City of; Montgomery, City of	Confluence with Sycamore Creek	Approximately 1,880 feet upstream of Carriage Trail	05090202	3.8	N	A	September 2018
Northland Road Tributary	Springdale, City of	Confluence with Springdale Tributary	Approximately 320 feet upstream of Springfield Pike/ State Route 4	05090203	1.2	N	AE	July 1988
O'Bannon Creek	Loveland, City of	Confluence with Little Miami River	Eastern corporate limit of City of Loveland	05090202	0.9	Y	AE	September 2018
Ohio River	Addyston, Village of; Cincinnati, City of; Hamilton County, Unincorporated Areas; North Bend, Village of	Approximately 0.35 miles downstream of the confluence of Great Miami River	Approximately 1.15 miles upstream of the confluence of Eight Mile Creek	05090201, 05090203	43.5	Y	AE	January 2011
Pleasant Run	Hamilton County, Unincorporated Areas	100 feet downstream of John Gray Road	Approximately 0.5 miles upstream of confluence of Pleasant Run Tributary	05080002	0.6	Y	AE	04/26/2006
Polk Run	Hamilton County, Unincorporated Areas; Montgomery, City of	Approximately 3,850 feet upstream from Loveland Madeira Road	Approximately 380 feet upstream from E. Kemper Road	05090202	0.9	Y	AE	September 2018
Polk Run	Hamilton County, Unincorporated Areas; Montgomery, City of	Approximately 380 feet upstream from E. Kemper Road	Fields Ertel Road	05090202	2.6	N	A	September 2018
Polk Run	Hamilton County, Unincorporated Areas	Confluence with Little Miami River	Approximately 3,850 feet upstream from Loveland Madeira Road	05090202	1	N	A/AE	September 2018

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Raiders Run	Blue Ash, City of; Hamilton County, Unincorporated Areas	Confluence with West Fork of Sycamore Creek	South of Ronald Reagan Cross CO EB Highway	05090202	1.4	Y	AE	March 1979
Section Road Creek	Amberley, Village of; Cincinnati, City of	Approximately 0.2 mile downstream of Elbrook Avenue	Approximately 0.3 mile upstream of West Beechlands Drive	05090203	1.5	Y	AE	December 1978
Sharon Creek	Evendale, Village of; Sharonville, City of	Confluence with Mill Creek	Approximately 440 feet upstream of Park Road	05090203	2.2	Y	AE	July 2009
Sharon Creek Tributary	Evendale, Village of; Sharonville, City of	Confluence with Sharon Creek	0.5 mile upstream of Main Street	05090203	1.0	Y	AE	July 2009
Springdale Tributary	Sharonville, City of; Springdale, City of	Chesterdale Road	Approximately 50 feet upstream of Cloverdale Avenue	05090203	3.1	N	AE	July 1988
Sycamore Creek	Hamilton County, Unincorporated Areas; The Village of Indian Hill, City of	Confluence with Little Miami River	Approximately 4,580 feet upstream of Keller Road	05090202	2.8	N	A/AE	September 2018
Sycamore Creek	Madeira, City of; The Village of Indian Hill, City of	Approximately 4,580 feet upstream of Keller Road	Approximately 700 feet upstream from Camargo Road	05090202	1.2	Y	AE	September 2018
Tributary A	North College Hill, City of	Mouth at West Fork Lake Tributary	Approximately 820 feet upstream of Northbridge Avenue	05090203	0.3	Y	AE	May 1985
Tributary To Pleasant Run	Hamilton County, Unincorporated Areas	Confluence with Pleasant Run	Approximately 0.6 mile upstream of confluence with Pleasant Run	05080002	0.6	Y	AE	04/26/2006
West Fork Creek	Cincinnati, City of	Confluence with Mill Creek	Confluence of McFarland Creek	05090203	2.6	Y	AE	March 1979

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
West Fork Lake Tributary	City of Cincinnati; Hamilton County, Unincorporated Areas; Mount Healthy, City of; North College Hill, City of	200 feet downstream of Desoto Drive	Approximately 340 feet upstream of Emerson Avenue	05090203	1.7	Y	AE	May 1985
West Fork Mill Creek	Arlington Heights, Village of; Hamilton County, Unincorporated Areas; Lockland, Village of; Mount Healthy, City of; Woodlawn, Village of; Wyoming, City of	Confluence with Mill Creek	Just upstream of Blue Rock Road	05090203	12.1	Y	AE	October 1992
West Fork Mill Creek South Tributary	Woodlawn, Village of	Confluence with West Fork Mill Creek	Just upstream of footbridge	05090203	0.4	Y	AE	June 1985
West Fork of Sycamore Creek	Hamilton County, Unincorporated Areas; The Village of Indian Hill, City of	Confluence with Sycamore Creek	Approximately 1.6 miles above confluence with Sycamore Creek	05090202	1.6	N	A	September 2018
West Fork of Sycamore Creek	Hamilton County, Unincorporated Areas	Approximately 1.6 miles above confluence with Sycamore Creek	North of East Galbraith Road	05090202	1.0	Y	AE	March 1979
Whitewater River	Hamilton County, Unincorporated Areas; Harrison, City of	Confluence with Great Miami River	Approximately 1.7 miles upstream of Jamison Road	05080003	10.6	Y	AE	March 1979
Winton Woods Creek	Hamilton County, Unincorporated Areas; Mount Healthy, City of	Approximately 1.6 miles downstream of Bridgecreek Lane	Approximately 200 feet upstream of Desoto Drive	05090203	2.9	Y	AE	03/02/1993

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Wulff Run	Hamilton County, Unincorporated Areas	Approximately 0.3 mile downstream of Delhi Road	Anderson Ferry Road	05090203	0.8	Y	AE	March 1979
Yonote Creek	Cincinnati, City of; Hamilton County, Unincorporated Areas	Confluence with Duck Creek	South of I-71 NB Expressway	05090202	0.3	Y	AE	09/20/2013
Zone A Stream (Little Miami Tributary)	Hamilton County, Unincorporated Areas	Approximately 500 feet upstream of Round Bottom Road	Approximately 0.75 mile upstream of Round Bottom Road	05090202	0.6	N	A	March 1979
Zone A Streams (Lower Great Miami, Indiana, Ohio Tributaries)	Various	Varies	Varies	05080002	Varies	N	A	March 1979
Zone A Streams (Middle Ohio - Laughery Tributaries)	Various	Varies	Varies	05090203	Varies	N	A	June 1985
Zone A Streams (Ohio Brush-Whiteoak Tributaries)	Various	Varies	Varies	05090201	Varies	N	A	March 1979
Zone A Streams (Whitewater Tributaries)	Various	Varies	Varies	05080003	Varies	N	A	March 1979

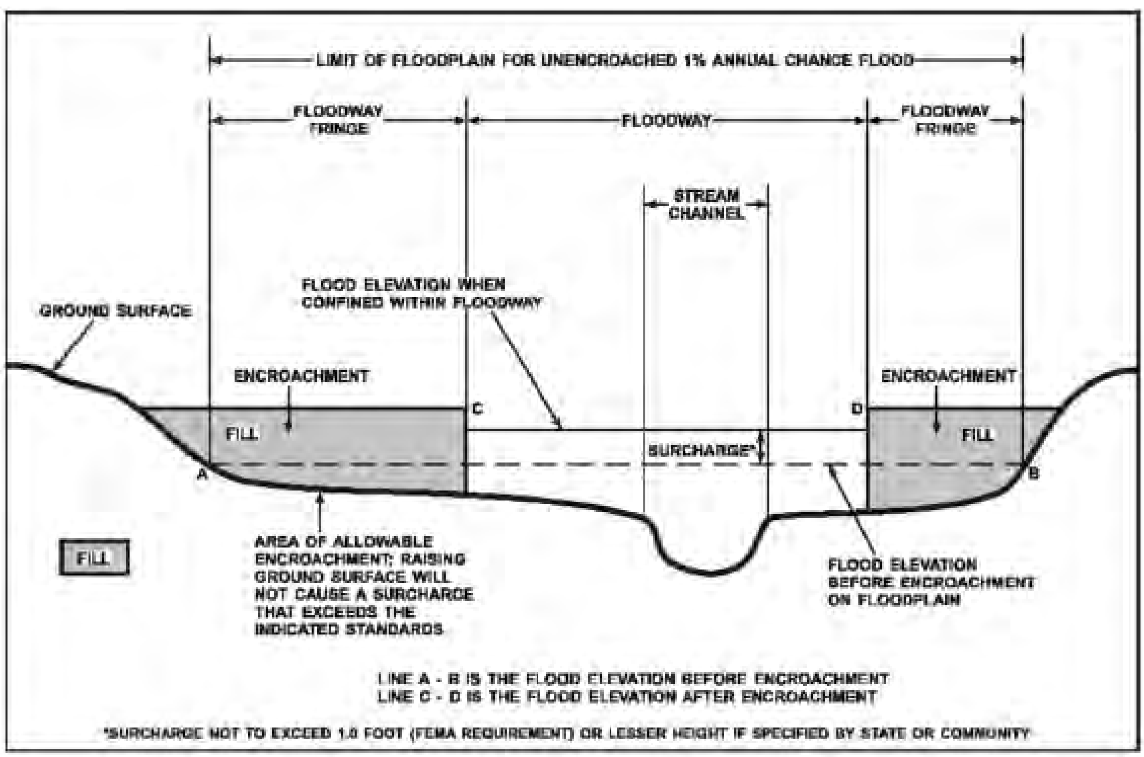
2.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard.

For purposes of the NFIP, a floodway is used as a tool to assist local communities in balancing floodplain development against increasing flood hazard. With this approach, the area of the 1-percent-annual-chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1-percent-annual-chance flood. The floodway fringe is the area between the floodway and the 1-percent-annual-chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 23, “Floodway Data.”

All floodways that were developed for this Flood Risk Project are shown on the FIRM using the symbology described in Figure 3. In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1-percent-annual-chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

BFEs are primarily intended for flood insurance rating purposes. Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. For example, the user may use the FIRM to determine the stream station of a location of interest and then use the profile to determine the 1-percent-annual-chance elevation at that location. Because only selected cross sections may be shown on the FIRM for riverine areas, the profile should be used to obtain the flood elevation between mapped cross sections. Additionally, for riverine areas, whole-foot elevations shown on the FIRM may not exactly reflect the elevations derived from the hydraulic analyses; therefore, elevations obtained from the profile may more accurately reflect the results of the hydraulic analysis.

2.4 Non-Encroachment Zones

This section is not applicable to this Flood Risk Project.

The State of Ohio participates within the minimum NFIP standards.

2.5 Coastal Flood Hazard Areas

This section is not applicable to this Flood Risk Project.

2.5.1 Water Elevations and the Effects of Waves

This section is not applicable to this Flood Risk Project.

Figure 5: Wave Runup Transect Schematic

[Not Applicable to this Flood Risk Project]

2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

This section is not applicable to this Flood Risk Project.

2.5.3 Coastal High Hazard Areas

This section is not applicable to this Flood Risk Project.

Figure 6: Coastal Transect Schematic

[Not Applicable to this Flood Risk Project]

2.5.4 Limit of Moderate Wave Action

This section is not applicable to this Flood Risk Project.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, "Map Legend for FIRM." Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in Hamilton County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Addyston, Village of	AE, X
Amberley, Village of	AE, AO, X
Arlington Heights, Village of	AE, X
Blue Ash, City of	A, AE, X
Cheviot, City of*	X
Cincinnati, City of	A, AE, X
Cleves, Village of	AE, X
Deer Park, City of*	X
Elmwood Place, Village of	A, AE, X
Evendale, Village of	A, AE, X
Fairfax, Village of	AE, X
Forest Park, City of	A, AE, X
Glendale, Village of	A, X
Golf Manor, City of*	X
Greenhills, Village of	A, X
Hamilton County, Unincorporated Areas	A, AE, X
Harrison, City of	A, AE, X
Lincoln Heights, Village of*	X
Lockland, Village of	A, AE, X
Loveland, City of	A, AE, X
Madeira, City of	A, AE, X
Mariemont, Village of	AE, X
Montgomery, City of	A, AE, X
Mount Healthy, City of	A, AE, X
Newtown, Village of	A, AE, X
North Bend, Village of	AE, X
North College Hill, City of	A, AE, X
Norwood, City of*	X
Reading, City of	A, AE, X
Sharonville, City of	A, AE, X

*No Special Flood Hazard Areas Identified

Table 3: Flood Zone Designations by Community *(continued)*

Community	Flood Zone(s)
Silverton, City of*	X
Springdale, City of	A, AE, X
St. Bernard, City of	A, AE, X
Terrace Park, Village of	AE, X
The Village of Indian Hill, City of	A, AE, X
Woodlawn, Village of	A, AE, X
Wyoming, City of	A, AE, X

*No Special Flood Hazard Areas Identified

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 4 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 4: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (Square Miles)
Little Miami	05090202	Little Miami River	East Hamilton County	1,758
Lower Great Miami, Indiana, Ohio	05080002	Great Miami River	West Hamilton County	1,381
Middle Ohio-Laughery	05090203	Mill Creek - Ohio River	Central Hamilton County	1,410
Ohio Brush-Whiteoak	05090201	Ohio River	Southeast Hamilton County	2,100
Whitewater	05080003	Whitewater River	Northwest Hamilton County	1,474

4.2 Principal Flood Problems

Table 5 contains a description of the principal flood problems that have been noted for Hamilton County by flooding source.

Table 5: Principal Flood Problems

Flooding Source	Description of Flood Problems
Duck Creek & Little Duck Creek	The low-lying areas of the Village of Fairfax are subject to periodic flooding caused by the overflow of Duck Creek and Little Duck Creek. The principal problem from Duck Creek occurs from the Red Bank Road bridge to the upstream end of the study area. The right overbank is low lying, and flow during a higher magnitude flood will cover the area. A building supported by piers extends across the creek in this reach, giving the effect of 170-foot bridge which allows no weir flow. Upstream overbank flow for higher level floods will leave the stream and cross the above-mentioned low-lying area before reentering the stream. This area is primarily paved parking surrounding scattered buildings. A higher concentration of culverts and bridges on Little Duck Creek (five in 0.33 mile) causes backwater and low stream velocities. This results in ponding conditions above the railroad culverts and the Columbia Parkway culvert during all frequency floods of this study. The Red Bank Road and the railroad culverts, due to their relatively low capacities and high embankments, cause exceptionally high surcharges with a resulting high tailwater elevation at the Columbia Parkway culvert. The ponds thus formed above the railroad and Columbia Parkway serve as retention basins for the downstream reaches of the stream and reduce the peak discharges through the downstream bridges. The low-lying area between these culverts has several commercial buildings and a paved parking area on the left bank. The lower area above the Columbia Parkway culvert is also along the left bank but contains primarily residential dwellings. The Little Duck Creek flows above the ponding area causing overflow flooding in the upper reaches of the stream, which are also primarily residential. Debris buildup in the Little Duck Creek structures also causes overbank flow in the upper reaches. In general, obstructions intensify the flooding situation by causing overbank flows with possible damage to or destruction of bridges, flooding in unpredictable areas, and by increasing velocities of flow immediately downstream.
Mill Creek	Flooding has been a chronic problem on Mill Creek for some time with the March 1913 event as the flood of record. However, the most damaging flood occurred in January 1959. There have been numerous other headwater floods of lesser magnitudes such as those that occurred in May 1996, April 1998, and July 2001. A detailed economic analysis showed that for existing conditions, significant damages would occur from a flood with a 50-percent annual chance of occurrence. For the 1-percent-annual-chance flood, there are approximately 560 structures located in the floodplain with total residual damages of over $480 million with the existing USACE flood control project in place. Total average annual damages for the study area under existing conditions are over $32 million with about 92% occurring above Glendale-Milford Road in the Evendale and Sharonville areas. Table 5 presents total damages and number of structures flooded for a range of frequency floods. Damages shown in Table 5 are assumed to begin when floodwaters initially come in contact with the structures within the floodplain. These damages are based upon an economic analysis update for Mill Creek dated June 1997.

Table 6 contains information about historic flood elevations in the communities within Hamilton County.

Table 6: Historic Flooding Elevations

[Not Applicable to this Flood Risk Project]

4.3 Non-Levee Flood Protection Measures

Table 7 contains information about non-levee flood protection measures within Hamilton County such as dams, jetties, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 7: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Great Miami River Watershed	Miami Conservancy District (MCD) Dams	Dams	Along Great Miami River and its various tributaries	The Germantown, Englewood, Huffman, Lockington, and Taylorsville Dams, constructed from 1919 to 1922, aid in the reduction of flood peaks on the Great Miami River basin in conjunction with scattered levees and channel improvements.
Little Miami River	Caesar Creek Reservoir	Reservoir	Located approx. 30 miles northeast of Cincinnati	The reservoir controls a drainage area of 237 square miles of the total of 1,145 square miles at the City of Loveland
Ohio River	Barrier Dam	Dam	Near confluence with Ohio River along the Mill Creek	In order to provide protection against Ohio River backwater flooding, a barrier dam across Mill Creek near the mouth, 1,420 feet of levee and concrete wall between the western abutment of the dam and pump house, 5,660 feet of concrete wall to form the eastern closure of the dam, and 6 pumps were constructed starting in January 1941 and completed in March 1948.
Ohio River		Dike	Four Seasons Marina	Earthen embankment to control flooding from Ohio River and Little Miami River
West Fork Mill Creek	Winton Park Dam	Dam	1.5 miles upstream of Rockhampton Circle	The dam controls the flow that would occur as a result of the 10-, 2-, 1-, or 0.2-percent-annual-chance storms.
Whitewater River	Brookville Reservoir	Reservoir	Located in Brookville Township, Franklin County, Indiana, just north of Brookville, in the southeastern part of the state.	The earthen dam was constructed in 1974 by the United States Army Corps of Engineers with a height of 181 feet and 2,800 feet long at its crest. It impounds the East Fork of the Whitewater River for flood control and storm water management.

4.4 Levee Systems

For purposes of the NFIP, FEMA only recognizes levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with comprehensive floodplain management criteria. The Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) describes the information needed for FEMA to determine if a levee system reduces the flood hazard from the 1-percent-annual-chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate flood hazard zone.

Levee systems that are determined to reduce the hazard from the 1-percent-annual-chance flood are accredited by FEMA. FEMA can also grant provisional accreditation to a levee system that was previously accredited on an effective FIRM and for which FEMA is awaiting data and/or documentation to demonstrate compliance with 44 CFR 65.10. These levee systems are referred to as Provisionally Accredited Levees, or PALs. Provisional accreditation provides communities and levee owners with a specified timeframe to obtain the necessary data to confirm the levee system's accreditation status. Accredited levee systems and PALs are shown on the FIRM using the symbology shown in Figure 3**.** If the required information for a PAL is not submitted within the required timeframe, or if information indicates that a levee system no longer meets 44 CFR 65.10, FEMA will consider the levee system as non-accredited and issue an effective FIRM showing the levee-impacted area as a SFHA or Zone D.

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levees that exist within Hamilton County. Table 8, "Levee Systems," lists all accredited levees, PALs, and de-accredited levees shown on the FIRM for this FIS Report. Other categories of levees may also be included in the table. The Levee ID shown in this table may not match numbers based on other identification systems that were listed in previous FIS Reports. Levees identified as PALs in the table are labeled on the FIRM to indicate their provisional status.

Please note that the information presented in Table 8 is subject to change at any time. For that reason, the latest information regarding the levee systems presented in the table may be obtained by accessing the National Levee Database. For additional information, contact the levee owner/sponsor or the local community shown in Table 30**.**

Table 8: Levee Systems

Community	Flooding Source(s)	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Cincinnati, City of	Duck Creek	3905520001	Duck Creek, OH - Phase II Levee System	Accredited	39061C0243F	City of Cincinnati
Cincinnati, City of	Duck Creek	3905520002	Duck Creek, OH - Phase IIa Levee System	Non-Accredited	39061C0243F	City of Cincinnati
Cincinnati, City of	Duck Creek	3905520004	Duck Creek, OH - Phase IV B Section 1 Alignment A Levee System	Accredited	39061C0241F	City of Cincinnati
Cincinnati, City of	Duck Creek	3905520005	Duck Creek, OH - Phase IV B Section 1 Alignment B Levee System	Accredited	39061C0241F	City of Cincinnati
Fairfax, Village of	Duck Creek	3905520003	Duck Creek, OH - Phase III Levee System	Accredited	39061C0244F	City of Cincinnati
Cincinnati, City of; Hamilton County, Unincorporated Areas	Duck Creek & Yonote Creek	3905520006	Duck Creek, OH - Phase IV B Section 2 & Phase IV C Levee System	Accredited	39061C0241F	City of Cincinnati
Cincinnati, City of	Little Miami River & Ohio River	1505000015	Lunken Airport Levee System	Non-Accredited	39061C0356G, 39061C0357F, 39061C0358G	City of Cincinnati
Cincinnati, City of	Ohio River	3905000003	Cincinnati Levee System	Accredited	39061C0331F, 39061C0332F	City of Cincinnati
Cincinnati, City of	Ohio River	1505001104	Hamilton Unincorporated Levee	Non-Accredited	39061C0306F	City of Cincinnati

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 10-, 25-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance, respectively, of being equaled or exceeded during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

In addition to these flood events, the “1-percent-plus”, or “1%+”, annual chance flood elevation has been modeled and included on the flood profile for certain flooding sources in this FIS Report. While not used for regulatory or insurance purposes, this flood event has been calculated to help illustrate the variability range that exists between the regulatory 1-percent-annual-chance flood elevation and a 1-percent-annual-chance elevation that has taken into account an additional amount of uncertainty in the flood discharges (thus, the 1% “plus”). For flooding sources whose discharges were estimated using regression equations, the 1%+ flood elevations are derived by taking the 1-percent-annual-chance flood discharges and increasing the modeled discharges by a percentage equal to the average predictive error for the regression equation. For flooding sources with gage- or rainfall-runoff-based discharge estimates, the upper 84-percent confidence limit of the discharges is used to compute the 1%+ flood elevations.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 26, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 12. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 9. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 10. Stream gage information is provided in Table 11.

Table 9: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Brookwood Creek	At the CONRAIL crossing located just downstream of the downstream corporate limits	0.3	890	*	1,370	1,680	2,700
Clough Creek	At mouth	8.0	4,774	*	7,847	9,781	13,500
Clough Creek	At Turpinhills Drive	7.4	4,600	*	7,000	8,800	12,000
Clough Creek	Below Hunley Road	6.3	4,441	*	6,313	8,595	11,700
Clough Creek	Below Berkshire Lane Tributary	5.4	3,700	*	5,900	7,100	10,700
Clough Creek	Above Berkshire Lane Tributary	2.0	2,775	*	4,044	4,463	5,950
Clough Creek	At State Road- Clough Pike Intersection	1.8	2,210	*	3,420	4,200	5,000
Clough Creek	At State Road-Wolfangle Road intersection	0.9	1,580	*	2,440	3,000	4,700
Congress Run	At mouth	3.8	3,333	*	5,118	7,072	10,000
Congress Run	Above tributary at Caldwell Drive	1.9	2,439	*	3,779	4,205	5,825
Congress Run	Above Cincinnati corporate limit	1.4	2,078	*	3,215	3,617	5,000
Congress Run	At extension of View Place Drive	0.7	1,450	*	2,250	2,750	4,380
Dry Fork of the Whitewater River	At mouth	81.7	13,800	*	21,800	25,500	36,000
Dry Fork of the Whitewater River	Below confluence of Lee Creek	76.8	13,200	*	21,000	25,000	35,000
Dry Fork of the Whitewater River	Above confluence of Lee Creek	65.8	12,200	*	19,700	23,000	32,500
Dry Fork of the Whitewater River	Below confluence of Howard Creek	59.8	11,700	*	18,800	22,000	31,000

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Dry Fork of the Whitewater River	Above confluence of Howard Creek	52.1	11,000	*	17,400	20,700	29,500
Duck Creek	At Conrail CSX	15.0	7,090	*	9,410	10,120	10,510
Duck Creek	Below confluence of Little Duck Creek	14.2	6,000	*	9,300	11,200	16,500
Duck Creek	Just upstream of Norfolk Railroad	10.1	5,030	*	6,780	7,330	7,750
Duck Creek	Above confluence of Little Duck Creek	9.7	5,300	*	7,000	7,630	7,950
Duck Creek	At railroad	9.1	4,850	*	6,860	8,650	12,150
Duck Creek	At Erie Avenue	8.6	3,450	*	4,100	4,700	4,750
Duck Creek	At railroad	6.6	3,500	*	4,200	4,500	4,850
Duck Creek	At Madison Road	6.3	3,000	*	3,300	3,400	3,600
Duck Creek	Just upstream of railroad	6.3	4,000	*	4,500	4,600	5,000
Duck Creek	At Kennedy Avenue Extension	3.8	3,900	*	4,000	4,300	4,500
East Fork Mill Creek	At mouth	9.4	1,100	*	1,850	2,210	3,110
Fork of McCullough Run	At mouth	2.1	2,400	*	3,700	4,550	7,000
Fork of McCullough Run	Below Ragland Road	1.9	2,300	*	3,550	4,300	6700
Great Miami River	At mouth	5,371	115,130	*	161,137	179,444	225,000
Great Miami River	Above confluence of Whitewater River	3,881	82,314	*	116,273	128,900	163,000

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Great Miami River	At Hamilton	3,630	814,000	*	114,600	128,400	162,000
Hazelwood Creek	Kenwood Road	0.8	1,550	*	2,400	2,900	4,650
Howard Creek	At mouth	7.6	4,400	*	7,000	8,400	12,500
Lake Chetac Creek	At Montgomery City Limits	2.4	990	1,275	1,515	1,770	2,395
Lake Chetac Creek	At confluence with Polk Run	2.4	905	1,160	1,375	1,590	2,105
Left Fork Section Road Creek	At mouth	0.4	1,030	*	1,600	1,950	3,100
Little Duck Creek[1]	At confluence with Duck Creek	4.1	1,305	1,540	1,750	1,980	2,535
Little Duck Creek[1]	Approximately 275 feet downstream of Red Bank Road	4.1	1,305	1,545	1,755	1,985	2,545
Little Duck Creek	Approximately 90 feet downstream of Murray Road	3.5	1,400	1,820	2,170	2,540	3,450
Little Miami River	Approximately 1,140 feet downstream of OH-32 Beechmont Avenue	1,759	48,320	62,025	73,155	84,620	114,925
Little Miami River	Approximately 1,120 feet downstream of OH-32 Beechmont Avenue	1,755	49,520	62,840	73,750	85,270	115,625
Little Miami River	At confluence with Duck Creek	1,743	49,540	62,820	73,720	85,235	115,545
Little Miami River	At confluence with East Fork Little Miami River	1,707	51,635	64,470	74,780	86,465	116,590
Little Miami River	Approximately 675 feet upstream from the Hamilton/Clermont County Boundary	1,199	32,885	42,210	49,795	58,755	82,180
Little Miami River	At confluence with Sycamore Creek	1,186	33,045	41,900	49,645	58,405	81,780
Little Miami River	At confluence with Polk Run	1,162	31,745	40,070	47,335	55,610	78,025

*Data not available

[1] Discharges reduced by ponding above the railroad bridge and the Columbia Parkway bridge

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Little Miami River	At confluence of O'Bannon Creek	1,148	31,350	39,575	46,770	54,900	77,935
McCullough Run	At mouth	4.2	3,300	*	5,200	6,300	9,600
McCullough Run	Above Fork of McCullough Run	1.7	2,200	*	3,400	4,200	6,450
Mill Creek	At mouth	160	12,810	*	18,060	20,160	25,660
Mill Creek	Above Lower West Fork	139	10,570	*	14,830	16,940	21,840
Mill Creek	At Mitchell Avenue	123	8,700	*	11,620	12,970	16,230
Mill Creek	At Carthage Gage	115	7,310	*	9,780	10,940	13,740
Mill Creek	Above West Fork	74.3	4,820	*	6,440	7,300	9,390
Mill Creek	Above Cooper Creek	63.3	3,580	*	4,490	4,880	5,770
Mill Creek	Above Glendale Road	50.4	2,960	*	3,340	3,630	4,320
Mill Creek	At Sharon Road	48	2,830	*	4,000	4,620	6,230
Mill Creek	At Kemper Road	43.9	2,790	*	4,190	4,950	7,010
Mill Creek	Above East Fork	32.8	2,280	*	3,390	3,990	5,520
Muddy Creek	At mouth	16.2	7,123	*	11,732	13,480	19,100
Muddy Creek	Above confluence of West Fork	13.3	5,772	*	9,780	11,216	16,100
Muddy Creek	Below Warsaw Road	10.2	5,679	*	8,840	10,109	14,000
Muddy Creek	At Devils Backbone Road	8.9	4,800	*	7,400	9,000	13,300
Muddy Creek	Below Ebenezer Road	7.9	4,500	*	7,100	8,600	12,800
Muddy Creek	At Muddy Creek Road at Sidney Road	5.3	3,700	*	5,750	7,000	10,500
Muddy Creek	At Hillside Avenue	1.9	5,700	*	9,000	10,300	15,200
Newton (Clear) Creek	At mouth	1.1	1,750	*	2,700	3,350	5,200
Newton (Clear) Creek	Below Norfolk & Western Railroad	0.5	1,210	*	1,880	2,300	3,650
North Branch Sycamore Creek	Approximately 1,820 feet upstream of Carriage Trail	4.6	1,250	1,605	1,900	2,230	3,040

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
North Branch Sycamore Creek	At confluence with Sycamore Creek	4.6	1,125	1,460	1,740	2,030	2,685
North Branch Sycamore Creek	Approximately 345 feet downstream of Interstate 71	2.3	655	830	975	1,125	1,495
Northland Road Tributary	At West Kemper Road	0.7	510	*	660	800	*
Northland Road Tributary	At Northland Road	0.3	*	*	*	300	*
O'Bannon Creek	At confluence with Little Miami River	59.7	7,615	9,890	11,590	13,530	17,880
O'Bannon Creek	Approximately 1,065 feet upstream of Warren Clermont County Boundary	55.9	7,485	9,720	11,605	13,610	18,460
Ohio River	At Cincinnati (mile 470.5)	76,580	532,000	*	663,000	718,000	844,200
Ohio River	Approximately one mile downstream of the confluence of the Little Miami River (mile 464.5)	72,890	524,600	*	626,600	677,900	800,700
Ohio River	Approximately 0.4 mile upstream of the confluence of Eight Mile Creek (mile 456.0)	71,100	520,000	*	604,000	653,000	775,000
Pleasant Run	*	*	*	*	*	*	*
Polk Run	Approximately 1,720 feet upstream of E. Kemper Road	6.7	1,475	1,975	2,405	2,835	3,870
Polk Run	At confluence with Little Miami River	6.7	1,450	1,950	2,275	2,650	3,600
Polk Run	At confluence with Lake Chetac Creek	5.8	1,220	1,700	2,070	2,470	3,375
Polk Run	Approximately 615 feet downstream of Fields Ertel Road	1.7	570	760	925	1,095	1,525

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Raiders Run	At Montgomery Road	1.9	1,500	*	1,820	1,876	1,900
Raiders Run	Above Pepperell Lane	1.7	1,250	*	1,530	1,660	1,800
Raiders Run	At Interstate Route 71	1.5	2,050	*	3,150	3,850	5,500
Raiders Run	At Donjoy Drive	0.8	1,370	*	2,400	2,550	3,800
Raiders Run	At Bellview Avenue	0.7	1,676	*	2,628	2,899	4,050
Section Road Creek	At the Conrail crossing located just downstream of the downstream corporate limits	2.5	2,930	*	4,591	5,182	7,400
Section Road Creek	At the private drive located approximately 2,400 feet upstream of Left Fork Section Road Creek	2	2,384	*	4,383	4,976	7,000
Section Road Creek	Just downstream of Ridge Road	1.5	1,995	*	3,503	3,896	5,900
Sharon Creek	At mouth	10.5	3,500	*	5,050	6,000	8,350
Sharon Creek	Above confluence of Sharon Creek Tributary	6.7	3,250	*	4,800	5,750	8,250
Sharon Creek	At Reading Road	5.8	3,180	*	4,730	5,650	8,200
Sharon Creek Tributary	At mouth	3.6	1,700	*	2,110	2,590	4,050
Sharon Creek Tributary	Above Main Street	3.1	1,700	*	2,110	2,590	4,050
Sharon Creek Tributary	Above Thornview Drive	0.6	1,380	*	2,100	2,590	4,050
Springdale Tributary	At Chesterfield Road	4.5	1,700	*	2,400	2,640	*
Springdale Tributary	At Interstate Route 275	3.4	1,500	*	2,130	2,340	*
Springdale Tributary	At Princeton Road	3.4	1,470	*	2,100	2,310	*

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Springdale Tributary	At Neuss Avenue	2.4	1,210	*	1,700	1,880	*
Springdale Tributary	At Springfield Road	1.4	840	*	1,180	1,290	*
Springdale Tributary	At Cloverdale Avenue	0.6	470	*	620	760	*
Sycamore Creek	At confluence with North Branch Sycamore Creek	20.6	6,295	8,020	9,450	10,950	14,510
Sycamore Creek	At confluence with Little Miami River	20.6	4,540	5,440	6,370	7,505	9,795
Sycamore Creek	Approximately 60 feet upstream of Camargo Road	1.9	670	840	980	1,130	1,485
Sycamore Creek	Approximately 880 feet upstream of Camargo Road	0.4	285	355	420	480	635
West Fork	At mouth	9.4	4,340	*	6,586	7,910	11,940
West Fork	Above Interstate Highway 74	8.9	4,800	*	7,600	9,200	13,600
West Fork	Above Runnymede Avenue	6.8	4,300	*	6,500	7,800	11,800
West Fork Lake Tributary	Just downstream of Clovemook Avenue	2.6	*	*	*	4,580	*
West Fork Mill Creek	At mouth	36.4	1,725	*	2,050	2,175	2,450
West Fork Mill Creek	At Riddle Road	32.2	1,600	*	1,900	2,010	2,270
West Fork Mill Creek	Just downstream of West Fork Lake	29.9	1,400	*	1,400	1,400	1,400
West Fork Mill Creek	Just downstream of Hamilton Avenue	11.2	5,300	*	8,400	10,000	14,800

*Data not available

Table 9: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
West Fork Mill Creek South Tributary	At mouth	0.4	700	*	1,080	1,330	2,070
West Fork of Sycamore Creek	At Indian Hill Village corporate limit	4.2	3,411	*	5,409	7,024	9,800
West Fork of Sycamore Creek	Above Raiders Run	1.8	2,222	*	3,612	4,595	6,600
West Fork of Sycamore Creek	Below Galbraith Road	0.5	720	*	1,350	1,650	2,900
West Fork of Sycamore Creek	Below Hosbrook Avenue	0.4	1,130	*	1,750	2,110	3,400
Whitewater River	At mouth	1,474	43,739	*	56,451	64,747	87,807
Whitewater River	Above Dry Fork	1,385	43,621	*	56,298	64,571	87,563
Whitewater River	At Harrison Special Study site (near Dearborn County Line)	1,368	42,500	*	55,000	62,000	83,600
Winton Woods Creek	At McKelvey Road	7.3	4,830	*	7,311	8,313	11,000
Winton Woods Creek	Below Daly Road	2.7	2,660	*	4,200	5,100	8,800
Winton Woods Creek	Just downstream of Clovemook Avenue	2.6	*	*	*	4,580	*
Wulff Run	At Delhi Pike near Hillbrook Drive	1.5	1,971	*	3,154	3,862	5,500
Wulff Run	At Delhi Pike near Viscount Drive	1.3	1,900	*	2,900	3,600	5,000
Wulff Run	At Morrvue Drive	0.7	1,400	*	2,150	2,600	4,150
Yonote Creek	At. U.S. Highway 71	1.6	830	*	1,360	1,470	1,720

*Data not available

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this Flood Risk Project]

Table 10: Summary of Non-Coastal Stillwater Elevations

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Duck Creek (Old Channel)	An area of ponding along Duck Creek bounded by Red Bank Road to the North and South	*	*	*	503.4	*

*Data not available

Table 11: Stream Gage Information Used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Little Miami River	03245500	USGS	Little Miami River at Milford, Clermont County, Ohio	1,203	03/04/1977	12/27/2015

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed in Table 23, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 12. Roughness coefficients are provided in Table 13. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Bares Run	Approximately 25 feet downstream from the crossing of East Loveland Avenue	Approximately 2,905 feet upstream from the crossing of E Loveland Ave	Regression Equations	HEC-RAS 4.1	09/30/2016	A	
Berkshire Creek	Confluence with Clough Creek	Approximately 110 feet upstream from Stanley Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
Brookwood Creek	Approximately 450 feet downstream of Fair Oaks Drive	Fair Oaks Drive	Regression Equations	HEC-2	December 1978	AE w/ Floodway	
Clough Creek	Confluence with Little Miami River	Approximately 645 feet upstream from State Road	OTHER	HEC-2	March 1979	AE w/ Floodway	Redelineation of effective stream on September 2018
Congress Run	Confluence with Mill Creek	Approximately 580 feet upstream of North Hill Lane	Regression Equations	HEC-2	March 1979	AE w/ Floodway	
Dry Fork of The Whitewater River	Confluence with Whitewater River	Approximately 160 feet upstream of Marion Road	OTHER	HEC-2	March 1979	AE w/ Floodway	
Dry Run	Approximately 650 feet downstream from Railroad	Approximately 95 feet upstream from Whiting Way	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
Duck Creek	Confluence with Little Miami River	Approximately 1,200 feet upstream of Red Bank Road	Regression Equations	HEC-RAS 3.1.1 and up	02/22/2007	AE w/ Floodway	Redelineation of effective stream on September 2018

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Duck Creek	Approximately 1,200 feet upstream of Red Bank Road	Approximately 957 feet upstream from Ridge Ave	Regression Equations	HEC-RAS 3.1.1 and up	09/20/2013	AE w/ Floodway	LOMR 13-05-0281P
East Fork Mill Creek	Confluence with Mill Creek	Crescentville Road	Regression Equations	HEC-2	July 2009	AE w/ Floodway	
Fork of McCullough Run	Confluence with McCullough Run	Ragland Road	OTHER	HEC-2	March 1979	AE w/ Floodway	Redelineation of effective stream on September 2018
Great Miami River	Confluence with Ohio River	Approximately 0.9 miles upstream of State Route 126	OTHER	HEC-2	March 1979	AE w/ Floodway	
Hazelwood Creek	Kenwood Road	Cornell Road	Regression Equations	HEC-2	December 1978	AE w/ Floodway	
Howard Creek	Confluence with Whitewater River	Oxford Road	OTHER	HEC-2	March 1979	AE w/ Floodway	
Lake Chetac Creek	Confluence with Polk Run	Corporate limits of City of Montgomery	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Lake Chetac Creek	Corporate limits of City of Montgomery	Fields Ertel Road and Hamilton/Warren County Boundary	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
Left Fork Section Road Creek	Confluence with Section Road Creek	Aracoma Forest Drive	Regression Equations	HEC-2	December 1978	AE w/ Floodway	
Little Duck Creek	Confluence with Duck Creek	Approximately 500 feet downstream from Red Bank Road	Regression Equations	HEC-RAS 3.1.1 and up	02/22/2007	AE w/ Floodway	Redelineation of effective stream on September 2018
Little Duck Creek	Approximately 500 feet downstream from Red Bank Road	Approximately 100 feet upstream of Murray Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Little Duck Creek	Approximately 100 feet upstream of Murray Road	Approximately 780 feet upstream from Dawson Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
Little Miami River	Confluence with Ohio River	Northern Hamilton/Warren County Boundary	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Loveland Creek	Confluence with Little Miami River	Approximately 1800 feet upstream of Rich Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A/AE	
McCullough Run	Confluence with Little Miami River	Turpin Lane	OTHER	HEC-2	March 1979	AE w/ Floodway	Redelineation of effective stream on September 2018
Mill Creek	Barrier Dam	E Sharon Rd	Regression Equations	HEC-2	04/20/2000	AE w/ Floodway	
Mill Creek	E Sharon Rd	Just upstream of Crescentville Road	Regression Equations	HEC-2	July 2009	AE w/ Floodway	
Muddy Creek	Confluence with Ohio River	0.2 miles upstream of Sidney Road	OTHER	HEC-2	March 1979	AE w/ Floodway	
Newton (Clear) Creek	Confluence with Little Miami River	Railroad	OTHER	HEC-2	September 2018	AE w/ Floodway	Superseded by Little Miami River flood study
North Branch Sycamore Creek	Confluence with Sycamore Creek	Approximately 1,880 feet upstream of Carriage Trail	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
North Branch Sycamore Creek	Approximately 1,880 feet upstream of Carriage Trail	I-71 Highway	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Northland Road Tributary	Confluence with Springdale Tributary	Approximately 320 feet upstream of Springfield Pike/ State Route 4	Regression Equations	HEC-2	July 1988	AE	

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
O'Bannon Creek	Confluence with Little Miami River	Eastern corporate limit of City of Loveland	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Ohio River	Approximately 0.35 miles downstream of the confluence of Great Miami River	Approximately 1.15 miles upstream of the confluence of Eight Mile Creek	Natural Discharge Frequency Curves	HEC-RAS 4.0	January 2011	AE w/ Floodway	USACE – Statistical Methods in Hydrology
Pleasant Run	100 feet downstream of John Gray Road	Approximately 0.5 miles upstream of confluence of Pleasant Run Tributary	Regression Equations	HEC-2	04/26/2006	AE w/ Floodway	
Polk Run	Confluence with Little Miami River	Approximately 3,850 feet upstream from Loveland Madeira Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A/AE	
Polk Run	Approximately 3,850 feet upstream from Loveland Madeira Road	Approximately 380 feet upstream from E. Kemper Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Polk Run	Approximately 380 feet upstream from E. Kemper Road	Fields Ertel Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	
Raiders Run	Confluence with West Fork of Sycamore Creek	South of Ronald Reagan Cross CO EB Highway	OTHER	HEC-2	March 1979	AE w/ Floodway	Redelineation of effective stream on September 2018
Section Road Creek	Approximately 0.2 miles downstream of Elbrook Avenue	Approximately 0.3 miles upstream of West Beechlands Drive	Regression Equations	HEC-2	December 1978	AE w/ Floodway	
Sharon Creek	Confluence with Mill Creek	Approximately 440 feet upstream of Park Road	Regression Equations	HEC-2	July 2009	AE w/ Floodway	
Sharon Creek Tributary	Confluence with Sharon Creek	0.5 miles upstream of Main Street	Regression Equations	HEC-2	July 2009	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Springdale Tributary	Chesterdale Road	Approximately 50 feet upstream of Cloverdale Avenue	Regression Equations	HEC-2	July 1988	AE	
Sycamore Creek	Confluence with Little Miami River	Approximately 4,580 feet upstream of Keller Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A/AE	
Sycamore Creek	Approximately 4,580 feet upstream of Keller Road	Approximately 700 feet upstream from Camargo Road	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	AE w/ Floodway	
Tributary A	Mouth at West Fork Lake Tributary	Approximately 820 feet upstream of Northbridge Avenue	Regression Equations	HEC-2	May 1985	AE w/ Floodway	
Tributary To Pleasant Run	Confluence with Pleasant Run	Approximately 0.6 mile upstream of confluence with Pleasant Run	Regression Equations	HEC-2	04/26/2006	AE w/ Floodway	
West Fork Creek	Confluence with Mill Creek	Confluence of McFarland Creek	Regression Equations	HEC-2	March 1979	AE w/ Floodway	
West Fork Lake Tributary	200 feet downstream of Desoto Drive	Approximately 340 feet upstream of Emerson Avenue	Regression Equations	HEC-2	May 1985	AE w/ Floodway	
West Fork Mill Creek	Confluence with Mill Creek	Just upstream of Blue Rock Road	HEC-1	HEC-2	October 1992	AE w/ Floodway	
West Fork Mill Creek South Tributary	Confluence with West Fork Mill Creek	Just upstream of footbridge	HEC-1	HEC-2	June 1985	AE w/ Floodway	
West Fork of Sycamore Creek	Confluence with Sycamore Creek	approximately 1.6 miles above confluence with Sycamore Creek	HEC-HMS 4.2	HEC-RAS 5.0.1	September 2018	A	

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
West Fork of Sycamore Creek	Approximately 1.6 miles above confluence with Sycamore Creek	North of East Galbraith Road	OTHER	HEC-2	March 1979	AE w/ Floodway	Redelineation of effective stream on September 2018
Whitewater River	Confluence with Great Miami River	Approximately 1.7 miles upstream of Jamison Road	OTHER	HEC-2	March 1979	AE w/ Floodway	
Winton Woods Creek	Approximately 1.6 miles downstream of Bridgecreek Lane	Approximately 200 feet upstream of Desoto Drive	Regression Equations	HEC-2	03/02/1993	AE w/ Floodway	
Wulff Run	Approximately 0.3 mile downstream of Delhi Road	Anderson Ferry Road	OTHER	HEC-2	March 1979	AE w/ Floodway	
Yonote Creek	Confluence with Duck Creek	South of I-71 NB Expressway	Regression Equations	HEC-RAS 3.1.1 and up	09/20/2013	AE w/ Floodway	LOMR 13-05-0281P
Zone A Stream (Little Miami Tributary)	Approximately 500 feet upstream of Round Bottom Road	Approximately 0.75 mile upstream of Round Bottom Road	HEC-1	HEC-2	March 1979	A	

Table 12: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Zone A Streams (Lower Great Miami, Indiana, Ohio Tributaries)	Varies	Varies	HEC-1	HEC-2	March 1979	A	
Zone A Streams (Middle Ohio - Laughery Tributaries)	Varies	Varies	HEC-1	HEC-2	June 1985	A	
Zone A Streams (Ohio Brush-Whiteoak Tributaries)	Varies	Varies	HEC-1	HEC-2	March 1979	A	
Zone A Streams (Whitewater Tributaries)	Varies	Varies	HEC-1	HEC-2	March 1979	A	

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Berkshire Creek	0.045	0.070 - 0.090
Brookwood Creek	0.040	0.080 - 0.090
Clough Creek	0.050 - 0.070	0.065 - 0.120
Congress Run	0.040 - 0.047	0.070 - 0.100
Dry Fork of the Whitewater River	0.035 - 0.055	0.020 - 0.100
Dry Run	0.045	0.070 - 0.090
Duck Creek	0.015 - 0.075	0.012 - 0.120
East Fork Mill Creek	0.035 - 0.035	0.060 - 1.000
Fork of McCullough Run	0.020 - 0.045	0.060 - 0.100
Great Miami River	0.030 - 0.060	0.050 - 0.100
Hazelwood Creek	0.025 - 0.045	0.070 - 0.120
Howard Creek	0.020 - 0.035	0.040 - 0.070
Lake Chetac Creek	0.045 - 0.080	0.040 - 0.140
Left Fork Section Road Creek	0.020 - 0.045	0.060 - 0.100
Little Duck Creek	0.015 - 0.055	0.025 - 0.130
Little Miami River	0.035 - 0.055	0.020 - 0.140
Loveland Creek	0.045 - 0.055	0.070 - 0.120
McCullough Run	0.040	0.060 - 0.070
Mill Creek	0.030 - 0.050	0.060 - 2.000
Muddy Creek	0.020 - 0.035	0.050 - 0.070
Newton (Clear) Creek	0.050	0.070 - 0.100
North Branch Sycamore Creek	0.030 - 0.045	0.025 - 0.150
Northland Road Tributary	*	*
O'Bannon Creek	0.040 - 0.070	0.040 - 0.140
Ohio River	0.025 - 0.030	0.100 - 0.110
Pleasant Run	*	*
Polk Run	0.030 - 0.060	0.030 - 0.150
Raiders Run	0.040	0.070 - 0.100
Section Road Creek	0.020 - 0.045	0.070 - 0.100
Sharon Creek	0.040	0.065-0.075
Sharon Creek Tributary	0.045	0.060
Springdale Tributary	*	*
Sycamore Creek	0.030 - 0.045	0.025 - 0.130
Tributary A	*	*
Tributary to Pleasant Run	*	*
West Fork Lake Tributary	0.015 - 0.080	0.055 - 0.080
West Fork Mill Creek	0.035 - 0.047	0.075
West Fork Mill Creek (below the dam)	0.045	0.090 - 0.120

*Data not available

Table 13: Roughness Coefficients *(continued)*

Flooding Source	Channel "n"	Overbank "n"
West Fork Mill Creek (downstream of Pippin Road)	0.020 - 0.040	0.080 - 0.110
West Fork Mill Creek (upstream of Pippin Road)	0.015 - 0.075	0.045 - 0.120
West Fork Mill Creek South Tributary	0.045	0.075
West Fork of Sycamore Creek	0.020 - 0.055	0.070 - 0.120
Whitewater River	0.030 - 0.055	0.020 - 0.100
Winton Woods Creek	0.040	0.070 - 0.100
Wulff Run	0.020 - 0.035	0.050 - 0.070
Yonote Creek	0.015 - 0.065	0.060

5.3 Coastal Analyses

This section is not applicable to this Flood Risk Project.

Table 14: Summary of Coastal Analyses

[Not Applicable to this Flood Risk Project]

5.3.1 Total Stillwater Elevations

This section is not applicable to this Flood Risk Project.

Figure 8: 1-Percent-Annual-Chance Total Stillwater Elevations for Coastal Areas

[Not Applicable to this Flood Risk Project]

Table 15: Tide Gage Analysis Specifics

[Not Applicable to this Flood Risk Project]

5.3.2 Waves

This section is not applicable to this Flood Risk Project.

5.3.3 Coastal Erosion

This section is not applicable to this Flood Risk Project.

5.3.4 Wave Hazard Analyses

This section is not applicable to this Flood Risk Project.

Table 16: Coastal Transect Parameters

[Not Applicable to this Flood Risk Project]

Figure 9: Transect Location Map

[Not applicable to this Flood Risk Project]

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project.

Table 17: Summary of Alluvial Fan Analyses

[Not applicable to this Flood Risk Project]

Table 18: Results of Alluvial Fan Analyses

[Not applicable to this Flood Risk Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

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

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov.

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please visit the NGS website at www.ngs.noaa.gov.

The datum conversion value that was calculated for Hamilton County is provided in Table 19.

Table 19: Countywide Vertical Datum Conversion

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
*	*	*	*	*
Average Conversion from NGVD29 to NAVD88 = -0.593 feet				

* Data Not Available

Table 20: Stream-Based Vertical Datum Conversion

[Not applicable to this Flood Risk Project]

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM Database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/flood-maps/guidance-partners/guidelines-standards.

Base map information shown on the FIRM was derived from the sources described in Table 21.

Table 21: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
National Hydrography Dataset (NHD) - High Resolution	United States Geological Survey (USGS)	1999	N/A	Spatial and attribute information for STARR II revised Hydrology analysis - Subbasins feature areas (NHD 1999)
Ortho-Imagery of Hamilton County, Ohio	Ohio Geographically Information Referenced Program (OGRIP)	2018	N/A	Ortho-Imagery for Little Miami River PMR (OGRIP 2018)
Ortho-Imagery of Hamilton County, Ohio	Cincinnati Area Geographic Information System (CAGIS)	2007	N/A	Ortho-Imagery of Hamilton County, Ohio, outside Little Miami PMR (CAGIS 2007)

Table 21: Base Map Sources *(continued)*

Data Type	Data Provider	Data Date	Data Scale	Data Description
Public Land Survey System (PLSS), Political Boundaries	Federal Emergency Management Agency (FEMA)	2012	N/A	Spatial and attribute information for public land survey system and political boundaries as part of the effective FIS (NFHL 2012)
Surface Water Features for Hamilton County	Cincinnati Area Geographic Information System (CAGIS)	2012	N/A	Spatial and attribute information for water feature lines (CAGIS 2012)
Transportation Features for Hamilton County	Cincinnati Area Geographic Information System (CAGIS)	2016	N/A	Spatial and attribute information for transportation and water features (CAGIS 2016)

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 22.

In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 23, "Floodway Data."

Table 22: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Vertical Accuracy	Horizontal Accuracy	Citation
Hamilton County and various Incorporated Areas	All within HUC 05090202 and the Ohio River	Light Detection and Ranging data (LiDAR)	RMSE of 0.5-foot - 95% confidence level	The aerial LiDAR acquisition for the State of Ohio was flown to support the creation of digital orthophotography with a 0.5-foot and 1-foot pixel resolution	OGRIP 2007
Hamilton County and various Incorporated Areas	All within HUC 05080002, 05080003, 05090201, 05090203, excluding Ohio River	2001 2-foot contours	Not provided	Not provided	CAGIS 2001

BFEs shown at cross sections on the FIRM represent the 1-percent-annual-chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report.

Table 23: Floodway Data

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Brookwood Creek								
A	1,775 [1]	53	407	4.1	606.1	606.1	606.6	0.5
B	2,365 [1]	45	136	9.0	611.9	611.9	612.0	0.1
Clough Creek								
A	1,300 [2]	86	682	14.3	500.8	472.6 [3]	473.1	0.5
B	2,095 [2]	134	1,087	9.0	500.8	483.3 [3]	483.8	0.5
C	2,781 [2]	81	701	13.9	500.8	493.5 [3]	493.6	0.1
D	3,470 [2]	157	2,289	4.3	506.1	506.1	506.1	0.0
E	4,665 [2]	125	1,355	7.2	508.2	508.2	508.3	0.1
F	5,665 [2]	207	968	10.1	513.0	513.0	513.2	0.2
G	6,876 [2]	146	1,520	6.4	523.6	523.6	524.2	0.6
H	7,982 [2]	240	1,969	5.0	528.1	528.1	528.6	0.5
I	8,940 [2]	150	1,276	6.9	532.1	532.1	532.4	0.3
J	10,091 [2]	231	1,715	5.1	543.1	543.1	543.8	0.7
K	11,219 [2]	126	791	11.1	551.4	551.4	551.5	0.1
L	12,711 [2]	156	1,461	6.0	565.7	565.7	566.7	1.0
M	14,023 [2]	200	935	9.2	572.8	572.8	573.0	0.2
N	14,975 [2]	159	1,630	5.3	581.5	581.5	581.8	0.3
O	16,217 [2]	80	1,202	7.1	591.5	591.5	592.2	0.7
P	17,298 [2]	74	729	9.7	602.0	602.0	602.0	0.0

[1] Distances measured in feet above Village of Amberley corporate limits

[2] Distances measured in feet above confluence with Little Miami River

[3] Computed without consideration of backwater effects from the Ohio River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: BROOKWOOD CREEK – CLOUGH CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[3] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Clough Creek (Continued)									
Q	17,904 [1]	147		1,455	4.9	617.0	617.0	617.1	0.1
R	18,905 [1]	65		430	10.4	628.7	628.7	628.7	0.0
S	19,975 [1]	43		349	12.8	657.2	657.2	657.2	0.0
T	20,523 [1]	52		461	9.7	666.6	666.6	666.8	0.2
U	21,725 [1]	50	43	448	9.4	684.7	684.7	685.0	0.3
V	22,690 [1]	111		2,435	1.7	728.5	728.5	729.3	0.8
W	23,715 [1]	72		467	9.0	737.7	737.7	737.9	0.2
X	24,737 [1]	186		966	4.3	752.2	752.2	752.3	0.1
Y	25,272 [1]	90	73	687	6.1	756.9	756.9	756.9	0.0
Z	26,223 [1]	110		644	4.7	768.4	768.4	768.8	0.4
Congress Run									
A	1,180 [2]	111		1,014	7.0	524.7	524.7	525.3	0.6
B	2,110 [2]	112		840	5.0	528.0	528.0	528.7	0.7
C	3,050 [2]	66		509	8.3	534.9	534.9	535.5	0.6
D	3,460 [2]	95		808	5.2	542.3	542.3	543.0	0.7
E	4,535 [2]	261		750	5.6	550.7	550.7	551.4	0.7
F	5,828 [2]	50		397	10.6	587.3	587.3	587.3	0.0
G	6603 [2]	38		716	5.9	622.0	622.0	622.7	0.7

[1] Distances measured in feet above confluence with Little Miami River [3] See explanation in Section 2.2 Floodways

[2] Distances measured in feet above confluence with Mill Creek

TABLE	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: CLOUGH CREEK – CONGRESS RUN**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[4] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Congress Run (Continued)									
H	7,675 [1]	46		265	13.6	634.5	634.5	634.5	0.0
I	9,735 [1]	48		222	12.4	709.8	709.8	709.8	0.0
J	11,050 [1]	54		233	11.8	758.3	758.3	758.3	0.0
K	12,370 [1]	72		255	10.8	795.4	795.4	795.4	0.0
L	13,625 [1]	45		219	12.5	823.8	823.8	823.8	0.0
M	14,445 [1]	80	81	2,001	1.4	850.7	850.7	850.8	0.1
Dry Fork of the Whitewater River									
A	8,131 [2]	855		6,293	4.1	498.5	498.5	498.8	0.3
B	9,610 [2]	197		2,632	9.7	499.0	499.0	499.7	0.7
C	11,405 [2]	833		5,579	4.6	502.3	502.3	503.3	1.0
D	13,622 [2]	760		4,386	5.8	504.8	504.8	505.8	1.0
E	15,734 [2]	358		2,523	10.1	509.8	509.8	510.0	0.2
F	17,213 [2]	413		3,559	7.2	513.0	513.0	513.3	0.3
G	19,219 [2]	447		4,116	6.2	515.9	515.9	516.4	0.5
H	19,958 [2]	554		4,993	5.1	518.5	518.5	519.1	0.6
I	22,704 [2]	133		1,724	14.8	521.3	521.3	521.8	0.5
J	24,182 [2]	336		3,890	6.4	527.1	527.1	527.5	0.4
K	25,819 [2]	377		4,090	6.1	528.7	528.7	529.5	0.8

[1] Distances measured in feet above confluence with Mill Creek

[2] Distances measured in feet above confluence with Whitewater River

[3] Distances measured in feet above confluence with Whitewater River

[4] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: CONGRESS RUN – DRY FORK OF THE WHITEWATER RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Dry Fork of the Whitewater River (continued)								
L	26,928	640	8,751	2.9	532.3	532.3	533.2	0.9
M	27,826	852	10,311	2.4	533.1	533.1	534.0	0.9
N	29,726	289	4,231	5.9	533.5	533.5	534.4	0.9
O	30,413	325	3,326	7.5	534.8	534.8	535.8	1.0
P	33,264	580	5,279	4.7	538.4	538.4	539.3	0.9
Q	35,693	747	7,132	3.2	543.6	543.6	544.4	0.8
R	37,277	489	4,215	5.5	544.4	544.4	545.1	0.7
S	39,758	926	8,121	2.8	547.9	547.9	548.5	0.6
T	41,395	1,036	7,030	3.1	549.4	549.4	550.0	0.6
U	42,504	1,399	7,887	2.8	552.5	552.5	553.2	0.7
V	44,616	547	5,051	4.4	555.1	555.1	555.7	0.6
W	48,312	1,050	6,975	3.0	558.5	558.5	559.3	0.8
X	49,262	152	2,183	9.5	562.4	562.4	562.6	0.2
Y	51,058	1,169	8,781	2.4	564.9	564.9	565.7	0.8
Z	51,533	590	6,079	3.4	566.1	566.1	566.9	0.8
AA	53,962	753	6,261	3.3	567.3	567.3	568.2	0.9
AB	55,757	414	2,664	7.8	570.7	570.7	571.3	0.6
AC	58,661	624	2,716	7.6	576.4	576.4	576.7	0.3

[1] Distances measured in feet above confluence with Whitewater River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: DRY FORK OF THE WHITEWATER RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Dry Fork of the Whitewater River (continued)								
AD	59,822 [1]	247	3,049	6.8	579.4	579.4	580.1	0.7
AE	61,301 [1]	194	1,832	11.3	581.9	581.9	582.5	0.6
AF	62,040 [1]	882	7,235	2.9	586.7	586.7	587.5	0.8
AG	64,522 [1]	503	2,885	7.2	587.9	587.9	588.4	0.5
AH	65,894 [1]	780	4,757	4.4	592.3	592.3	592.9	0.6
Duck Creek								
A	1,820 [2]	528 [4]	1,986	7.4	500.8	474.1 [3]	474.6	0.5
B	4,670 [2]	380	4,259	3.4	500.8	477.8 [3]	478.6	0.8
C	6,065 [2]	256	2,248	6.5	500.8	488.4 [3]	488.8	0.4
D	7,005 [2]	260	2,240	6.5	501.3	490.0 [4]	490.8	0.8
E	8,285 [2]	194	1,436	10.2	501.4	493.0 [4]	493.8	0.8
F	9,495 [2]	180	1,150	12.7	501.7	498.2 [4]	499.1	0.9
G	11,403 [2]	314	4,407	2.5	509.4	509.4	510.3	0.9
H	15,877 [2]	109	1,284	3.7	523.5	523.5	523.5	0.0
I	16,347 [2]	120	951	4.9	523.9	523.9	524.0	0.1
J	17,161 [2]	83	615	7.6	524.2	524.2	524.2	0.0
K	18,038 [2]	66	515	9.1	524.9	524.9	525.0	0.1

[1] Distances measured in feet above confluence with Whitewater River

[2] Distances measured in feet above confluence with Little Miami River

[3] Computed without consideration of backwater effects from the Ohio River

[4] Computed without consideration of effects from Little Miami River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: DRY FORK OF THE WHITEWATER RIVER – DUCK CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Duck Creek (Continued)								
L	19,727 [1]	52	441	10.2	526.4	526.4	526.4	0.0
M	20,752 [1]	132	1,132	4.0	533.7	533.7	533.7	0.0
N	23,782 [1]	43	291	15.5	536.5	536.5	536.5	0.0
O	25,104 [1]	77	840	5.5	545.2	545.2	545.4	0.2
P	26,590 [1]	71	552	7.8	547.1	547.1	547.5	0.4
East Fork Mill Creek								
A	2,200 [2]	269	1,685	1.3	584.1	584.1	584.6	0.5
B	3,600 [2]	167	1,134	2.0	585.3	585.3	585.8	0.5
C	4,000 [2]	86	623	3.6	585.8	585.8	586.3	0.5
D	5,000 [2]	78	569	3.9	586.0	586.0	586.5	0.5
Fork of McCullough Run								
A	2,715 [3]	350	1,307	3.5	501.6	501.6	502.1	0.5
B	3,277 [3]	294	850	5.4	504.2	504.2	504.6	0.4
C	3,707 [3]	166	606	7.1	506.9	506.9	507.8	0.9

[1] Distances measured in feet above confluence with Little Miami River

[2] Distances measured in feet above confluence with Mill Creek

[3] Distances measured in feet above confluence with McCullough Run

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: DUCK CREEK – EAST FORK MILL CREEK – FORK OF McCULLOUGH RUN

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Great Miami River								
A	5,000	7,236 / 0 [2]	109,493	1.6	489.9	471.7 [3]	472.7	1.0
B	11,560	5,008/2505 [2]	77,005	2.3	489.9	472.3 [3]	473.3	1.0
C	23,900	6,631	56,059	3.2	489.9	473.9 [3]	474.7	0.8
D	26,833	3,882	35,705	5.0	489.9	474.9 [3]	475.6	0.7
E	30,400	2,656	40,406	4.4	489.9	478.6 [3]	479.1	0.5
F	33,900	2,318	34,408	5.2	489.9	479.8 [3]	480.4	0.6
G	38,300	1,527	22,076	5.8	489.9	482.3 [3]	483.0	0.7
H	40,905	1,473	22,808	5.7	489.9	484.3 [3]	485.2	0.9
I	44,925	991	19,604	6.6	489.9	487.0 [3]	488.0	1.0
J	46,872	1,010	17,714	7.3	489.9	488.7 [3]	489.6	0.9
K	51,480	1,671	20,804	6.2	495.5	495.5	496.4	0.9
L	56,595	926	21,228	6.1	499.2	499.2	500.1	0.9
M	61,980	1,805	33,396	3.9	503.4	503.4	504.4	1.0
N	66,670	757	16,907	7.6	505.4	505.4	506.3	0.9
O	72,620	1,390	30,146	4.3	509.5	509.5	510.4	0.9
P	75,650	1,206	23,353	5.5	510.5	510.5	511.4	0.9
Q	80,036	664	17,395	7.4	515.0	515.0	516.0	1.0
R	82,893	2,027	36,910	3.5	517.1	517.1	518.1	1.0

[1] Distances measured in feet above confluence with Ohio River

[2] Total width/width within county

[3] Computed without consideration of backwater effects from the Ohio River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: GREAT MIAMI RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Great Miami River (continued))								
S	86,320	2,146	38,034	3.4	518.0	518.0	519.0	1.0
T	88,655	2,428	42,354	3.0	518.7	518.7	519.7	1.0
U	91,545	2,539	52,025	2.5	519.4	519.4	520.4	1.0
V	95,005	2,118	31,577	4.1	520.1	520.1	520.9	0.8
W	99,890	2,644	41,179	3.1	522.4	522.4	523.3	0.9
X	101,100	1,816	24,810	5.2	522.6	522.6	523.5	0.9
Y	106,110	1,299	18,185	7.1	526.3	526.3	527.0	0.7
Z	112,700	1,125	22,754	5.6	531.6	531.6	532.2	0.6
AA	114,220	575	14,220	9.0	532.9	532.9	533.3	0.4
AB	117,330	970	18,280	7.0	537.0	537.0	537.7	0.7
AC	121,245	1,199	27,483	4.7	540.5	540.5	541.4	0.9
AD	124,890	859	19,169	6.7	544.4	544.4	545.4	1.0
AE	132,670	5,413	61,199	2.1	548.1	548.1	549.0	0.9
AF	139,575	3,096/1,380 [2]	35,087	3.7	550.3	550.3	551.2	0.9
AG	143,830	1,101/414 [2]	29,064	4.4	554.3	554.3	555.1	0.8

[1] Distances measured in feet above confluence with Ohio River

[2] Total width/width within county

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: GREAT MIAMI RIVER**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hazelwood Creek								
A	490 [1]	95	725	4.0	821.1	821.1	821.4	0.3
B	1,450 [1]	145	974	3.0	822.9	822.9	823.3	0.4
C	2,480 [1]	112	677	4.3	827.7	827.7	828.0	0.3
D	3,998 [1]	151	865	3.4	835.3	835.3	835.6	0.3
E	4,933 [1]	125	755	3.8	840.9	840.9	841.5	0.6
Howard Creek								
A	1,705 [2]	768	4,277	2.0	562.8	559.3 [4]	560.0	0.7
B	2,605 [2]	174	1,183	7.1	563.5	559.5 [4]	560.3	0.8
C	4,145 [2]	464	2,166	3.9	563.5	563.5	564.1	0.6
Lake Chetac Creek								
A	119 [3]	30	230	7.7	682.0	680.7 [5]	681.1	0.4
B	640 [3]	25	201	8.8	688.3	688.3	689.2	0.9
C	1,125 [3]	31	216	8.2	693.3	693.3	694.3	1.0
D	1,551 [3]	36	292	6.1	697.4	697.4	698.4	1.0
E	2,422 [3]	24	168	10.6	709.4	709.4	710.2	0.8
F	2,643 [3]	56	508	3.5	718.0	718.0	718.0	0.0
G	3,133 [3]	38	293	6.0	720.1	720.1	720.8	0.7
H	3,935 [3]	66	735	2.4	722.8	722.8	723.8	1.0

[1] Distances measured in feet above Kenwood Road

[2] Distances measured in feet above confluence with Dry Fork of the Whitewater River

[3] Distances measured in feet above confluence with Polk Run

[4] Computed without consideration of backwater effects from Dry Fork of Whitewater River

[5] Computed without consideration of backwater effects from Polk Run

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: HAZELWOOD CREEK – HOWARD CREEK – LAKE CHETAC CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Left Fork Section Road Creek								
A	100 [1]	175 [5]	1,310	1.5	591.3	589.2 [3]	589.2	0.0
B	1,385 [1]	119	317	6.2	613.5	613.5	613.6	0.1
C	1,930 [1]	91	562	3.5	621.3	621.3	621.7	0.4
D	2,727 [1]	90	372	5.2	633.6	633.6	634.1	0.5
Little Duck Creek								
A	475 [2]	100	152	11.5	509.4	504.4 [4]	504.4	0.0
B	528 [2]	69	647	2.7	509.4	506.6 [4]	506.6	0.0
C	1,563 [2]	219	2,949	0.9	524.0	524.0	524.1	0.1
D	1,788 [2]	115	1,528	1.7	524.0	524.0	524.1	0.1
E	2,424 [2]	22	340	7.5	525.1	525.1	525.6	0.5
F	2,847 [2]	105	1,651	1.5	533.3	533.3	533.8	0.5
G	3,910 [2]	37	694	3.7	533.4	533.4	534.1	0.7
H	4,603 [2]	160	1,957	1.3	533.8	533.8	534.7	0.9
I	5,467 [2]	185	1,636	1.6	533.9	533.9	534.8	0.9
J	6,403 [2]	172	1,031	2.5	534.7	534.7	535.5	0.8
K	6,969 [2]	71	551	4.6	535.2	535.2	535.9	0.7
L	7,209 [2]	115	700	3.6	538.0	538.0	538.8	0.8

[1] Distances measured in feet above confluence with Section Road Creek

[2] Distances measured in feet above confluence with Duck Creek

[3] Computed without consideration of backwater effects from Section Road Creek

[4] Computed without consideration of backwater effects from Duck Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: LEFT FORK SECTION ROAD CREEK – LITTLE DUCK CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Duck Creek (continued)								
M	7,752 [1]	360	1,671	1.5	538.3	538.3	539.3	1.0
N	7,901 [1]	271	1,258	2.0	538.4	538.4	539.4	1.0
O	8,049 [1]	201	887	2.9	538.6	538.6	539.5	0.9
P	8,231 [1]	93	557	4.6	538.8	538.8	539.7	0.9
Q	8,407 [1]	33	322	7.9	539.2	539.2	540.0	0.8
Little Miami River								
A	5,617 [2]	5,011	37,061	1.9	500.8	483.4 [3]	484.2	0.8
B	9,243 [2]	661	13,420	5.1	500.8	484.8 [3]	485.2	0.4
C	15,904 [2]	1,997	26,657	2.6	500.8	486.6 [3]	487.1	0.5
D	18,966 [2]	3,731	49,404	1.4	500.8	487.6 [3]	488.4	0.8
E	25,190 [2]	5,335	59,290	1.2	500.8	488.0 [3]	488.9	0.9
F	34,233 [2]	4,231	30,512	2.4	500.8	488.6 [3]	489.4	0.8
G	36,422 [2]	3,399	26,477	3.0	500.8	491.6 [3]	492.2	0.6
H	39,180 [2]	3,324	25,978	3.1	500.8	492.5 [3]	493.1	0.6
I	42,449 [2]	1,650	18,957	4.2	500.8	494.3 [3]	494.8	0.5
J	43,673 [2]	1,973	21,386	3.8	500.8	496.0 [3]	497.0	1.0
K	46,266 [2]	2,071	21,713	3.7	500.8	497.6 [3]	498.4	0.8

[1] Distances measured in feet above confluence with Duck Creek

[2] Distances measured in feet above confluence with Ohio River

[3] Computed without consideration of backwater effects from the Ohio River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: LITTLE DUCK CREEK – LITTLE MIAMI RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Miami River (continued)								
L	50,191	842	11,618	6.9	500.8	500.5[3]	501.4	0.9
M	51,893	491	8,936	9.0	502.0	502.0	502.5	0.5
N	57,851	1,368	13,018	6.3	505.7	505.7	506.7	1.0
O	61,118	786	9,432	5.8	510.0	510.0	510.5	0.5
P	64,107	210[2] / 113	4,874	11.3	512.5	512.5	512.5	0.0
Q	66,344	279[2] / 158	5,945	9.3	515.8	515.8	516.3	0.5
R[4]	72,286	667[2] / 0	7,157	7.7	522.2	522.2	522.8	0.6
S	77,263	587[2] / 190	6,879	8.0	529.1	529.1	529.3	0.2
T	79,980	748[2] / 591	7,134	7.7	532.7	532.7	532.8	0.1
U	80,545	601[2] / 544	6,046	9.1	533.8	533.8	534.3	0.5
V	82,596	906[2] / 188	11,304	4.9	537.5	537.5	538.4	0.9
W	87,928	780[2] / 662	6,336	8.7	541.6	541.6	541.7	0.1
X	90,971	600[2] / 181	8,183	6.8	547.8	547.8	548.0	0.2
Y	91,853	1,035[2] / 329	11,470	4.8	549.7	549.7	550.3	0.6
Z	94,761	662[2] / 172	7,423	7.5	552.0	552.0	552.6	0.6
AA	97,241	229[2] / 116	5,777	9.6	554.7	554.7	555.4	0.7
AB	100,464	338[2] / 230	5,920	9.4	558.7	558.7	559.6	0.9

[1] Distances measured in feet above confluence with Ohio River

[2] Total width/width within County

[3] Computed without consideration of backwater effects from the Ohio River

[4] Located in City of Milford (Area Not Included) data included for informational purposes

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: LITTLE MIAMI RIVER**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Miami River (continued)								
AC	102,252	361 [2] / 201	7,885	6.6	562.0	562.0	562.8	0.8
AD	103,522	351 [2] / 142	6,353	8.4	562.8	562.8	563.6	0.8
AE	108,152	494 [2] / 211	9,068	5.9	566.7	566.7	567.4	0.7
AF	111,533	446 [2] / 297	7,929	6.7	570.0	570.0	570.7	0.7
AG	112,102	302 [2] / 64	8,096	6.6	571.1	571.1	571.9	0.8
AH	113,227	784 [2] / 104	10,231	5.2	572.0	572.0	572.7	0.7
AI	114,652	508 [2] / 320	9,286	5.7	573.0	573.0	573.7	0.7
AJ	115,178	357 [2] / 241	8,487	6.3	573.6	573.6	574.5	0.9
AK	117,114	620 [2] / 439	10,783	4.9	574.9	574.9	575.6	0.7
AL	120,365	505 [2] / 116	7,897	6.7	577.0	577.0	577.7	0.7
AM	123,634	446 [2] / 130	8,451	6.3	579.7	579.7	580.6	0.9
AN	127,349	530 [2] / 527	7,329	7.2	581.9	581.9	582.7	0.8
AO	127,876	649	7,984	6.6	584.0	584.0	585.0	1.0
AP	128,180	541	9,049	5.9	584.6	584.6	585.5	0.9
AQ	128,625	385	7,457	5.8	585.4	585.4	586.0	0.6
AR	130,565	616 [2] / 123	11,076	4.2	586.4	586.4	587.2	0.8
AS	132,685	692 [2] / 197	8,930	5.2	588.0	588.0	589.0	1.0
AT	135,962	521 [2] / 87	10,361	4.6	591.3	591.3	592.2	0.9

[1] Distances measured in feet above confluence with Ohio River

[2] Total width/width within county

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: LITTLE MIAMI RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[6] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
McCullough Run									
A	4,306 [1]	400 [5]		3,008	2.1	500.8	483.5 [3]	483.9	0.4
B	5,083 [1]	420 [5]		3,118	2.0	500.8	488.7 [3]	489.4	0.7
C	7,406 [1]	113		458	8.2	500.8	491.6 [3]	491.6	0.0
D	8,576 [1]	225		1,384	3.0	500.8	495.4 [3]	496.3	0.9
Mill Creek									
A	580 [2]	186		4,075	4.9	478.9	478.9 [4]	478.9	0.0
B	3,473 [2]	212		4,524	4.5	481.0	481.0 [4]	481.0	0.0
C	7,798 [2]	186		3,599	5.6	482.7	482.7 [4]	482.7	0.0
D	8,009 [2]	200		3,582	5.6	482.8	482.8 [4]	482.8	0.0
E	9,459 [2]	154		3,135	6.4	483.2	483.2 [4]	483.2	0.0
F	12,549 [2]	243		4,945	4.1	484.0	484.0 [4]	484.0	0.0
G	17,109 [2]	304		4,778	4.2	484.9	484.9 [4]	484.9	0.0
H	17,756 [2]	269		4,833	3.5	485.1	485.1 [4]	485.1	0.0
I	19,673 [2]	253		3,580	4.7	485.4	485.4 [4]	485.5	0.1
J	20,893	206		2,752	6.2	485.8	485.8	485.9	0.1
K	21,403	245	50	3,995	4.2	486.3	486.3	486.4	0.1
L	24,530	232		3,530	4.5	487.5	487.5	487.6	0.1
M	27,600	120		2,004	7.9	488.2	488.2	488.3	0.1

[1] Distances measured in feet above confluence with Little Miami River

[2] Distances measured in feet above Barrier Dam

[3] Computed without consideration of backwater effects from Little Miami River

[4] Computed considering flood elevations controlled by Barrier Dam

[5] Computed without consideration of Little Miami River floodway

[6] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MCCULLOUGH RUN – MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[3] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Mill Creek (continued)									
N	27,925	132		1,861	8.5	488.2	488.2	488.3	0.1
O	29,855	133	30	1,673	7.8	489.2	489.2	489.3	0.1
P	29,885	132	36	1,657	7.9	489.3	489.3	489.4	0.1
Q	29,975	140		1,631	8.0	489.4	489.4	489.5	0.1
R	32,250	150		1,621	8.1	490.0	490.0	490.1	0.1
S	32,400	150		1,663	7.8	490.4	490.4	490.4	0.0
T	34,550	110		1,254	10.4	490.8	490.8	490.8	0.0
U	34,850	116	28	1,130	11.5	491.2	491.2	491.3	0.1
V	36,065	110		1,062	12.2	492.8	492.8	492.8	0.0
W	36,295	100	33	1,107	11.7	493.3	493.3	493.3	0.0
X	36,825	137		1,052	12.3	493.7	493.7	493.7	0.0
Y	37,277	181		1,636	7.9	495.5	495.5	495.5	0.0
Z	40,235	123	30	1,110	11.7	498.1	498.1	498.1	0.0
AA	40,285	103	50	1,189	10.9	499.0	499.0	499.0	0.0
AB	41,518	166		1,345	8.1	508.1	508.1	508.2	0.1
AC	43,728	146		2,339	4.7	513.6	513.6	514.3	0.7
AD	43,798	137		2,306	4.7	514.0	514.0	514.8	0.8
AE	44,828	127		2,654	4.1	515.6	515.6	516.5	0.9
AF	46,068	210		2,700	4.1	517.3	517.3	518.1	0.8

[1] Distances measured in feet above Barrier Dam

[2] Computed considering flood elevations controlled by Barrier Dam

[3] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[3] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Mill Creek (continued)									
AG	46,578	165		2,655	4.1	518.1	518.1	518.9	0.8
AH	50,536	134		2,014	5.4	521.6	521.6	522.4	0.8
AI	50,623	177		2,627	4.2	522.0	522.0	522.9	0.9
AJ	51,638	191	36	3,025	3.6	523.4	523.4	524.0	0.6
AK	51,791	210		2,734	4.0	523.4	523.4	524.0	0.6
AL	52,893	157	727	963	11.4	528.0	528.0	528.2	0.2
AM	53,864	107		1,479	7.4	528.4	528.4	528.6	0.2
AN	54,376	141		1,716	6.4	530.0	530.0	530.2	0.2
AO	55,046	142		1,909	5.7	531.2	531.2	531.5	0.3
AP	59,940	93		1,372	5.3	536.1	536.1	536.3	0.2
AQ	60,771	79		1,194	6.1	537.2	537.2	537.6	0.4
AR	62,833	81		1,220	6.0	542.4	542.4	543.4	1.0
AS	62,867	81		1,224	6.0	542.5	542.5	543.4	0.9
AT	64,620	95		1,274	5.7	546.7	546.7	547.4	0.7
AU	64,680	96		1,284	5.7	546.9	546.9	547.6	0.7
AV	65,464	157		1,361	5.4	548.6	548.6	549.4	0.8
AW	65,984	66		1,144	6.4	549.5	549.5	550.4	0.9
AX	66,222	77		1,291	5.7	550.1	550.1	551.0	0.9
AY	68,988	109		1,650	4.4	552.9	552.9	553.9	1.0

[1] Distances measured in feet above Barrier Dam

[2] Computed considering flood elevations controlled by Barrier Dam

[3] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[3] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Mill Creek (continued)									
AZ	69,026	109		1,652	4.4	552.9	552.9 [2]	553.9	1.0
BA	71,416	143	56	1,908	3.8	555.9	555.9 [2]	556.8	0.9
BB	71,471	192		1,975	3.7	556.2	556.2 [2]	557.1	0.9
BC	71,711	153		1,924	3.8	556.7	556.7 [2]	557.6	0.9
BD	72,696	112		1,456	4.4	557.8	557.8 [2]	558.6	0.8
BE	73,021	214		2,281	2.8	558.5	558.5 [2]	559.1	0.6
BF	76,651	153		956	5.1	562.1	562.1 [2]	563.0	0.9
BG	77,114	249		2,102	2.3	563.1	563.1 [2]	563.8	0.7
BH	80,111	141		1,489	3.3	567.5	567.5 [2]	568.3	0.8
BI	80,292	100		1,165	4.2	567.6	567.6 [2]	568.4	0.8
BJ	81,557	119		1,456	2.5	570.7	570.7 [2]	571.6	0.9
BK	81,663	106		1,297	2.8	570.9	570.9 [2]	571.7	0.8
BL	81,759	110		1,264	2.9	571.7	571.7 [2]	572.5	0.8
BM	83,091	163		1,794	2.5	572.7	572.7 [2]	573.7	1.0
BN	83,816	517		3,987	1.1	573.1	573.1 [2]	574.0	0.9
BO	85,271	143		1,796	2.6	574.5	574.5	575.3	0.8
BP	85,459	132		1,464	3.2	574.8	574.8	575.7	0.9
BQ	86,555	133		1,556	3.0	576.4	576.4	577.2	0.8
BR	86,631	450		1,885	2.5	576.7	576.7	577.0	0.3

[1] Distances measured in feet above Barrier Dam

[2] Computed considering flood elevations controlled by Barrier Dam

[3] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[4] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mill Creek (continued)									
BS	88,862 [1]	135		1,554	3.1	578.7	578.7	579.2	0.5
BT	88,996 [1]	244		1,809	2.7	579.2	579.2	579.6	0.4
BU	92,196 [1]	126		1,577	3.1	581.1	581.1	581.6	0.5
BV	92,316 [1]	211		1,776	2.8	581.4	581.4	581.9	0.5
BW	93,397 [1]	130		1,643	3.0	582.4	582.4	582.9	0.5
BX	93,991 [1]	466		4,066	1.2	583.5	583.5	584.0	0.5
BY	97,491 [1]	432		2,649	1.0	584.9	584.9	585.4	0.5
Muddy Creek									
A	596 [2]	165		2,451	5.5	492.4	467.1 [3]	467.9	0.8
B	2,336 [2]	535		8,052	1.7	492.4	469.1 [3]	469.6	0.5
C	3,549 [2]	521		3,994	2.8	492.4	471.5 [3]	472.1	0.6
D	4,474 [2]	400		3,204	3.5	492.4	471.8 [3]	472.4	0.6
E	5,564 [2]	427		2,359	4.8	492.4	472.5 [3]	473.1	0.6
F	10,500 [2]	171		1,623	9.1	492.4	483.1 [3]	483.3	0.2
G	11,620 [2]	180		850	12.1	492.4	489.9 [3]	489.9	0.0
H	13,145 [2]	96	45	934	11.0	504.0	504.0	504.0	0.0
I	13,704 [2]	83	43	746	13.8	510.5	510.5	510.5	0.0

[1] Distances measured in feet above Barrier Dam

[2] Distances measured in feet above confluence with Ohio River

[3] Computed without consideration of backwater effects from the Ohio River

[4] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MILL CREEK – MUDDY CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Muddy Creek (continued)								
J	16,850 [1]	70	601	16.8	542.4	542.4	542.4	0.0
K	18,630 [1]	79	628	16.1	572.1	572.1	572.1	0.0
L	19,840 [1]	71	603	16.8	595.4	595.4	595.4	0.0
M	21,130 [1]	77	621	16.3	612.8	612.8	612.8	0.0
N	22,200 [1]	58	567	17.8	631.1	631.1	631.1	0.0
O	24,115 [1]	80	604	14.9	680.4	680.4	680.4	0.0
P	24,800 [1]	73	656	13.7	687.7	687.7	688.2	0.5
Q	27,080 [1]	93	600	14.3	722.3	722.3	722.3	0.0
R	28,490 [1]	55	551	15.6	735.2	735.2	735.4	0.2
S	29,330 [1]	65	568	15.1	747.6	747.6	747.6	0.0
T	30,700 [1]	91	1,097	7.8	761.4	761.4	762.1	0.7
U	31,255 [1]	120	2,164	3.2	762.3	762.3	762.3	0.0
V	33,023 [1]	50	443	15.8	771.5	771.5	771.5	0.0
W	33,850 [1]	30	405	17.3	781.5	781.5	781.5	0.0
Newton (Clear) Creek								
A[5]	1,780 [2]	*	*	*	500.8	*	*	*
B	5,270 [2]	175 [4]	1,224	1.9	500.8	484.3[3]	485.3	1.0

[1] Distances measured in feet above confluence with Ohio River
[2] Distances measured in feet above confluence with Little Miami River
[3] Computed without consideration of backwater effects from the Ohio River
[4] Computed without consideration of Little Miami River floodway
[5] Cross section is fully contained within the Little Miami River floodway

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: MUDDY CREEK – NEWTON (CLEAR) CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Branch Sycamore Creek								
A	23,504	38	235	7.9	698.2	698.2	698.5	0.3
B	24,314	33	253	7.4	704.8	704.8	705.6	0.8
C	25,267	37	232	8.0	709.5	709.5	710.2	0.7
D	26,411	38	259	7.2	717.0	717.0	717.7	0.7
E	26,780	46	305	4.9	720.2	720.2	720.6	0.4
F	27,109	24	164	9.1	720.5	720.5	721.0	0.5
G	27,499	32	173	8.6	724.0	724.0	724.0	0.0
H	27,710	24	119	12.6	725.8	725.8	725.8	0.0
I	28,178	40	190	7.9	729.5	729.5	730.2	0.7
J	28,441	29	132	11.3	733.0	733.0	733.1	0.1
K	28,992	28	204	7.3	738.3	738.3	738.7	0.4
L	29,548	30	169	8.8	741.5	741.5	741.9	0.4
M	29,757	43	383	3.9	744.5	744.5	744.8	0.3
N	31,619	45	209	5.4	754.1	754.1	754.5	0.4
O	33,159	32	137	8.2	765.9	765.9	766.9	1.0
P	33,327	47	139	8.1	768.7	768.7	769.3	0.6
Q	33,583	32	183	6.1	771.4	771.4	771.8	0.4
R	34,222	60	413	2.7	778.0	778.0	779.0	1.0

[1] Distances measured in feet above confluence with Sycamore Creek

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: NORTH BRANCH SYCAMORE CREEK**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
O'Bannon Creek								
A	481 [1]	434	5,260	2.6	586.1	581.8 [4]	582.7	0.9
B	855 [1]	182	2,745	4.9	586.1	582.6 [4]	583.4	0.8
C	1,228 [1]	353	3,811	3.6	586.1	583.1 [4]	584.0	0.9
D	1,524 [1]	145	2,436	5.6	586.1	584.1 [4]	584.9	0.8
E	2,534 [1]	231	2,538	5.4	586.1	586.1	586.6	0.5
F	3,525 [1]	137	1,613	8.4	588.4	588.4	589.0	0.6
G	4,523 [1]	127	1,591	8.6	591.7	591.7	592.6	0.9
Ohio River								
A	490.75 [2]	1,762 / 233 [3]	121,533	5.9	489.8	489.8	490.8	1.0
B	490.25 [2]	1,370 / 153 [3]	104,252	6.9	489.9	489.9	490.9	1.0
C	489.50 [2]	2,140 / 656 [3]	124,572	5.8	490.3	490.3	491.3	1.0
D	489.00 [2]	1,995 / 411 [3]	126,192	5.7	490.5	490.5	491.5	1.0
E	488.50 [2]	1,683 / 226 [3]	113,032	6.4	490.6	490.6	491.6	1.0
F	488.00 [2]	1,399 / 99 [3]	105,946	6.8	490.7	490.7	491.6	0.9
G	487.50 [2]	1,326 / 134 [3]	98,996	7.3	490.7	490.7	491.7	1.0
H	486.00 [2]	1,936 / 337 [3]	124,136	5.8	491.6	491.6	492.6	1.0
I	485.25 [2]	2,085 / 212 [3]	129,283	5.6	491.8	491.8	492.8	1.0
J	483.75 [2]	2,277 / 490 [3]	122,275	5.9	492.3	492.3	493.2	0.9
K	483.25 [2]	1,942 / 189 [3]	125,681	5.7	492.4	492.4	493.4	1.0

[1] Distances measured in feet above confluence with Little Miami River

[2] Miles below headwaters at Pittsburgh

[3] Total width/width within county

[4] Computed without consideration of backwater effects from Little Miami River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: O'BANNON CREEK – OHIO RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)[2]	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ohio River (continued)								
L	482.50	1,470 / 242	109,046	6.6	492.6	492.6	493.6	1.0
M	482.00	1,941 / 325	112,846	6.4	492.8	492.8	493.8	1.0
N	481.25	1,558 / 265	107,506	6.7	493.0	493.0	494.0	1.0
O	480.75	1,628 / 500	105,839	6.8	493.2	493.2	494.2	1.0
P	480.25	1,740 / 278	119,559	6.0	493.5	493.5	494.5	1.0
Q	479.50	1,635 / 131	114,112	6.3	493.7	493.7	494.7	1.0
R	477.50	1,730 / 460	112,902	6.4	494.3	494.3	495.3	1.0
S	477.00	1,671 / 586	111,524	6.4	494.5	494.5	495.4	0.9
T	476.50	1,557 / 464	107,724	6.7	494.6	494.6	495.6	1.0
U	476.00	1,900 / 332	125,775	5.7	495.0	495.0	496.0	1.0
V	475.00	1,471 / 354	102,984	7.0	495.1	495.1	496.1	1.0
W	474.50	1,625 / 490	111,379	6.5	495.4	495.4	496.4	1.0
X	474.00	1,546 / 250	109,421	6.6	495.6	495.6	496.6	1.0
Y	473.50	1,383 / 234	89,554	8.0	495.6	495.6	496.6	1.0
Z	473.00	1,324 / 298	99,781	7.2	496.0	496.0	497.0	1.0
AA	472.75	1,368 / 193	106,064	6.8	496.2	496.2	497.2	1.0
AB	472.25	1,220 / 217	88,391	8.1	496.2	496.2	497.2	1.0
AC	472.00	1,265 / 345	87,096	8.2	496.3	496.3	497.3	1.0

[1] Miles below headwaters at Pittsburgh

[2] Total width/width within county

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: OHIO RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)[2]	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ohio River (continued)								
AD	471.75	1,089 / 207	81,444	8.8	496.3	496.3	497.3	1.0
AE	471.50	1,168 / 182	82,908	8.7	496.5	496.5	497.5	1.0
AF	471.00	1,531 / 249	104,776	6.9	497.4	497.4	498.4	1.0
AG	470.50	1,406 / 225	103,307	7.0	497.5	497.5	498.5	1.0
AH	470.00	1,640 / 245	95,870	7.1	497.8	497.8	498.8	1.0
AI	469.50	1,626 / 224	93,336	7.3	497.9	497.9	499.0	1.0
AJ	469.00	1,506 / 284	97,824	6.9	498.3	498.3	499.3	1.0
AK	468.00	1,588 / 226	97,145	7.0	498.7	498.7	499.7	1.0
AL	467.00	2,400 / 353	122,037	5.6	499.3	499.3	500.3	1.0
AM	466.00	2,365 / 973	120,837	5.6	499.7	499.7	500.7	1.0
AN	465.25	1,850 / 669 [3]	113,150	6.0	500.0	500.0	501.0	1.0
AO	465.00	1,537 / 417	106,983	6.3	500.1	500.1	501.1	1.0
AP	464.50	2,232 / 1,159 [3]	131,625	5.2	500.3	500.3	501.3	1.0
AQ	464.00	1,970 / 920 [4]	136,898	4.8	500.6	500.6	501.6	1.0
AR	463.25	2,220 / 1,120 [4]	127,626	5.1	500.8	500.8	501.8	1.0
AS	463.00	1,486 / 467 [3]	109,971	5.9	500.8	500.8	501.8	1.0
AT	462.75	1,348 / 426 [3]	101,406	6.4	500.9	500.9	501.9	1.0
AU	462.00	1,798 / 750	118,785	5.5	501.3	501.3	502.3	1.0
AV	461.00	2,938 / 599	152,481	4.3	501.8	501.8	502.8	1.0

[1] Miles below headwaters at Pittsburgh

[2] Total width/width within county

[3] Width updated to match county boundary

[4] Floodway width updated to county boundary & 2012 FIS extent within county

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: OHIO RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ohio River (continued)								
AW	460.5 [1]	3,380 / 1,448 [3]	157,562	4.1	501.9	501.9	502.9	1.0
AX	460.0 [1]	3,429 / 1,680 [3]	157,030	4.2	502.0	502.0	503.0	1.0
AY	459.5 [1]	3,023 / 1,150 [3]	144,353	4.5	502.1	502.1	503.1	1.0
AZ	459.0 [1]	2,770 / 539 [3]	143,238	4.6	502.2	502.2	503.2	1.0
BA	458.0 [1]	3,368 / 418 [3]	137,930	4.7	502.3	502.3	503.3	1.0
BB	457.0 [1]	2,100 / 327 [3]	144,392	4.5	502.6	502.6	503.6	1.0
BC	456.0 [1]	3,122 / 569 [3]	162,286	4.0	502.8	502.8	503.8	1.0
Pleasant Run								
A	84 [2]	36	173	9.9	664.1	664.1	664.4	0.3
B	785 [2]	40	233	7.3	672.8	672.8	673.1	0.3
C	1,758 [2]	113	171	8.5	685.3	685.3	685.3	0.0
D	2,628 [2]	20	92	9.1	697.0	697.0	697.5	0.5
E	3,274 [2]	23	105	8.0	705.8	705.8	706.6	0.8

[1] Miles below headwaters at Pittsburgh

[2] Distances measured in feet above John Gray Road

[3] Total width/width within county

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: OHIO RIVER – PLEASANT RUN

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[3] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Polk Run									
A	5,161 [1]	78		477	5.9	592.4	592.4	593.4	1.0
B	6,258 [1]	103		333	7.4	610.6	610.6	610.6	0.0
C	7,003 [1]	47		376	6.6	622.8	622.8	623.7	0.9
D	7,674 [1]	63		376	6.6	636.0	636.0	636.9	0.9
E	8,396 [1]	56		359	6.9	652.7	652.7	652.7	0.0
F	8,966 [1]	77		431	5.7	661.4	661.4	661.5	0.1
G	9,430 [1]	39		195	12.6	670.9	670.9	670.9	0.0
H	9,783 [1]	90		675	3.7	681.7	681.7	681.7	0.0
Raiders Run									
A	240 [2]	54		593	3.2	708.1	708.1	708.1	0.0
B	2,185 [2]	49		162	10.3	731.0	731.0	731.0	0.0
C	3,768 [2]	183	31	3,917	1.0	778.9	778.9	779.4	0.5
D	4,323 [2]	190		3,310	0.8	779.3	779.3	779.8	0.5
E	4,735 [2]	99		1,048	2.4	779.3	779.3	779.8	0.5
F	5,085 [2]	76		616	4.1	779.4	779.4	779.9	0.5
G	6,155 [2]	115		698	4.2	792.3	792.3	792.8	0.5
H	6,760 [2]	60		269	10.8	798.5	798.5	798.5	0.0

[1] Distances measured in feet above confluence with Little Miami River

[2] Distances measured in feet above confluence with West Fork Sycamore Creek

[3] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: POLK RUN – RAIDERS RUN

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Section Road Creek								
A	725 [1]	190	3,261	1.6	589.4	589.4	589.9	0.5
B	1,579 [1]	226	3,716	1.4	591.3	591.3	591.6	0.3
C	2,366 [1]	180	1,687	2.9	592.0	592.0	592.0	0.0
D	3,792 [1]	280	2,265	2.2	601.7	601.7	601.8	0.1
E	5,217 [1]	200	310	6.1	623.4	623.4	623.8	0.4
F	6,896 [1]	198	1,342	2.9	635.1	635.1	635.5	0.4
Sharon Creek								
A	306 [2]	133	955	6.3	569.9	569.9	570.9	1.0
B	1,573 [2]	159	1,051	5.7	573.6	573.6	574.4	0.8
C	2,883 [2]	141	1,179	5.1	576.7	576.7	577.7	1.0
D	3,432 [2]	75	681	8.5	577.9	577.9	578.4	0.5
E	4,736 [2]	140	735	7.8	582.1	582.1	582.5	0.4
F	5,000 [2]	135	838	6.9	584.0	584.0	584.5	0.5
G	7,065 [2]	72	550	10.3	591.6	591.6	591.6	0.0
H	7,297 [2]	195	1,263	4.5	595.9	595.9	596.1	0.2
I	8,670 [2]	195	1,256	4.5	597.4	597.4	597.7	0.3
J	10,037 [2]	75	473	12.0	600.0	600.0	600.4	0.4
K	10,169 [2]	350	1,700	3.3	608.6	608.6	608.8	0.2

[1] Distances measured in feet above corporate limits

[2] Distances measured in feet above confluence with Mill Creek

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: SECTION ROAD CREEK – SHARON CREEK**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sharon Creek (continued)								
L	11,194 [1]	106	1,115	5.1	622.4	622.4	622.8	0.4
M	11,563 [1]	77	739	7.6	622.4	622.4	622.7	0.3
Sharon Creek Tributary								
A	1,373 [2]	85	366	7.1	582.2	582.2	582.5	0.3
B	1,996 [2]	65	300	8.6	586.5	586.5	586.6	0.1
C	2,270 [2]	50	321	8.1	588.9	588.9	589.4	0.5
D	2,724 [2]	60	400	6.5	592.8	592.8	593.2	0.4
E	3,131 [2]	70	391	6.6	594.3	594.3	594.7	0.4
F	3,226 [2]	60	427	6.1	595.2	595.2	595.7	0.5
G	4,303 [2]	40	210	12.4	602.7	602.7	603.2	0.5
H	5,016 [2]	40	211	12.3	621.2	621.2	621.2	0.0
I	5,333 [2]	41	204	12.7	627.6	627.6	628.1	0.5
Sycamore Creek								
A	11,519 [3]	43	135	8.3	701.7	701.7	701.7	0.0
B	11,936 [3]	31	292	3.3	711.3	711.3	712.3	1.0
C	12,653 [3]	21	166	5.8	716.9	716.9	717.4	0.5
D	13,676 [3]	202	457	1.8	726.3	726.3	726.5	0.2
E	13,905 [3]	40	325	2.5	728.0	728.0	729.0	1.0

[1] Distances measured in feet above confluence with Mill Creek

[2] Distances measured in feet above confluence with Sharon Creek

[3] Distances measured in feet above confluence with Little Miami River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: SHARON CREEK – SHARON CREEK TRIBUTARY – SYCAMORE CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sycamore Creek (continued)								
F	14,725 [1]	67	275	2.9	733.9	733.9	734.2	0.3
G	14,835 [1]	51	226	3.6	735.6	735.6	736	0.4
H	15,316 [1]	103	446	1.8	738.4	738.4	739	0.6
I	15,878 [1]	187	497	1.6	739.3	739.3	740.1	0.8
J	16,330 [1]	37	148	4.4	742.7	742.7	743.4	0.7
K	16,805 [1]	22	75	6.4	745.3	745.3	745.8	0.5
L	16,992 [1]	70	405	1.2	751.4	751.4	752.2	0.8
M	17,630 [1]	47	68	7.0	755.9	755.9	755.9	0.0
Tributary A								
A	206 [2]	46	278	7.0	786.6	786.6	787.6	1.0
B	444 [2]	38	232	8.3	788.1	788.1	789.0	0.9
C	686 [2]	63	272	7.1	790.8	790.8	791.8	1.0
D	1,119 [2]	51	303	6.4	796.4	796.4	797.2	0.8
E	1,410 [2]	43	254	7.6	798.2	798.2	799.0	0.8
F	1,705 [2]	29	191	10.2	801.0	801.0	801.9	0.9

[1] Distances measured in feet above Keller Road

[2] Distances measured in feet above mouth at confluence with West Fork Lake Tributary

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: SYCAMORE CREEK – TRIBUTARY A

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[4] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary to Pleasant Run									
A	659 [1]	30		87	10.0	680.0	680.0	680.2	0.2
B	1,237 [1]	19		95	9.1	689.8	689.8	690.3	0.5
C	2,111 [1]	28		122	7.0	699.4	699.4	700.0	0.6
D	2,641 [1]	19		101	8.5	704.2	704.2	704.8	0.6
E	3,120 [1]	74		335	2.6	706.6	706.6	707.0	0.4
West Fork									
A	600 [2]	60		544	14.5	485.0	477.9 [3]	478.4	0.5
B	1,351 [2]	85		769	10.3	485.0	482.4 [3]	482.8	0.4
C	2,061 [2]	198		1,729	4.6	485.7	485.7	485.7	0.0
D	3,043 [2]	68		654	12.1	486.6	486.6	487.1	0.5
E	4,160 [2]	198	57	1,790	4.4	492.2	492.2	492.4	0.2
F	5,945 [2]	82		1,345	5.8	500.6	500.6	501.1	0.5
G	7,125 [2]	545		4,623	1.7	507.5	507.5	508.0	0.5
H	8,148 [2]	131		1,861	4.2	507.6	507.6	508.1	0.5
I	9,288 [2]	99		886	8.8	510.6	510.6	510.6	0.0
J	10,466 [2]	86		673	11.6	516.9	516.9	516.9	0.0
K	12,539 [2]	52		488	16.0	546.2	546.2	546.5	0.3
L	13,419 [2]	80		1,025	7.6	558.2	558.2	558.7	0.5

[1] Distances measured in feet above confluence with Pleasant Run

[2] Distances measured in feet above confluence with Mill Creek

[3] Computed without consideration of backwater effects from Mill Creek

[4] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: TRIBUTARY TO PLEASANT RUN – WEST FORK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Lake Tributary								
L	19,932	146	1,009	4.5	781.0	781.0	782.0	1.0
M	20,117	64	724	6.3	781.4	781.4	782.3	0.9
N	20,323	110	1,130	4.1	782.1	782.1	783.1	1.0
O	20,539	107	1,063	4.3	782.4	782.4	783.4	1.0
P	20,676	180	1,327	3.5	782.8	782.8	783.7	0.9
Q	20,951	218	2,023	2.3	783.1	783.1	784.0	0.9
R	21,162	129	1,180	3.9	783.2	783.2	784.1	0.9
S	21,574	257	2,225	2.1	783.5	783.5	784.5	1.0
T	21,928	168	1,165	3.9	783.6	783.6	784.5	0.9
U	22,303	158	969	4.7	784.3	784.3	785.3	1.0
V	22,646	32	173	5.0	785.6	785.6	786.4	0.8
W	22,746	28	130	6.7	785.9	785.9	786.7	0.8
X	23,338	91	603	1.5	794.0	794.0	794.0	0.0
Y	23,654	74	370	2.4	794.0	794.0	794.0	0.0
Z	24,399	74	295	3.0	798.8	798.8	798.8	0.0
AA	24,552	47	220	4.0	801.4	801.4	801.4	0.0
AB	25,080	42	189	5.9	802.5	802.5	803.1	0.6
AC	25,291	24	158	7.0	804.6	804.6	805.1	0.5
AD	27,667	33	244	4.5	830.5	830.5	831.2	0.7

[1] Distances measured in feet above confluence with Mill Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK LAKE TRIBUTARY

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Lake Tributary (continued)								
AE	28,406	71	327	8.8	835.3	835.3	835.6	0.3
AF	28,829	72	867	3.3	844.8	844.8	845.6	0.8
AG	29,040	71	793	3.6	844.9	844.9	845.7	0.8

[1] Distances measured in feet above confluence with Mill Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK LAKE TRIBUTARY

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 2 OF 3

HAMILTON COUNTY, OHIO

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
ADDYSTON, VILLAGE OF	390205	LOVELAND, CITY OF	390068
AMBERLEY, VILLAGE OF	390206	MADEIRA, CITY OF	390225
ARLINGTON HEIGHTS, VILLAGE OF	390207	MARIEMONT, VILLAGE OF	390226
BLUE ASH, CITY OF	390208	MONTGOMERY, CITY OF	390228
CHEVIOT, CITY OF*	390209	MOUNT HEALTHY, CITY OF	390229
CINCINNATI, CITY OF	390210	NEWTOWN, VILLAGE OF	390230
CLEVES, VILLAGE OF	390211	NORTH BEND, VILLAGE OF	390231
DEER PARK, CITY OF*	390212	NORTH COLLEGE HILL, CITY OF	390232
ELMWOOD PLACE, VILLAGE OF	390213	NORWOOD, CITY OF*	390233
EVENDALE, VILLAGE OF	390214	READING, CITY OF	390234
FAIRFAX, VILLAGE OF	390215	SHARONVILLE, CITY OF	390236
FOREST PARK, CITY OF	390216	SILVERTON, CITY OF*	390237
GLENDALE, VILLAGE OF	390217	SPRINGDALE, CITY OF	390877
GOLF MANOR, CITY OF*	390218	ST. BERNARD, CITY OF	390235
GREENHILLS, VILLAGE OF	390219	TERRACE PARK, VILLAGE OF	390633
HAMILTON COUNTY, UNINCORPORATED AREAS	390204	THE VILLAGE OF INDIAN HILL, CITY OF	390221
HARRISON, CITY OF	390220	WOODLAWN, VILLAGE OF	390239
LINCOLN HEIGHTS, VILLAGE OF*	390222	WYOMING, CITY OF	390240
LOCKLAND, VILLAGE OF	390223		

*No Special Flood Hazard Areas Identified

REVISED:

JUNE 7, 2023

FLOOD INSURANCE STUDY NUMBER

39061CV002D

Version Number 2.5.3.5

FEMA

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Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Mill Creek								
A	449	53	379	5.7	536.2	528.5 [2]	529.1	0.6
B	792	68	351	6.2	536.2	529.9 [2]	530.3	0.4
C	1,035	101	661	3.3	536.2	530.8 [2]	531.2	0.4
D	1,420	75	451	4.8	536.2	531.3 [2]	531.6	0.3
E	1,647	69	366	5.9	536.2	532.4 [2]	532.5	0.1
F	2,534	95	492	4.4	536.2	535.4 [2]	535.4	0.0
G	3,221	52	399	6.4	537.2	537.2	537.2	0.0
H	5,127	70	442	4.9	543.0	543.0	543.0	0.0
I	5,333	94	633	3.4	543.4	543.4	543.4	0.0
J	5,597	63	352	6.2	543.6	543.6	543.6	0.0
K	5,972	94	544	4.0	545.0	545.0	545.0	0.0
L	6,531	94	492	4.4	545.9	545.9	545.9	0.0
M	6,780	71	370	5.9	546.1	546.1	546.1	0.0

[1] Distances measured in feet above confluence with Mill Creek

[2] Computed without consideration of backwater effects from Mill Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[2] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Mill Creek (continued)									
N	8,480	78		513	4.2	549.3	549.3	549.3	0.0
O	8,728	61	31	583	3.7	549.6	549.6	549.6	0.0
P	8,844	60	27	464	4.7	549.6	549.6	549.6	0.0
Q	9,103	68		517	4.2	550.2	550.2	550.2	0.0
R	11,774	65		447	4.9	553.6	553.6	553.6	0.0
S	13,427	68		426	5.1	556.9	556.9	556.9	0.0
T	13,765	96		438	5.0	557.6	557.6	557.6	0.0
U	14,509	105		498	4.4	559.2	559.2	559.2	0.0
V	14,916	86		335	6.5	559.8	559.8	559.8	0.0
W	19,061	119		574	3.5	566.4	566.4	566.4	0.0
X	19,906	63		393	5.1	567.5	567.5	567.5	0.0
Y	20,381	66		460	4.4	568.3	568.3	568.3	0.0
Z	20,539	54		289	7.0	568.3	568.3	568.3	0.0
AA	20,962	55		286	7.0	570.3	570.3	570.3	0.0
AB	21,278	77		379	5.3	571.3	571.3	571.3	0.0
AC	22,915	82		430	4.7	575.0	575.0	575.0	0.0
AD	23,549	60		263	7.6	575.9	575.9	575.9	0.0
AE	26,083	76		282	5.0	584.8	584.8	584.8	0.0
AF	27,826	73		261	5.4	593.1	593.1	593.1	0.0

[1] Distances measured in feet above confluence with Mill Creek

[2] See explanation in Section 2.2 Floodways

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY **HAMILTON COUNTY, OHIO** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: WEST FORK MILL CREEK**

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[2] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Mill Creek (continued)									
AG	31,780	42		301	4.6	614.7	614.7	615.7	1.0
AH	32,145	41		158	8.9	621.6	621.6	621.6	0.0
AI	32,825	60		419	3.3	626.0	626.0	626.4	0.4
AJ	33,185	73		442	3.2	626.9	626.9	627.3	0.4
AK	33,635	27		134	10.4	629.9	629.9	629.9	0.0
AL	34,045	37		261	5.4	634.4	634.4	634.9	0.5
AM	35,060	32		265	5.3	637.1	637.1	637.7	0.6
AN	50,060	187		1,610	6.2	708.0	708.0	708.0	0.0
AO	50,454	269		1,495	6.7	715.2	715.2	715.4	0.2
AP	50,995	116		948	10.6	715.4	715.4	715.5	0.1
AQ	51,671	344		1,689	5.9	720.0	720.0	720.4	0.4
AR	53,240	99		1,025	9.8	727.4	727.4	727.9	0.5
AS	54,350	252		2,813	3.6	731.0	731.0	731.5	0.5
AT	55,070	207		2,571	3.9	731.9	731.9	732.4	0.5
AU	55,840	356		3,939	2.5	733.0	733.0	733.5	0.5
AV	56,555	141		1,649	5.9	733.6	733.6	734.1	0.5
AW	57,200	274		1,567	6.2	735.6	735.6	736.1	0.5
AX	58,025	159		967	10.0	739.6	739.6	739.6	0.0
AY	58,522	135		2,204	4.4	747.6	747.6	748.0	0.4

[1] Distances measured in feet above confluence with Mill Creek

[2] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[2] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Mill Creek (continued)									
AZ	59,027	322		4,529	2.1	748.3	748.3	748.9	0.6
BA	59,737	253		3,087	3.1	748.7	748.7	749.3	0.6
BB	60,440	146		1,714	5.7	748.9	748.9	749.5	0.6
BC	60,992	200		1,546	5.8	750.2	750.2	750.9	0.7
BD	61,640	136	31	1,063	8.5	752.7	752.7	752.8	0.1
BE	62,100	59		639	14.1	756.2	756.2	756.4	0.2
BF	62,510	201		1,662	5.4	764.9	764.9	765.9	1.0
BG	62,759	84		1,025	8.8	765.5	765.5	766.5	1.0
BH	63,139	100		1,341	6.7	767.8	767.8	768.4	0.6
BI	64,205	148	57	1,380	3.9	770.0	770.0	770.0	0.0
BJ	65,208	160		929	5.7	776.6	776.6	777.4	0.8
BK	68,218	129		939	5.3	787.5	787.5	788.1	0.6
BL	69,062	105		829	6.0	790.4	790.4	791.3	0.9
BM	69,590	152		987	5.0	792.0	792.0	792.8	0.8
BN	71,333	105		692	7.1	798.0	798.0	798.5	0.5
BO	72,283	121		1,013	4.9	801.6	801.6	802.2	0.6
BP	73,498	157		1,437	3.1	805.4	805.4	805.8	0.4
BQ	74,026	171		1,541	2.9	805.6	805.6	806.3	0.7
BR	74,765	70		802	3.7	806.2	806.2	807.2	1.0

[1] Distances measured in feet above confluence with Mill Creek

[2] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK MILL CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork Mill Creek (continued)								
BS	75,715 [1]	71	362	8.1	808.0	808.0	809.0	1.0
BT	76,296 [1]	279	1,013	2.9	811.7	811.7	812.6	0.9
BU	77,986 [1]	104	646	3.4	815.1	815.1	816.1	1.0
BV	78,566 [1]	132	843	2.2	817.1	817.1	818.1	1.0
BW	78,883 [1]	94	438	4.3	817.8	817.8	818.1	0.3
BX	79,781 [1]	135	755	2.3	819.7	819.7	820.6	0.9
BY	81,048 [1]	69	495	3.3	824.2	824.2	824.7	0.5
West Fork Mill Creek South Tributary								
A	422 [2]	28	135	9.9	587.0	587.0	587.1	0.1
B	950 [2]	51	166	8.0	595.4	595.4	595.4	0.0
C	1,003 [2]	45	153	8.7	598.9	598.9	598.9	0.0
D	1,426 [2]	72	194	6.9	609.4	609.4	609.5	0.1
E	1,531 [2]	53	188	7.1	611.4	611.4	611.8	0.4
F	2,006 [2]	43	144	9.3	622.5	622.5	622.5	0.0

[1] Distances measured in feet above confluence with Mill Creek

[2] Distances measured in feet above mouth at confluence with West Fork Mill Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK MILL CREEK – WEST FORK MILL CREEK SOUTH TRIBUTARY

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork of Sycamore Creek								
A	140 [1]	73	676	10.4	685.3	685.3	685.8	0.5
B	1,480 [1]	68	627	11.2	697.1	697.1	697.4	0.3
C	2,760 [1]	73	483	9.5	718.9	718.9	719.3	0.4
D	4,087 [1]	125	1,714	2.7	743.1	743.1	743.4	0.3
E	5,163 [1]	57	422	10.9	748.1	748.1	748.1	0.0
Whitewater River								
A	4,280 [2]	4,080	31,609	2.0	489.9	480.9 [3]	481.4	0.5
B	7,900 [2]	782	7,689	8.4	489.9	481.6 [3]	482.1	0.5
C	11,415 [2]	495	6,620	9.8	489.9	484.9 [3]	485.4	0.5
D	16,570 [2]	2,800	25,374	2.5	489.9	488.7 [3]	489.5	0.8
E	18,580 [2]	2,150	11,669	5.5	490.1	490.1	490.6	0.5
F	20,790 [2]	1,136	12,630	5.1	492.5	492.5	493.1	0.6
G	23,650 [2]	2,169	18,116	3.6	494.6	494.6	495.4	0.8
H	25,590 [2]	1,817	18,356	3.5	495.6	495.6	496.5	0.9
I	31,130 [2]	2,310	17,866	3.6	500.1	500.1	500.9	0.8
J	34,750 [2]	2,150	22,719	2.8	502.9	502.9	503.2	0.3
K	36,360 [2]	2,056	12,036	5.4	503.9	503.9	504.0	0.1
L	38,740 [2]	2,568	24,965	2.6	506.7	506.7	507.6	0.9
M	41,120 [2]	2,593	20,627	3.1	508.4	508.4	509.2	0.8

[1] Distances measured in feet above approximately 1.6 miles above confluence with Sycamore Creek

[2] Distances measured in feet above confluence with Great Miami River

[3] Computed without consideration of backwater effects from the Ohio River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WEST FORK OF SYCAMORE CREEK – WHITEWATER RIVER

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY				1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	WIDTH REDUCED FROM PRIOR STUDY[2] (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Winton Woods Creek									
A	750	89		778	10.7	702.9	702.9	702.9	0.0
B	1,801	99		637	13.0	712.1	712.1	712.1	0.0
C	3,233	110		650	12.8	719.8	719.8	719.8	0.0
D	4,458	111		844	9.8	728.8	728.8	728.9	0.1
E	6,983	298		2,344	3.5	736.9	736.9	737.2	0.3
F	9,262	299		2,308	3.6	740.5	740.5	741.2	0.7
G	10,605	138	46	1,479	5.6	742.7	742.7	743.3	0.6
H	12,115	102		834	6.4	754.3	754.3	754.4	0.1
I	12,750	72	85	862	5.9	757.8	757.8	758.2	0.4
J	13,885	153		1,200	3.8	766.2	766.2	767.1	0.9
K	14,810	120		1,042	4.4	777.6	777.6	778.6	1.0

[1] Distances measured in feet above McKelvey Road (extended)

[2] See explanation in Section 2.2 Floodways

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WINTON WOODS CREEK

Table 23 Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (Feet)	SECTION AREA (Sq. Feet)	MEAN VELOCITY (Feet/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wulff Run								
A	105 [1]	100	1,009	3.8	785.9	785.9	786.1	0.2
B	827 [1]	105	592	6.5	786.4	786.4	786.8	0.4
C	1,721 [1]	30	259	10.0	795.9	795.9	795.9	0.0
D	1,936 [1]	77	948	2.7	803.2	803.2	803.6	0.4
E	2,721 [1]	25	173	15.0	808.7	808.7	808.7	0.0
F	3,721 [1]	68	367	7.1	821.5	821.5	822.5	1.0
Yonote Creek								
A	327 [2]	26	171	8.6	546.4	543.9 [3]	543.9	0.0
B	887 [2]	63	369	4.0	548.4	548.4	548.4	0.0
C	1,411 [2]	286	541	2.7	554.1	554.1	554.1	0.0

[1] Distances measured in feet above Delhi Road

[2] Distances measured in feet above confluence with Duck Creek

[3] Computed without consideration of backwater effects from Duck Creek

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WULFF RUN – YONOTE CREEK

Table 24: Flood Hazard and Non-Encroachment Data for Selected Streams

[Not Applicable to this Flood Risk Project]

6.4 Coastal Flood Hazard Mapping

This section is not applicable to this Flood Risk Project.

Table 25: Summary of Coastal Transect Mapping Considerations

[Not Applicable to this Flood Risk Project]

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 30, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA.

To obtain an application for a LOMA, visit www.fema.gov/flood-maps/change-your-flood-zone and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at www.fema.gov/online-tutorials.

For more information about how to apply for a LOMA, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as that for a LOMA, by visiting www.fema.gov/flood-maps/change-your-flood-zone for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at www.fema.gov/online-tutorials.

6.5.3 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit www.fema.gov/media-library/assets/documents/1343 and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the Hamilton County FIRM are listed in Table 26. Please note that this table only includes LOMCs that have been issued on the FIRM panels updated by this map revision. For all other areas within this county, users should be aware that revisions to the FIS Report made by prior LOMRs may not be reflected herein and users will need to continue to use the previously issued LOMRs to obtain the most current data.

Table 26: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
13-05-0281P	09/20/2013	Duck Creek & Yonote Creek	39061C0241F, 39061C0242F, 39061C0243F, 39061C0244F

6.5.4 Physical Map Revisions

A Physical Map Revisions (PMR) is an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Hamilton County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 27, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 27 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first FHBM. This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as PMRs of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Hamilton County FIRMs in countywide format was 05/17/2004.

Table 27: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Addyston, Village of	03/01/1974	03/01/1974	05/21/1976	08/15/1983	02/16/2012 02/17/2010 05/17/2004
Amberley, Village of	09/30/1980	N/A	N/A	09/30/1980	02/17/2010 05/17/2004
Arlington Heights, Village of	02/01/1974	02/01/1974	12/05/1975	12/18/1986	02/17/2010 05/17/2004
Blue Ash, City of	02/21/1975	02/21/1975	N/A	08/01/1980	06/07/2023 02/17/2010 05/17/2004
Cheviot, City of [1, 2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Cincinnati, City of	06/28/1974	06/28/1974	07/30/1976	10/15/1982	06/07/2023 02/16/2012 02/17/2010 05/17/2004
Cleves, Village of	07/23/1976	07/23/1976	09/02/1977	02/01/1984	02/16/2012 02/17/2010 05/17/2004

[1] No Special Flood Hazard Areas identified

[2] This community did not have a FIRM prior to the first countywide FIRM for Hamilton County

Table 27: Community Map History *(continued)*

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Deer Park, City of [1, 2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Elmwood Place, Village of	02/01/1974	02/01/1974	04/23/1976	12/18/1984	02/17/2010 05/17/2004
Evendale, Village of	03/01/1974	03/01/1974	08/27/1976	09/29/1986	02/17/2010 05/17/2004
Fairfax, Village of	01/31/1975	01/31/1975	N/A	11/15/1979	06/07/2023 02/17/2010 05/17/2004
Forest Park, City of [2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Glendale, Village of [2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Golf Manor, City of [1, 2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Greenhills, Village of	01/25/1974	01/25/1974	06/04/1982 05/21/1976	09/01/1993	02/17/2010 05/17/2004
Hamilton County, Unincorporated Areas	04/14/1978	04/14/1978	N/A	06/01/1982	06/07/2023 02/16/2012 02/17/2010 05/17/2004 10/18/1995
Harrison, City of	02/15/1974	02/15/1974	12/24/1976 05/21/1976	04/03/1985	02/17/2010 05/17/2004
Lincoln Heights, Village of[1, 2]	05/17/2004	N/A	N/A	05/17/2004	02/17/2010
Lockland, Village of	02/15/1974	02/15/1974	01/13/1978	09/04/1986	02/17/2010 05/17/2004
Loveland, City of	02/01/1974	02/01/1974	05/28/1976	09/01/1978	06/07/2023 02/17/2010 05/17/2004
Madeira, City of	02/07/1975	02/07/1975	N/A	11/15/1979	06/07/2023 02/17/2010 05/17/2004 02/20/1981
Mariemont, Village of [2]	05/17/2004	N/A	N/A	05/17/2004	06/07/2023 02/17/2010
Montgomery, City of	06/28/1974	06/28/1974	04/11/1975	06/25/1976	06/07/2023 02/17/2010 05/17/2004 03/02/1993

[1] No Special Flood Hazard Areas identified

[2] This community did not have a FIRM prior to the first countywide FIRM for Hamilton County

Table 27: Community Map History *(continued)*

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Mount Healthy, City of	06/07/1974	06/07/1974	N/A	12/15/1978	02/17/2010 05/17/2004 03/02/1993
Newtown, Village of	02/01/1974	02/01/1974	11/03/1978 05/28/1976	12/15/1983	06/07/2023 02/17/2010 05/17/2004
North Bend, Village of	03/15/1974	03/15/1974	05/07/1976	10/18/1983	02/16/2012 02/17/2010 05/17/2004
North College Hill, City of	06/07/1974	06/07/1974	07/25/1975	09/29/1986	02/17/2010 05/17/2004
Norwood, City of [1, 2]	05/17/2004	N/A	N/A	05/17/2004	06/07/2023 02/17/2010
Reading, City of	02/08/1974	02/08/1974	05/18/1979 04/16/1976	12/18/1986	02/17/2010 05/17/2004
Sharonville, City of	04/12/1974	04/12/1974	07/27/1979 05/28/1976	01/02/1987	06/07/2023 02/17/2010 05/17/2004
Silverton, City of [1, 2]	05/17/2004	N/A	N/A	05/17/2004	06/07/2023 02/17/2010
Springdale, City of	08/14/1981	08/14/1981	N/A	12/05/1990	02/17/2010 05/17/2004
St. Bernard, City of	05/10/1974	05/10/1974	04/09/1976	09/19/1984	02/16/2012 02/17/2010 05/17/2004
Terrace Park, Village of	02/08/1974	02/08/1974	08/12/1977 10/08/1976	01/05/1984	06/07/2023 02/17/2010 05/17/2004
The Village of Indian Hill, City of	06/28/1974	06/28/1974	06/04/1976	05/01/1985	06/07/2023 02/17/2010 05/17/2004
Woodlawn, Village of	02/01/1974	02/01/1974	12/24/1976 06/04/1976	09/04/1986	02/17/2010 05/17/2004
Wyoming, City of	02/01/1974	02/01/1974	06/04/1976	03/02/1979	02/17/2010 05/17/2004

[1] No Special Flood Hazard Areas identified

[2] This community did not have a FIRM prior to the first countywide FIRM for Hamilton County

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 28 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 28: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Bares Run	06/07/2023	STARR	RM-FOA-FY14-OH-05090202	09/30/2016	Loveland, City of
Berkshire Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas
Brookwood Creek	February 1980	USACE	IAA-H-7-76	December 1978	Amberley, Village of
Clough Creek	12/01/1981	USACE	L&AH-76	March 1979	Cincinnati, City of; Hamilton County, Unincorporated Areas
Congress Run	12/01/1981	USACE	L&AH-76	March 1979	Cincinnati, City of; Hamilton County, Unincorporated Areas; Wyoming, City of
Dry Fork of The Whitewater River	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas
Dry Run	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; Newtown, Village of
Duck Creek	02/17/2010	LOMR	07-05-0437P	02/22/2007	Cincinnati, City of; Fairfax, Village of
Duck Creek	06/07/2023	LOMR	13-05-0281P	09/20/2013	Cincinnati, City of
East Fork Mill Creek	02/17/2010	STANTEC	HSFE05-05-D-0026	July 2009	Sharonville, City of
Fork of McCullough Run	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas; Newtown, Village of

Table 28: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Great Miami River	12/01/1981	USACE	L&AH-76	March 1979	Cleves, Village of; Hamilton County, Unincorporated Areas
Hazelwood Creek	February 1980	USACE	IAA-H-7-76	December 1978	Blue Ash, City of
Howard Creek	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas
Lake Chetac Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; Montgomery, City of
Left Fork Section Road Creek	February 1980	USACE	IAA-H-7-76	December 1978	Amberley, Village of
Little Duck Creek	02/17/2010	LOMR	07-05-0437P	02/22/2007	Fairfax, Village of
Little Duck Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Cincinnati, City of; Fairfax, Village of; Hamilton County, Unincorporated Areas; Madeira, City of
Little Miami River	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Cincinnati, City of; Hamilton County, Unincorporated Areas; Loveland, City of; Mariemont, Village of; Newtown, Village of; Terrace Park, Village of; The Village of Indian Hill, City of
Loveland Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; Loveland, City of
McCullough Run	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas; Newtown, Village of

Table 28: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Mill Creek	05/17/2010	USACE	General Reevaluation Report (GRR)	04/20/2000	Arlington Heights, Village of; Cincinnati, City of; Elmwood Place, Village of; Evendale, Village of; Hamilton County, Unincorporated Areas; Lockland, Village of; Reading, City of; Sharonville, City of; St. Bernard, City of
Mill Creek	02/17/2010	STANTEC	HSFE05-05-D-0026	July 2009	Sharonville, City of
Muddy Creek	12/01/1981	USACE	L&AH-76	March 1979	Addyston, Village of; Cincinnati, City of; Hamilton County, Unincorporated Areas
Newton (Clear) Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas
North Branch Sycamore Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Montgomery, City of; The Village of Indian Hill, City of
Northland Road Tributary	12/05/1990	USACE	EMW-87-E-2509	July 1988	Springdale, City of
O'Bannon Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Loveland, City of
Ohio River	02/16/2012	STARR	HSFEHQ-09-D-0370	January 2011	Addyston, Village of; Cincinnati, City of; Hamilton County, Unincorporated Areas; North Bend, Village of
Pleasant Run	02/17/2010	USACE	05-05-3352P	04/26/2006	Hamilton County, Unincorporated Areas
Polk Run	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; Montgomery, City of
Raiders Run	12/01/1981	USACE	L&AH-76	March 1979	Blue Ash, City of; Hamilton County, Unincorporated Areas

Table 28: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Section Road Creek	February 1980	USACE	IAA-H-7-76	December 1978	Amberley, Village of; Cincinnati, City of
Sharon Creek	02/17/2010	STANTEC	HSFE05-05-D-0026	July 2009	Evendale, Village of; Sharonville, City of
Sharon Creek Tributary	02/17/2010	STANTEC	HSFE05-05-D-0026	July 2009	Evendale, Village of; Sharonville, City of
Springdale Tributary	12/05/1990	USACE	EMW-87-E-2509	July 1988	Sharonville, City of; Springdale, City of
Sycamore Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; Madeira, City of; The Village of Indian Hill, City of
Tributary A	09/29/1986	USACE	EMW-84-E-1506	May 1985	North College Hill, City of
Tributary To Pleasant Run	02/17/2010	USACE	05-05-3352P	04/26/2006	Hamilton County, Unincorporated Areas
West Fork Creek	04/15/1982	USACE	IAA-H-7-76	March 1979	Cincinnati, City of
West Fork Lake Tributary	09/29/1986	USACE	EMW-84-E-1506	May 1985	City of Cincinnati; Hamilton County, Unincorporated Areas; Mount Healthy, City of; North College Hill, City of
West Fork Mill Creek	10/18/1995	USACE	EMW-9l-E-3529	October 1992	Arlington Heights, Village of; Hamilton County, Unincorporated Areas; Lockland, Village of; Mount Healthy, City of; Woodlawn, Village of; Wyoming, City of
West Fork Mill Creek South Tributary	09/04/1986	USACE	EMW-84-E-1504	June 1985	Woodlawn, Village of
West Fork of Sycamore Creek	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas

Table 28: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
West Fork of Sycamore Creek	06/07/2023	COMPASS	HSFE60-15-D-0003	September 2018	Hamilton County, Unincorporated Areas; The Village of Indian Hill, City of
Whitewater River	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas; Harrison, City of
Winton Woods Creek	03/02/1993	USACE	EMW-88-E-2768	03/02/1993	Hamilton County, Unincorporated Areas; Mount Healthy, City of
Wulff Run	12/01/1981	USACE	L&AH-76	March 1979	Hamilton County, Unincorporated Areas
Yonote Creek	06/07/2023	LOMR	13-05-0281P	09/20/2013	Cincinnati, City of; Hamilton County, Unincorporated Areas

7.2 Community Meetings

The dates of the community meetings held for this Flood Risk Project and previous Flood Risk Projects are shown in Table 29. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 29: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Addyston, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Addyston, and study contractor
Amberley, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Amberley, and study contractor
Arlington Heights, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Arlington Heights, and study contractor
Blue Ash, City of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Blue Ash, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Blue Ash, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Blue Ash, and study contractor
Cheviot, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Cheviot, and study contractor
Cincinnati, City of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Cincinnati, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Cincinnati, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Cincinnati, and study contractor
Cleves, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Cleves, and study contractor
Deer Park, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Deer Park, and study contractor

Table 29: Community Meetings *(continued)*

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Elmwood Place, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Elmwood Place, and study contractor
Evendale, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Evendale, and study contractor
Fairfax, Village of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Fairfax, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Fairfax, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Fairfax, and study contractor
Forest Park, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Forest Park, and study contractor
Glendale, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Glendale, and study contractor
Golf Manor, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Golf Manor, and study contractor
Greenhills, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Greenhills, and study contractor
Hamilton County Unincorporated Areas	06/07/2023	05/3/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Hamilton County, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Hamilton County, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Hamilton County, and study contractor

Table 29: Community Meetings *(continued)*

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Harrison, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Harrison, and study contractor
Lincoln Heights, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Lincoln Heights, and study contractor
Lockland, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Lockland, and study contractor
Loveland, City of	06/07/2023	06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Loveland, and study contractor
Maderia, City of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Maderia, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Maderia, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Maderia, and study contractor
Mariemont, Village of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Mariemont, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Mariemont, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Mariemont, and study contractor

Table 29: Community Meetings *(continued)*

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Montgomery, City of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Montgomery, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Montgomery, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Montgomery, and study contractor
Mount Healthy, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Mount Healthy, and study contractor
Newtown, Village of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Newtown, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Newtown, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Newtown, and study contractor
North Bend, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of North Bend, and study contractor
North College Hill, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of North College Hill, and study contractor
Norwood, City of	06/07/2023	06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Norwood, and study contractor
Reading, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Reading, and study contractor
Sharonville, City of	06/07/2023	06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Sharonville, and study contractor

Table 29: Community Meetings *(continued)*

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Silverton, City of	06/07/2023	06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Silverton, and study contractor
Springdale, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of Springdale, and study contractor
St. Bernard, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), City of St. Bernard, and study contractor
Terrace Park, Village of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Terrace Park, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Terrace Park, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Terrace Park, and study contractor
The Village of Indian Hill, City of	06/07/2023	05/03/2011	Project Discovery	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), The City of The Village of Indian Hill, and study contractor
		06/26/2018	Flood Risk Review	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), The City of The Village of Indian Hill, and study contractor
		06/10/2021	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), The City of The Village of Indian Hill, and study contractor
Woodlawn, Village of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Woodlawn, and study contractor

Table 29: Community Meetings *(continued)*

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Wyoming, City of	02/17/2010	09/30/2008	Final CCO	Representatives of FEMA, Ohio Department of Natural Resources (ODNR), Village of Wyoming, and study contractor

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see www.fema.gov.

Table 30 is a list of the locations where FIRMs for Hamilton County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 30: Map Repositories

Community	Address	City	State	Zip Code
Addyston, Village of	Municipal Building 235 Main Street	Addyston	OH	45001
Amberley, Village of	Municipal Building 7149 Ridge Road	Cincinnati	OH	45237
Arlington Heights, Village of	Village Hall 601 Elliot Avenue	Arlington Heights	OH	45215
Blue Ash, City of	City Hall 4343 Cooper Road	Blue Ash	OH	45242
Cheviot, City of [1]	City Hall 3814 Harrison Avenue	Cheviot	OH	45211
Cincinnati, City of	City Hall 801 Plum Street	Cincinnati	OH	45202
Cleves, Village of	City Hall 101 North Miami Avenue	Cleves	OH	45002
Deer Park, City of [1]	City Hall 7777 Blue Ash Road	Deer Park	OH	45236
Elmwood Place, Village of	Village Hall 6118 Vine Street	Elmwood Place	OH	45216
Evendale, Village of	Village Hall 10500 Reading Road	Evendale	OH	45241
Fairfax, Village of	Municipal Building 5903 Hawthorne Avenue	Fairfax	OH	45227
Forest Park, City of	City Hall 1201 West Kemper Road	Forest Park	OH	45240
Glendale, Village of	Village Hall 30 Village Square	Glendale	OH	45246
Golf Manor, City of [1]	Village Hall 6450 Wiehe Road	Golf Manor	OH	45237
Greenhills, Village of	Municipal Building 11000 Winton Road	Greenhills	OH	45218

[1] No Special Flood Hazard Areas Identified

Table 30: Map Repositories *(continued)*

Community	Address	City	State	Zip Code
Hamilton County	Hamilton County Department of Public Works 138 East Court Street Room 800	Cincinnati	OH	45202
Harrison, City of	Community Center 300 George Street	Harrison	OH	45030
Lincoln Heights, Village of [1]	Village Hall 1201 Steffen Avenue	Lincoln Heights	OH	45215
Lockland, Village of	Town Hall 101 North Cooper Avenue	Lockland	OH	45215
Loveland, City of	City Hall 120 West Loveland Avenue	Loveland	OH	45140
Madeira, City of	City Hall 7141 Miami Avenue	Madeira	OH	45243
Mariemont, Village of	Municipal Building 6907 Wooster Pike	Mariemont	OH	45227
Montgomery, City of	City Hall 10101 Montgomery Road	Montgomery	OH	45242
Mount Healthy, City of	City Administration Building 7700 Perry Street	Mt. Healthy	OH	45231
Newtown, Village of	Village Office – Municipal Center 3537 Church Street	Newtown	OH	45244
North Bend, Village of	Municipal Building 21 Taylor Avenue	North Bend	OH	45052
North College Hill, City of	City Hall 1500 West Galbraith Road	Cincinnati	OH	45231
Norwood, City of [1]	City Hall 4645 Montgomery Road	Norwood	OH	45212
Reading, City of	City Hall 1000 Market Street	Reading	OH	45215
Sharonville, City of	City Administration Building 10900 Reading Road	Sharonville	OH	45241
Silverton, City of [1]	City Hall 6943 Montgomery Road	Silverton	OH	45236
Springdale, City of	City Hall 11700 Springfield Pike	Springdale	OH	45246
St. Bernard, City of	City Hall 110 Washington Avenue	St. Bernard	OH	45217
Terrace Park, Village of	Community Building 428 Elm Avenue	Terrace Park	OH	45174
The Village of Indian Hill, City of	Indian Hill Village Hall 6525 Drake Road	Cincinnati	OH	45243

[1] No Special Flood Hazard Areas identified

Table 30: Map Repositories *(continued)*

Community	Address	City	State	Zip Code
Woodlawn, Village of	Village Hall 10141 Woodlawn Boulevard	Woodlawn	OH	45215
Wyoming, City of	City Building 800 Oak Avenue	Cincinnati	OH	45215

[1] No Special Flood Hazard Areas identified

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM Databases and LOMCs. Together they create a GIS data layer for a state or territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 31.

Table 31 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the State NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of state or territorial government to coordinate that state's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of state and local GIS data in their state.

Table 31: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library
NFIP website	www.fema.gov/national-flood-insurance-program
NFHL Dataset	msc.fema.gov
FEMA Region V	FEMA Region V 536 South Clark Street, 6th Floor Chicago, IL 60605 312-408-5500
Other Federal Agencies	
USGS website	www.usgs.gov
Hydraulic Engineering Center website	www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Alicia Silverio, CFM, Program Manager Ohio Department of Natural Resources Division of Soil & Water Resources Floodplain Management Program 2045 Morse Road, Building B-2 Columbus, OH 43229-6693 Phone: (614) 265-1006 alicia.silverio@dnr.state.oh.us
State GIS Coordinator	Jeff Smith Framework Development Manager 77 S High St - 19th Floor Columbus, OH 43215 (614) 466-4747 Jeff.Smith@das.ohio.gov

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 32 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 32: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
BPR	Bureau of Public Records	Capacity Change for Hydraulic Design for Highway Culverts	*	Washington, D.C.	1965	
CAGIS 1991	Cincinnati Area Geographic Information System	2-foot Contour Topographic Data	CAGIS	Cincinnati, OH	1991	
CAGIS 2001	Cincinnati Area Geographic Information System	2001 2-foot contours	CAGIS	Cincinnati, OH	2001	
CAGIS 2007	Cincinnati Area Geographic Information System	Ortho-Imagery of Hamilton County, Ohio	CAGIS	Cincinnati, OH	03/01/2007	
CAGIS 2012	Cincinnati Area Geographic Information System	Surface Water Features for Hamilton County	CAGIS	Cincinnati, OH	02/16/2012	
CAGIS 2016	Cincinnati Area Geographic Information System	Transportation Features for Hamilton County	CAGIS	Cincinnati, OH	03/16/2016	http://cagismaps.hamilton-co.org/cagisportal
Compass 2018a	Federal Emergency Management Agency	Approximate Study Hydraulics Data Capture Submission for RM-REG-FY's 13,15,17-OH-05090202-Little Miami River Watershed-O-W	COMPASS	Washington, D.C.	07/31/2018	
Compass 2018b	Federal Emergency Management Agency	Steady Detailed Study Hydraulics Data Capture Submission for RM-REG-FY's 13,15,17-OH-05090202-Little Miami River Watershed-O-W	COMPASS	Washington, D.C.	07/31/2018	

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
Compass 2018c	Federal Emergency Management Agency	Redelineation of Effective Data	COMPASS	Washington, D.C.	07/31/2018	
Compass 2018d	Federal Emergency Management Agency	Unsteady Detailed Study Hydraulics Data Capture Submission for RM-REG-FY's 13,15,17-OH-05090202-Little Miami River Watershed-O-W	COMPASS	Washington, D.C.	07/31/2018	
Compass 2018e	Federal Emergency Management Agency	Hydrologic Analyses for Little Miami Watershed-O-W HUC8 – Study – FY's 13, 15, 17 – REG	COMPASS	Washington, D.C.	07/31/2018	
Denver 1969	Denver Regional Council of Governments	Urban Storm Drainage Criteria Manual, Vols. I and II	*	Denver, CO	1969	
FEMA 1980	Federal Emergency Management Agency	Flood Insurance Study, Village of Amberley, Hamilton County, Ohio	FEMA	Washington, D.C.	02/01/1980	http://hazards.fema.gov
FEMA 1980	Federal Emergency Management Agency	Flood Insurance Study, City of Blue Ash, Hamilton County, Ohio	FEMA	Washington, D.C.	02/01/1980	http://hazards.fema.gov
FEMA 1981	Federal Emergency Management Agency	Flood Insurance Study, Hamilton County, Ohio (Unincorporated Areas)	FEMA	Washington, D.C.	12/01/1981	http://hazards.fema.gov
FEMA 1982	Federal Emergency Management Agency	Flood Insurance Study, City of Cincinnati, Hamilton County, Ohio	FEMA	Washington, D.C.	04/15/1982	http://hazards.fema.gov

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 1983	Federal Emergency Management Agency	Flood Insurance Study, Village of Addyston, Hamilton County, Ohio	FEMA	Washington, D.C.	02/15/1983	http://hazards.fema.gov
FEMA 1983	Federal Emergency Management Agency	Flood Insurance Study, Village of Cleves, Hamilton County, Ohio	FEMA	Washington, D.C.	08/01/1983	http://hazards.fema.gov
FEMA 1983	Federal Emergency Management Agency	Flood Insurance Study, Village of Newton, Hamilton County, Ohio	FEMA	Washington, D.C.	06/15/1983	http://hazards.fema.gov
FEMA 1983	Federal Emergency Management Agency	Flood Insurance Study, Village of North Bend, Hamilton County, Ohio	FEMA	Washington, D.C.	04/18/1983	http://hazards.fema.gov
FEMA 1983	Federal Emergency Management Agency	Flood Insurance Study, Village of Terrace Park, Hamilton County, Ohio	FEMA	Washington, D.C.	07/05/1983	http://hazards.fema.gov
FEMA 1984	Federal Emergency Management Agency	Flood Insurance Study, Village of Elmwood Place, Hamilton County, Ohio	FEMA	Washington, D.C.	06/18/1984	http://hazards.fema.gov
FEMA 1984	Federal Emergency Management Agency	Flood Insurance Study, City of Harrison, Hamilton County, Ohio	FEMA	Washington, D.C.	10/03/1984	http://hazards.fema.gov
FEMA 1984	Federal Emergency Management Agency	Flood Insurance Study, City of St. Bernard, Hamilton County, Ohio	FEMA	Washington, D.C.	03/19/1984	http://hazards.fema.gov
FEMA 1984	Federal Emergency Management Agency	Flood Insurance Study, City of the Village of Indian Hill, Hamilton County, Ohio	FEMA	Washington, D.C.	11/01/1984	http://hazards.fema.gov

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, Village of Arlington Heights, Hamilton County, Ohio	FEMA	Washington, D.C.	12/18/1986	http://hazards.fema.gov
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, Village of Evendale, Hamilton County, Ohio	FEMA	Washington, D.C.	09/29/1986	http://hazards.fema.gov
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, Village of Lockland, Hamilton County, Ohio	FEMA	Washington, D.C.	09/04/1986	http://hazards.fema.gov
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, City of North College Hill, Hamilton County, Ohio	FEMA	Washington, D.C.	09/29/1986	http://hazards.fema.gov
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, City of Reading, Hamilton County, Ohio	FEMA	Washington, D.C.	12/18/1986	http://hazards.fema.gov
FEMA 1986	Federal Emergency Management Agency	Flood Insurance Study, Village of Woodlawn, Hamilton County, Ohio	FEMA	Washington, D.C.	09/04/1986	http://hazards.fema.gov
FEMA 1987	Federal Emergency Management Agency	Flood Insurance Study, City of Sharonville, Hamilton County, Ohio	FEMA	Washington, D.C.	01/02/1987	http://hazards.fema.gov
FEMA 1990	Federal Emergency Management Agency	Flood Insurance Study, City of Springdale, Hamilton County, Ohio	FEMA	Washington, D.C.	12/05/1990	http://hazards.fema.gov

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 1993	Federal Emergency Management Agency	Flood Insurance Study, City of Mount Healthy, Hamilton County, Ohio	FEMA	Washington, D.C.	03/02/1993	http://hazards.fema.gov
FEMA 1993	Federal Emergency Management Agency	Flood Insurance Study, City of Montgomery, Hamilton County, Ohio	FEMA	Washington, D.C.	03/02/1993	http://hazards.fema.gov
FEMA 2004	Federal Emergency Management Agency	Flood Insurance Study, Hamilton County, Ohio	FEMA	Washington, D.C.	05/17/2004	http://hazards.fema.gov
FEMA 2010	Federal Emergency Management Agency	Hamilton County, OH and Incorporated Areas Flood Insurance Study – Ohio River PMR	FEMA	Washington, D.C.	02/17/2010	http://msc.fema.gov
FEMA 2012	Federal Emergency Management Agency	Hamilton County, OH and Incorporated Areas Flood Insurance Study	FEMA	Washington, D.C.	02/16/2012	http://msc.fema.gov
HUD 1978	U.S. Department of Housing and Urban Development, Federal Insurance Administration	Flood Insurance Study, City of Loveland, Hamilton, Warren and Clermont County, Ohio	FEMA	Washington, D.C.	03/01/1978	http://hazards.fema.gov
HUD 1979	U.S. Department of Housing and Urban Development, Federal Insurance Administration	Flood Insurance Study, Village of Fairfax, Hamilton County, Ohio	FEMA	Washington, D.C.	05/01/1979	http://hazards.fema.gov

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
HUD 1979	U.S. Department of Housing and Urban Development, Federal Insurance Administration	Flood Insurance Study, City of Madeira, Hamilton County, Ohio	FEMA	Washington, D.C.	05/01/1979	http://hazards.fema.gov
International AM	International Aerial Mapping Co.	Topographic Mapping, Altitude 1,500', Scale 1:600, Contour Interval 1 foot	*	San Antonio, TX	1973	
LOMR 2013	Federal Emergency Management Agency	LOMR 13-05-0281P	FEMA	Washington, D.C.	09/20/2013	http://msc.fema.gov
Metro TOPO 1962	Metropolitan Topographic Survey	Topographic Mapping, Scale 1:2,400, Contour Interval 5 feet	*	Cincinnati, OH	1962	
Metro TOPO 1965	Metropolitan Topographic Survey	Topographic Mapping, Scale 1:2,400, Contour Interval 5 feet	*	Cincinnati, OH	1965	
NFHL 2012	Federal Emergency Management Agency (FEMA)	Public Land Survey System (PLSS), Political Boundaries	United States Geological Survey	Washington, D.C.	02/16/2012	
NHD 1999	United States Geological Survey (USGS)	National Hydrography Dataset (NHD) - High Resolution	United States Geological Survey	Washington, D.C.	1999	

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
ODNR 1959	Ohio Department of Natural Resources, Division of Lands and Soils	Our Ohio Soils	*	Columbus, OH	1959	
ODNR 1959	Ohio Department of Natural Resources, Division of Water	Floods of January- February 1959 in Ohio	*	Columbus, OH	1959	
ODNR 1959	Ohio Department of Natural Resources, Division of Water	Floods in Ohio. Bulletin No.32, Report No. 4, Ohio Water Plan Inventory	*	Washington, D.C.	1959	
ODNR 1967	Ohio Department of Natural Resources, Division of Water	Ohio Water Plan Inventory Report No. 12a, Drainage Areas of Ohio Streams, supplement to Gazetteer of Ohio Streams	*	Columbus, OH	1967	
ODNR 1969	Ohio Department of Natural Resources, Division of Water	Supplement to Bulletin 32	*	Columbus, OH	1969	
OGRIP 2007	Ohio Geographically Referenced Information Program	Ohio Statewide Imagery Program (2006-2008)	OGRIP	Columbus, OH	2007	
OGRIP 2018	Ohio Geographically Referenced Information Program	Ortho-Imagery of Hamilton County, Ohio	OGRIP	Columbus, OH	12/31/2018	http://ogrip.oit.ohio.gov

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
STARR	Federal Emergency Management Agency	Data Capture Hydraulics Submission for RM-FOA-FY14-OH-05090202- Little Miami River Watershed (14-05-4502S)-W	STARR	Chicago, IL	09/30/2016	
USACE 1962	U.S. Army Corps of Engineers	Statistical Methods in Hydrology	Leo R. Beard	Sacramento, CA	1962	
USACE 1966	U.S. Army Corps of Engineers, Louisville District, in cooperation with the Ohio Department of Natural Resources	Flood Plain Information Study, Little Miami River, Ohio	*	Washington, D.C.	12/01/1966	
USACE 1968	U.S. Army Corps of Engineers, in cooperation with the Ohio Department of Natural Resources	Flood Plain Information, Ohio River. Hamilton County, Ohio	*	Cincinnati, OH	12/01/1968	
USACE 1971	U.S. Army Corps of Engineers	Ohio River Division, Water Resources Development	*	Cincinnati, OH	1971	
USACE 1973	U.S. Army Corps of Engineers	Mill Creek Flood Protection Project Design Memorandum No. 1	*	Washington, D.C.	02/01/1973	
USACE 1973	U.S. Army Corps of Engineers, Hydrologic Engineering Center	HEC-1 User's Manual	*	Davis, CA	1973	

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USACE 1976	U.S. Army Corps of Engineers, Louisville District	Eastern Kentucky Regional Frequency Study	*	Louisville, KY	08/01/1976	
USACE 1977	U.S. Army Corps of Engineers, Louisville District	Floodplain Information, Little Miami River, Hamilton, Clermont and Warren Counties, Ohio	*	Louisville, KY	03/01/1977	
USACE 1981	U.S. Army Corps of Engineers, Hydrologic Engineering Center	HEC-1 Flood Hydrograph Package, Generalized Computer Program	*	Davis, CA	09/01/1981	
USACE 1984	U.S. Army Corps of Engineers, Hydrologic Engineering Center	HEC-2 Water Surface Profiles, Generalized Computer Program	*	Davis, CA	04/01/1984	
USACE 1990	U.S. Army Corps of Engineers, Hydrologic Engineering Center	HEC-2, Water-Surface Profiles, User's Manual	*	Davis, CA	09/01/1990	
USACE 2008	U.S. Army Corps of Engineers, Hydrologic Engineering Center	HEC-RAS River Analysis System Version 4.0.0	*	Davis, CA	03/01/2008	https://www.hec.usace.army.mil/software/hec-ras/

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USDA 1969	U.S. Department of Agriculture, Soil Conservation Service	Work Plan for Watershed Protection and Flood Prevention, Upper Mill Creek Watershed, Butler and Hamilton Counties, Ohio	*	Washington, D.C.	1969	
USDA 1978	U.S. Department of Agriculture	Aerial Photography of Hamilton County, Ohio. Scale 1:20,000	*	Washington, D.C.	09/01/1978	
USDOC 1967	U.S. Department of Commerce, National Weather Service	Rainfall Frequency Atlas of the United States	*	Washington, D.C.	1967	
USDOC 2006	U.S. Department of Commerce, Bureau of the Census	Census 200, using American Fact Finder	*	Washington, D.C.	08/17/2006	http://factfinder.cencus.gov
USDOT 1986	U.S. Department of Transportation, Federal Highway Administration	Bridge Waterways Analysis Model: Research Report	J.O. Shearman, W.H. Kirby, V.R. Schneider, and H.N. Flippo	Washington, D.C.	07/01/1986	
USEPA 1971	U.S. Environmental Protection Agency	Storm Water Management Model. Vol. I - Final Report, 11 024DOC07/7 1	*	Washington, D.C.	1971	

*Data not available

Table 32: Bibliography and References *(continued)*

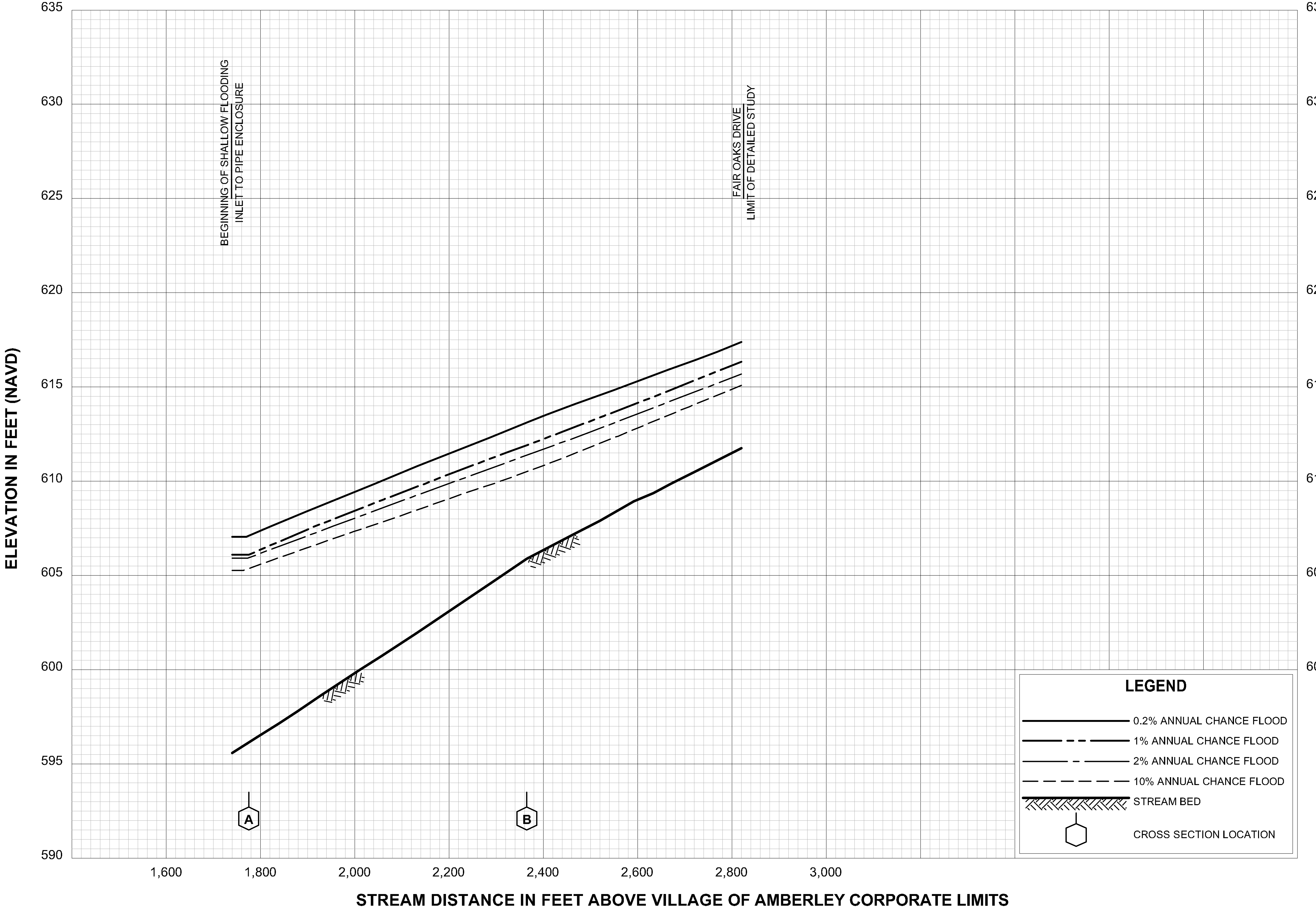
Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USGS 1970	U.S. Geological Survey	Topographic Maps, Scale 1:2,400, Contour Interval 5 feet	*	Cincinnati, OH	1970	
USGS 1974	U.S. Department of the Interior, Geological Survey	Water Resources Data for Ohio. Part 1, Surface Water Records	*	Washington, D.C.	1974	
USGS 1974	U.S. Geological Survey	7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet	*	Cincinnati, OH	1974	
USGS 1974	U.S. Department of the Interior, Geological Survey	7.5- Minute Series Topographic Maps, Scale 1:2,400, Contour Interval 10 feet	*	Cincinnati, OH	1974	
USGS 1974	U.S. Department of the Interior, Geological Survey	7.5-Minute Series (Topographic) Maps, Scale 1:24,000, enlarged to 1:9,600, Contour Interval 10 feet	*	Cincinnati, OH	1974	
USGS 1976	U.S. Department of the Interior, Geological Survey	Floods in Ohio-Magnitude and Frequency. Open-File Report 76-768	*	Washington, D.C.	12/01/1976	
USGS 1981	U.S. Geological Survey	7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet	*	Washington, D.C.	1981	

*Data not available

Table 32: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USGS 1983	U.S. Geological Survey	Flood Characteristics of Urban Watersheds in the United States	V.B. Sauer; W.O. Thomas, Jr.; V.A. Stricker; and K.V. Wilson	Washington, D.C.	1983	
USGS 1986	U.S. Geological Survey	Estimating Peak Discharges, Flood Volumes, and Hydrograph Shapes of Small Ungaged Urban Streams in Ohio	James M. Sherwood	Washington, D.C.	03/01/1986	
USGS 1990	U.S. Geological Survey Water Investigations Report 89-4126	Techniques for Estimating Flood Peak Discharges of Rural, Unregulated Streams in Ohio	Koltun, G.F. and John W. Roberts	Washington, D.C.	1990	
USGS 1990	U.S. Geological Survey	Techniques for Estimating Flood-Peak Discharges of Rural. Unregulated Streams in Ohio	G.F. Koltun, and J.W. Roberts	Washington, D.C.	03/01/1990	
WRC 1976	Water Resources Council	Guidelines for Determining Flood Flow Frequency," Bulletin No. 17	*	Washington, D.C.	03/01/1976	

*Data not available



FLOOD PROFILES

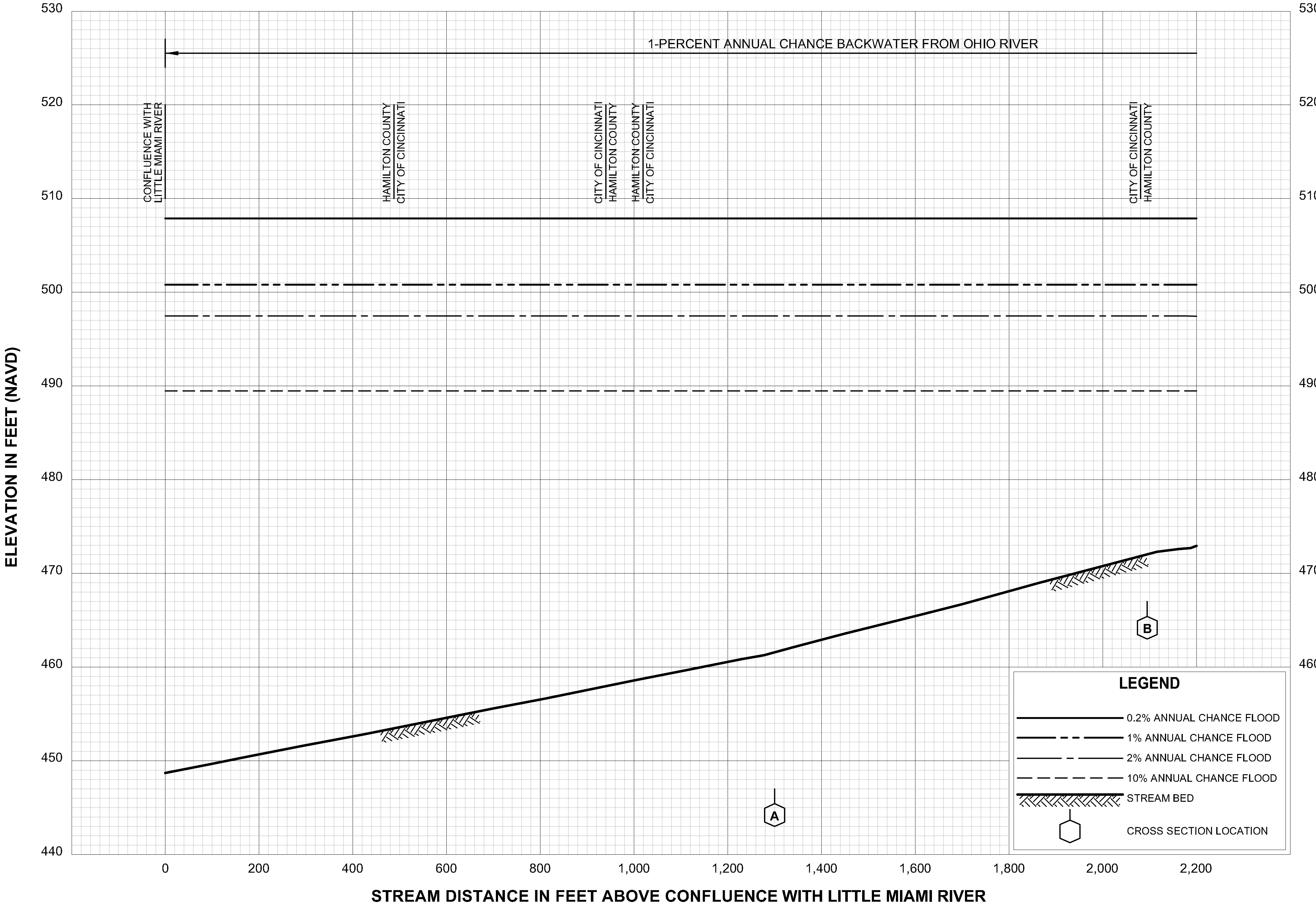
BROOKWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

001P



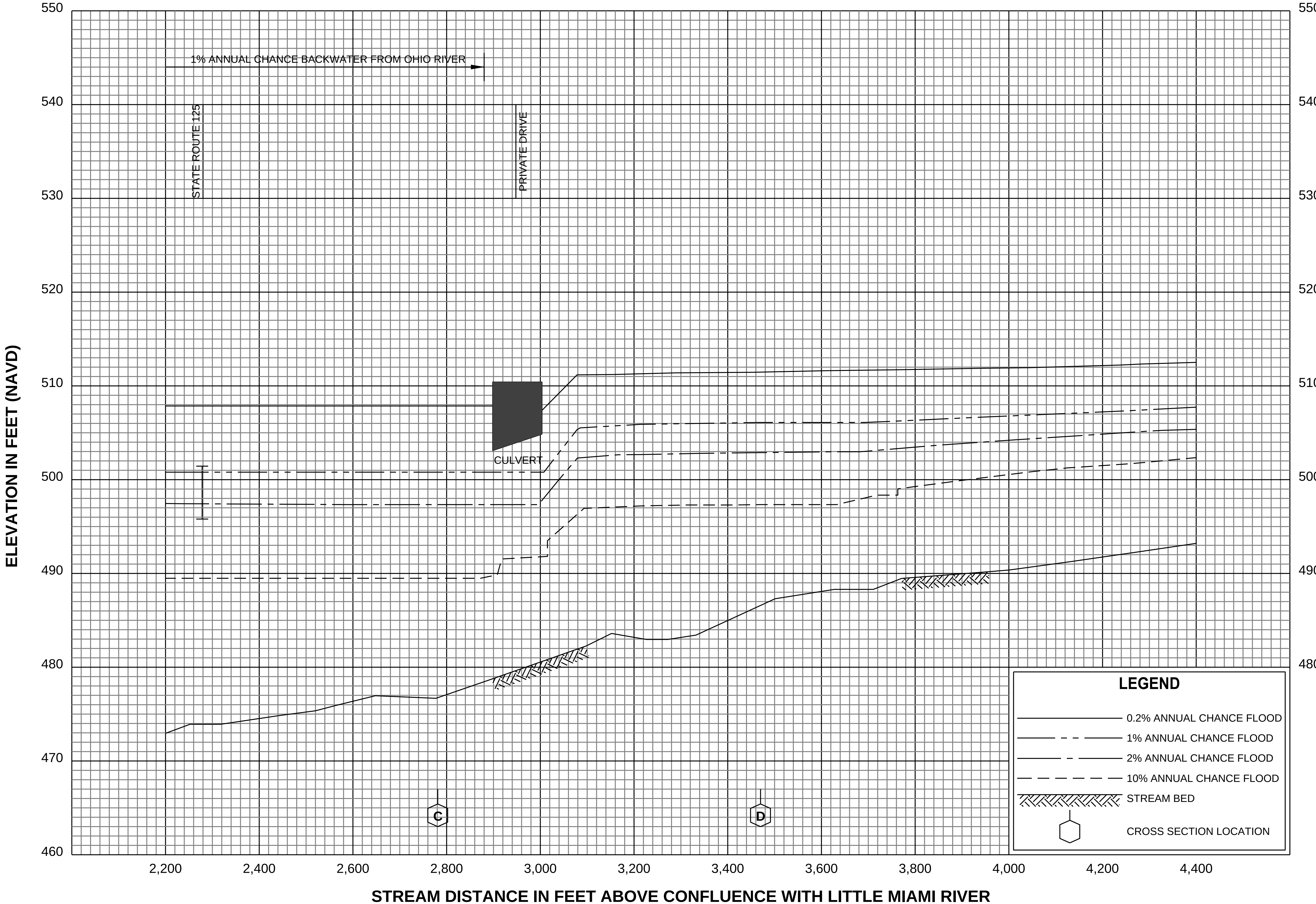
FLOOD PROFILES

CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

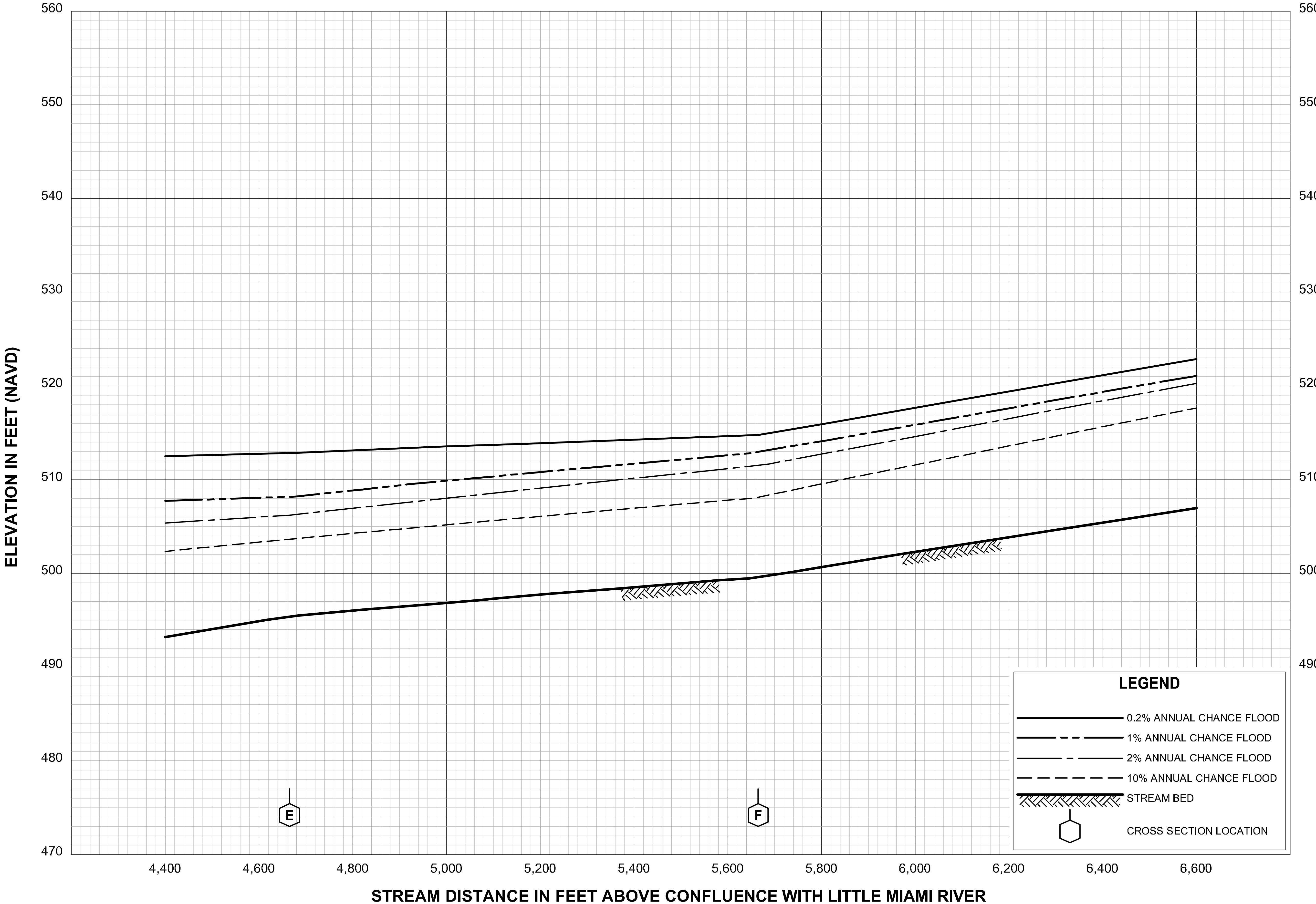
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

003P



FLOOD PROFILES

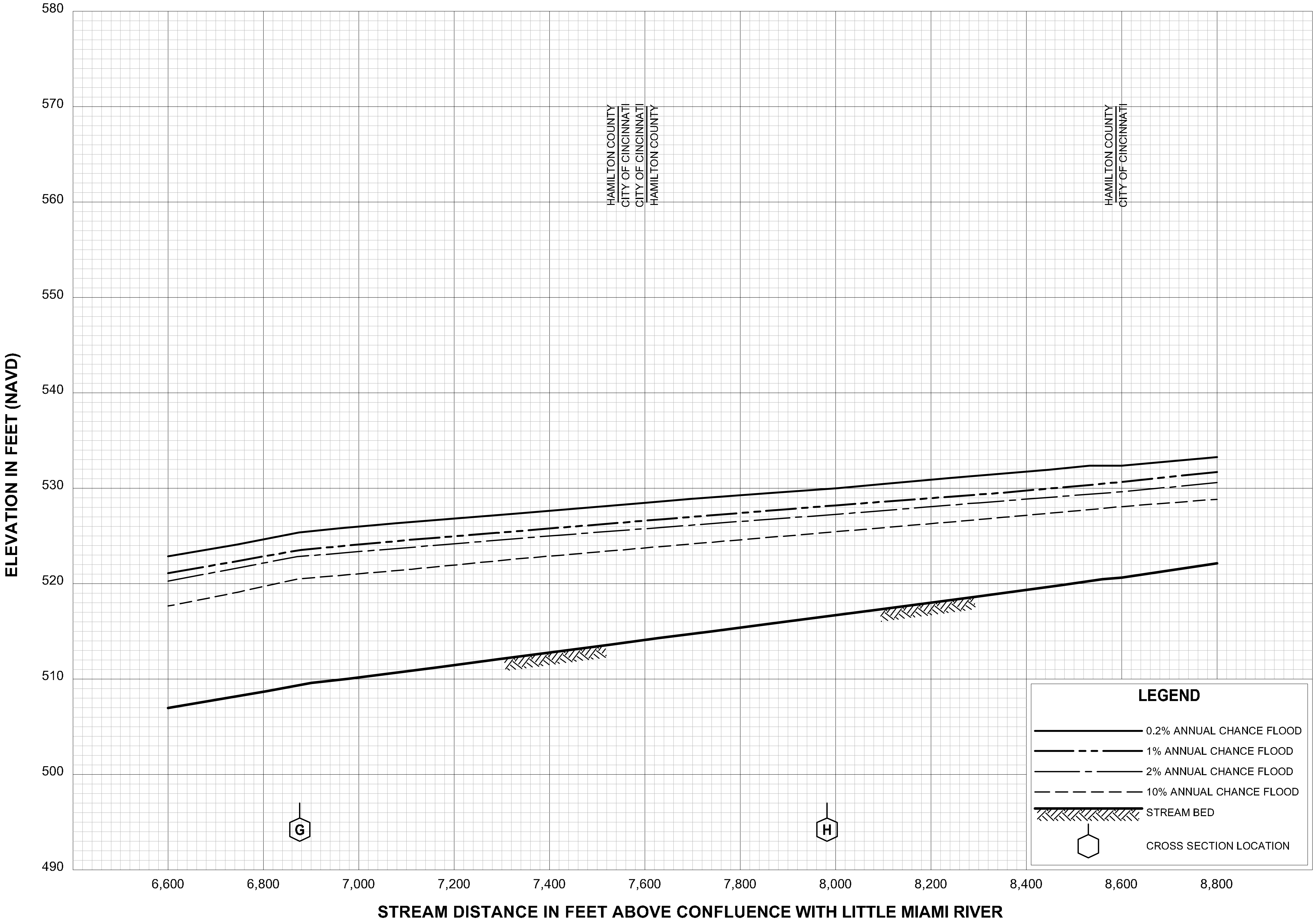
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

004P



FLOOD PROFILES

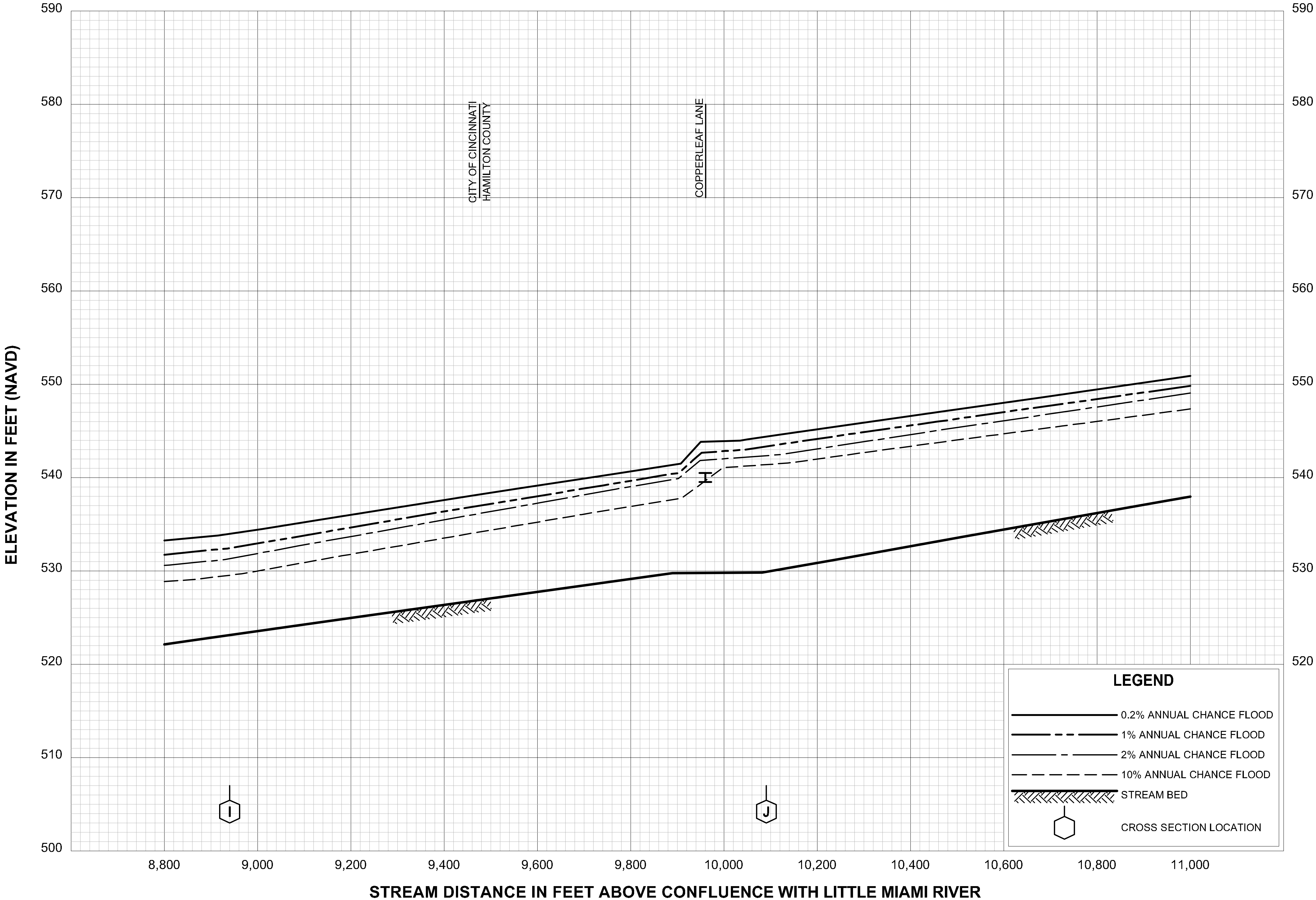
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

005P



FLOOD PROFILES

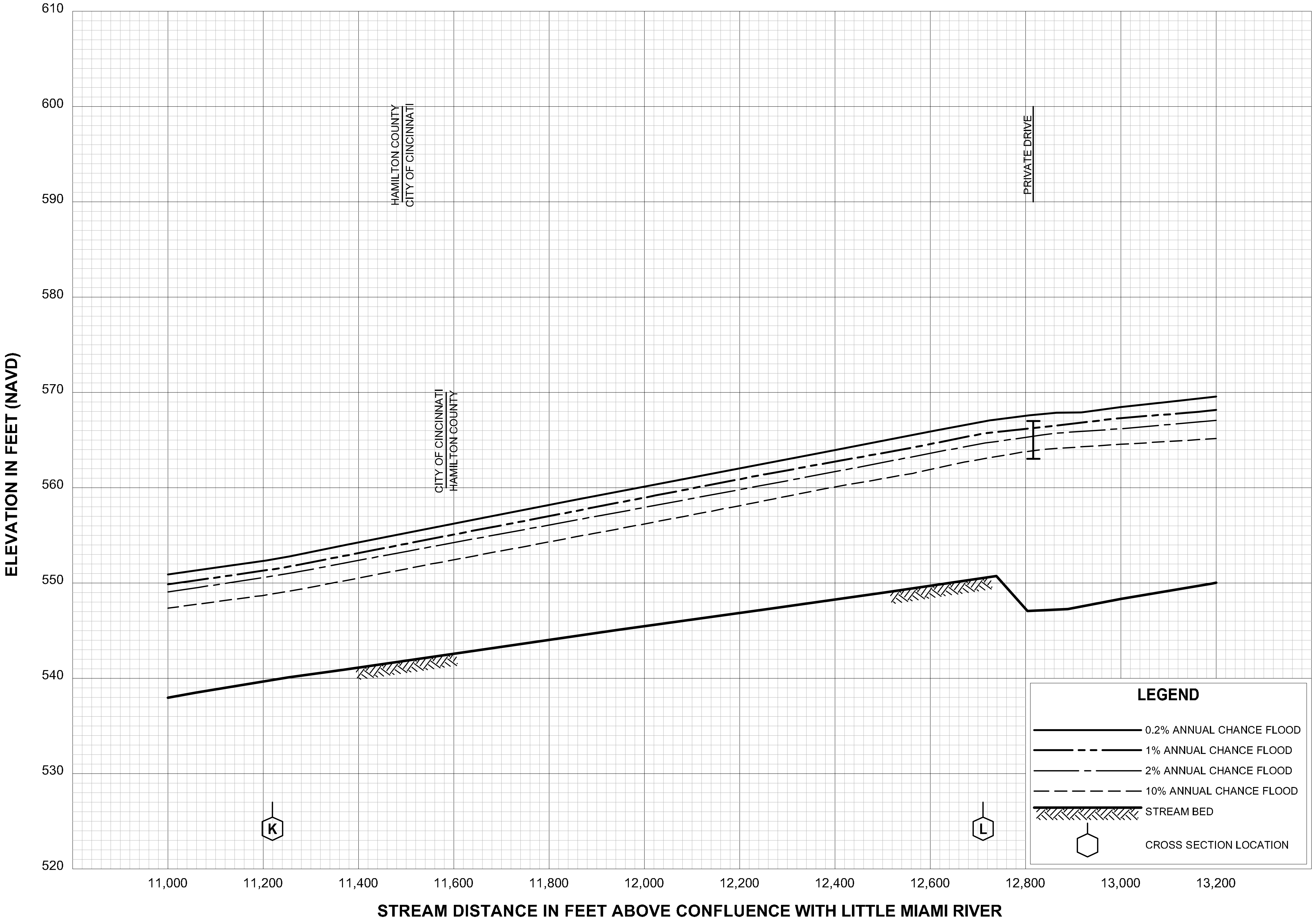
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

006P



FLOOD PROFILES

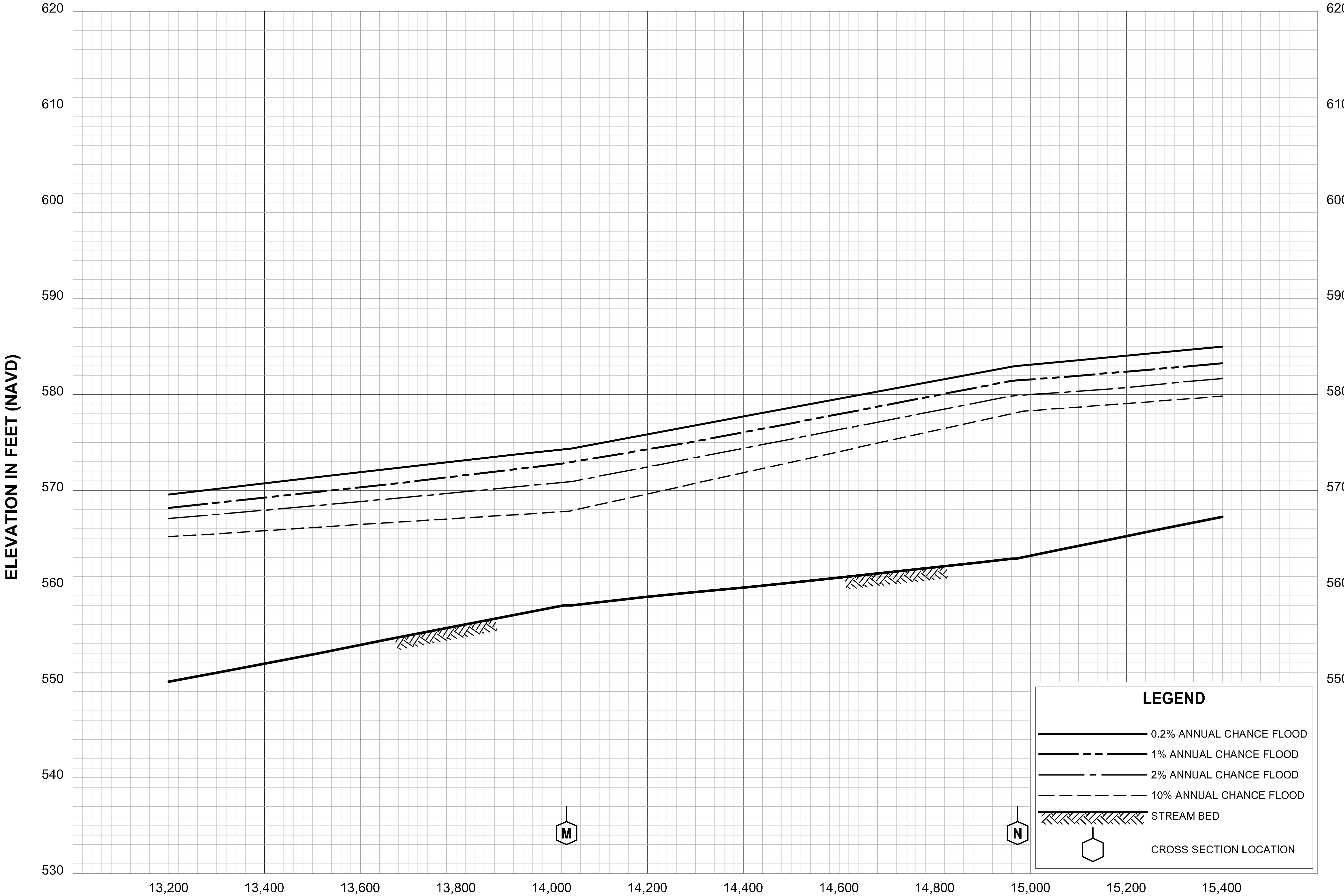
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

007P



STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH LITTLE MIAMI RIVER

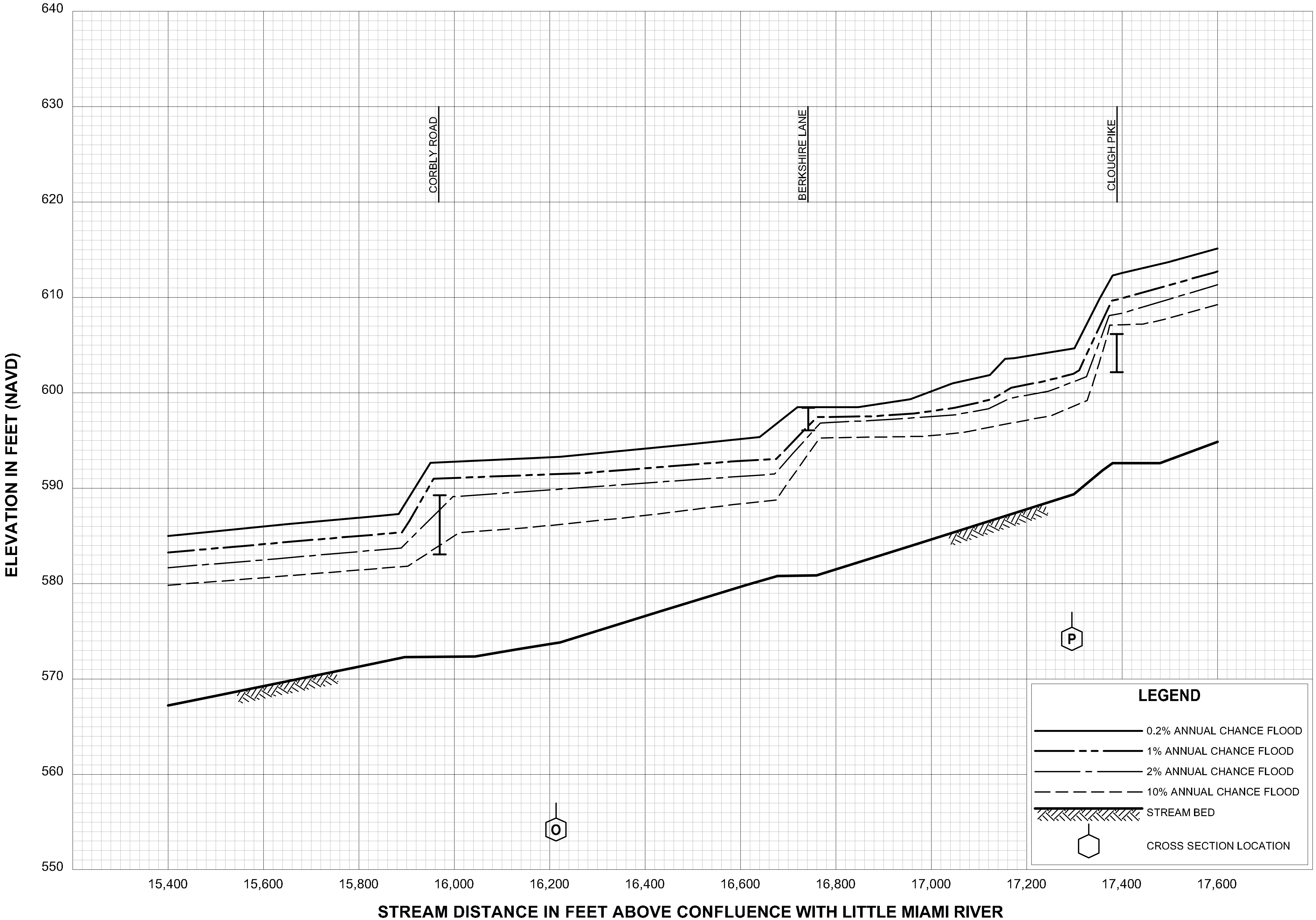
FLOOD PROFILES

CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

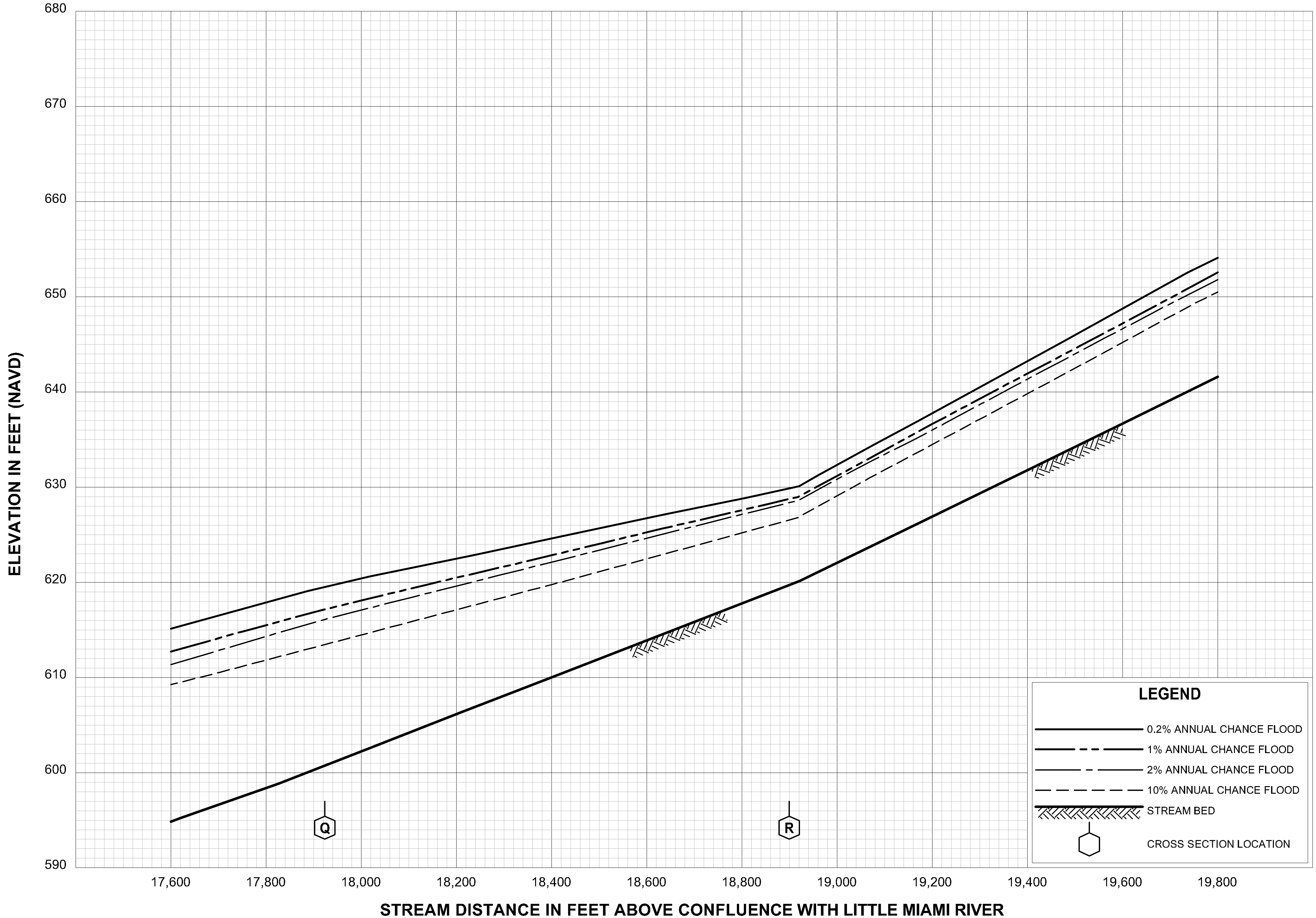
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

009P



FLOOD PROFILES

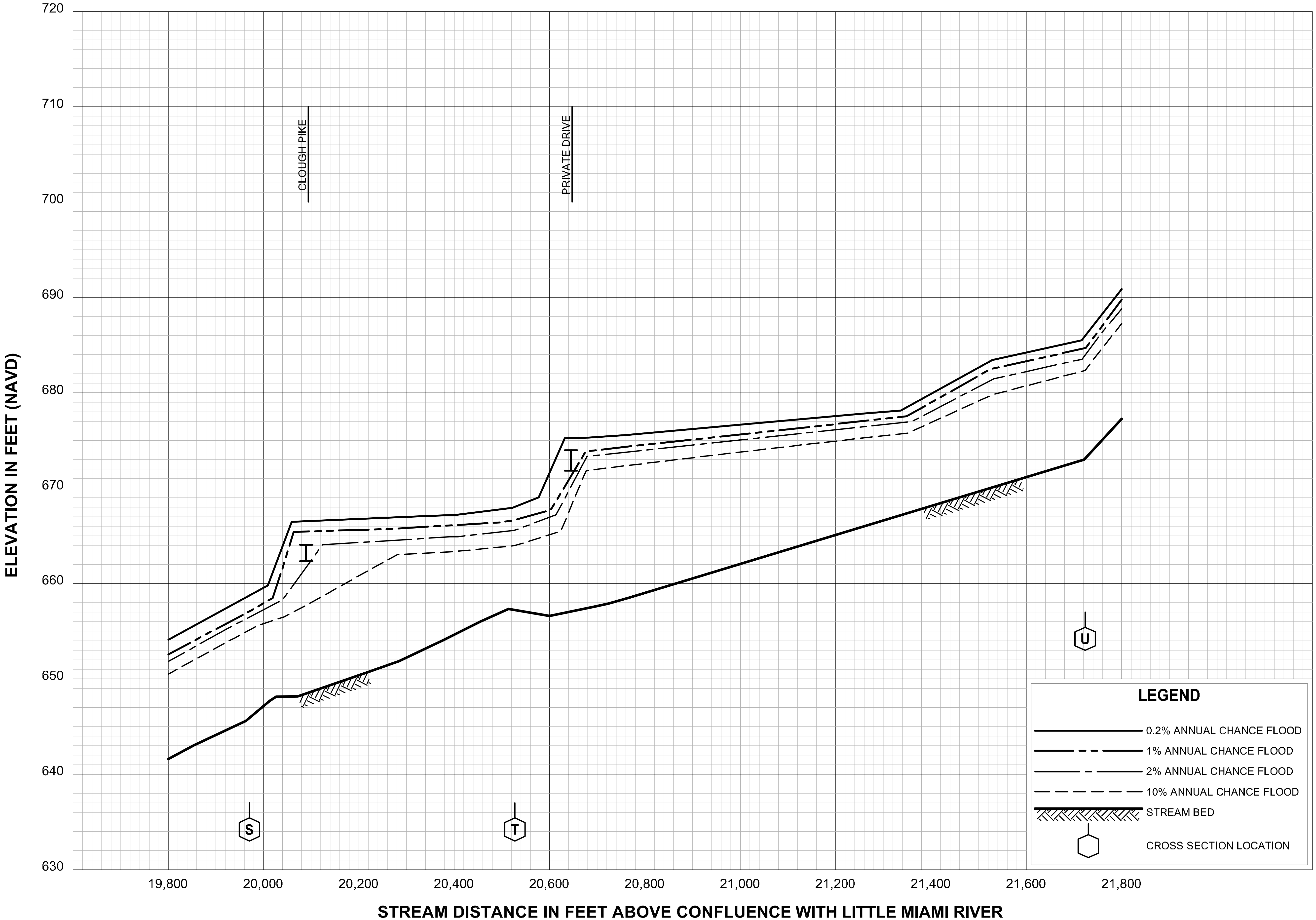
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

010P



FLOOD PROFILES

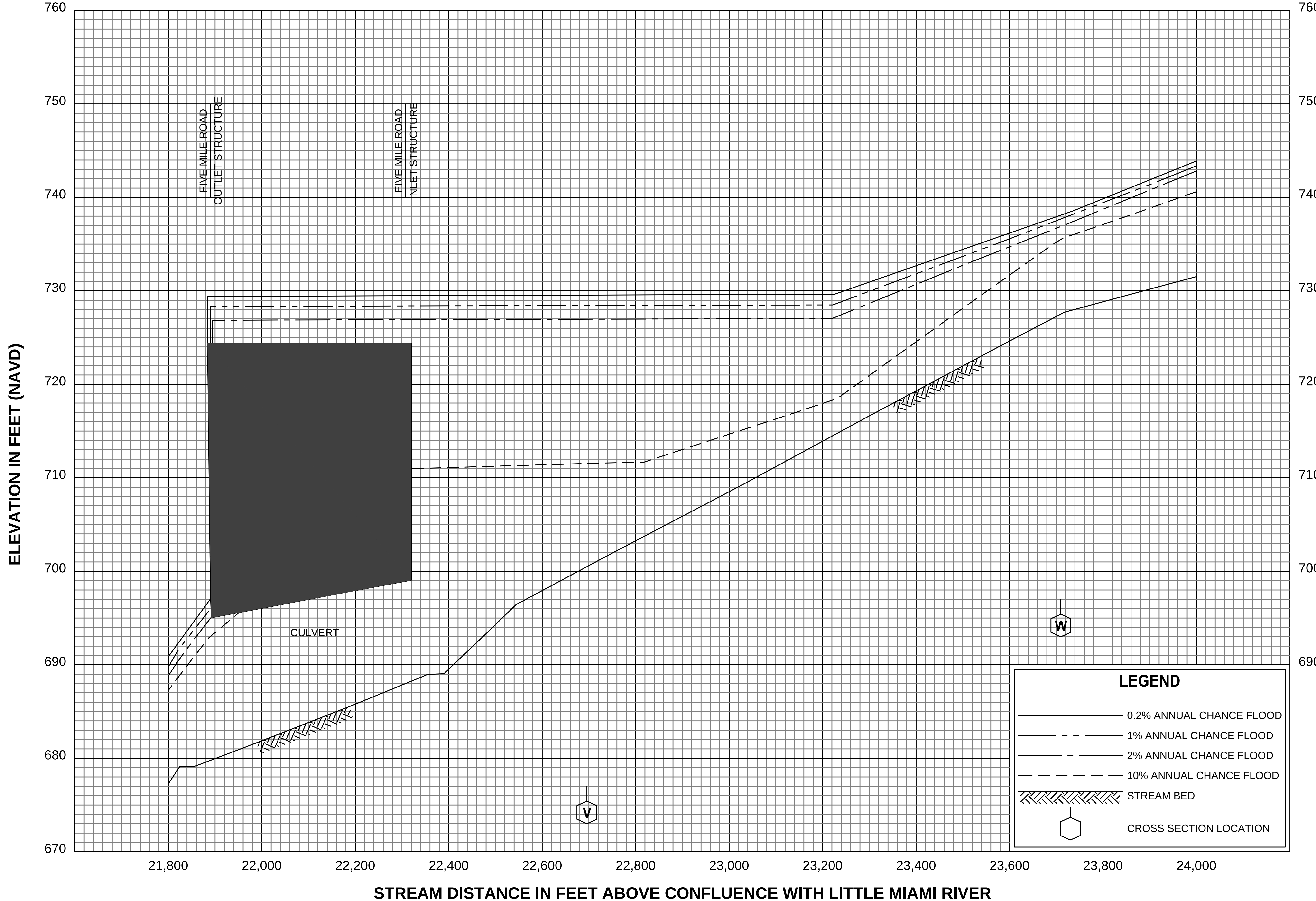
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

011P



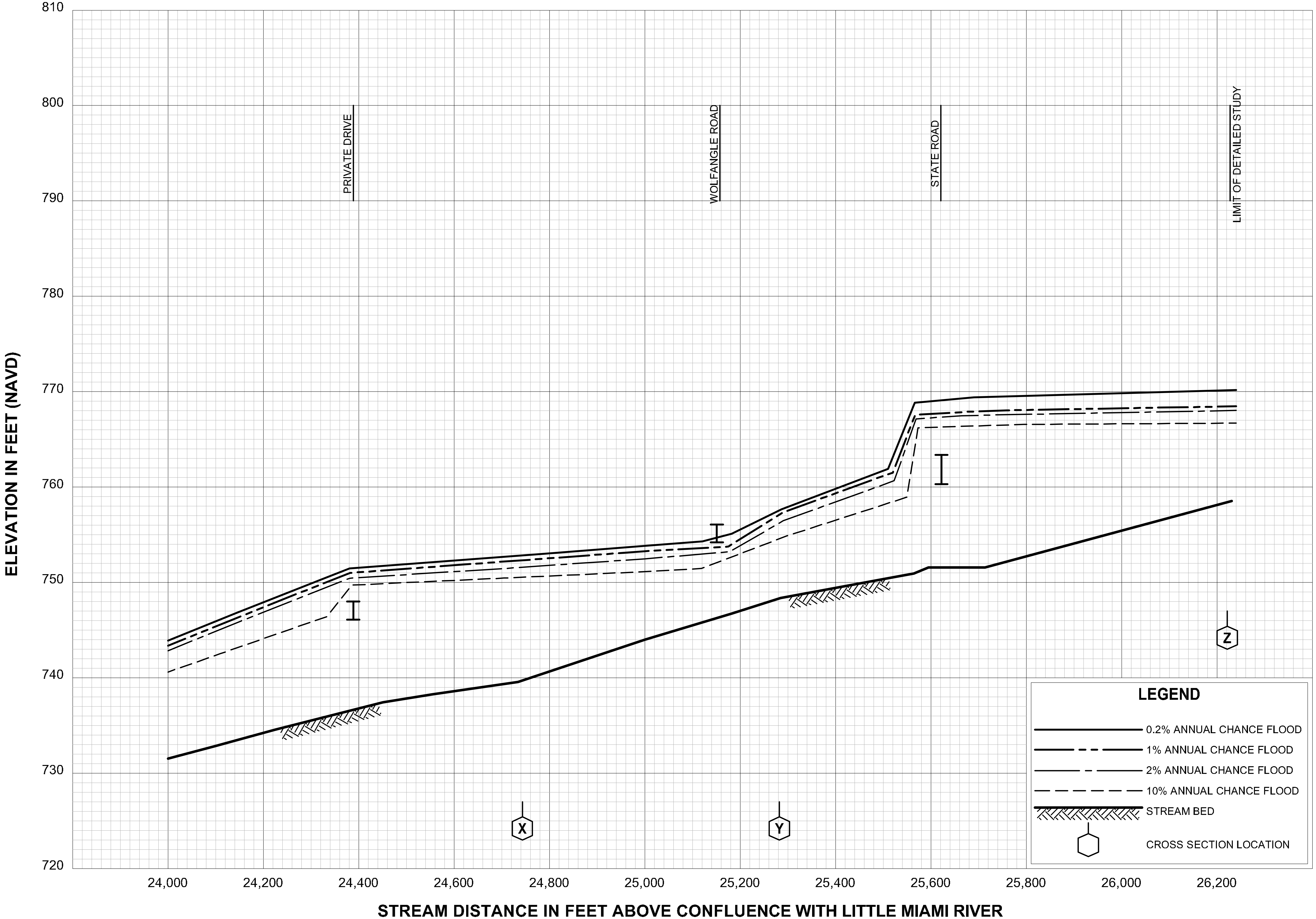
FLOOD PROFILES

CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

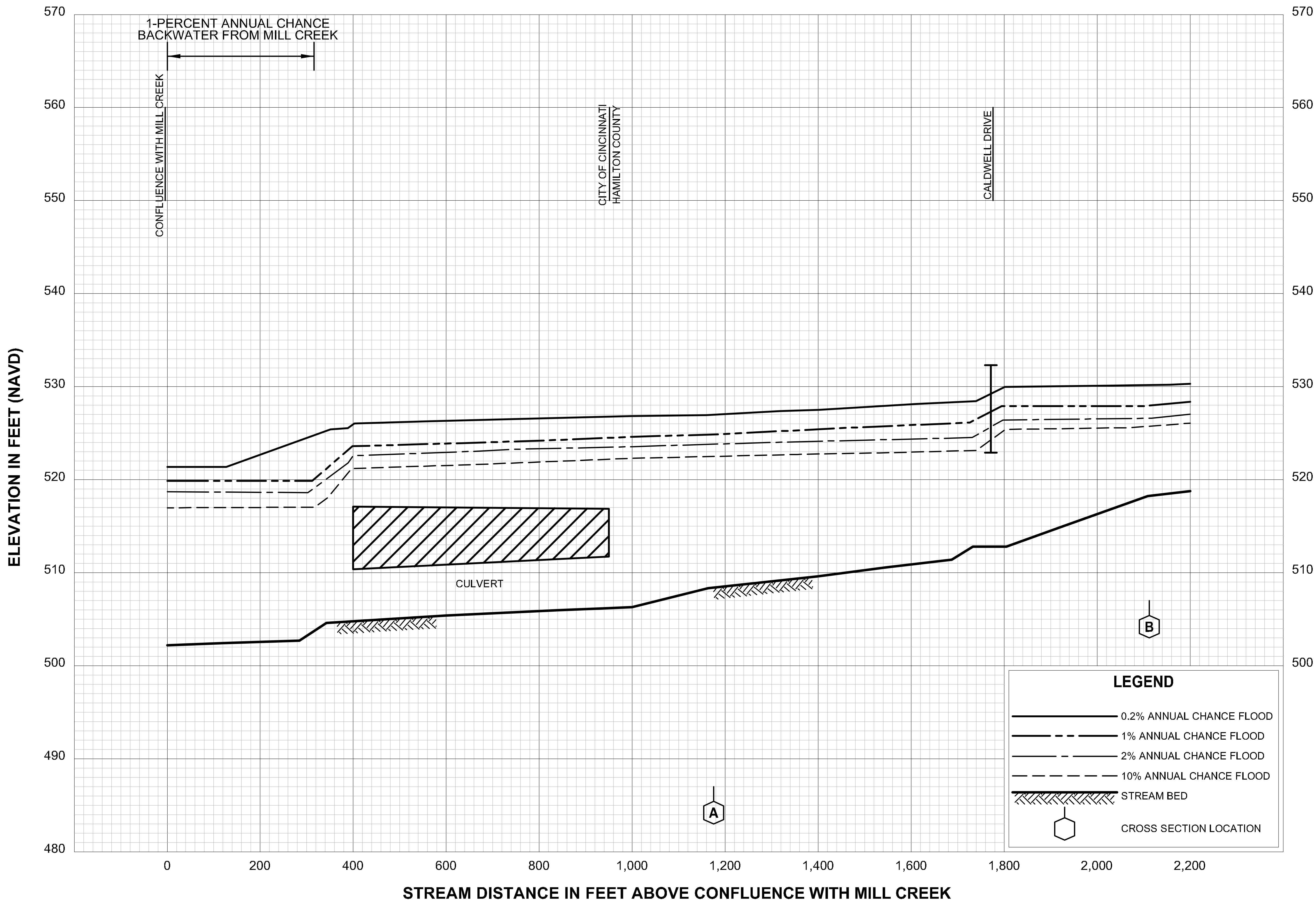
CLOUGH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

013P



FLOOD PROFILES

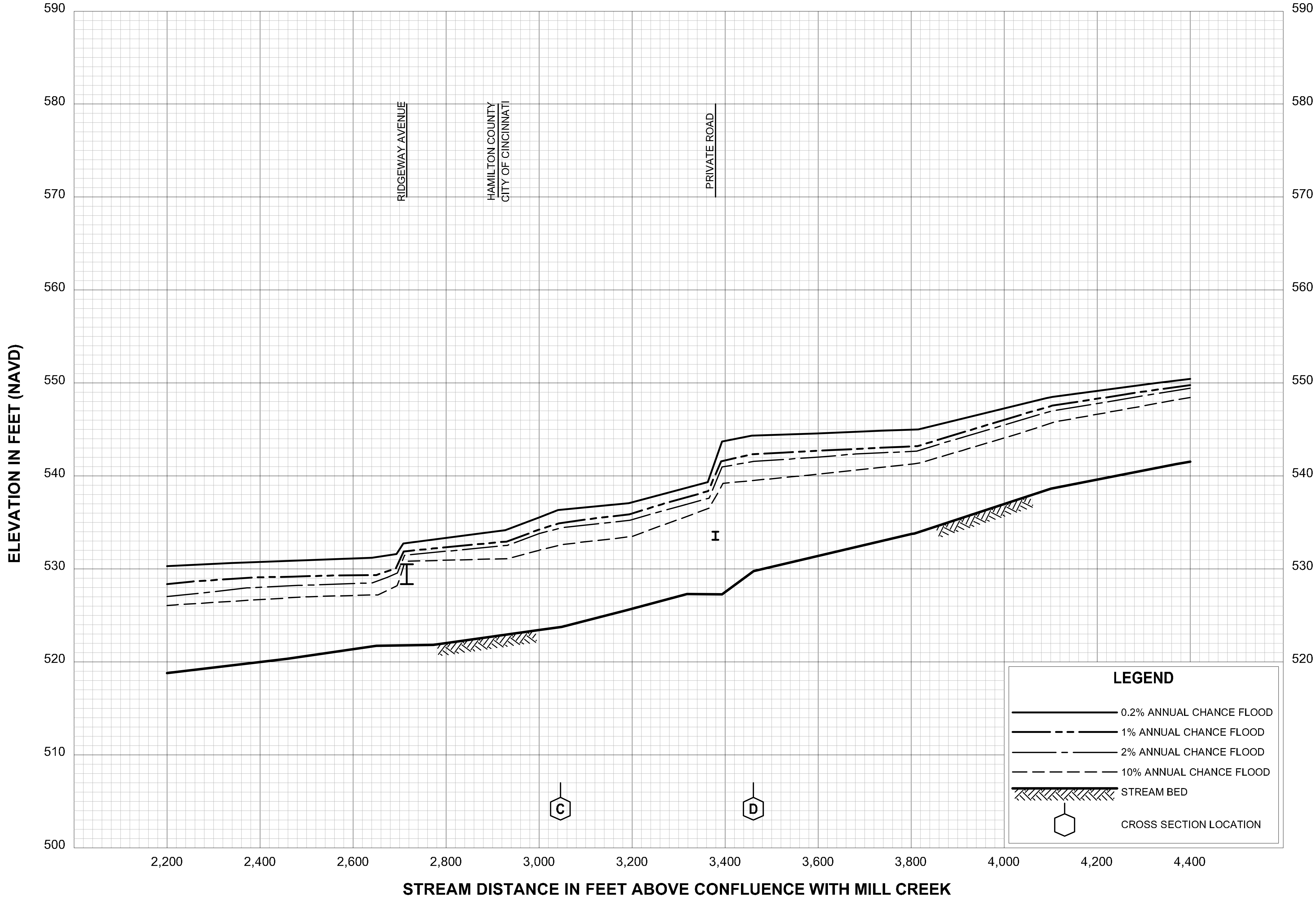
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

014P



FLOOD PROFILES

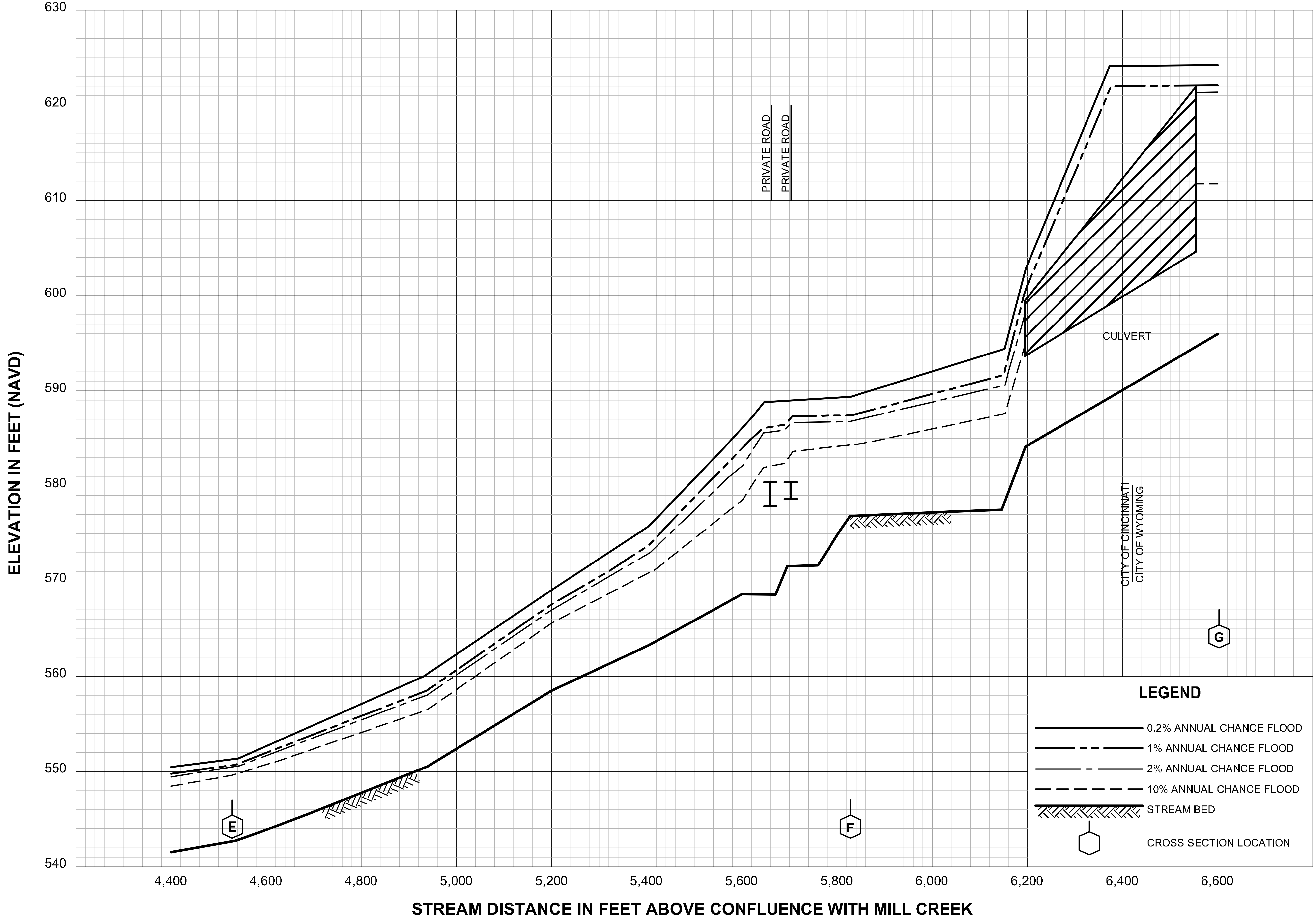
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

015P



FLOOD PROFILES

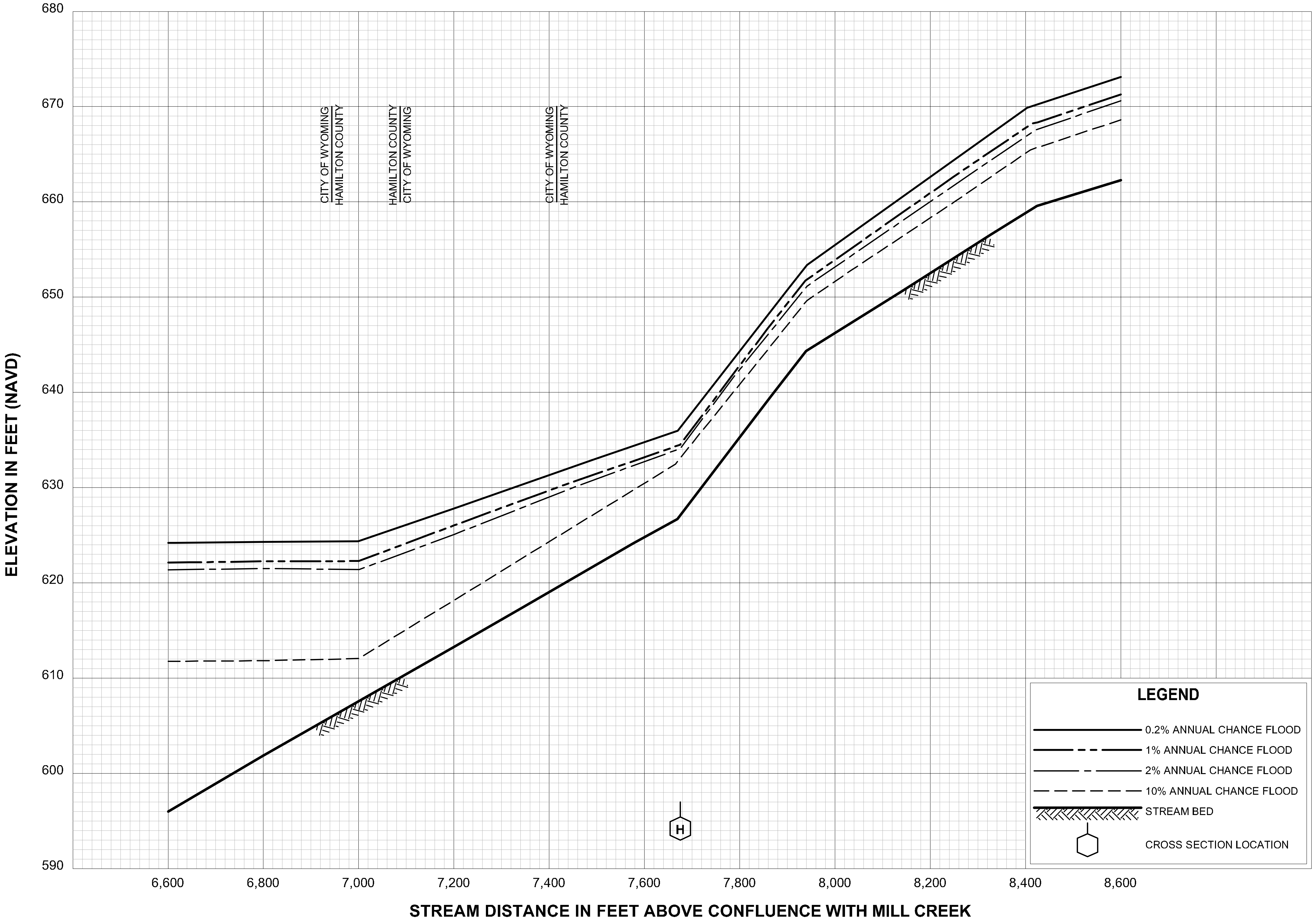
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

016P



FLOOD PROFILES

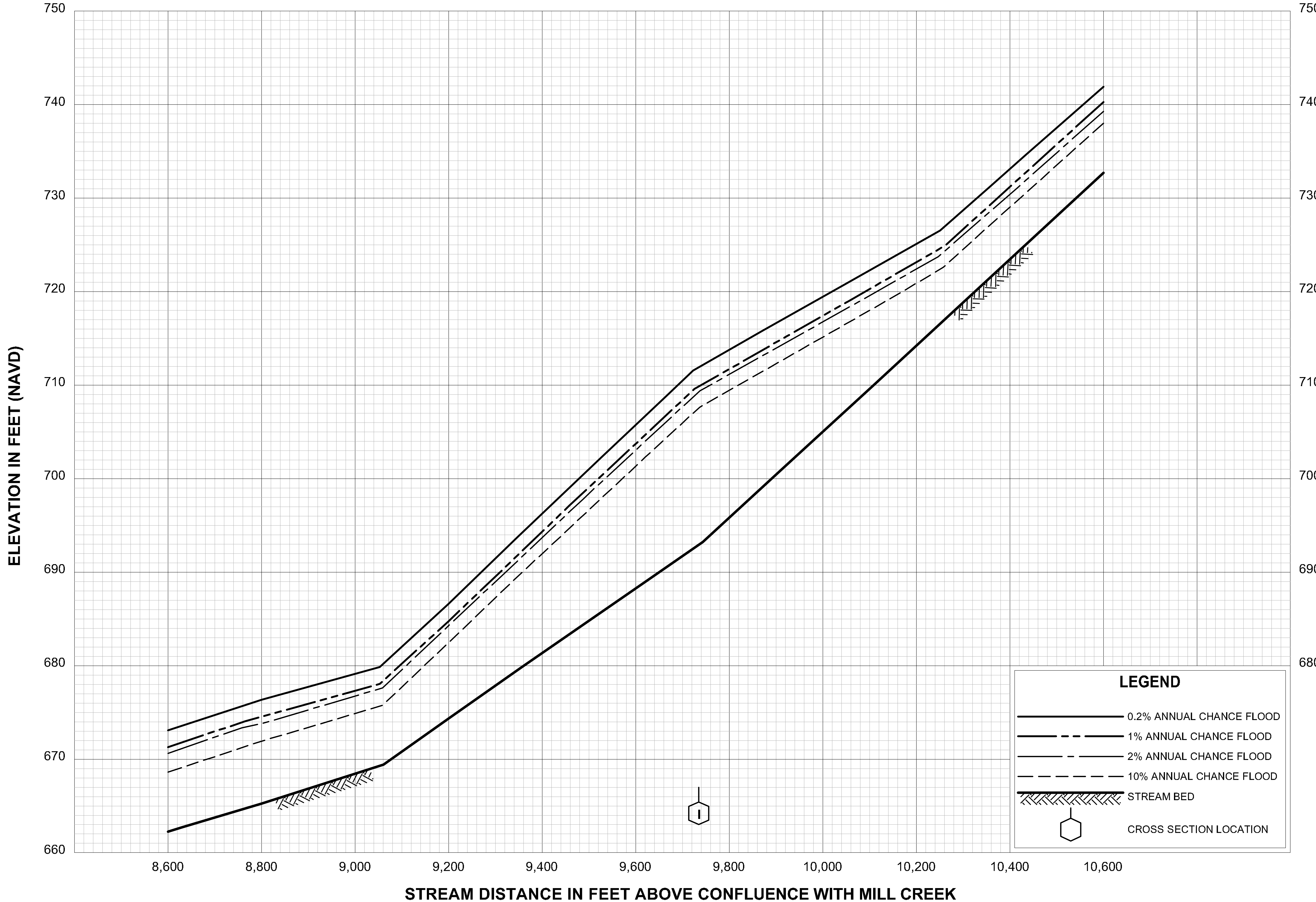
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

017P



FLOOD PROFILES

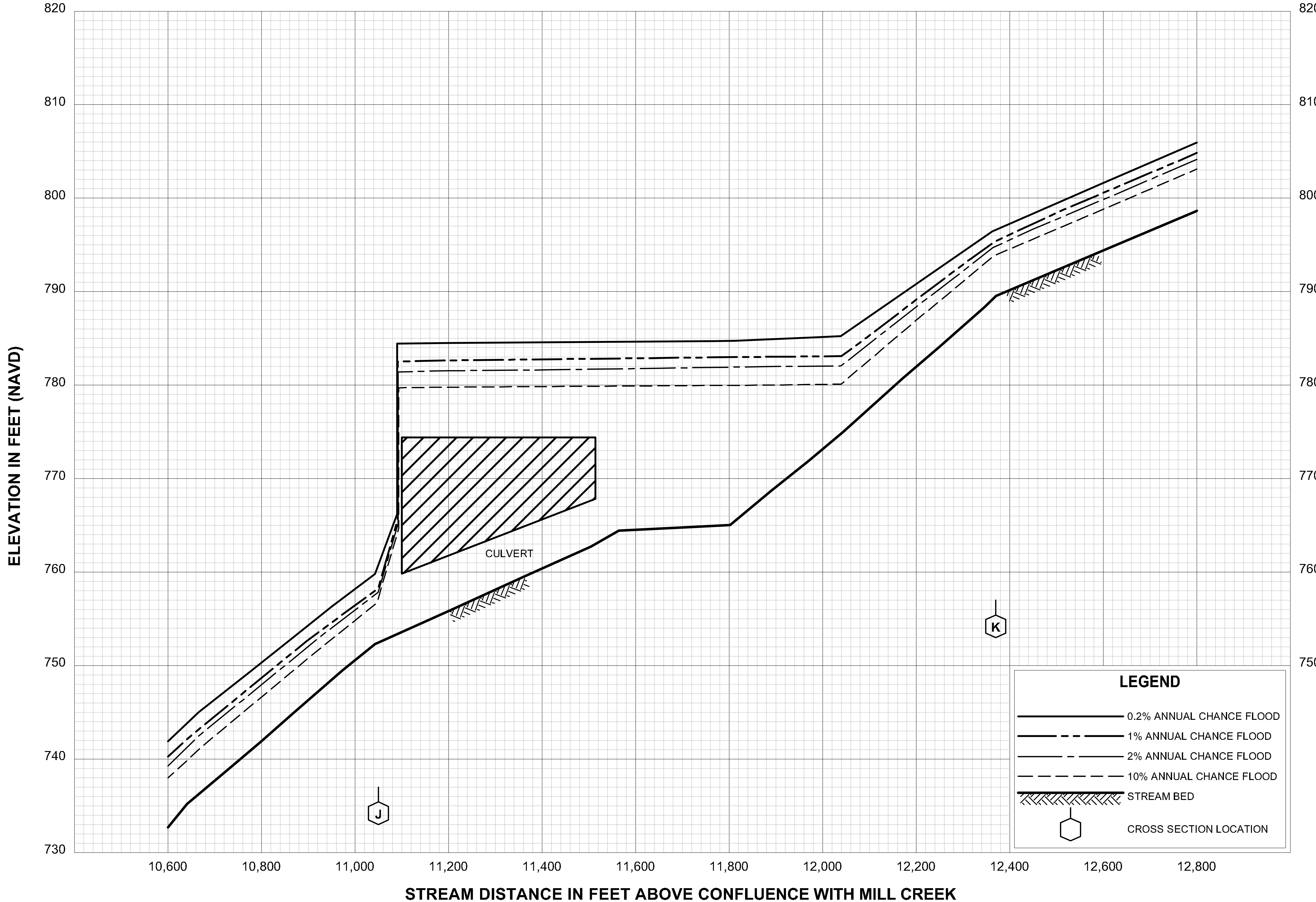
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

018P



FLOOD PROFILES

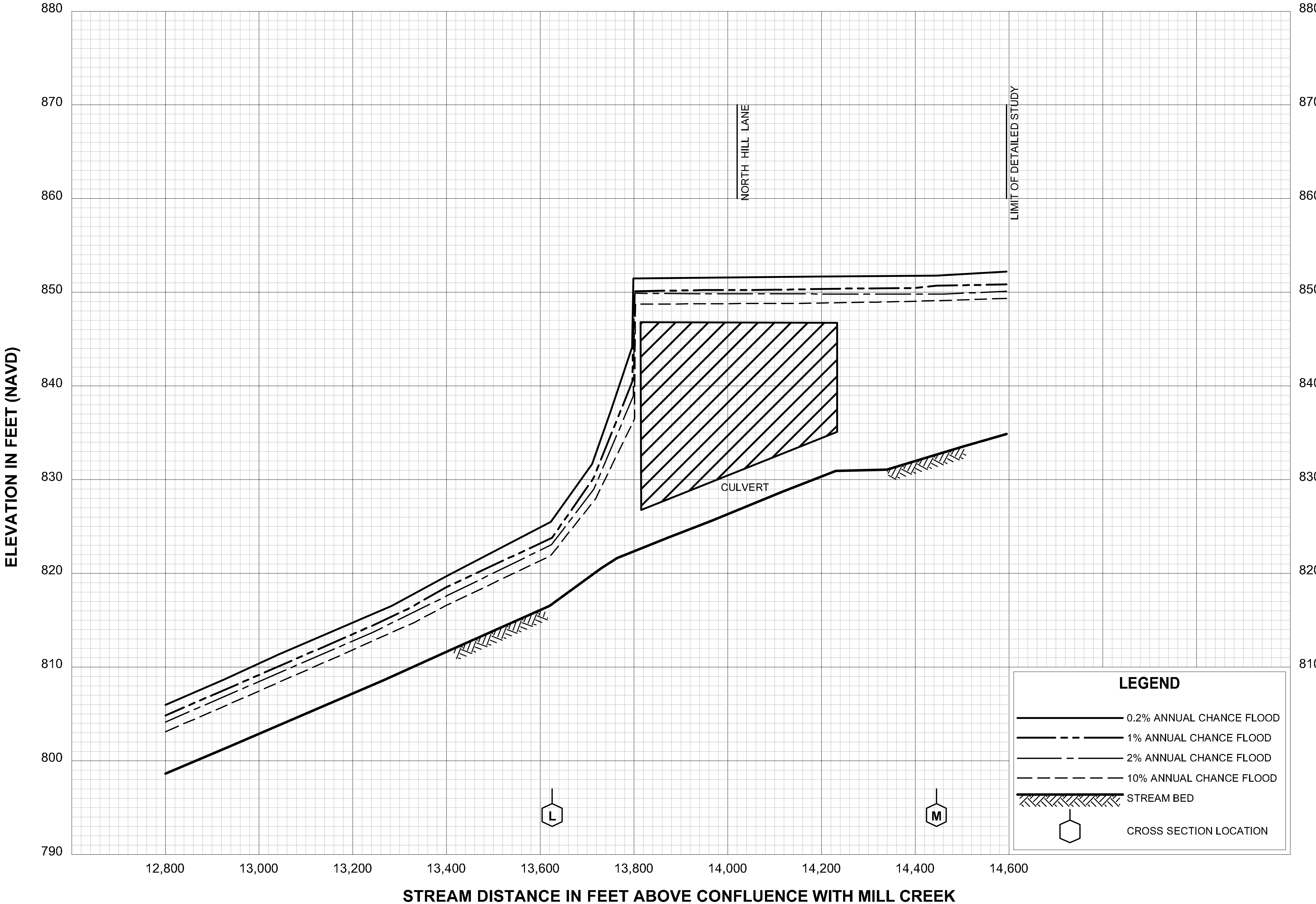
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

019P



FLOOD PROFILES

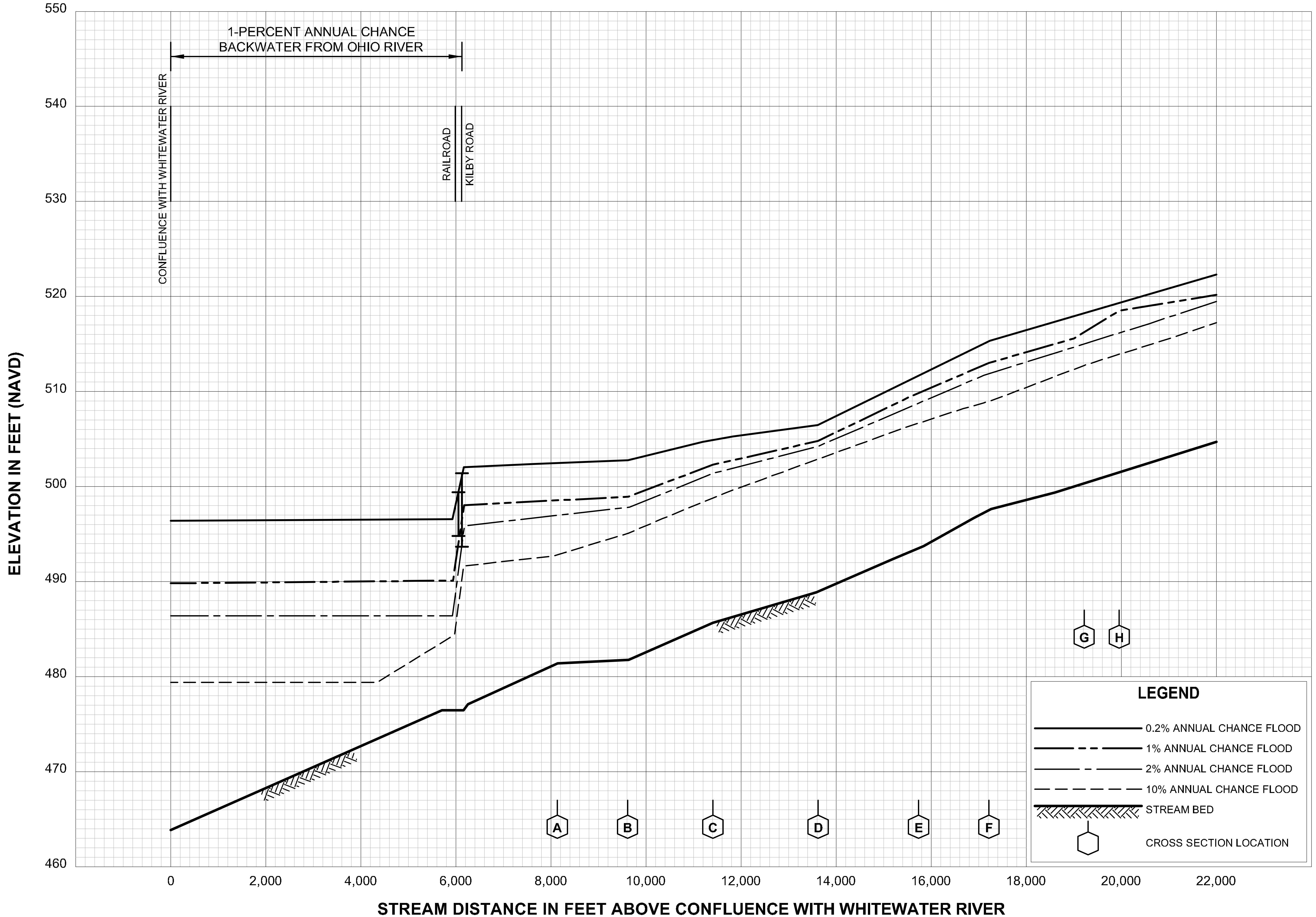
CONGRESS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

020P



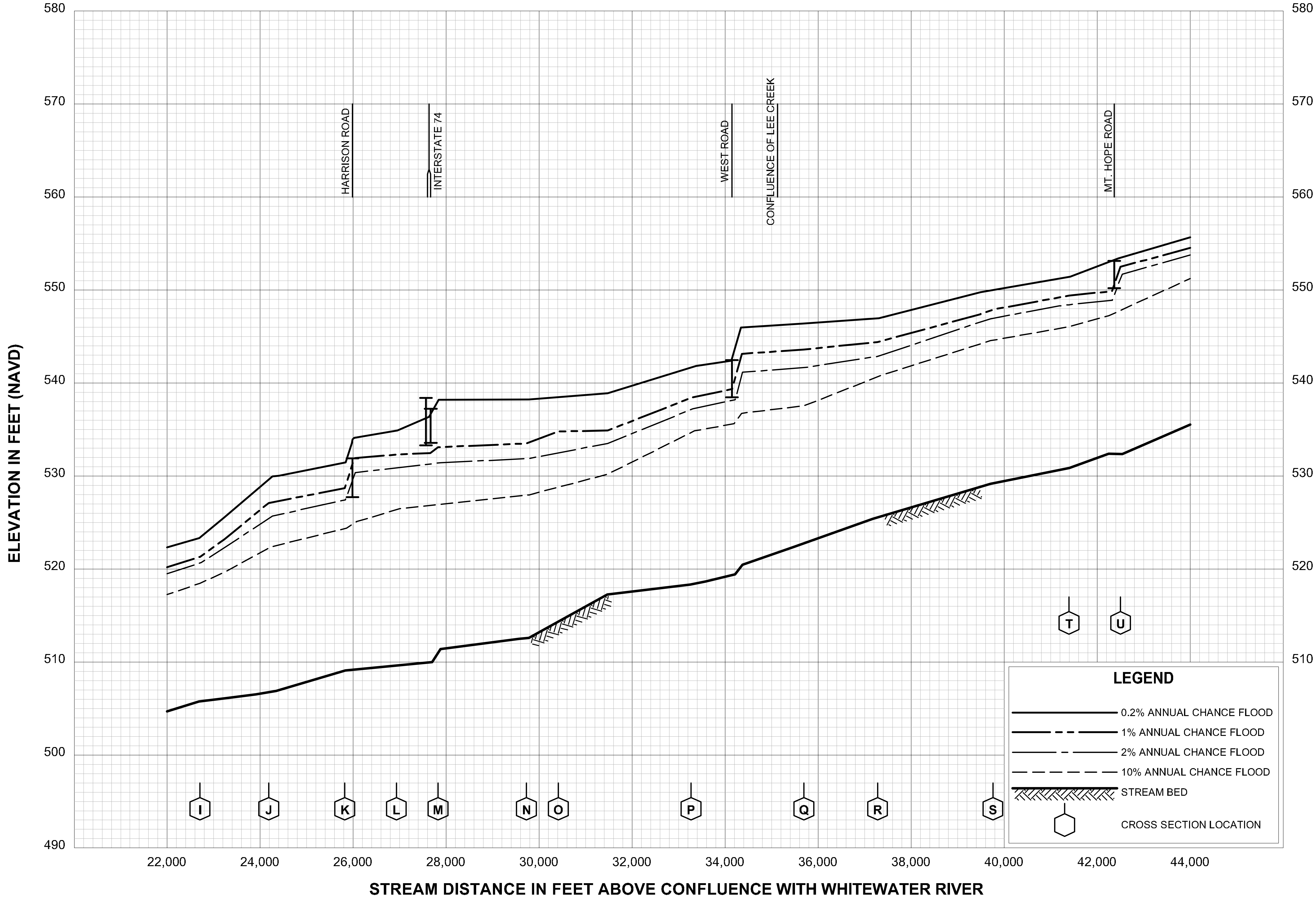
FLOOD PROFILES

DRY FORK OF THE WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



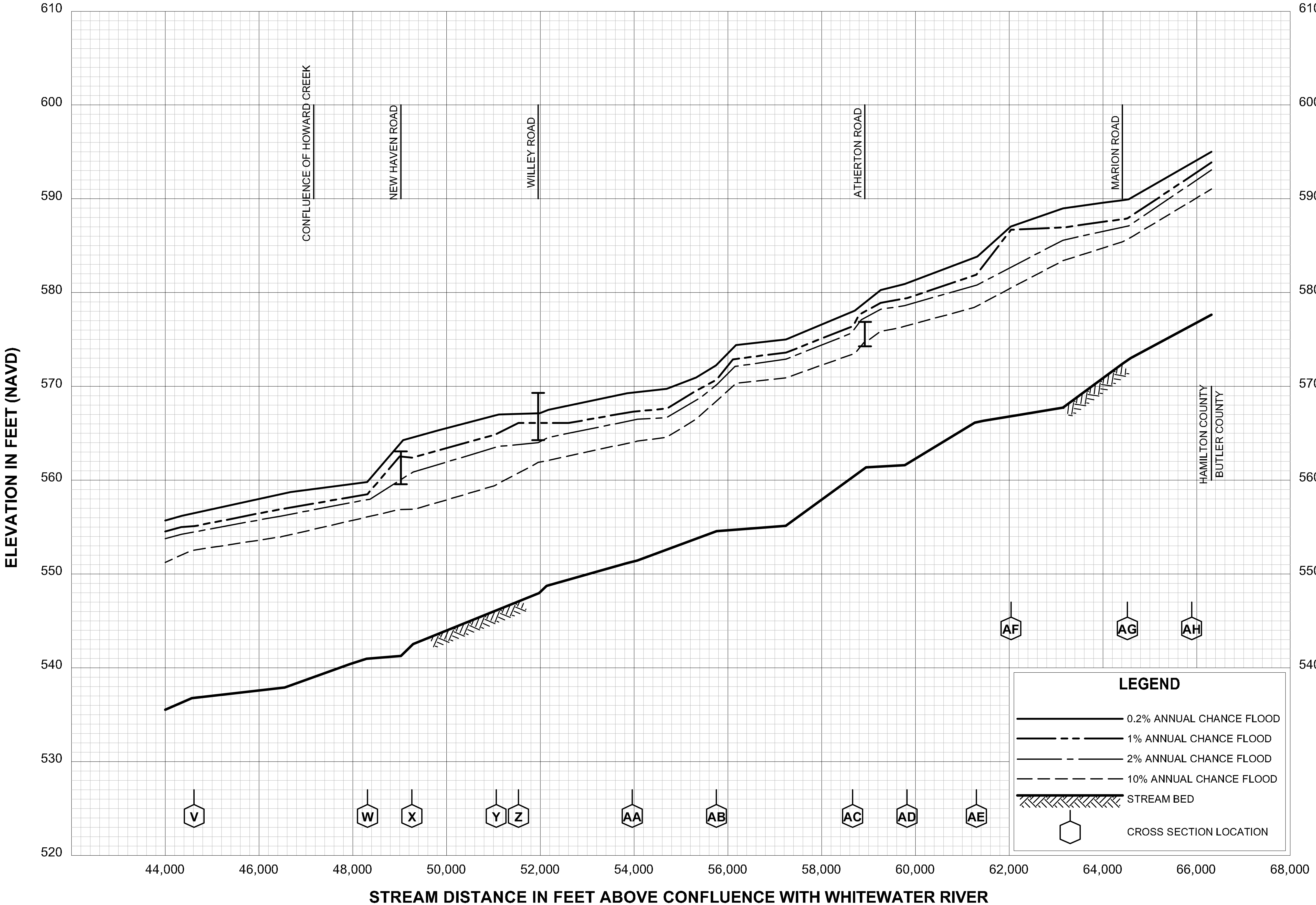
FLOOD PROFILES

DRY FORK OF THE WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



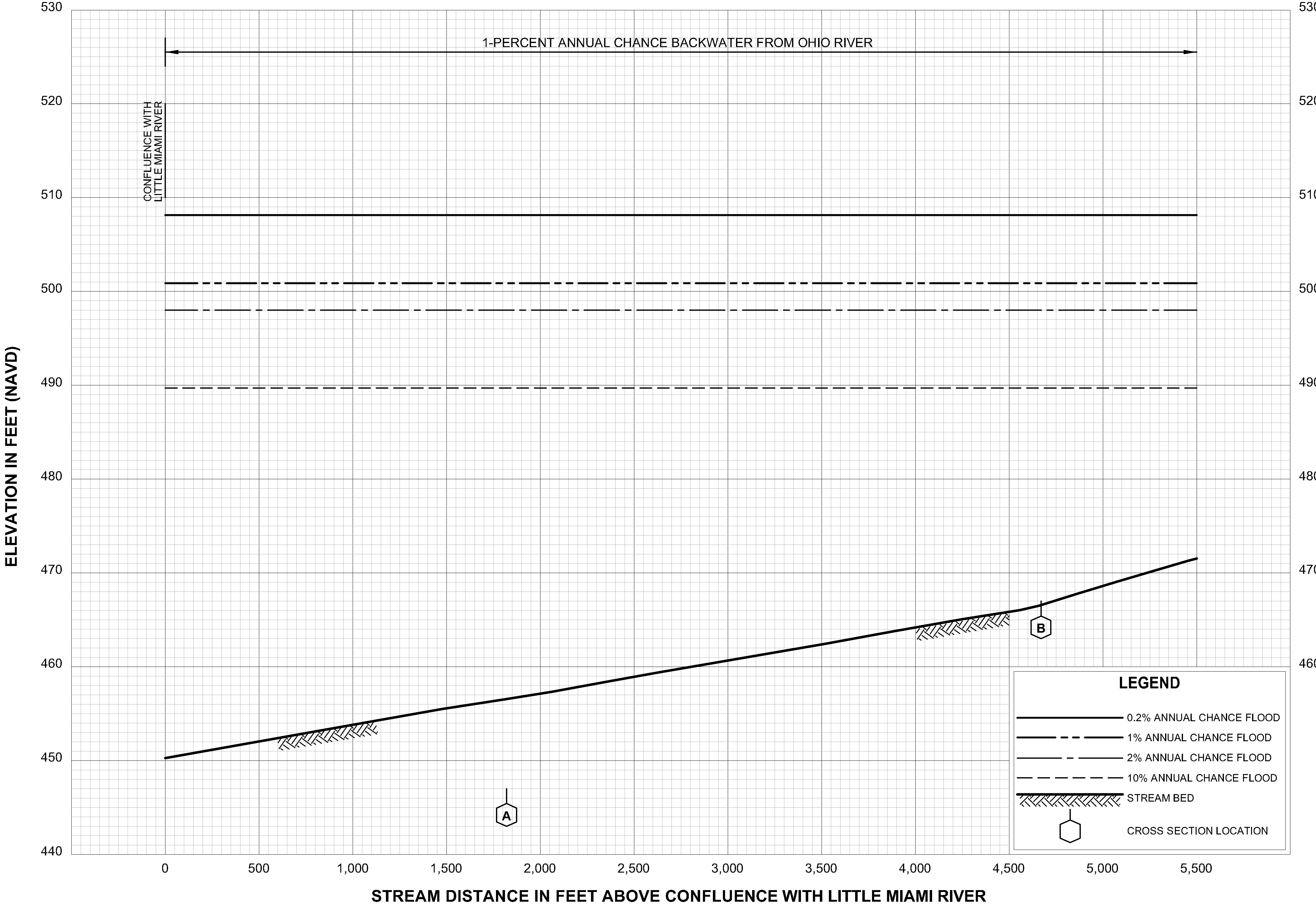
FLOOD PROFILES

DRY FORK OF THE WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



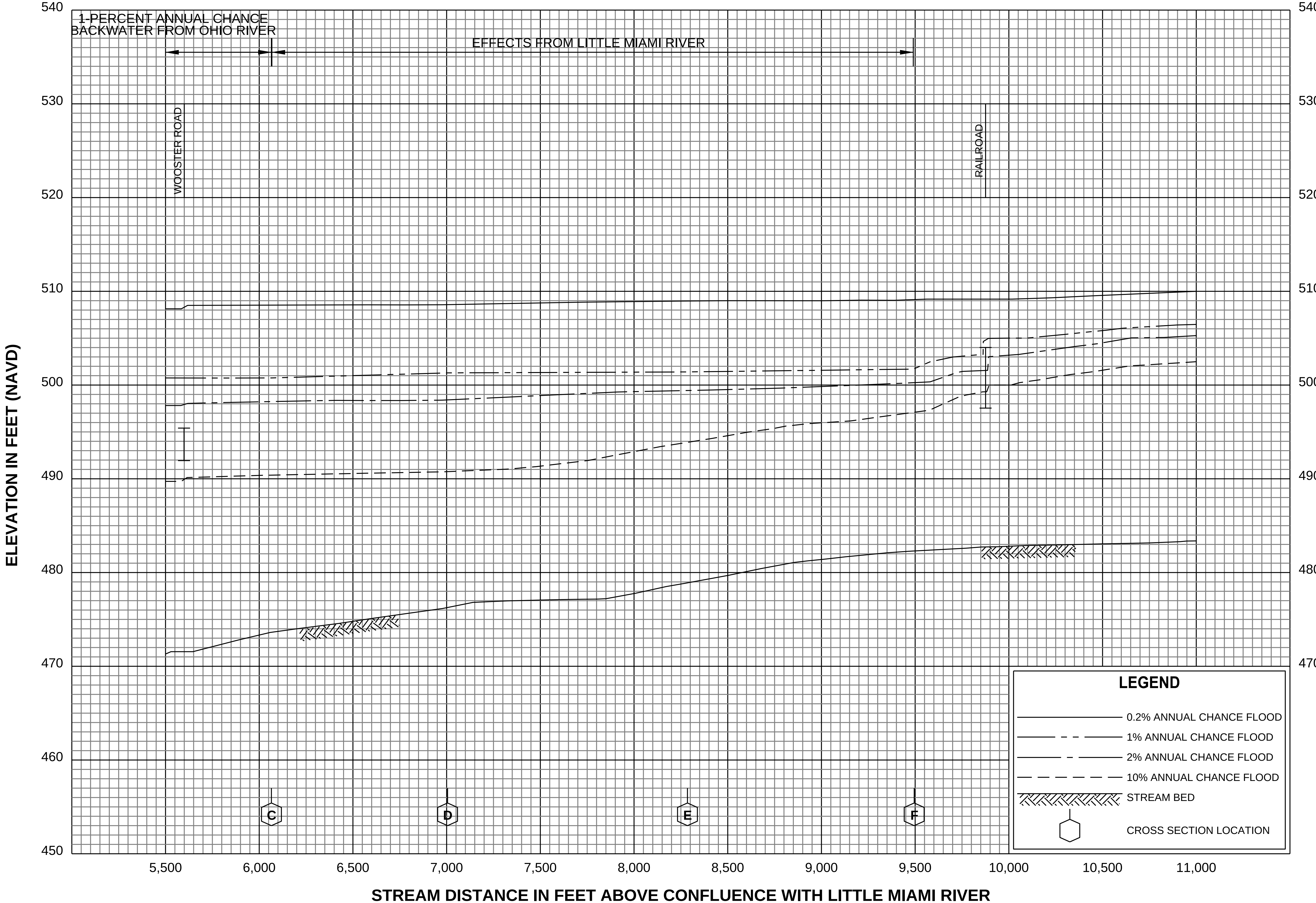
FLOOD PROFILES

DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

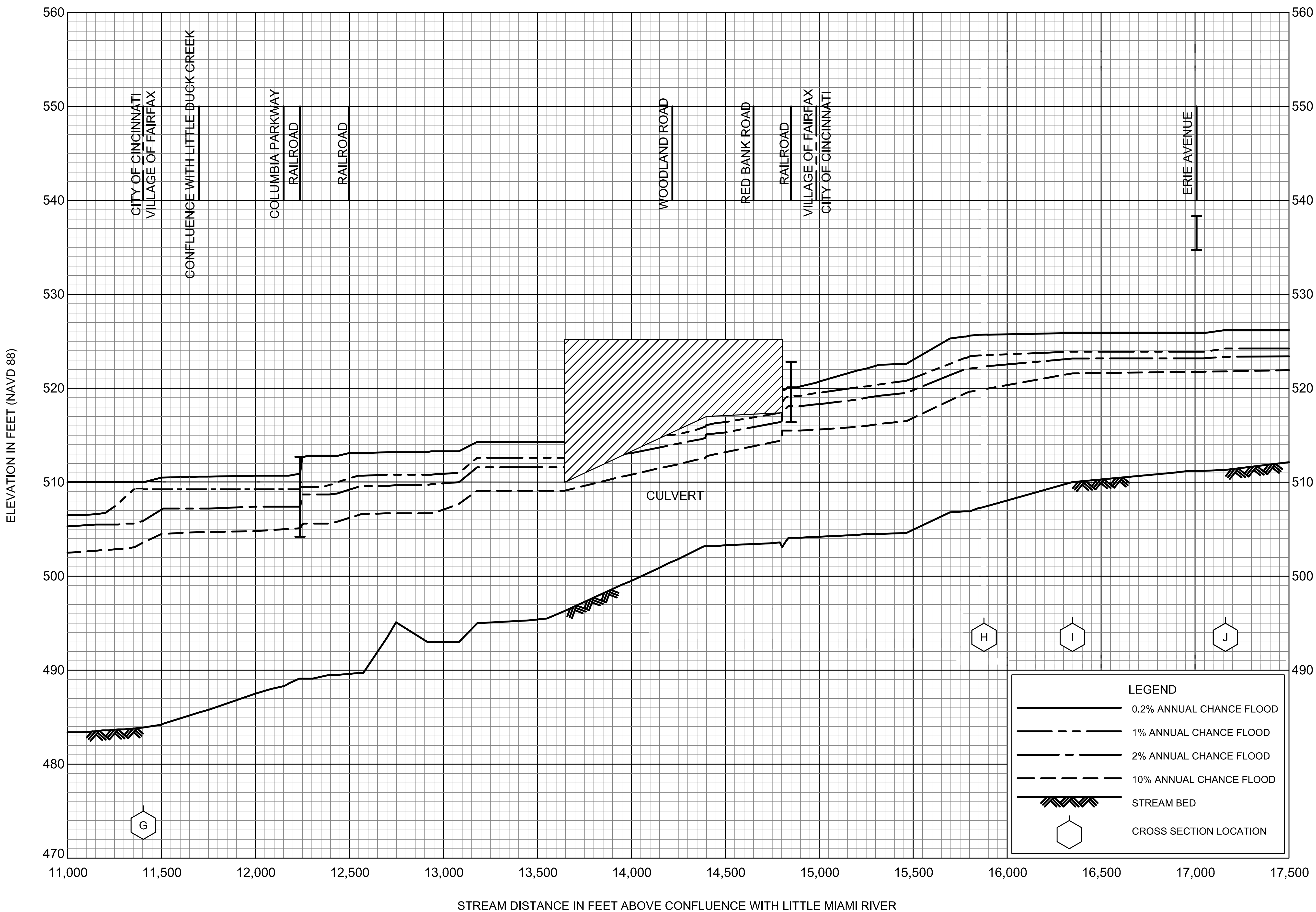
DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

025P



FLOOD PROFILES

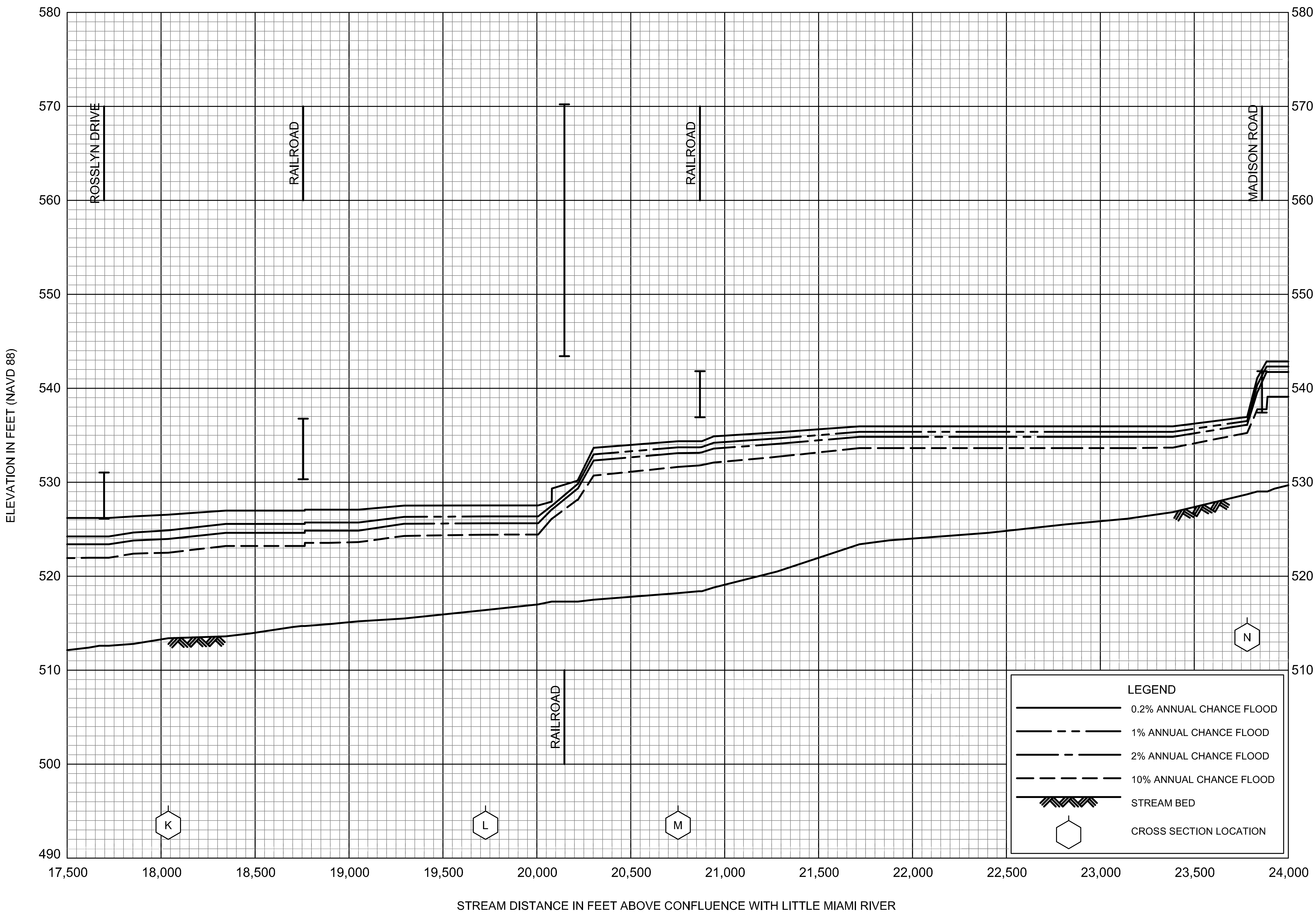
DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

026P



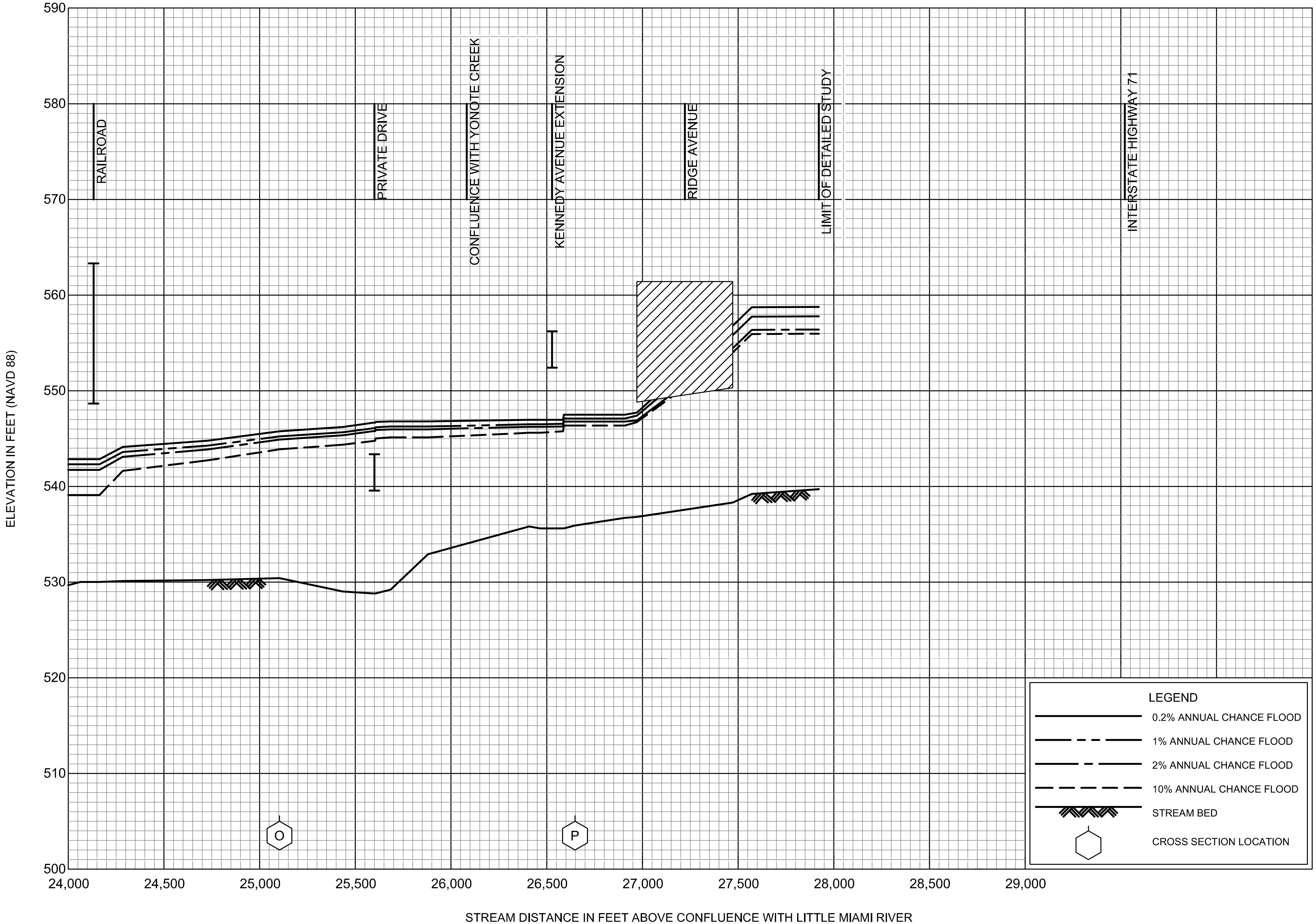
FLOOD PROFILES

DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

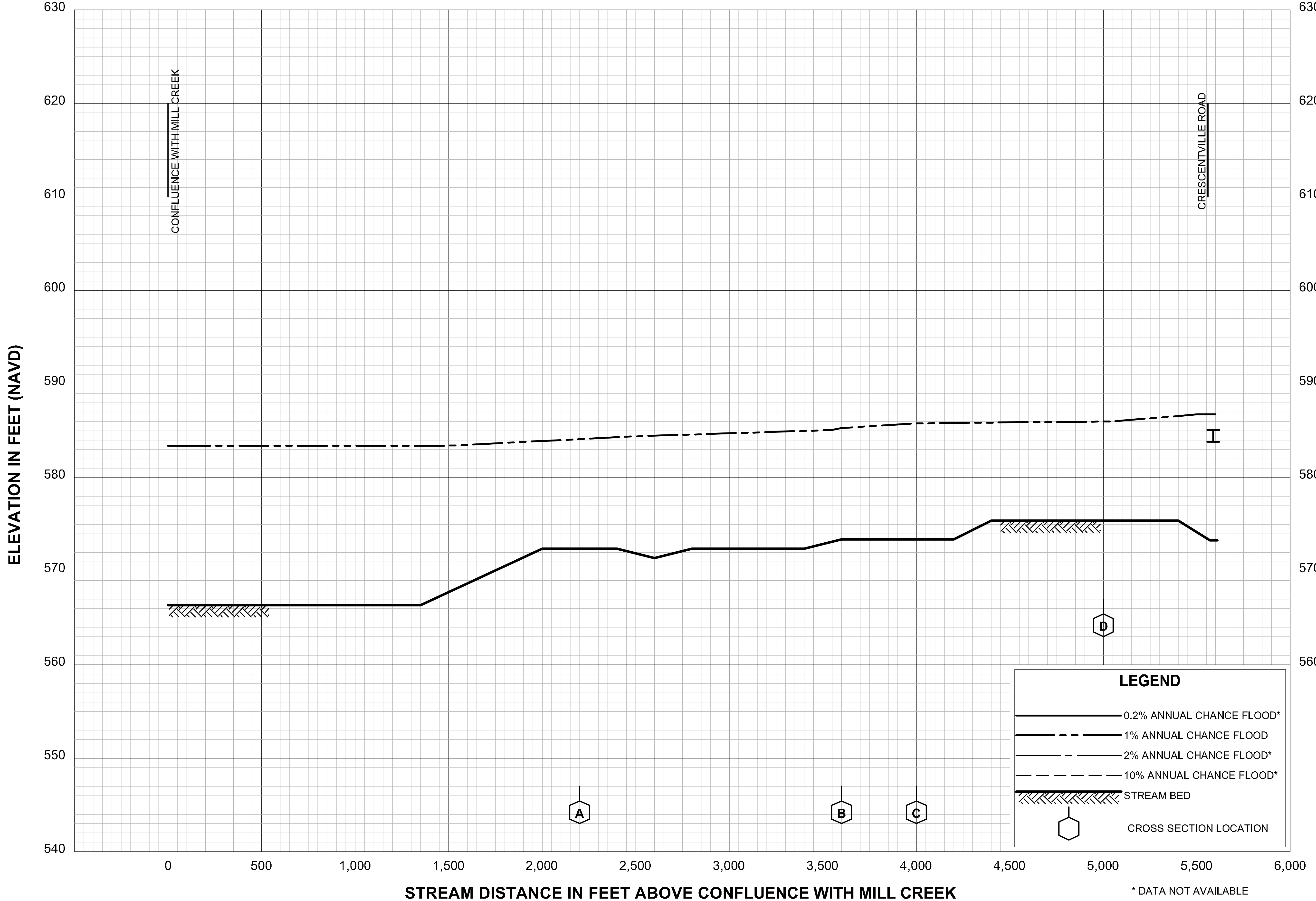
DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

028P



FLOOD PROFILES

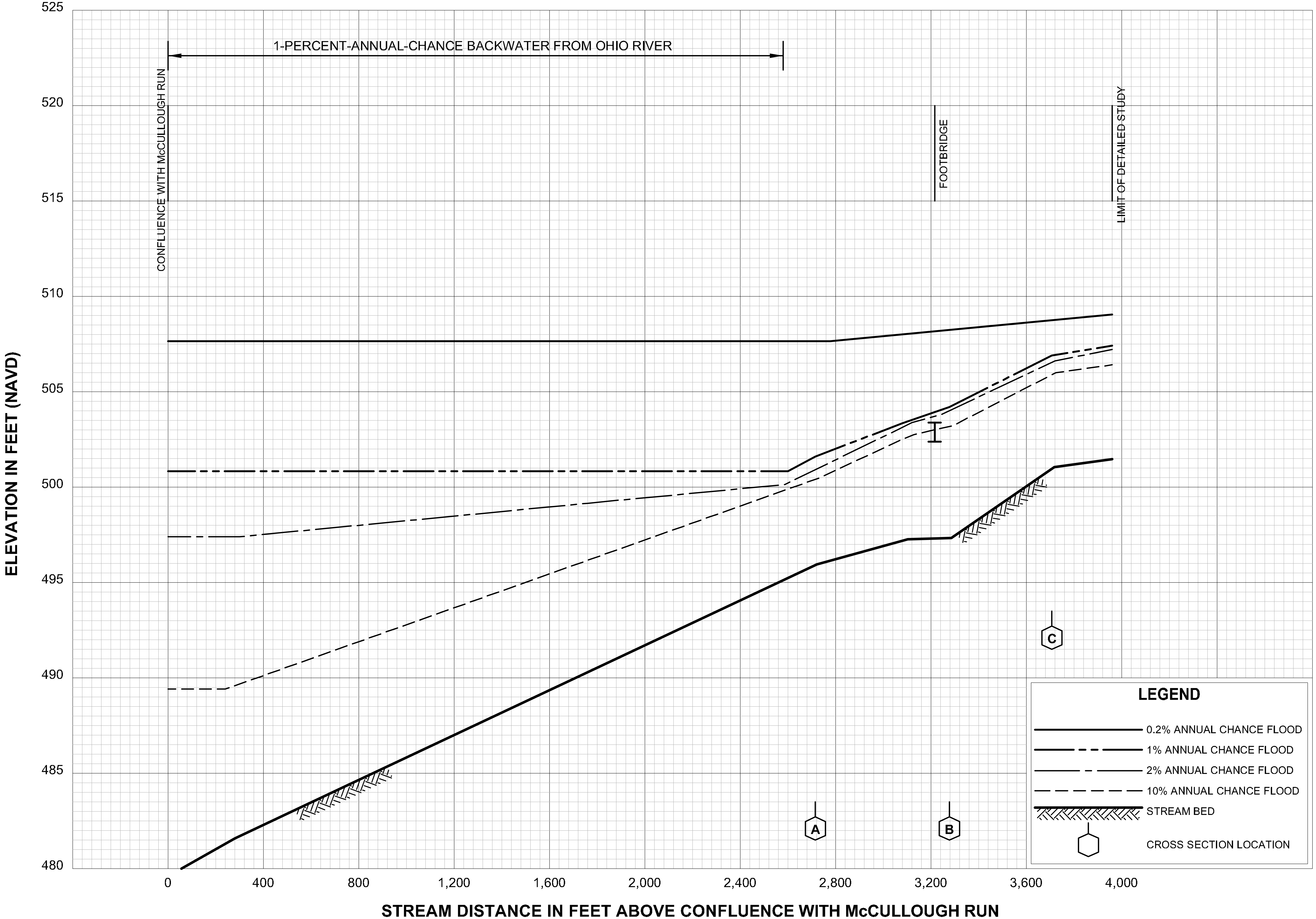
EAST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

029P



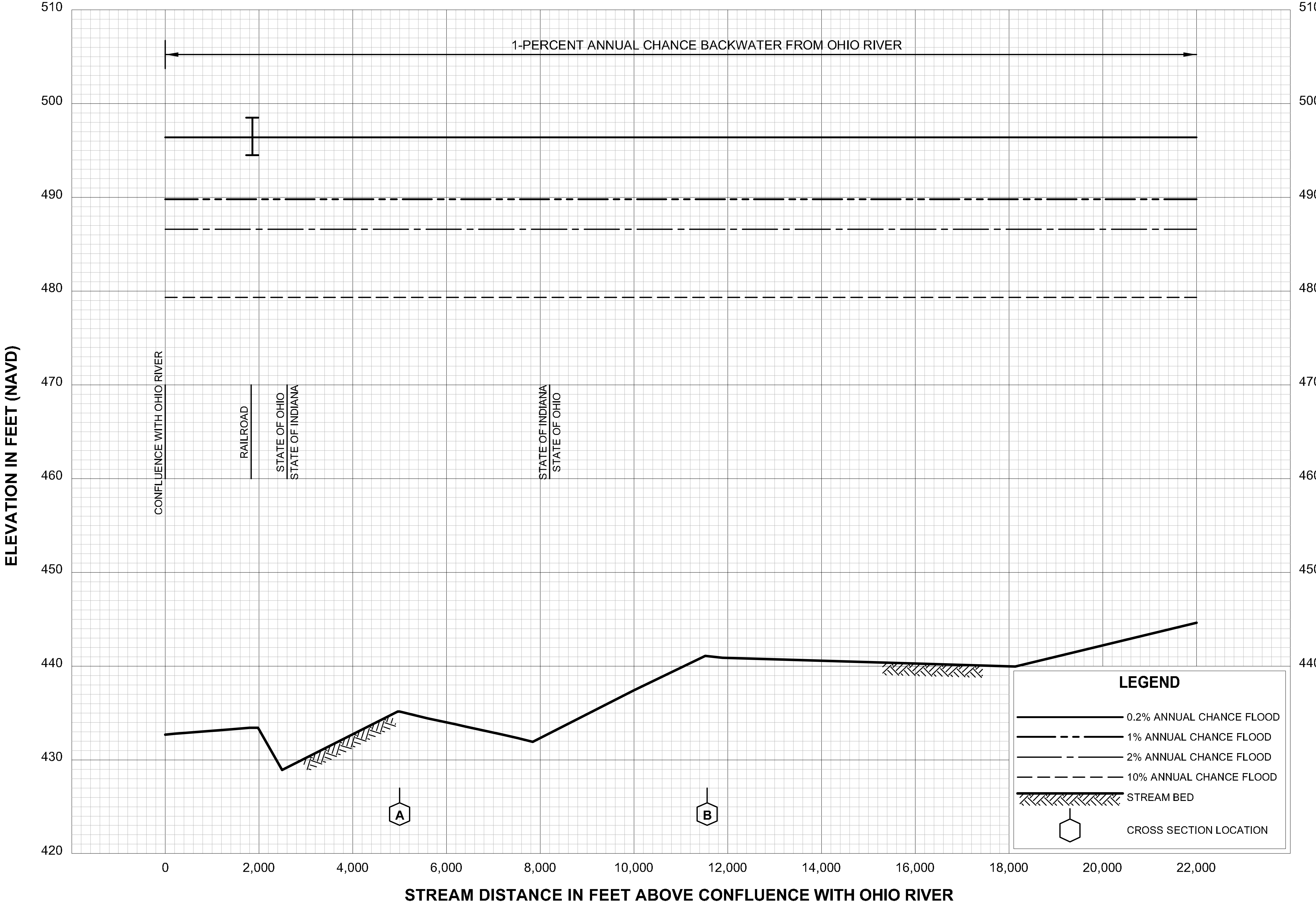
FLOOD PROFILES

FORK OF McCULLOUGH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



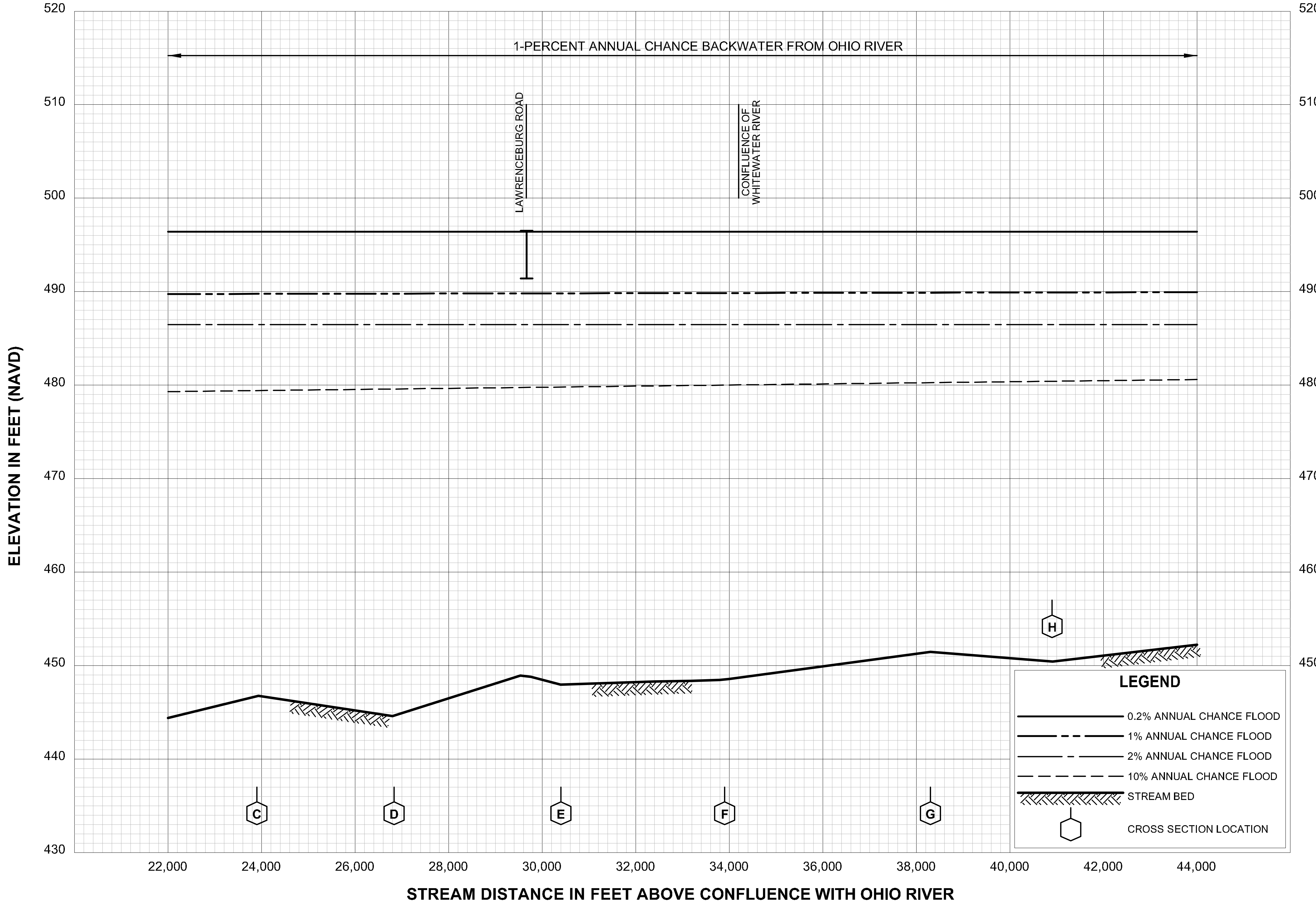
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



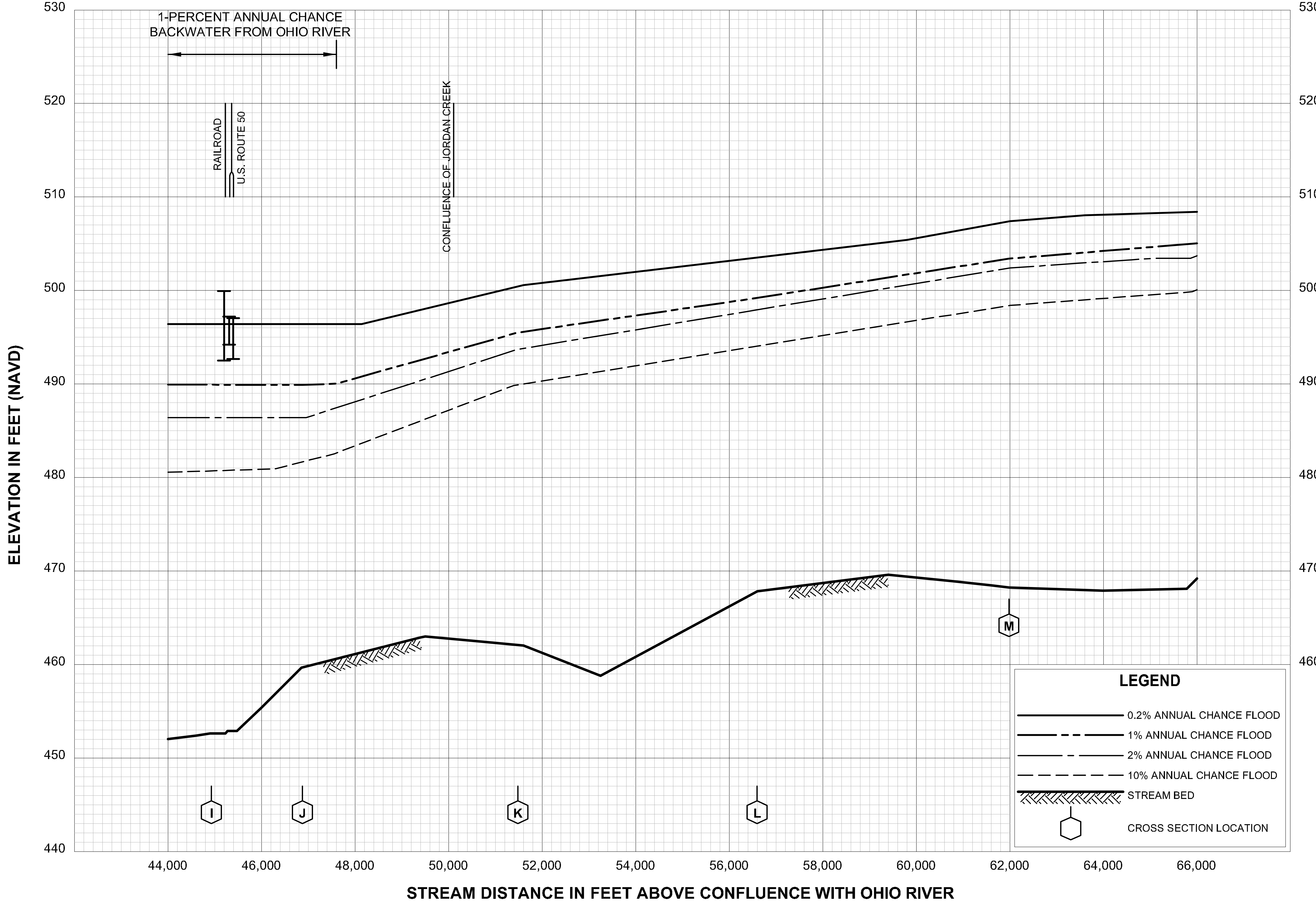
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



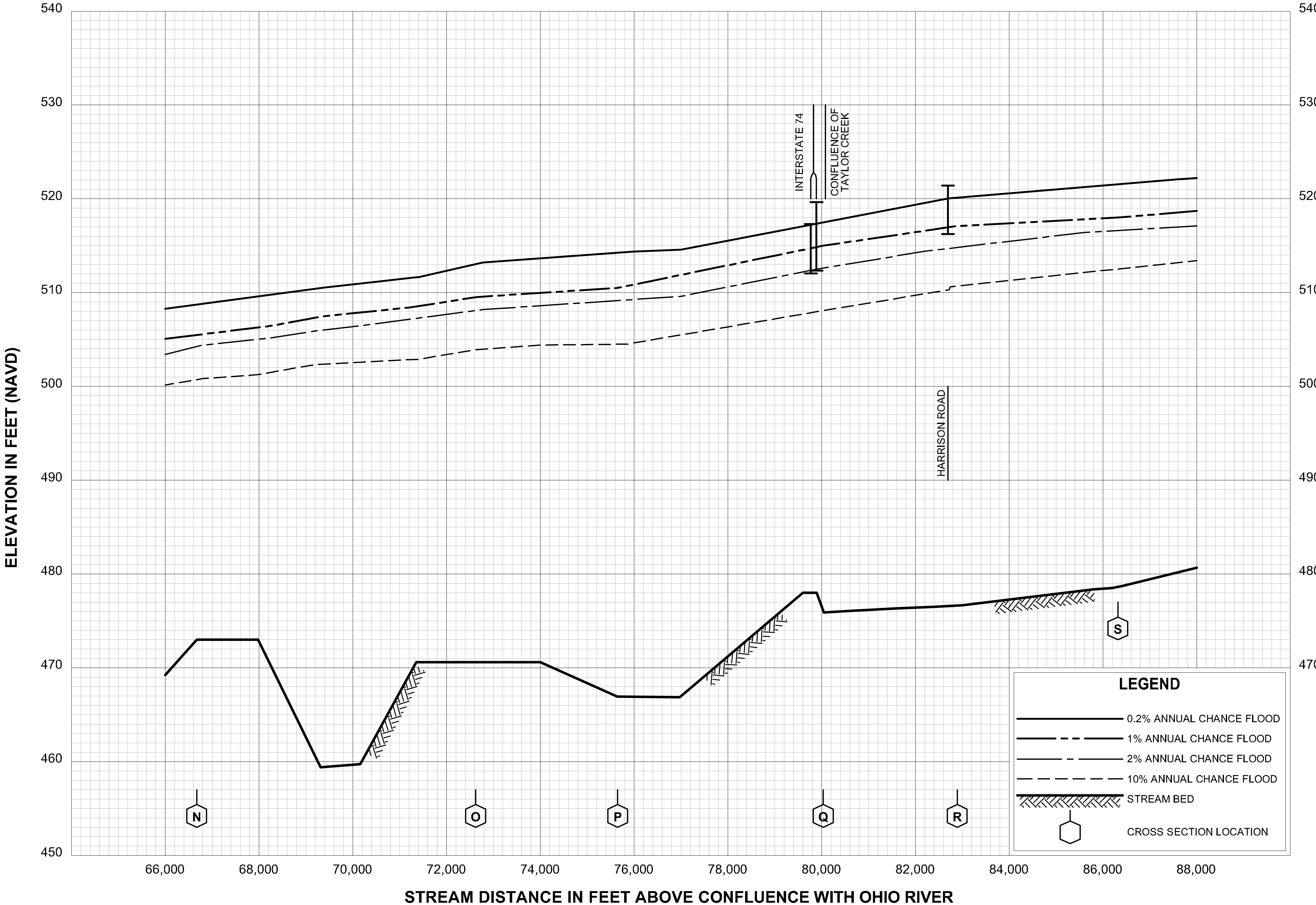
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

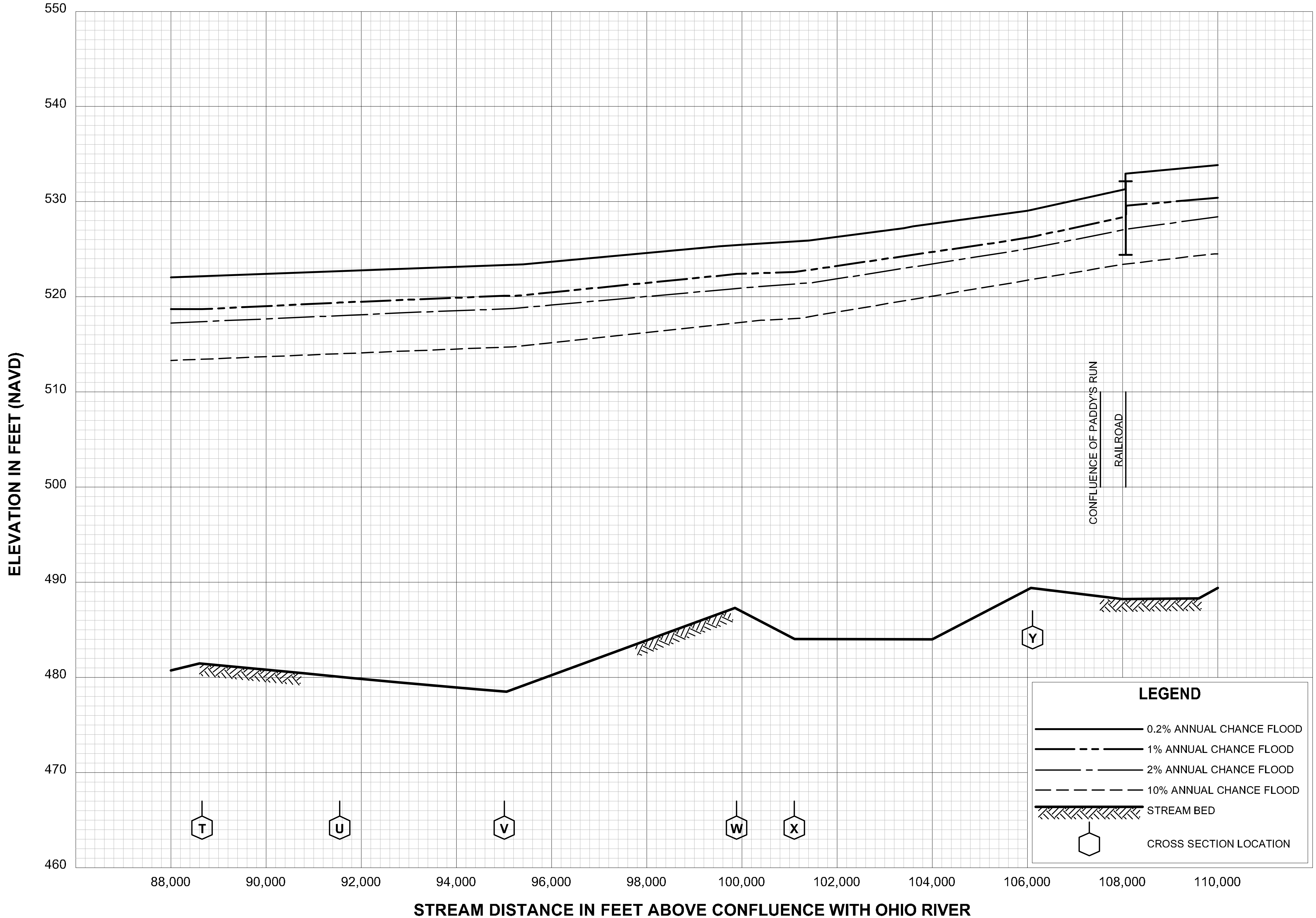
GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

034P



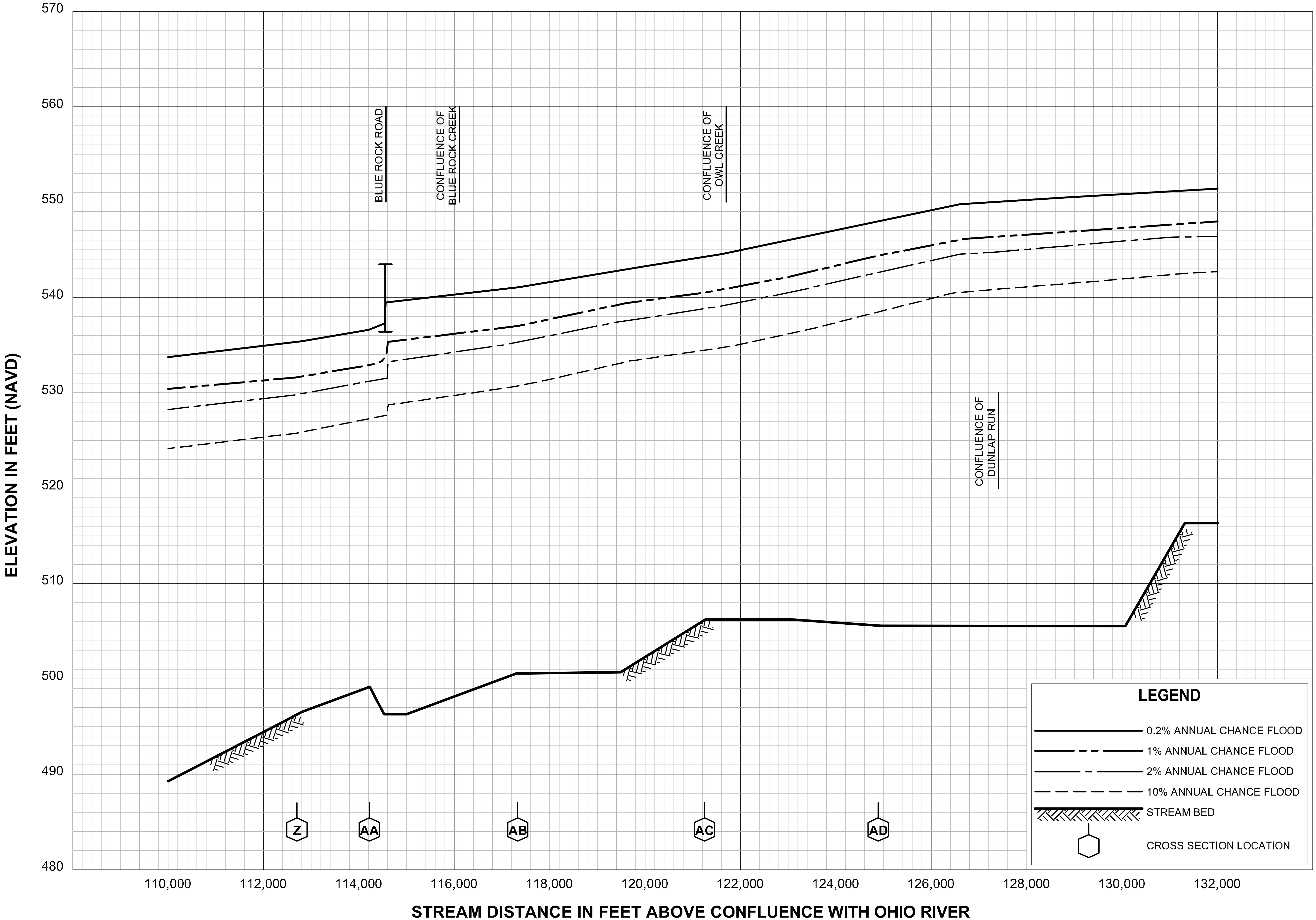
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



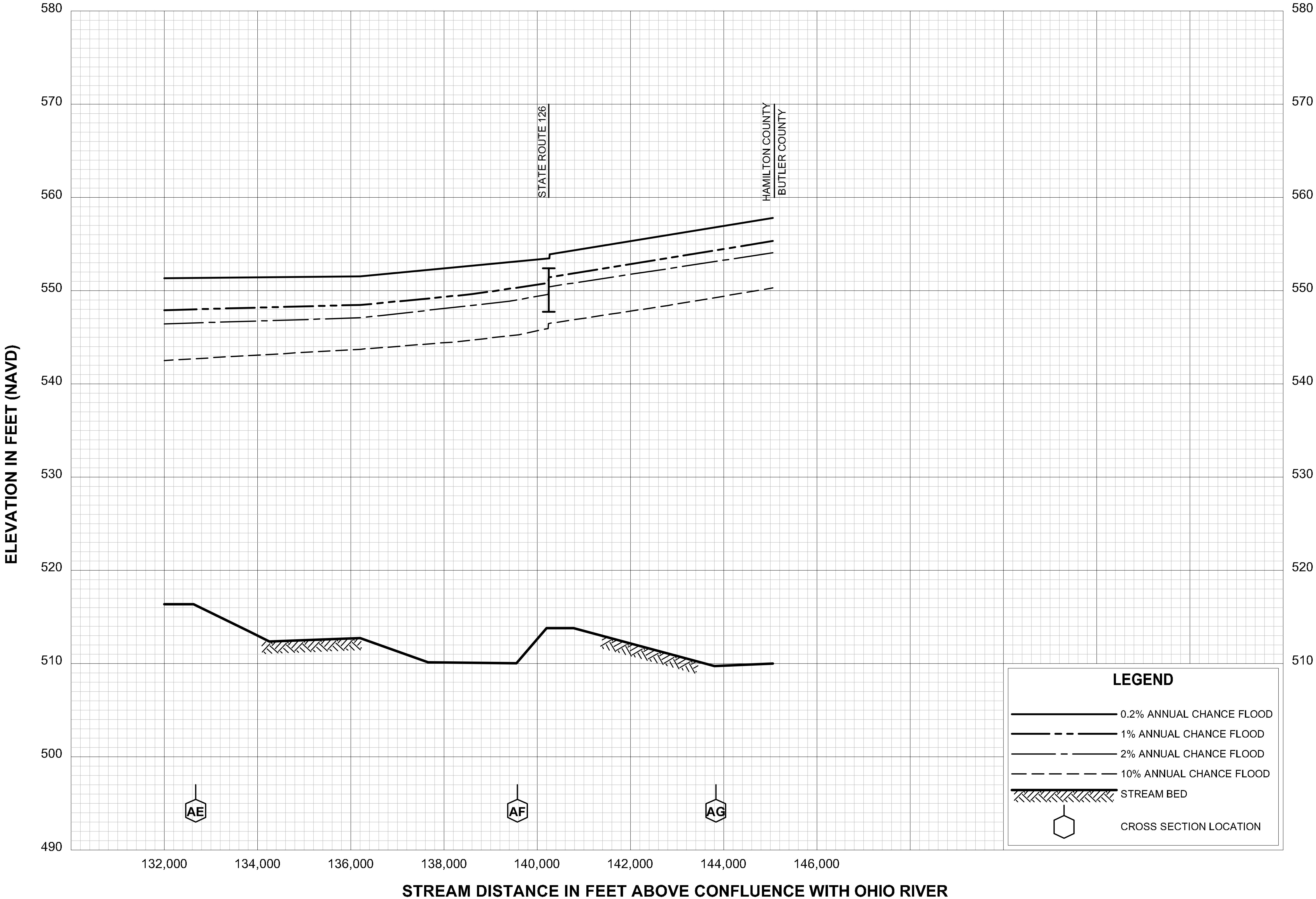
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



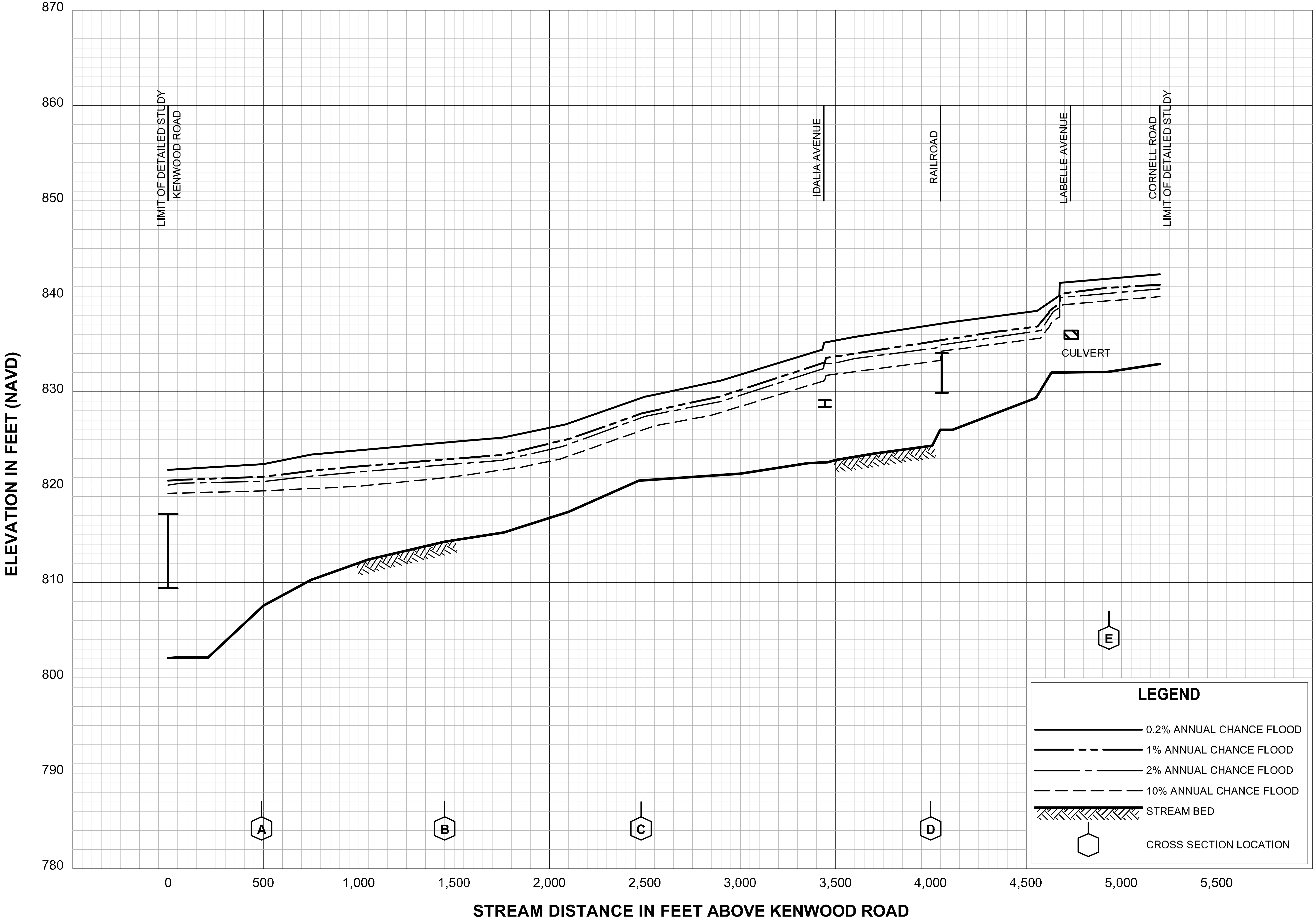
FLOOD PROFILES

GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



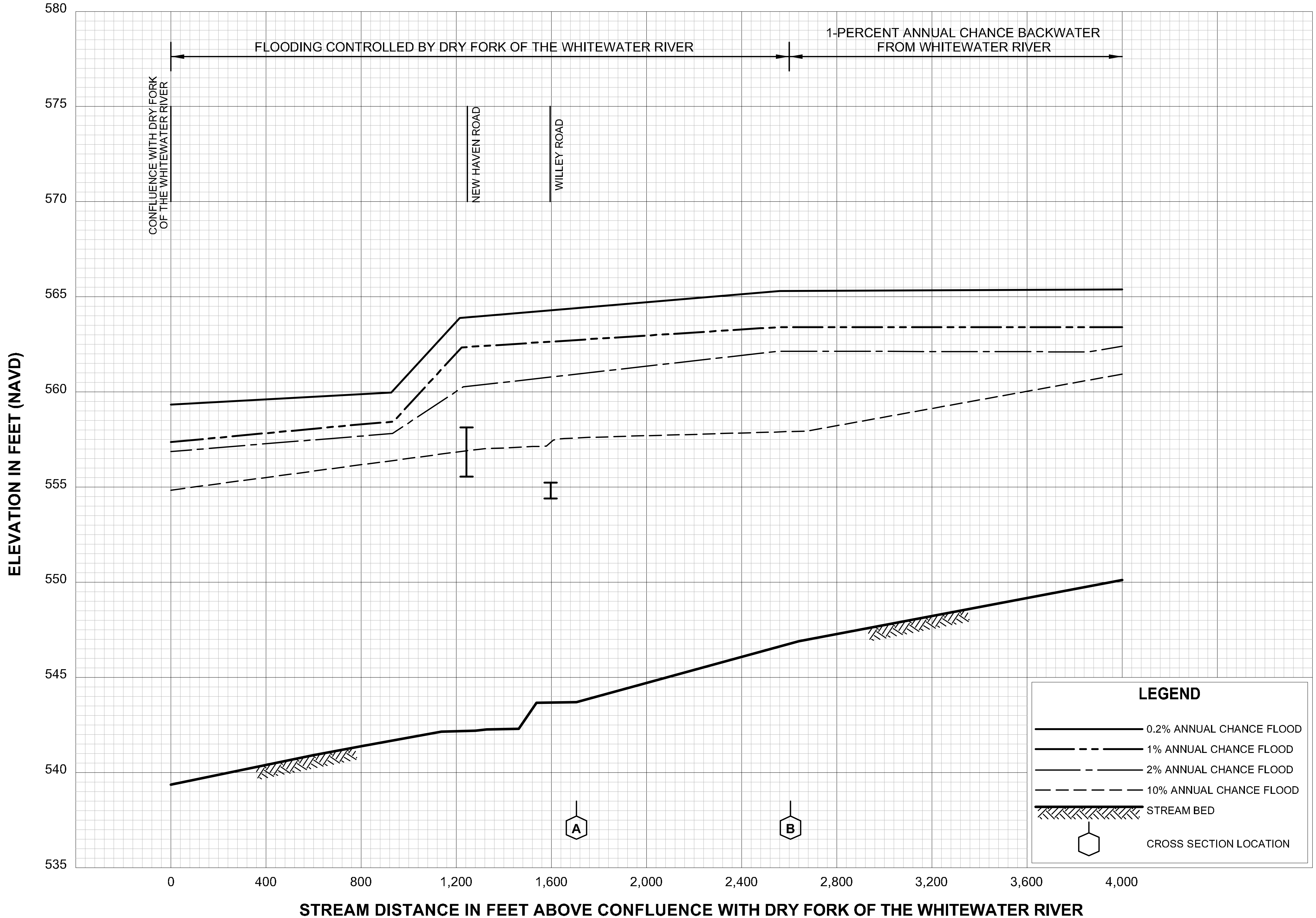
FLOOD PROFILES

HAZELWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



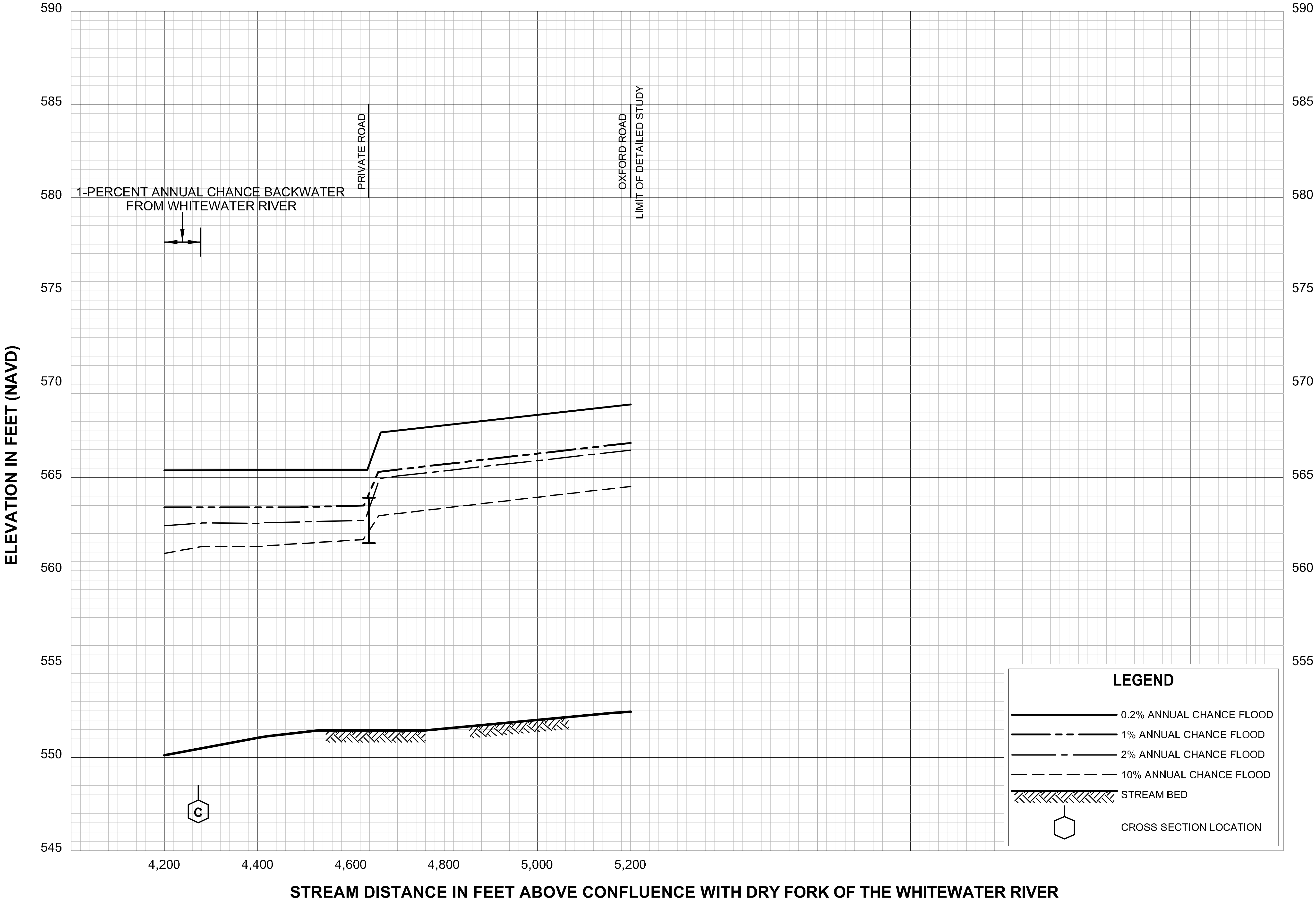
FLOOD PROFILES

HOWARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



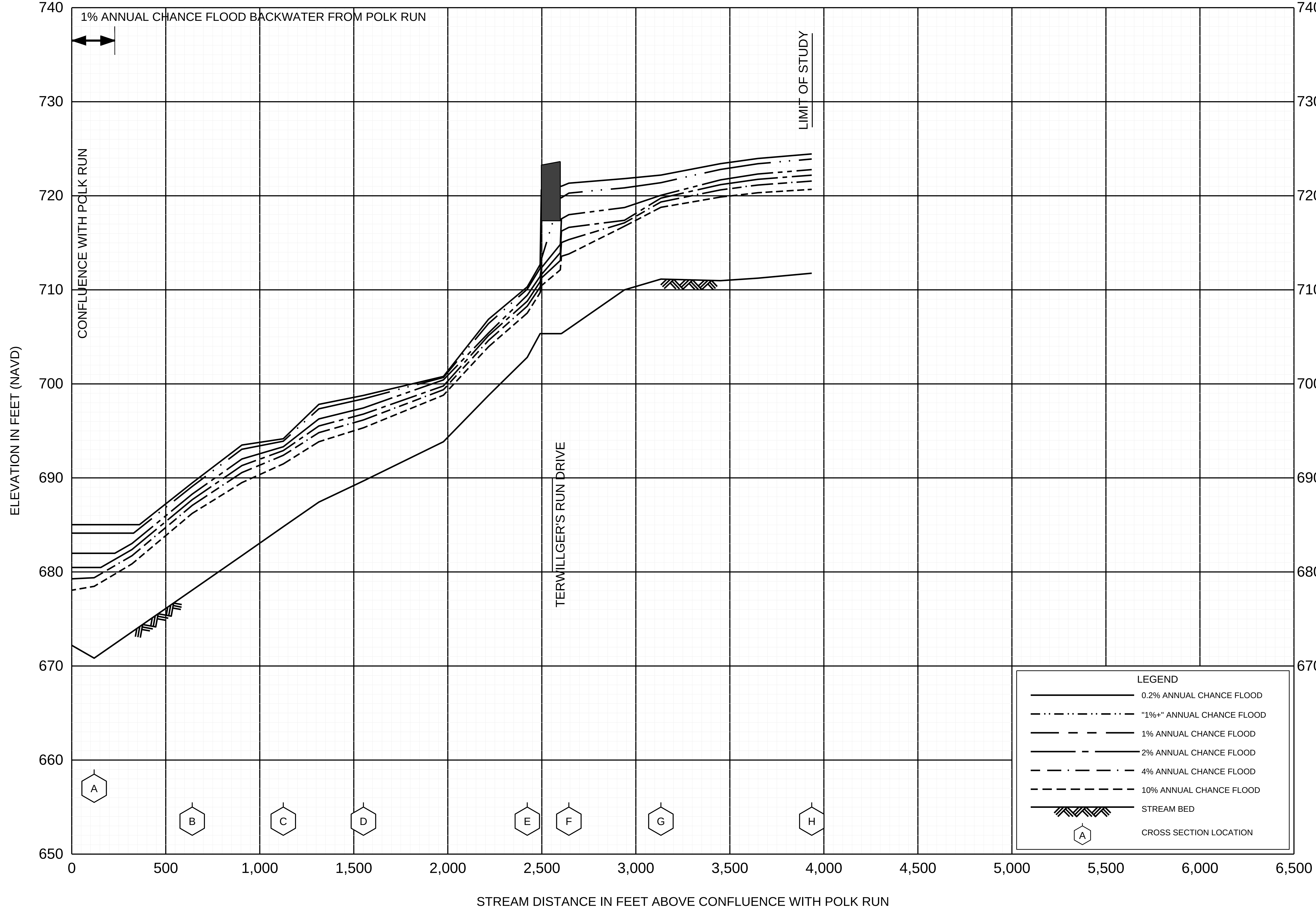
FLOOD PROFILES

HOWARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

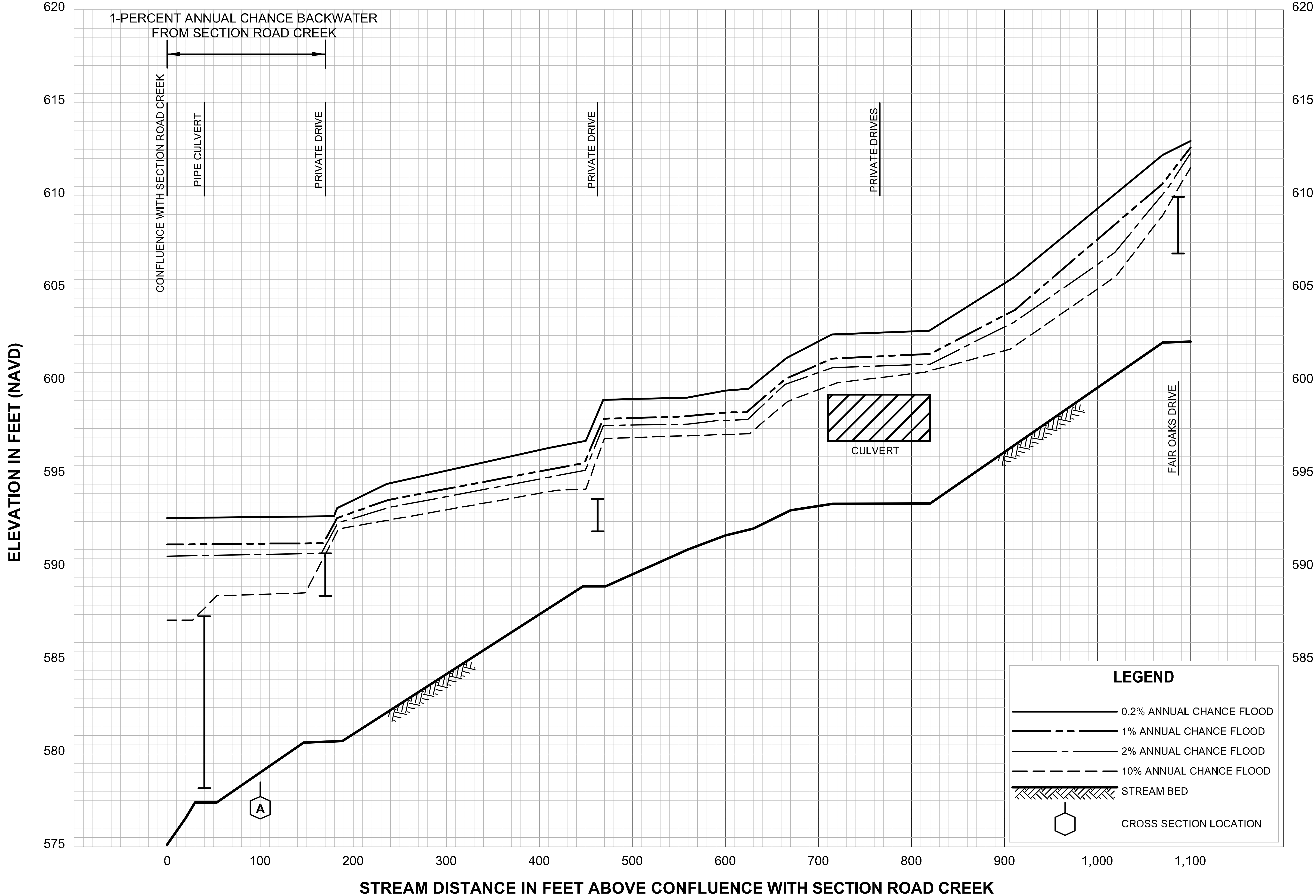
LAKE CHETAC CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

041P



FLOOD PROFILES

LEFT FORK SECTION ROAD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

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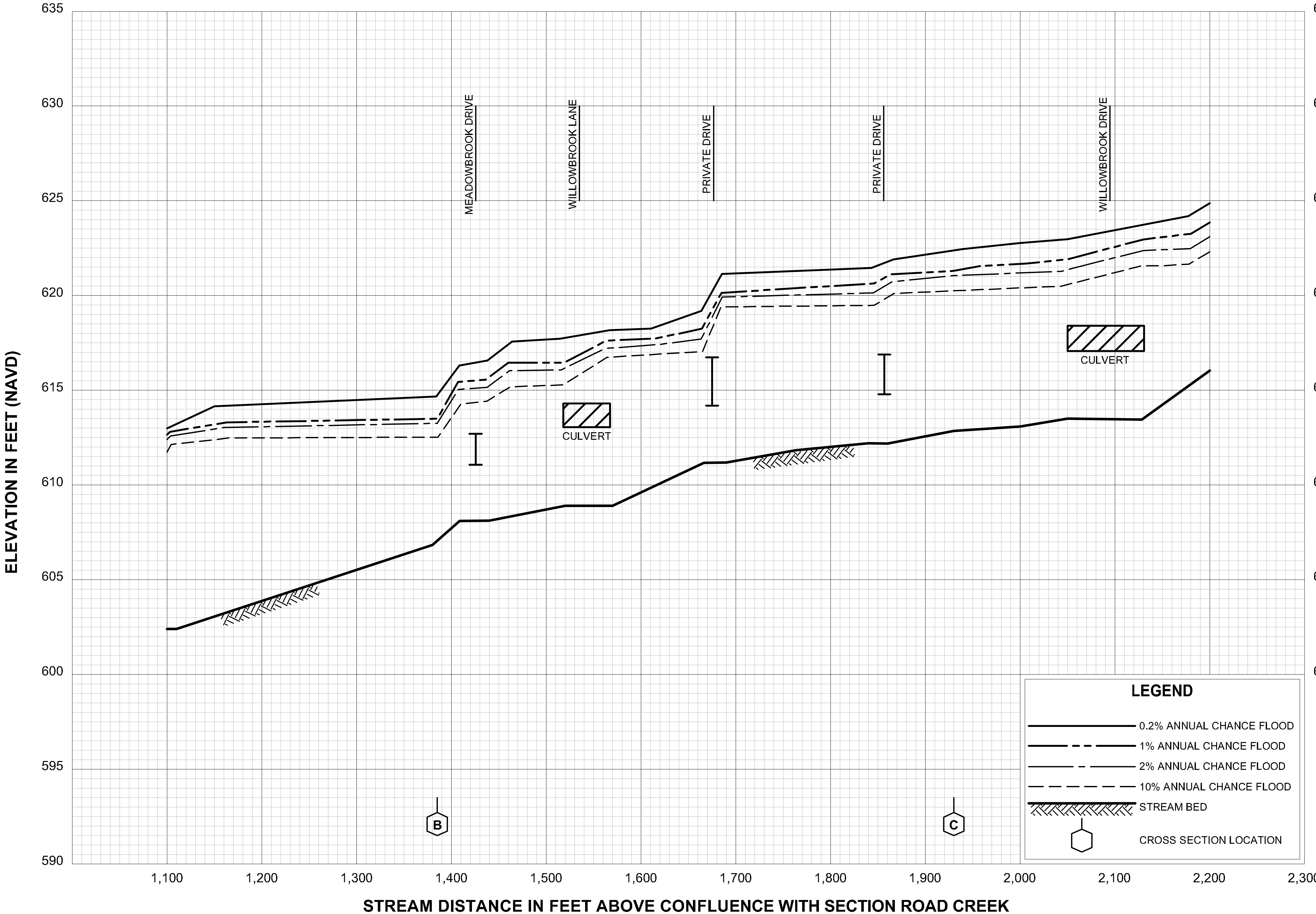

FLOOD PROFILES

LEFT FORK SECTION ROAD CREEK

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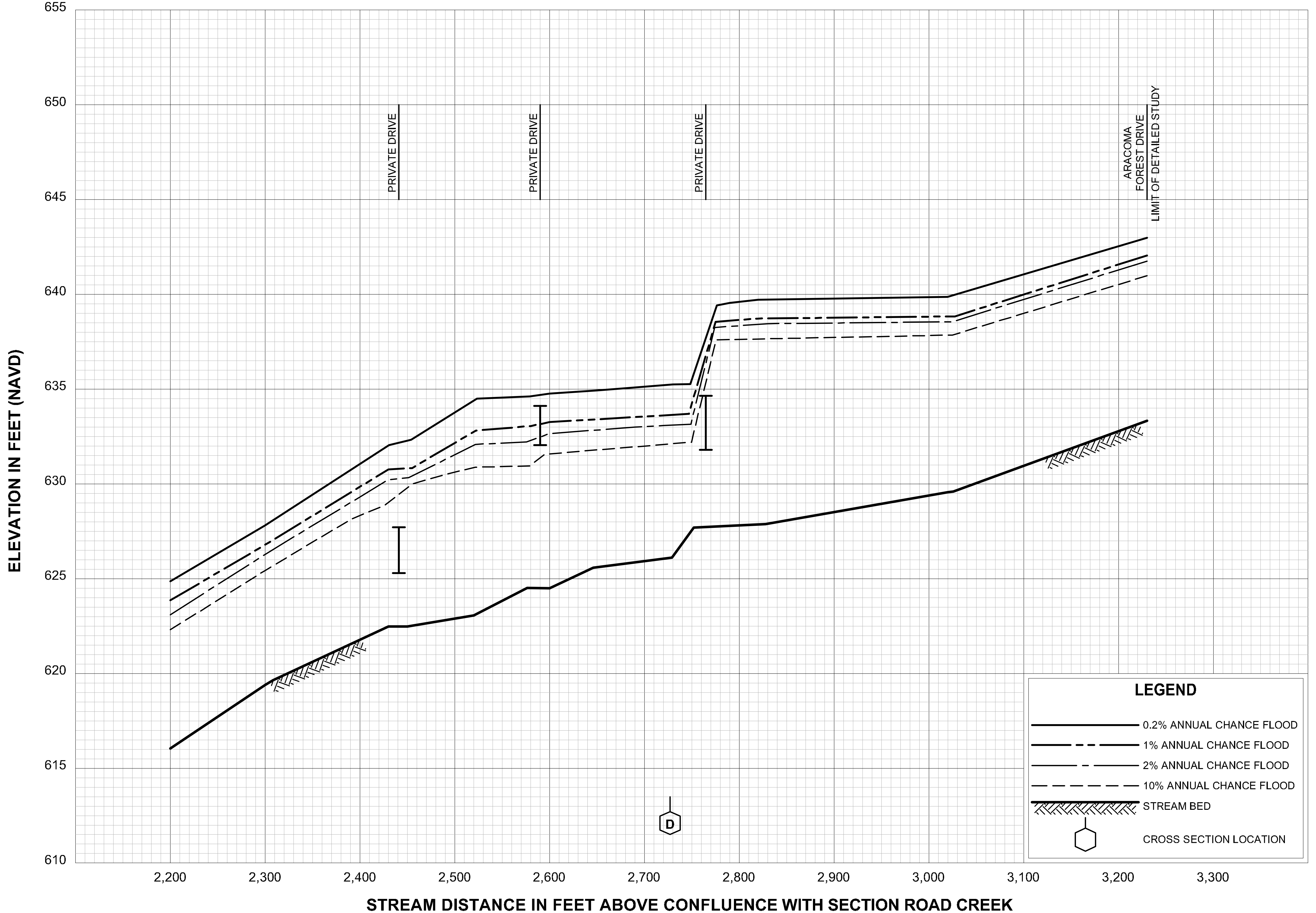

FLOOD PROFILES

LEFT FORK SECTION ROAD CREEK

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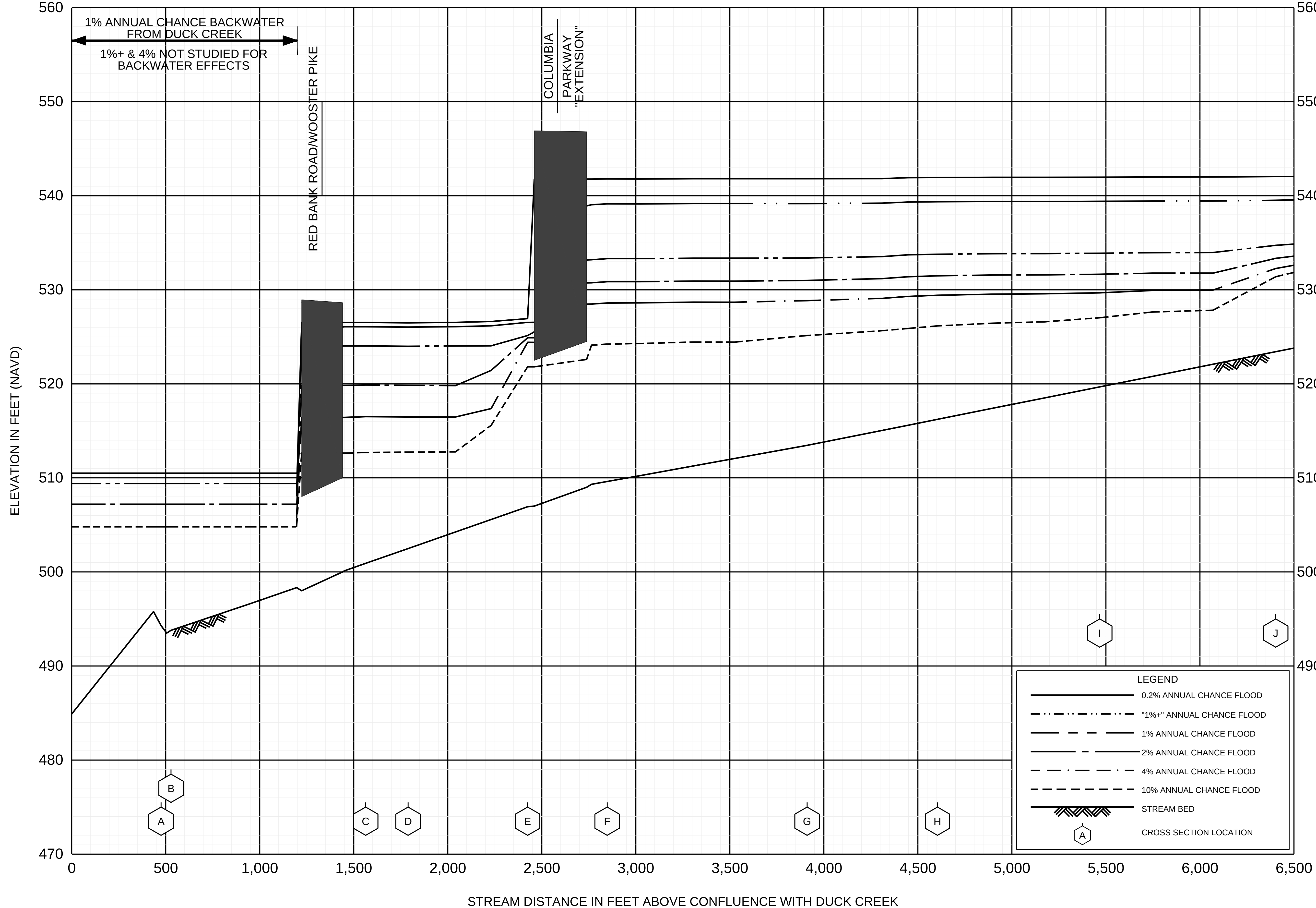

FLOOD PROFILES

LITTLE DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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AND INCORPORATED AREAS

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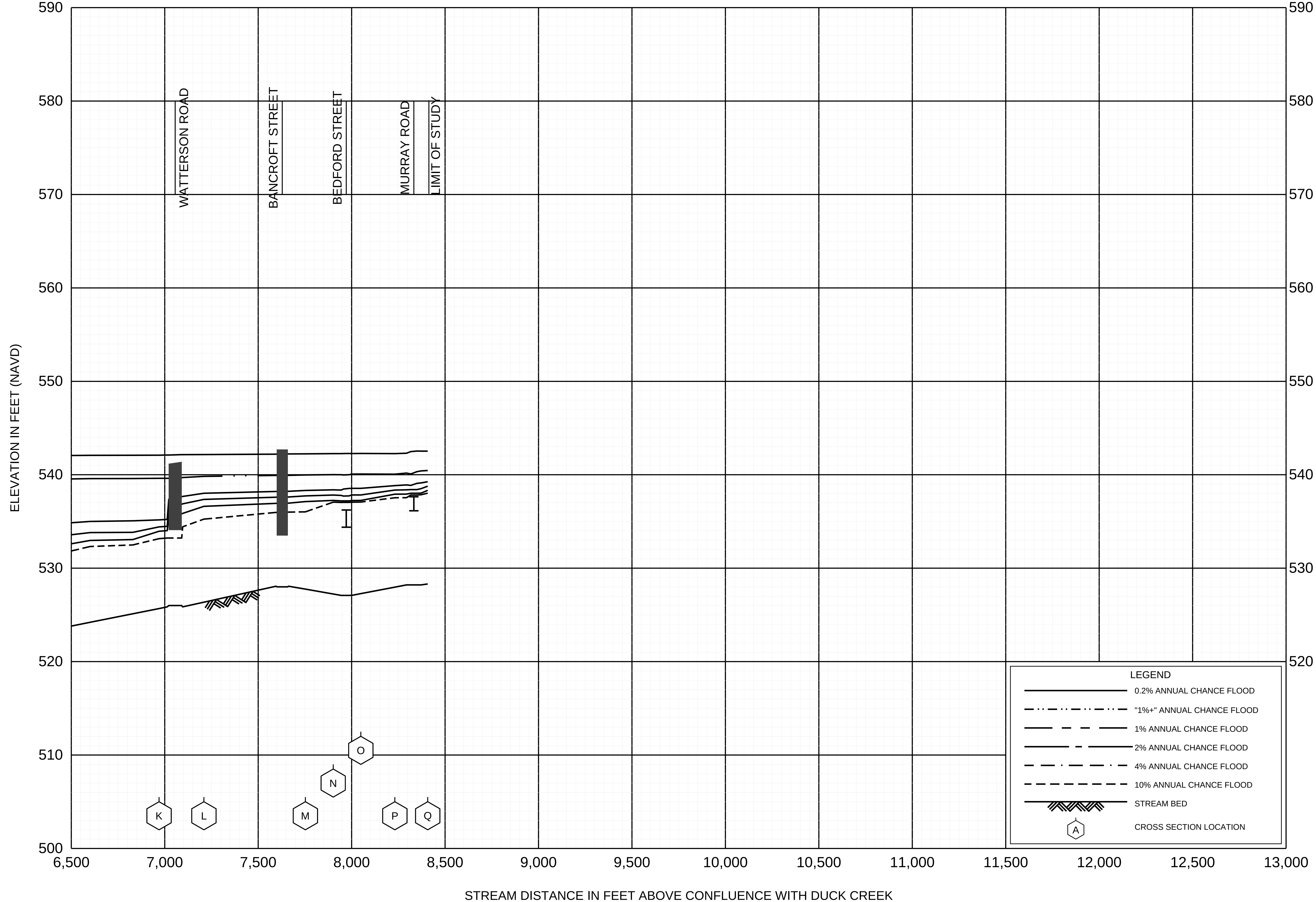

FLOOD PROFILES

LITTLE DUCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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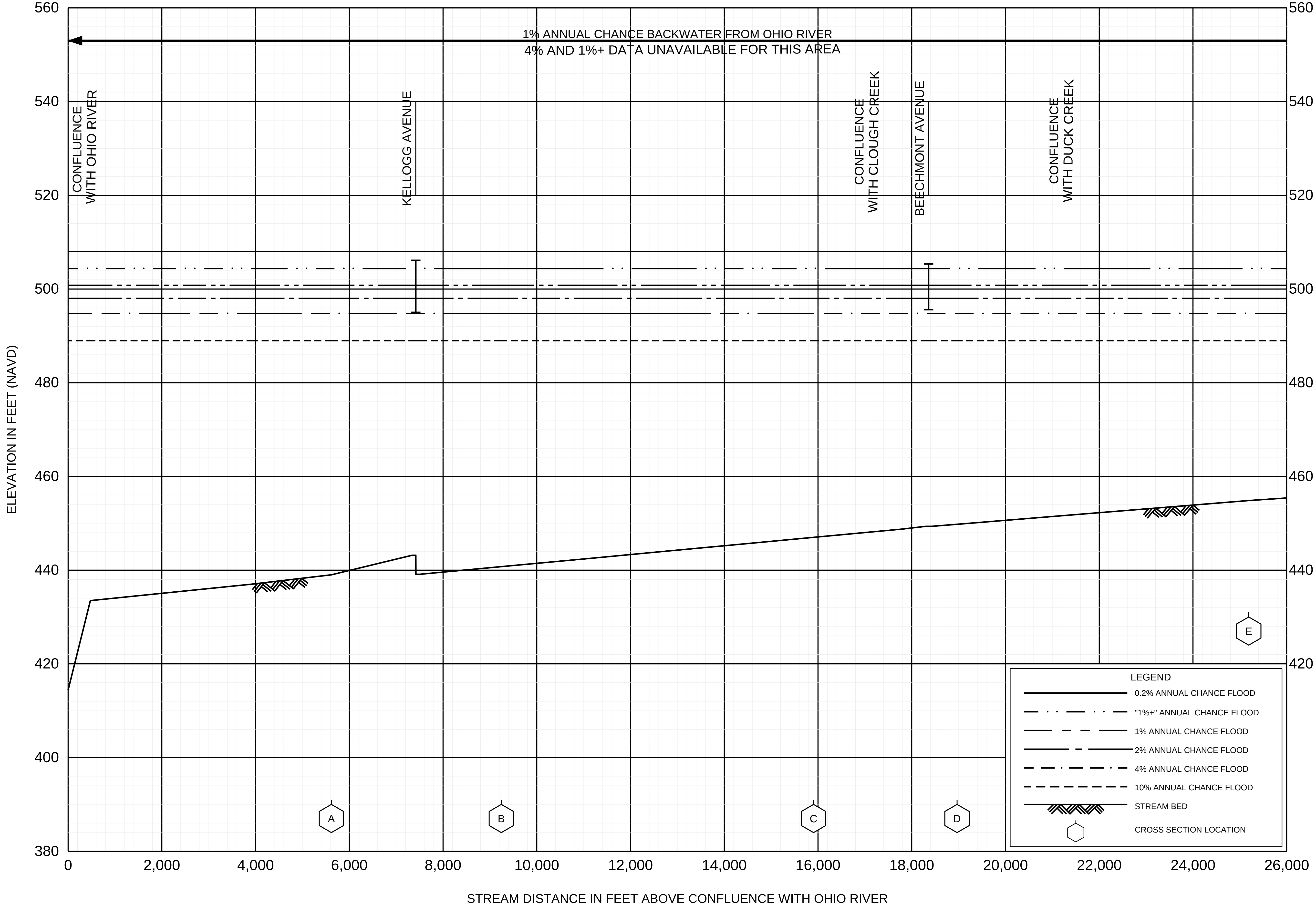

FLOOD PROFILES

LITTLE MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

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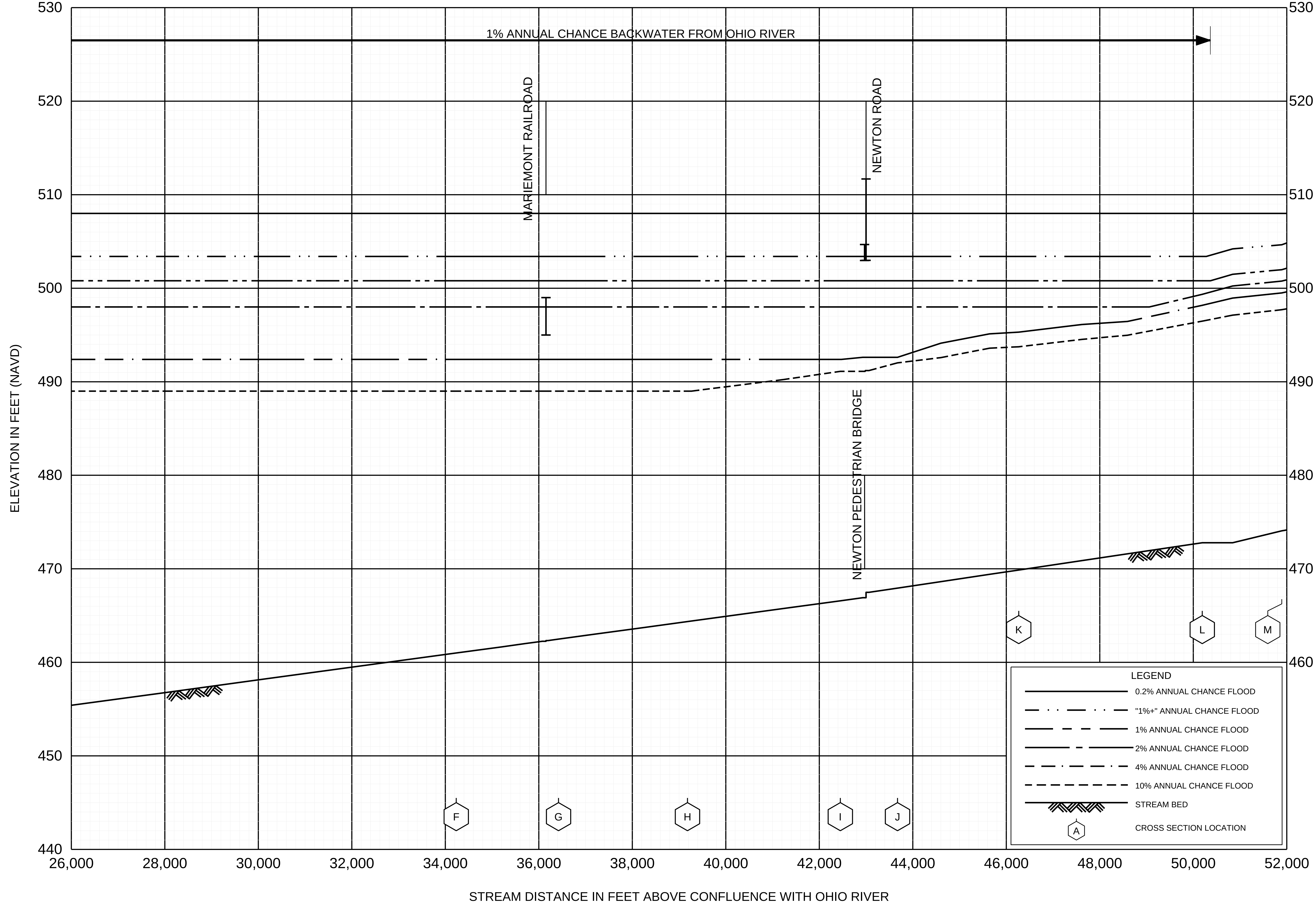

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LITTLE MIAMI RIVER

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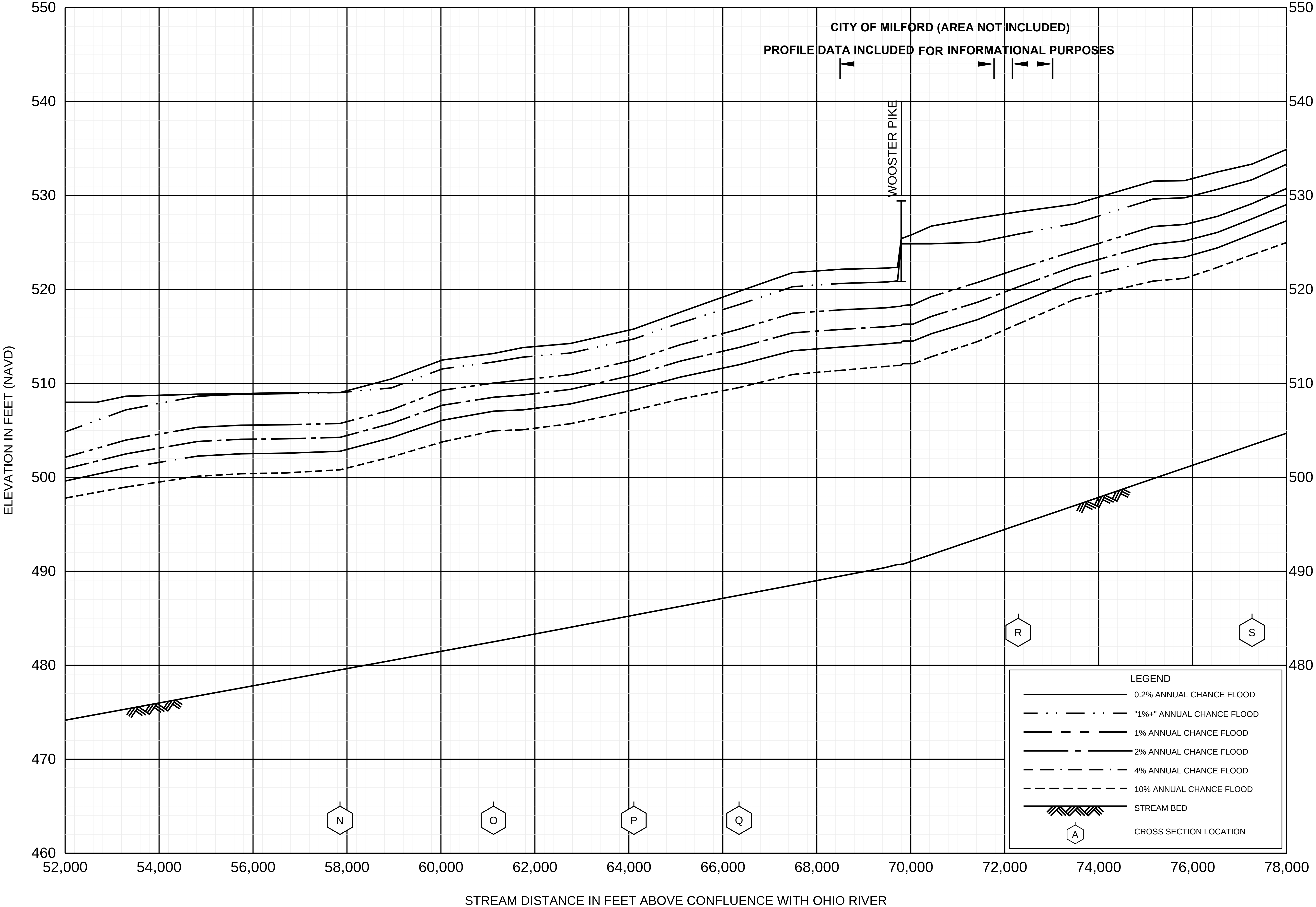

FLOOD PROFILES

LITTLE MIAMI RIVER

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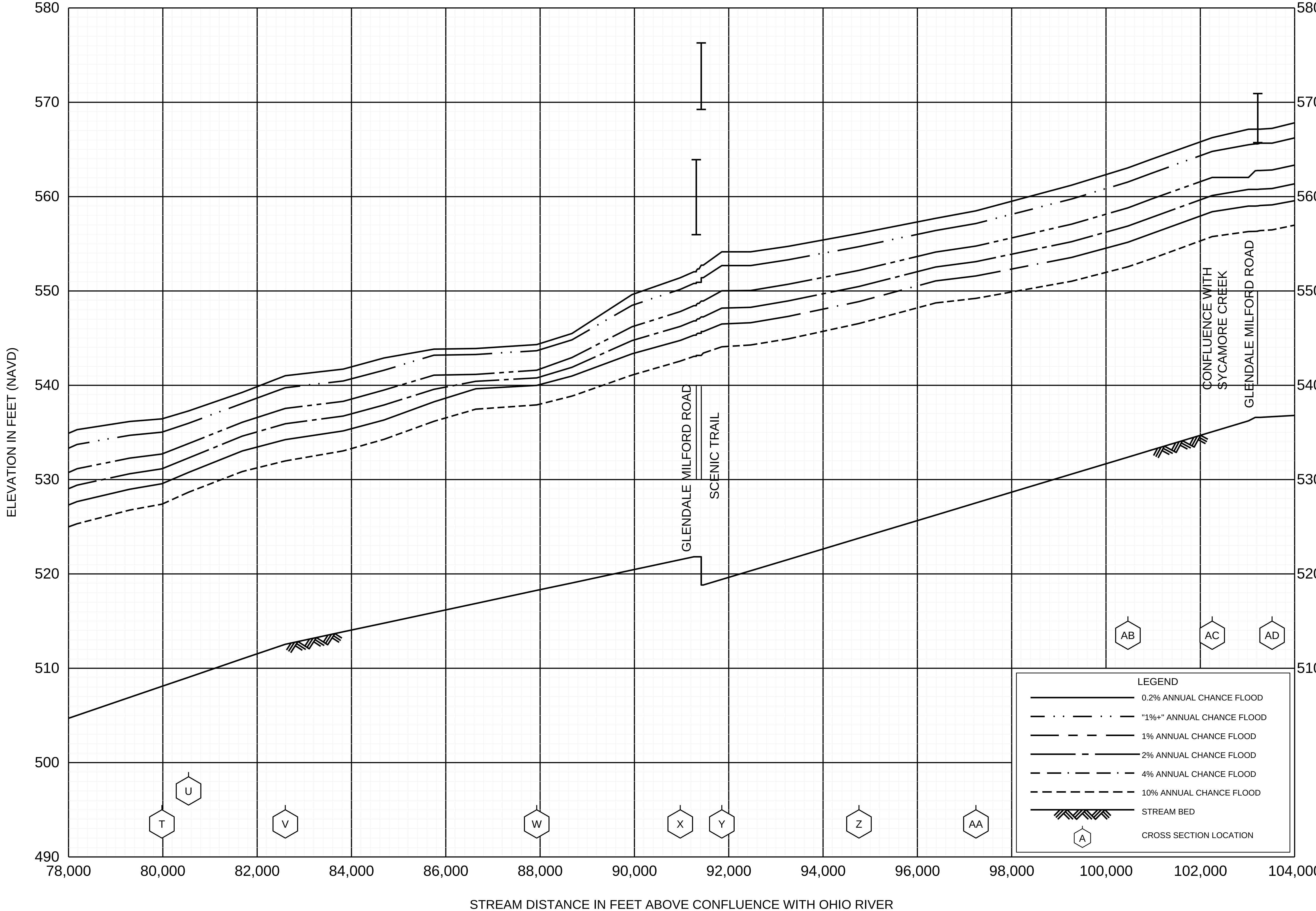

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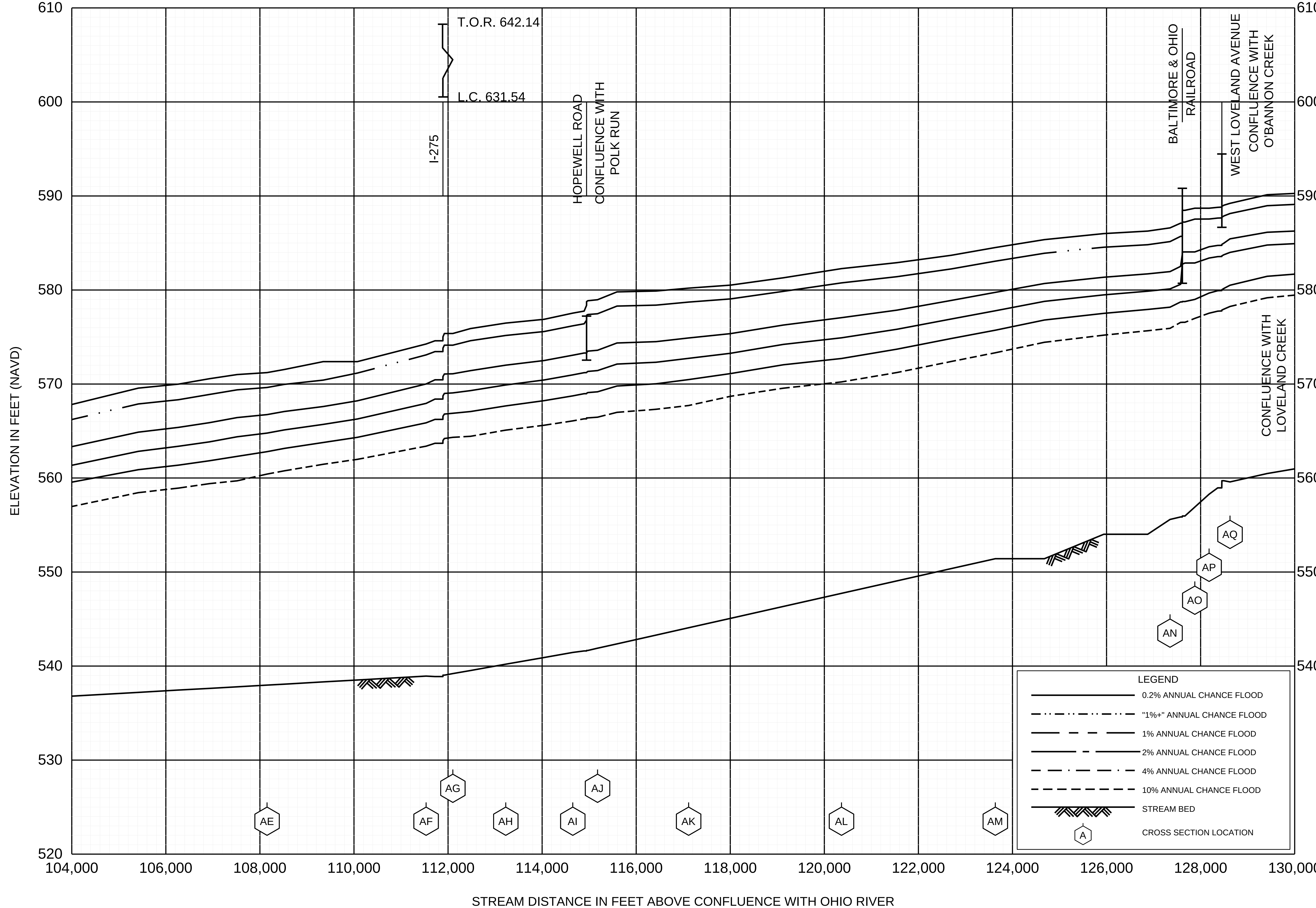

FLOOD PROFILES

LITTLE MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

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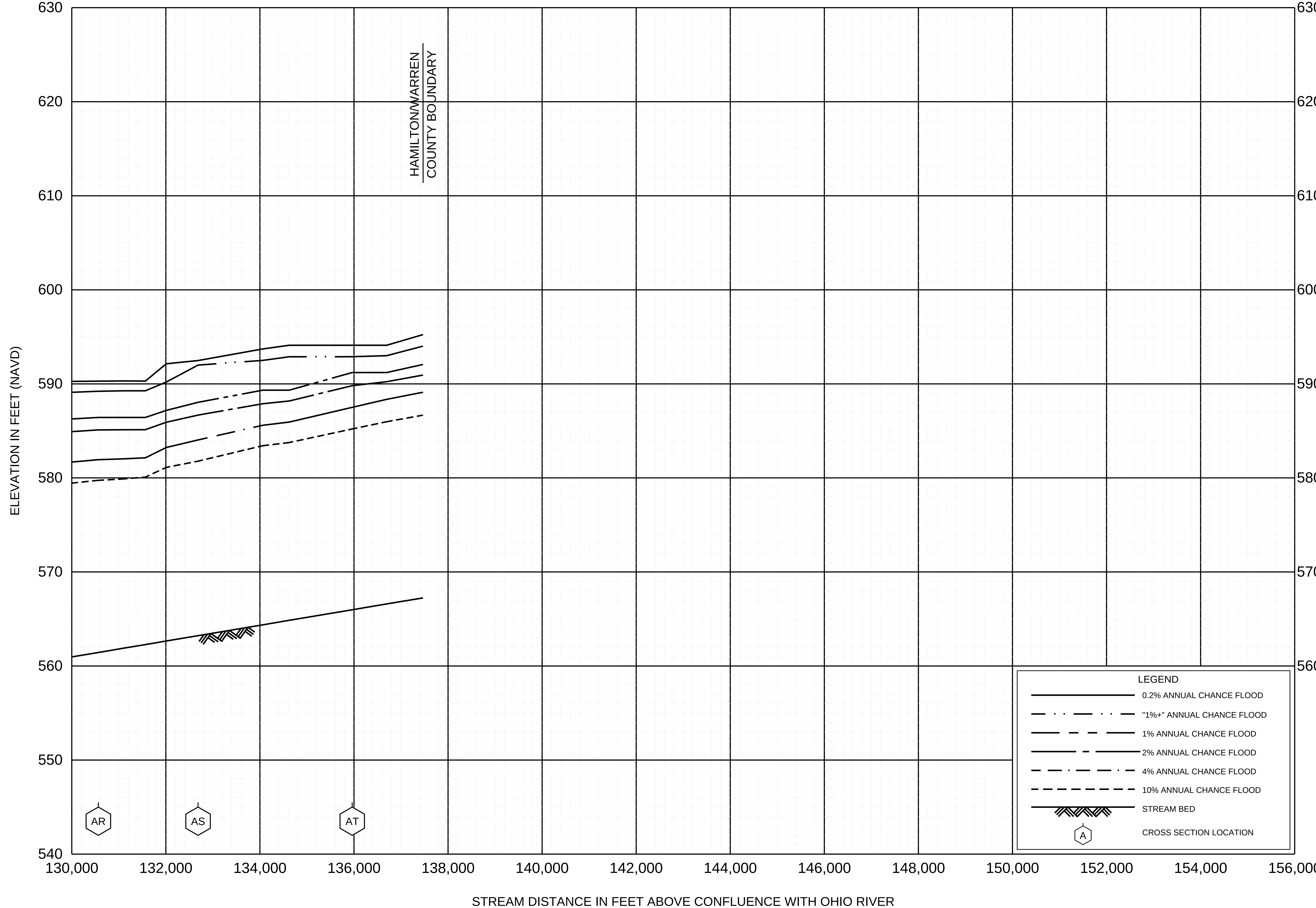

FLOOD PROFILES

LITTLE MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON CUNTY, OH

AND INCORPORATED AREAS

052P

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 3 OF 3

HAMILTON COUNTY, OHIO

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
ADDYSTON, VILLAGE OF	390205	LOVELAND, CITY OF	390068
AMBERLEY, VILLAGE OF	390206	MADEIRA, CITY OF	390225
ARLINGTON HEIGHTS, VILLAGE OF	390207	MARIEMONT, VILLAGE OF	390226
BLUE ASH, CITY OF	390208	MONTGOMERY, CITY OF	390228
CHEVIOT, CITY OF*	390209	MOUNT HEALTHY, CITY OF	390229
CINCINNATI, CITY OF	390210	NEWTOWN, VILLAGE OF	390230
CLEVES, VILLAGE OF	390211	NORTH BEND, VILLAGE OF	390231
DEER PARK, CITY OF*	390212	NORTH COLLEGE HILL, CITY OF	390232
ELMWOOD PLACE, VILLAGE OF	390213	NORWOOD, CITY OF*	390233
EVENDALE, VILLAGE OF	390214	READING, CITY OF	390234
FAIRFAX, VILLAGE OF	390215	SHARONVILLE, CITY OF	390236
FOREST PARK, CITY OF	390216	SILVERTON, CITY OF*	390237
GLENDALE, VILLAGE OF	390217	SPRINGDALE, CITY OF	390877
GOLF MANOR, CITY OF*	390218	ST. BERNARD, CITY OF	390235
GREENHILLS, VILLAGE OF	390219	TERRACE PARK, VILLAGE OF	390633
HAMILTON COUNTY, UNINCORPORATED AREAS	390204	THE VILLAGE OF INDIAN HILL, CITY OF	390221
HARRISON, CITY OF	390220	WOODLAWN, VILLAGE OF	390239
LINCOLN HEIGHTS, VILLAGE OF*	390222	WYOMING, CITY OF	390240
LOCKLAND, VILLAGE OF	390223		

*No Special Flood Hazard Areas Identified

REVISED:

JUNE 7, 2023

FLOOD INSURANCE STUDY NUMBER

39061CV003D

Version Number 2.5.3.5

FEMA

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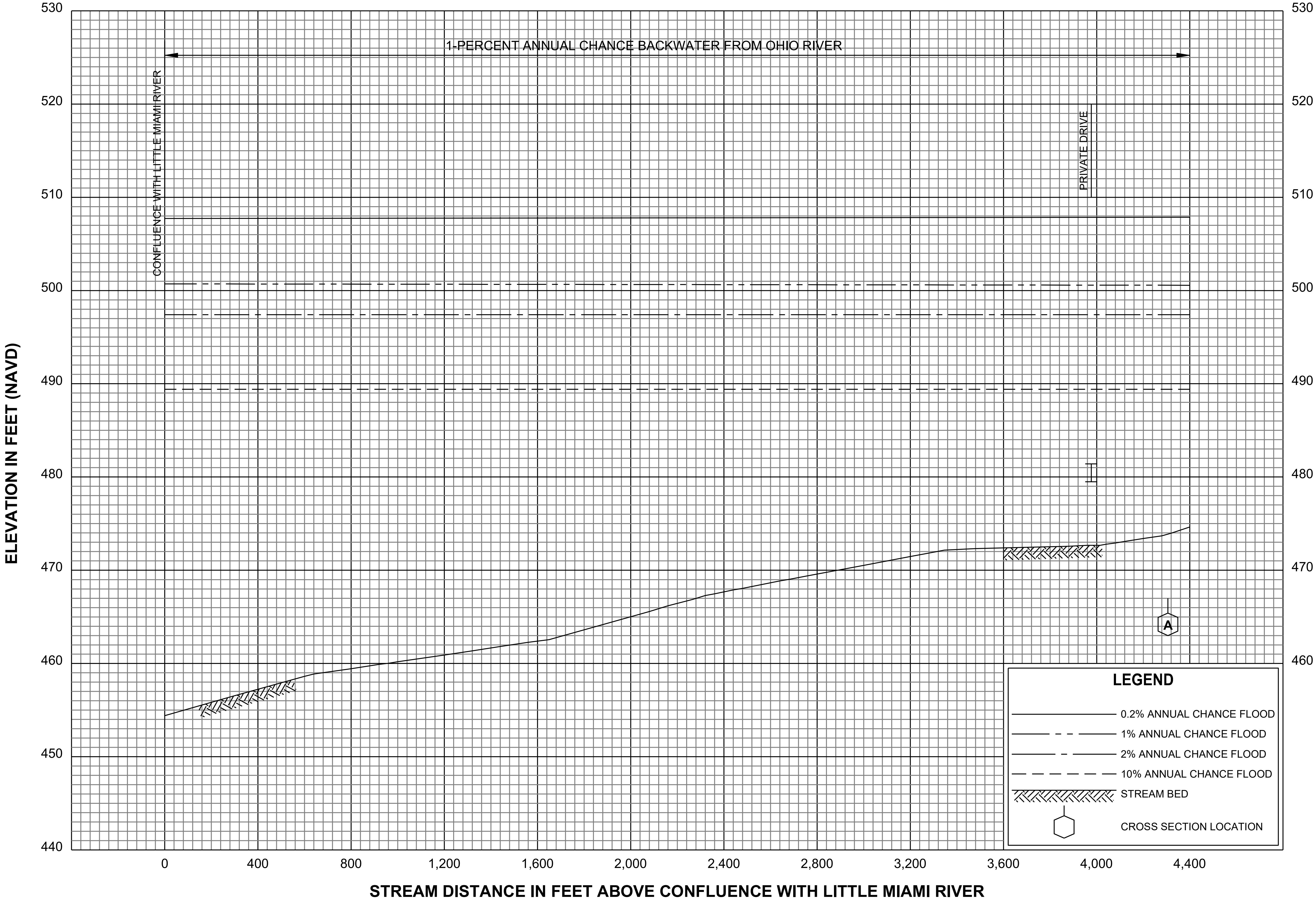


FLOOD PROFILES

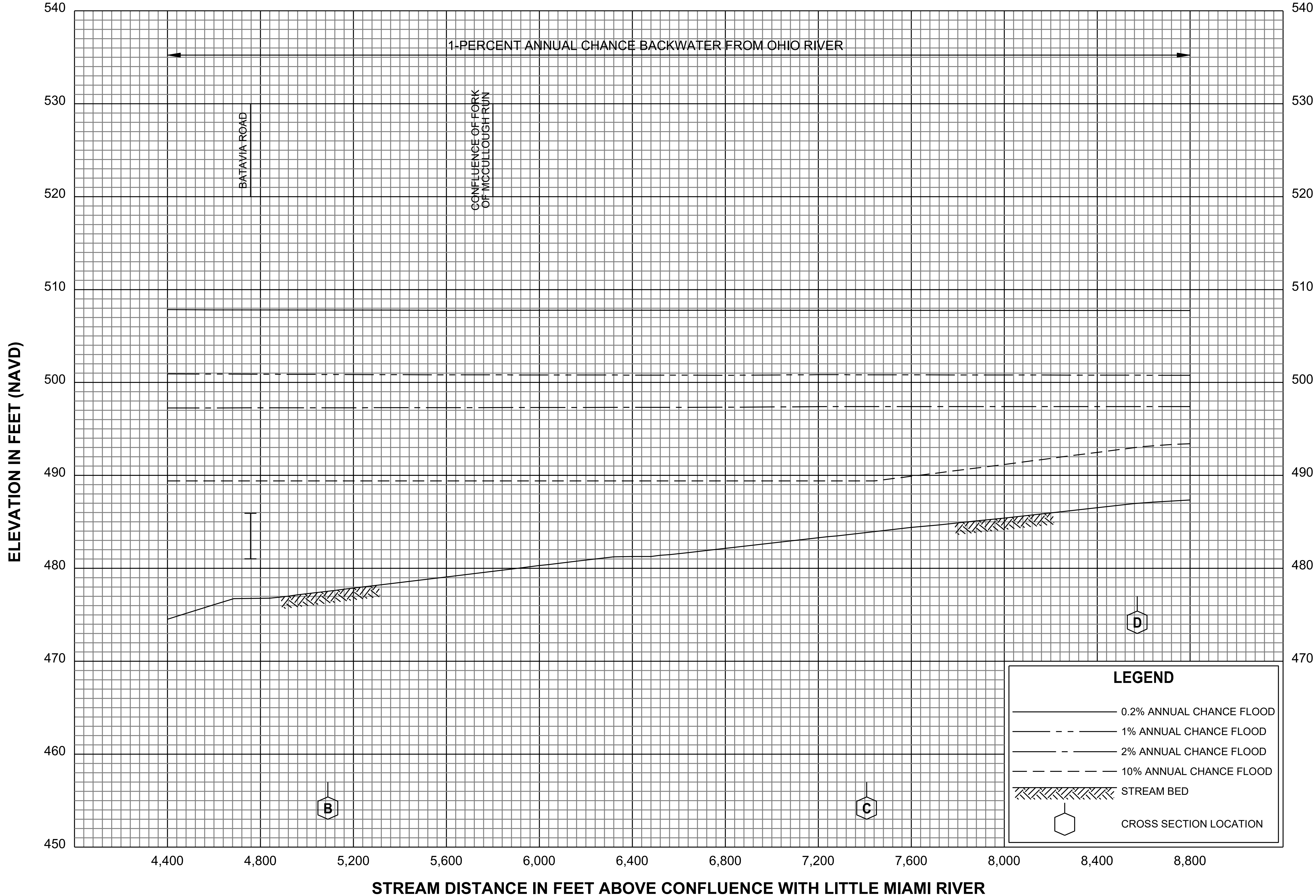
McCULLOUGH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

053P



FLOOD PROFILES

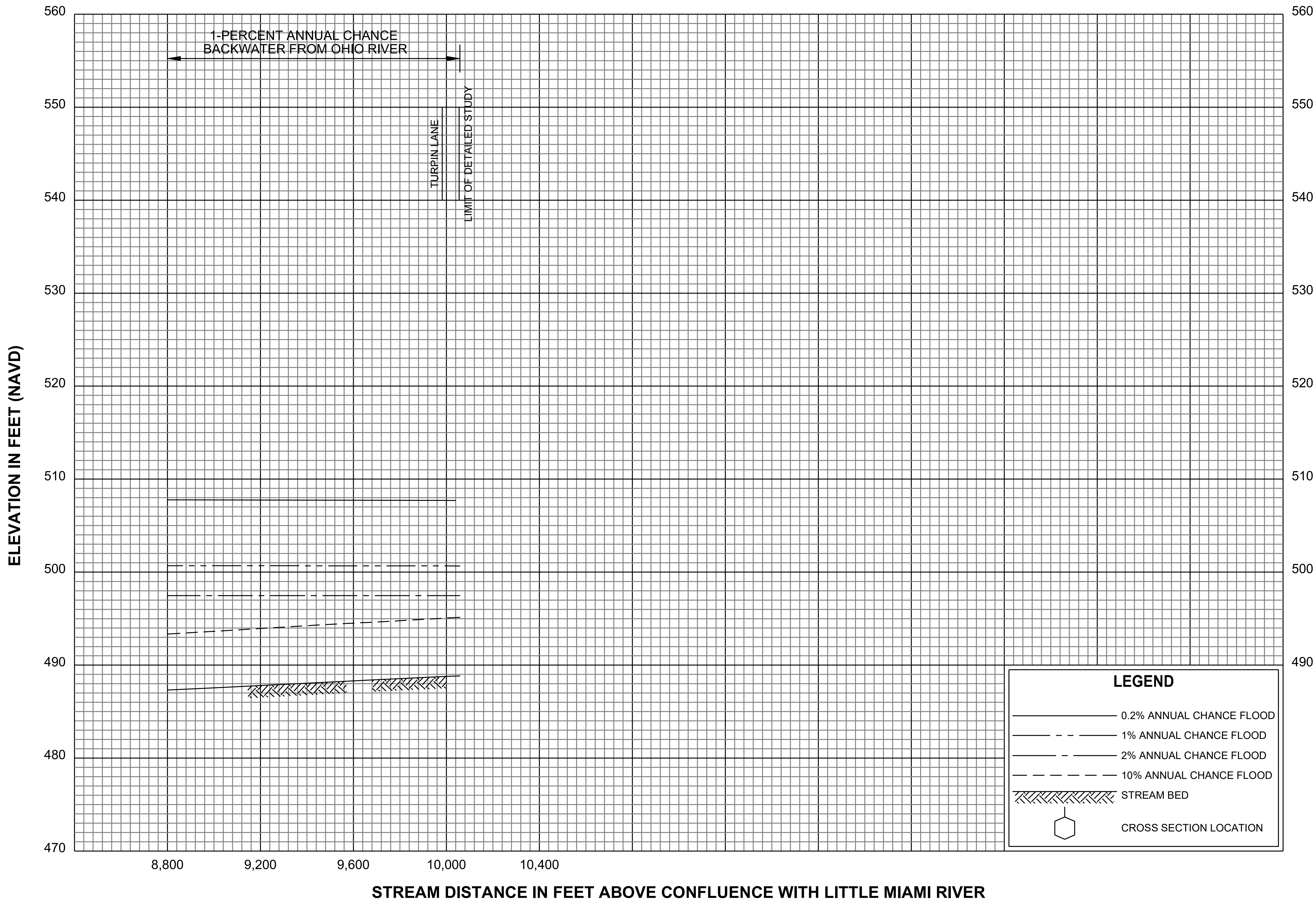
McCULLOUGH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

054P



FLOOD PROFILES

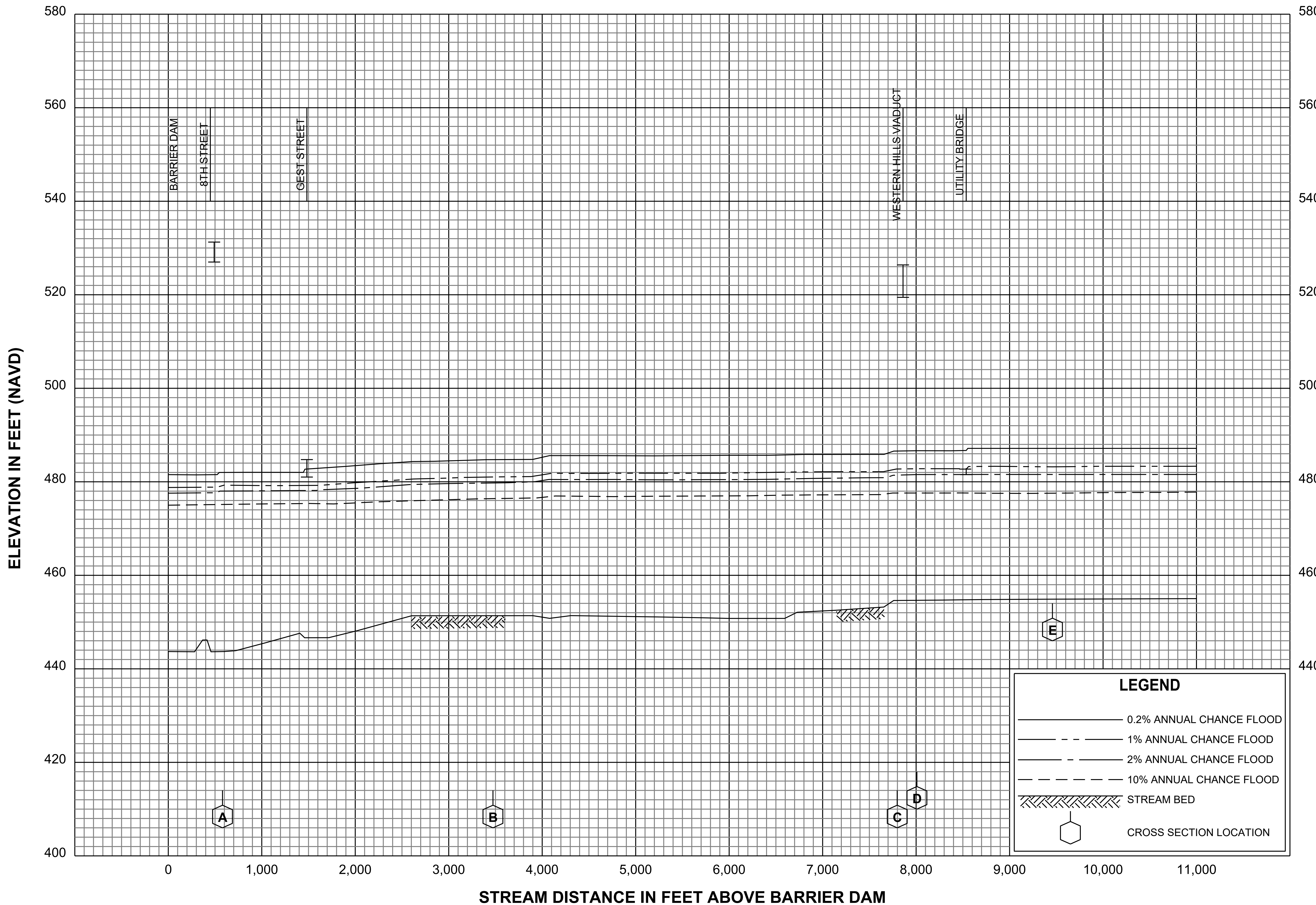
McCULLOUGH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

055P



FLOOD PROFILES

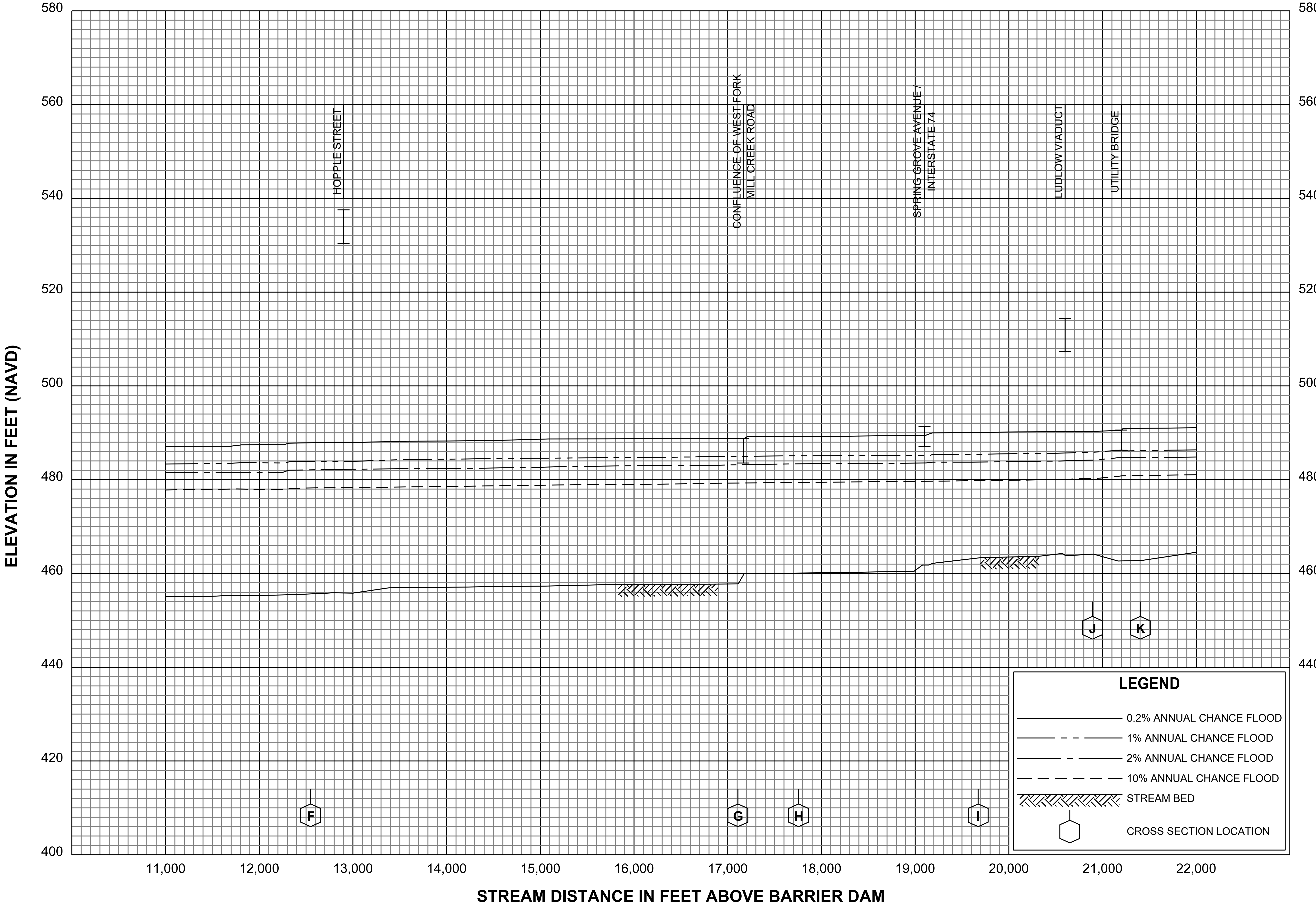
MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

056P



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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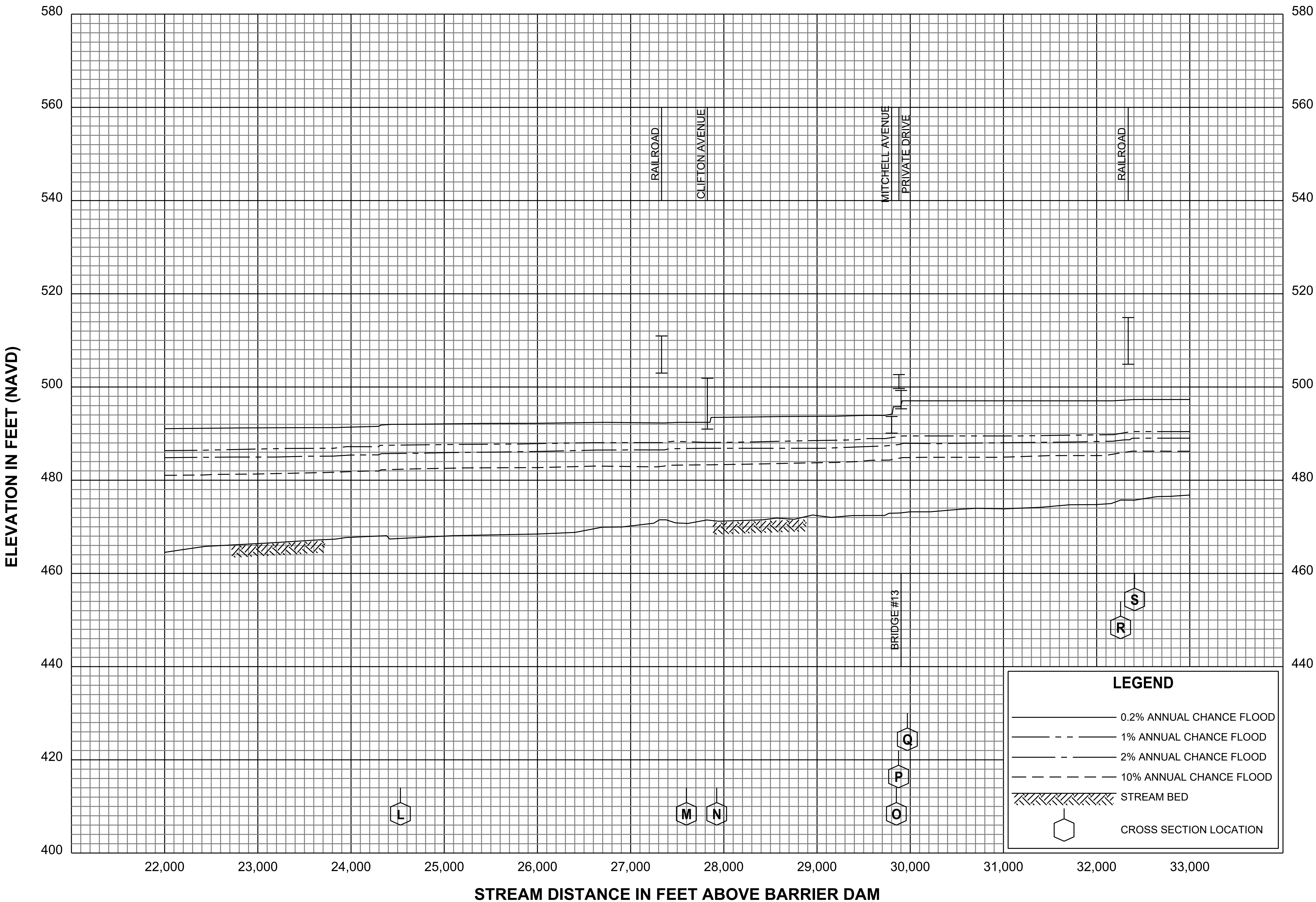
057P



FLOOD PROFILES

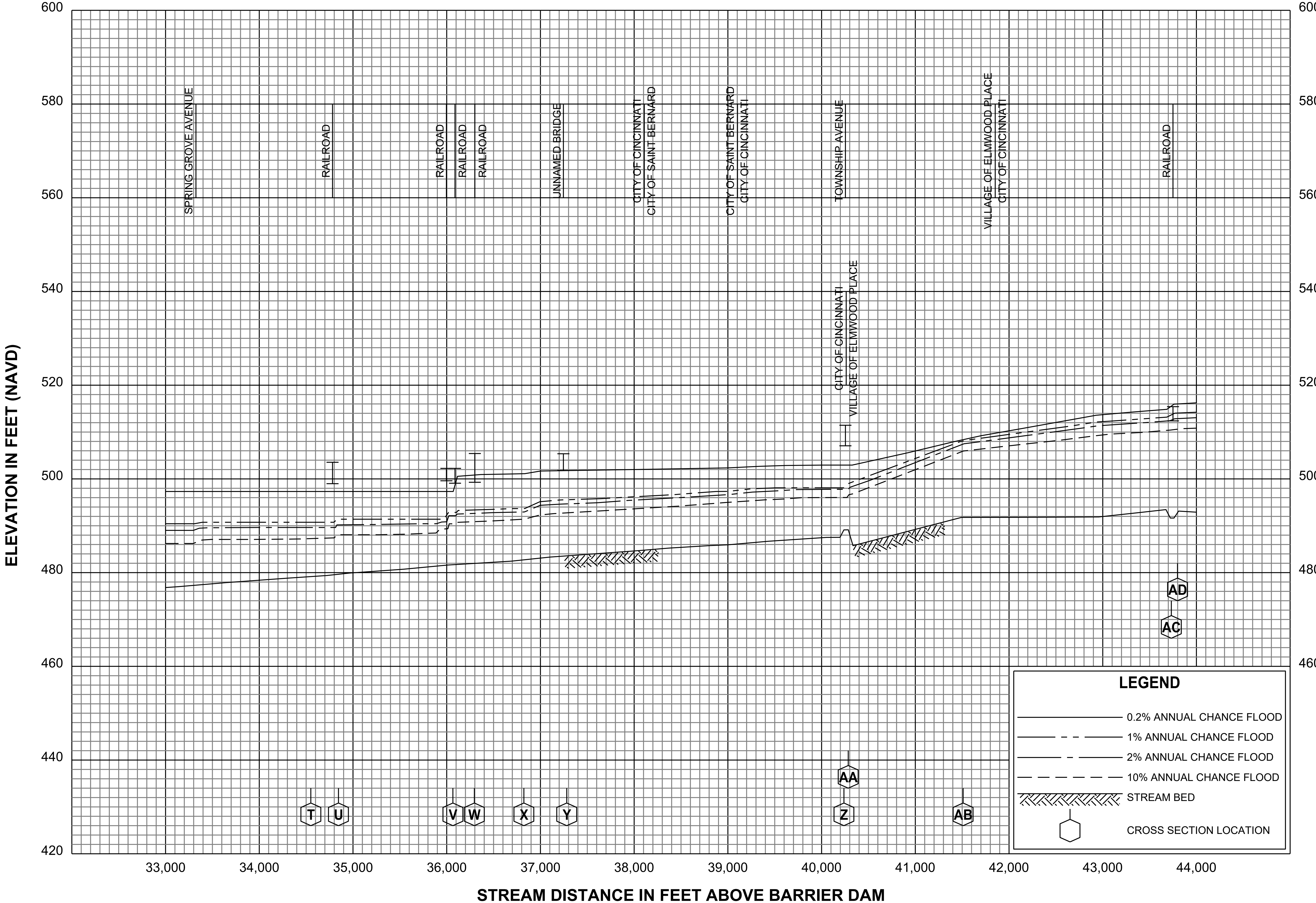
MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

058P



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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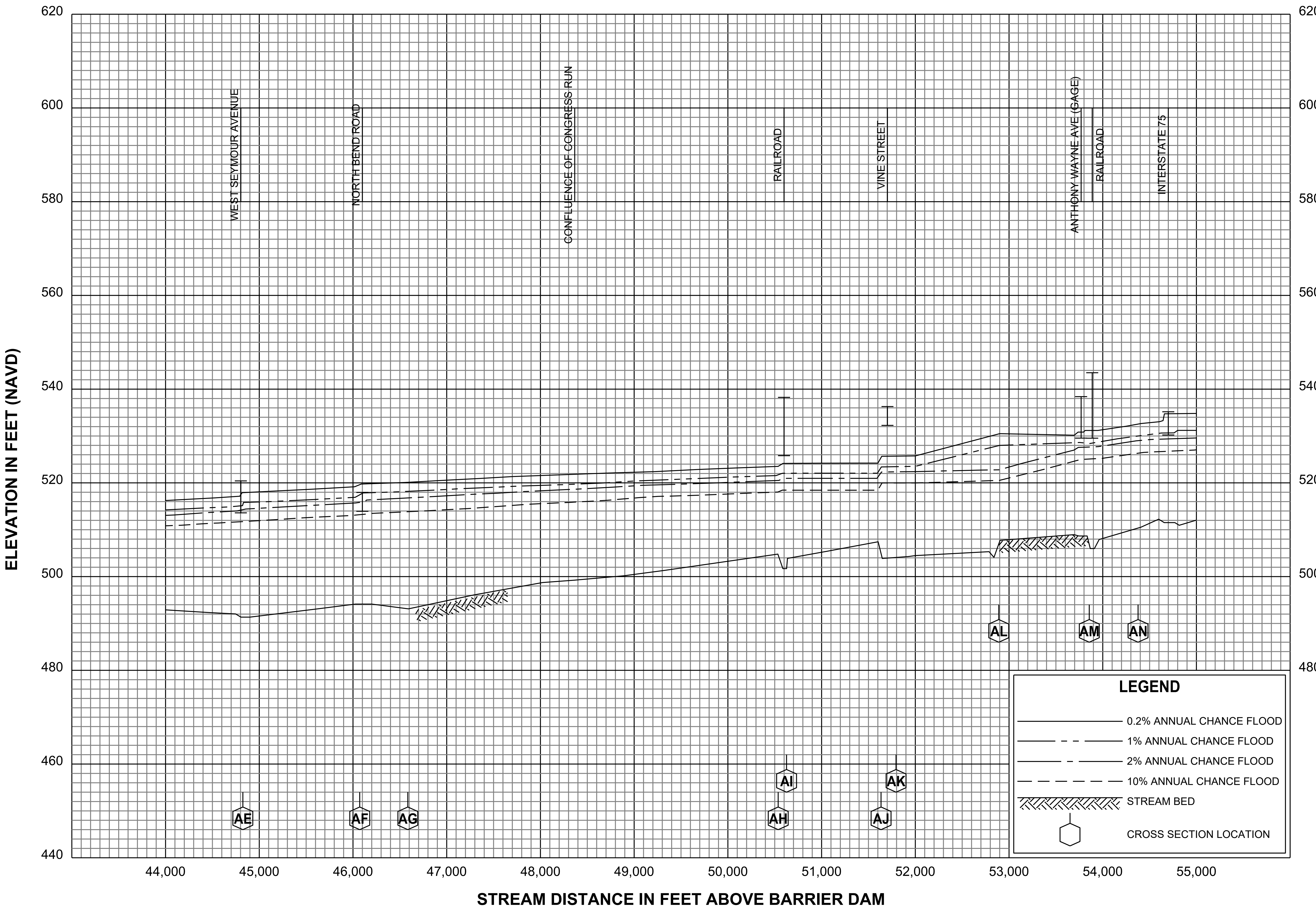
059P



FLOOD PROFILES

MILL CREEK

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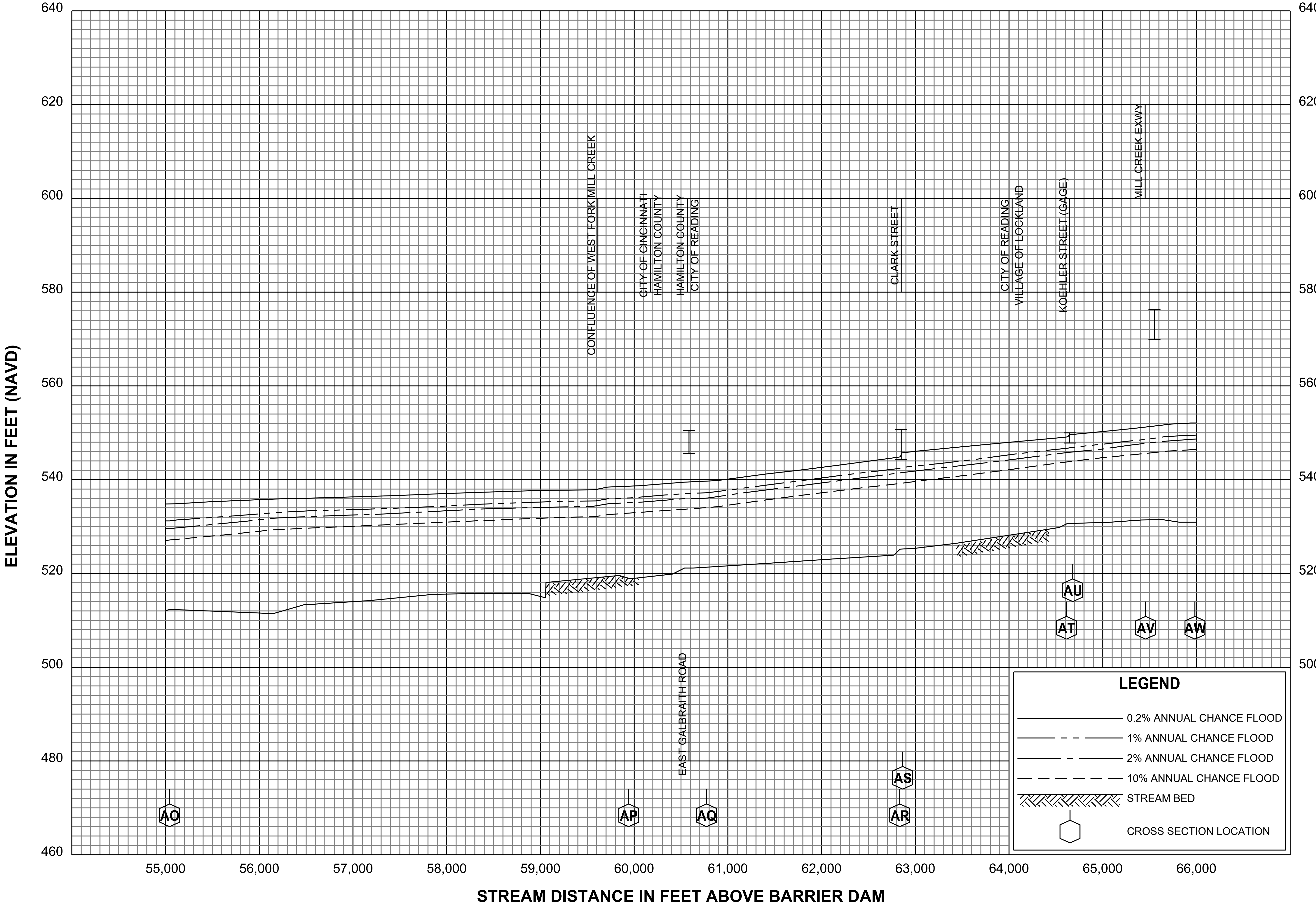
060P



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

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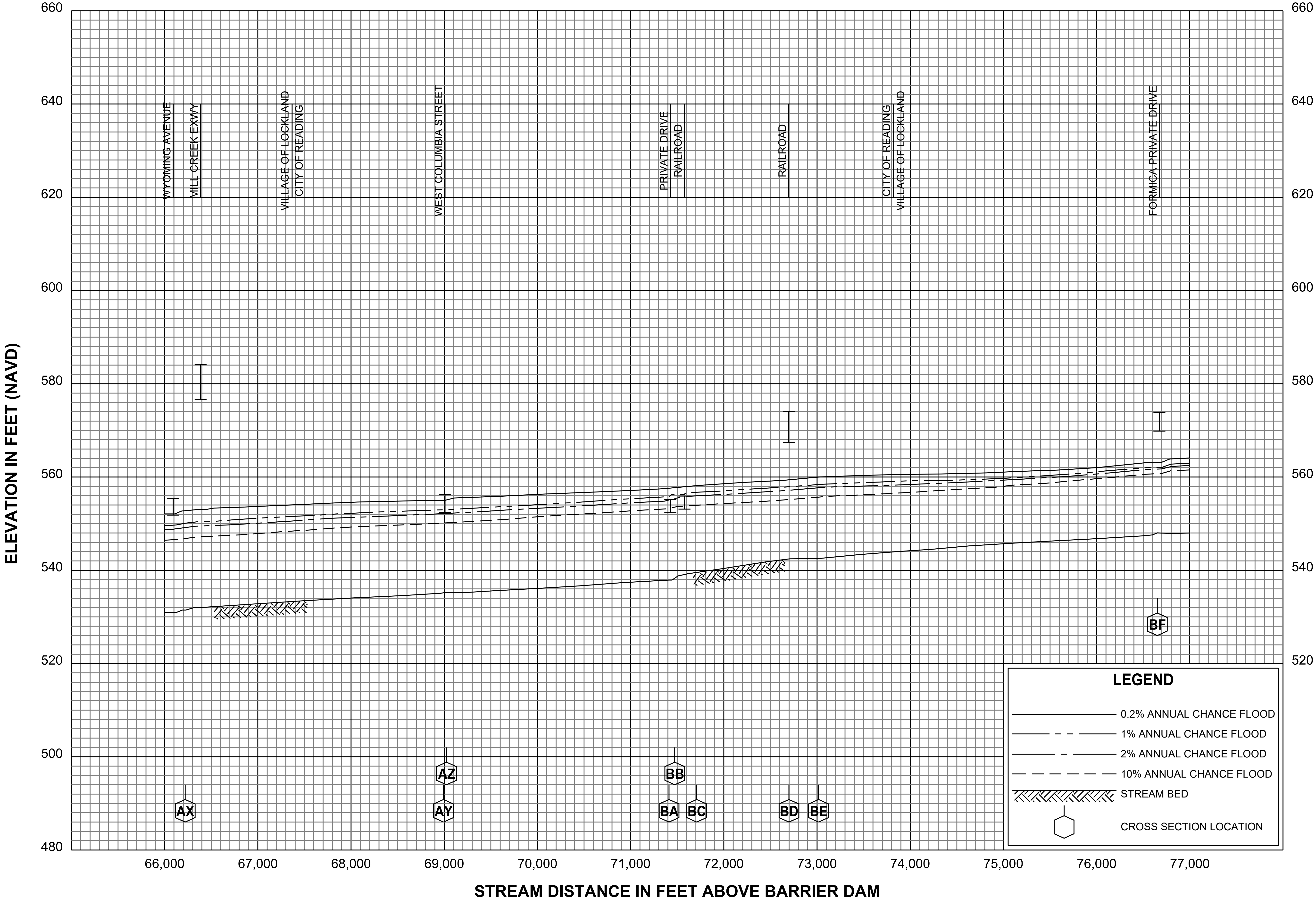
061P



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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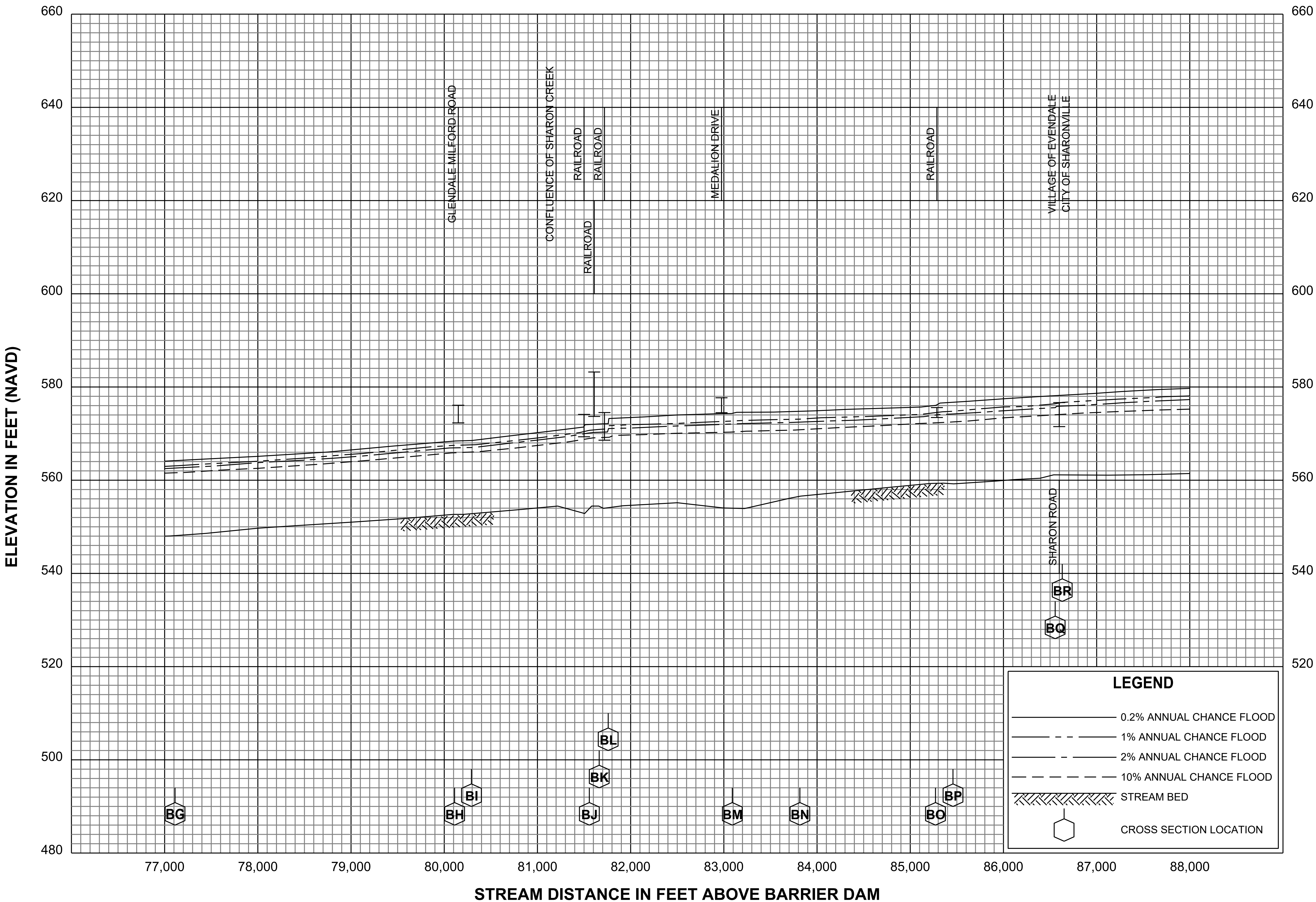

FLOOD PROFILES

MILL CREEK

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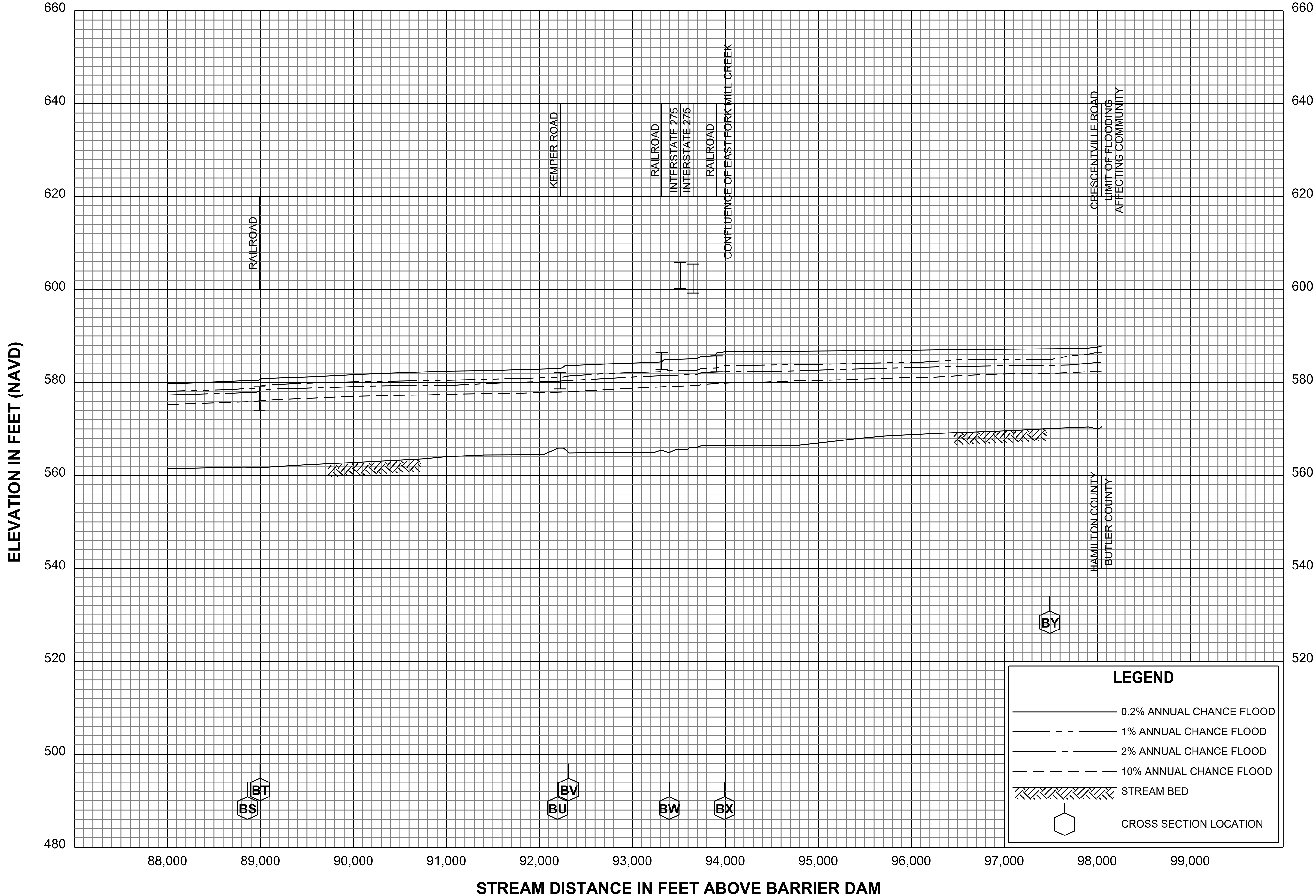

FLOOD PROFILES

MILL CREEK

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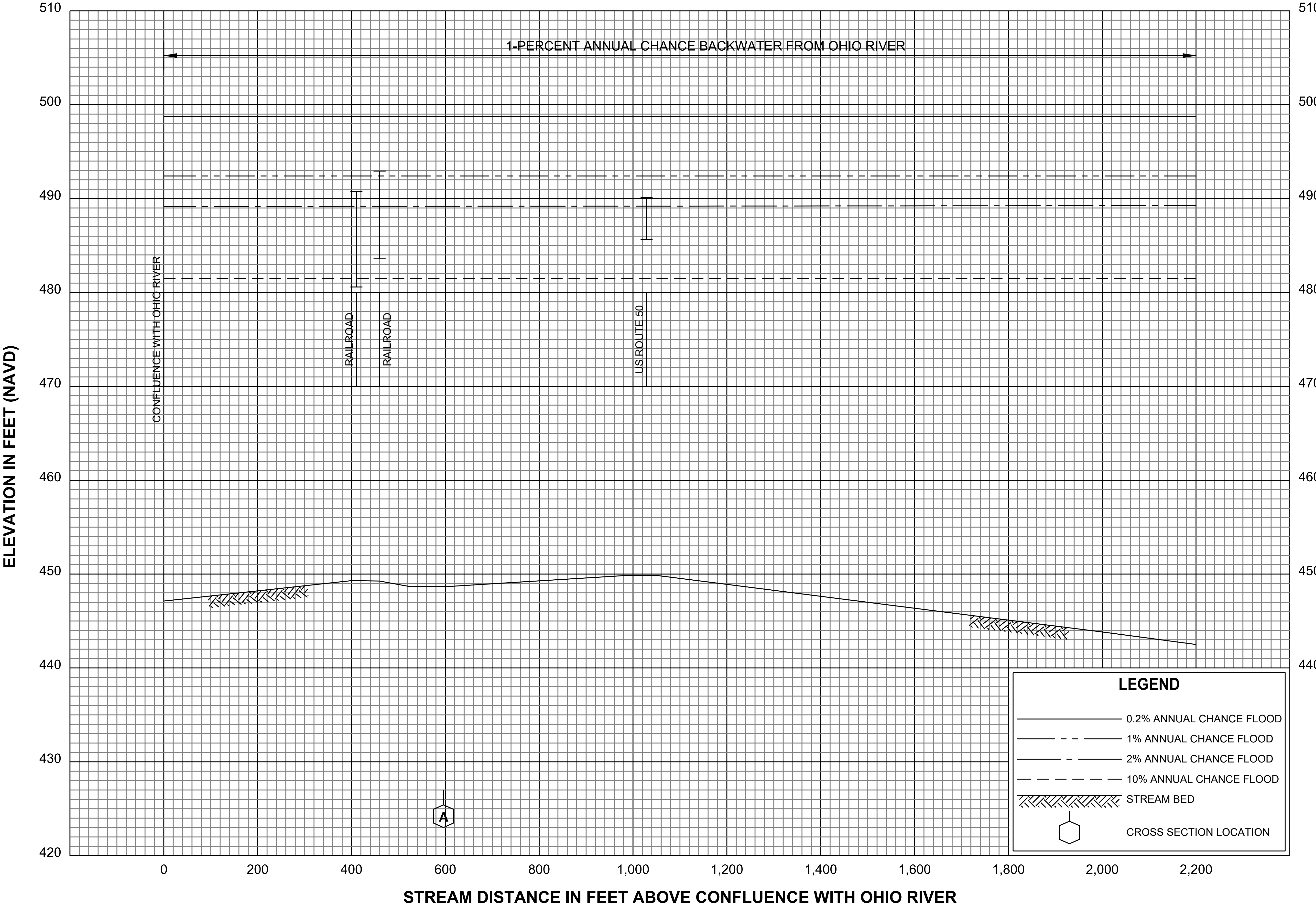

FLOOD PROFILES

MUDDY CREEK

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HAMILTON COUNTY, OH

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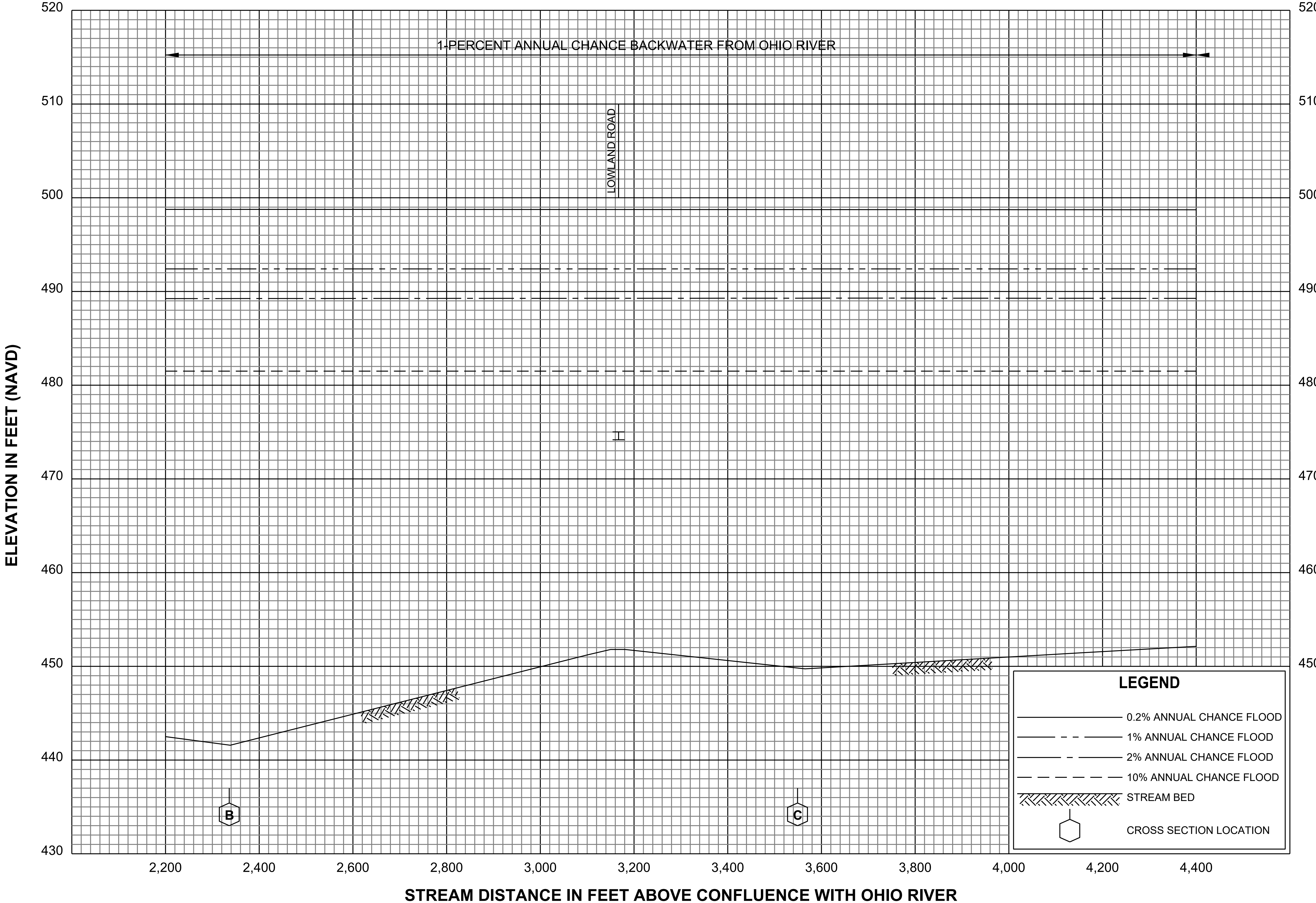
065P



FLOOD PROFILES

MUDDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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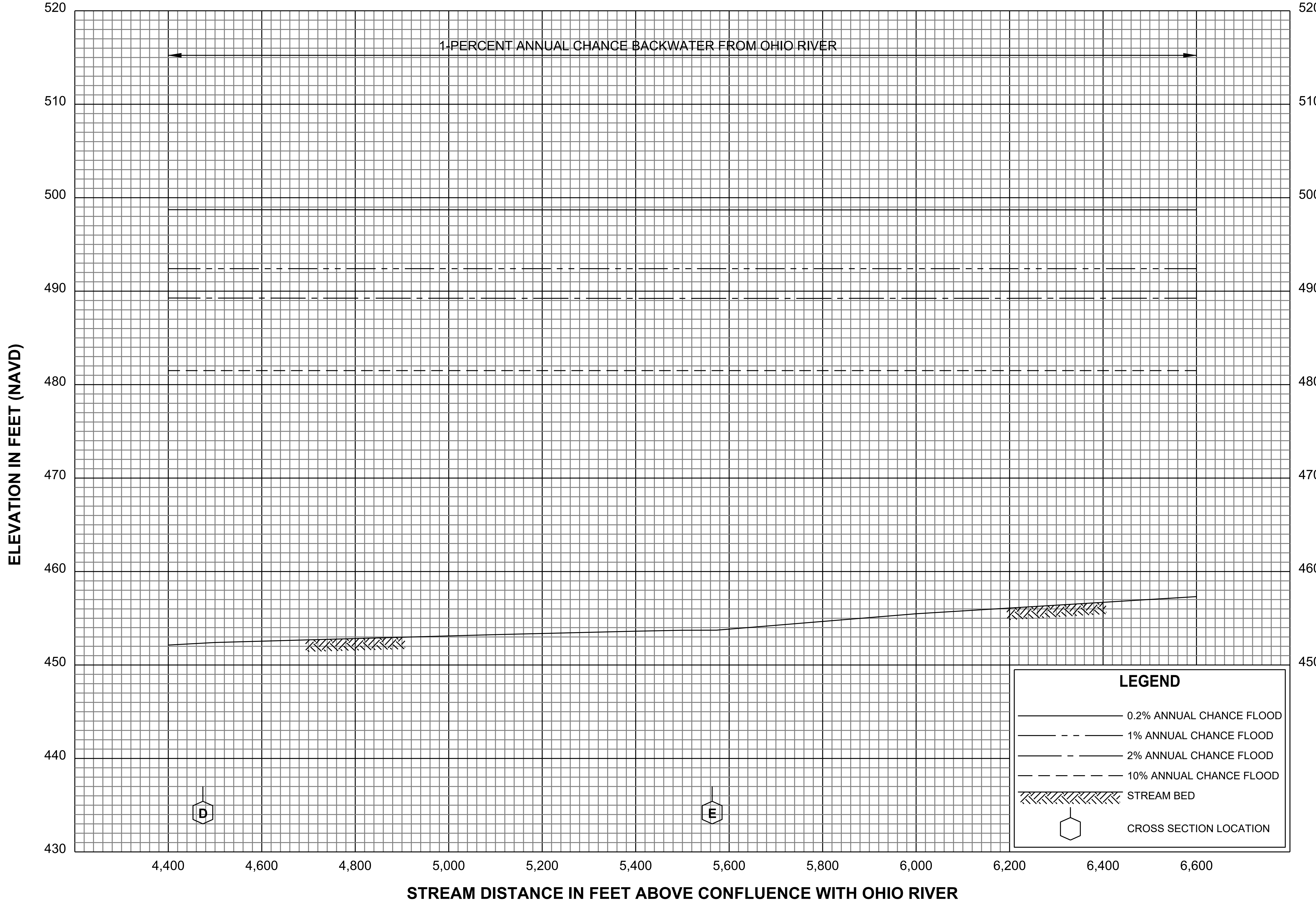
066P



FLOOD PROFILES

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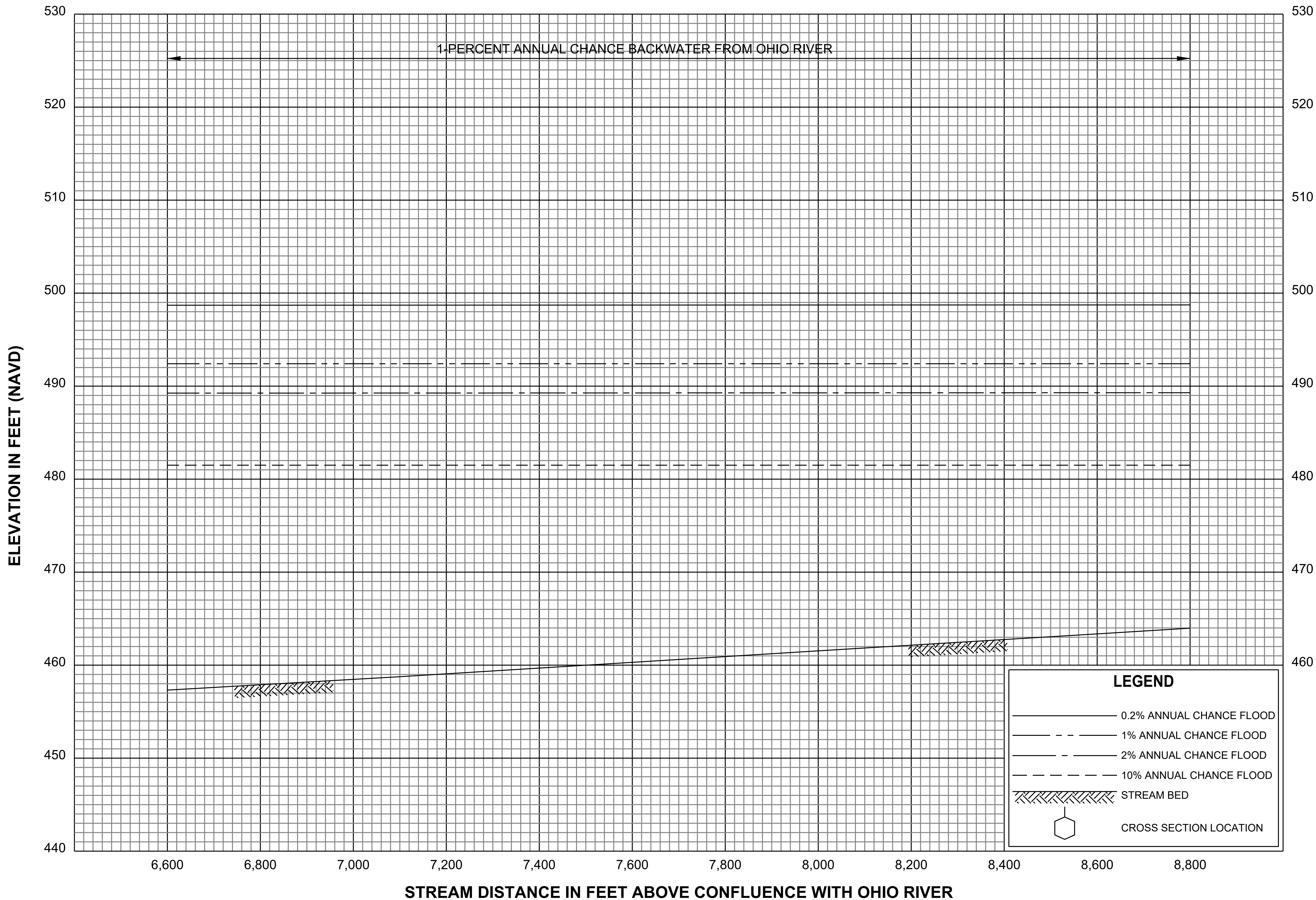

FLOOD PROFILES

MUDDY CREEK

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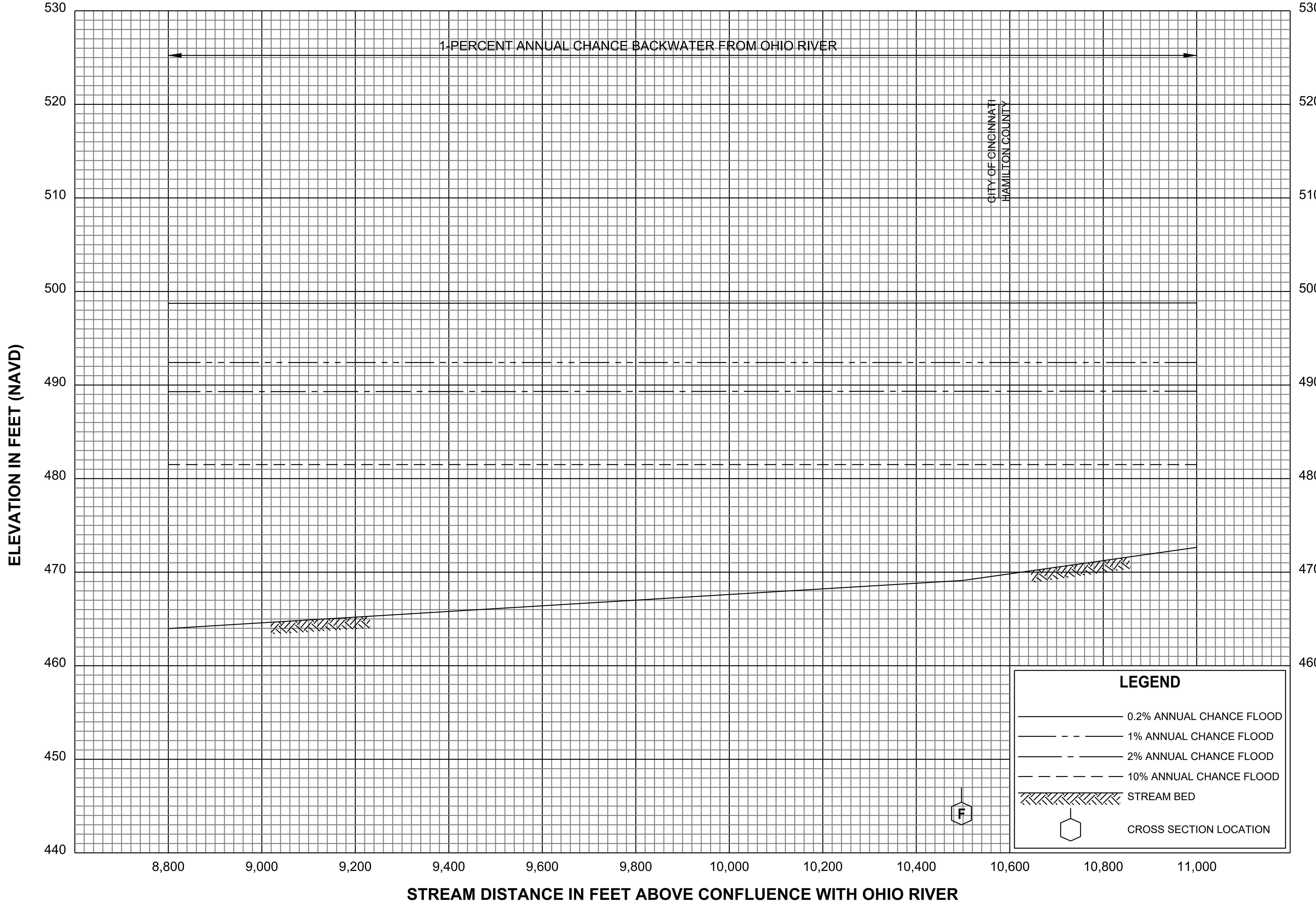

FLOOD PROFILES

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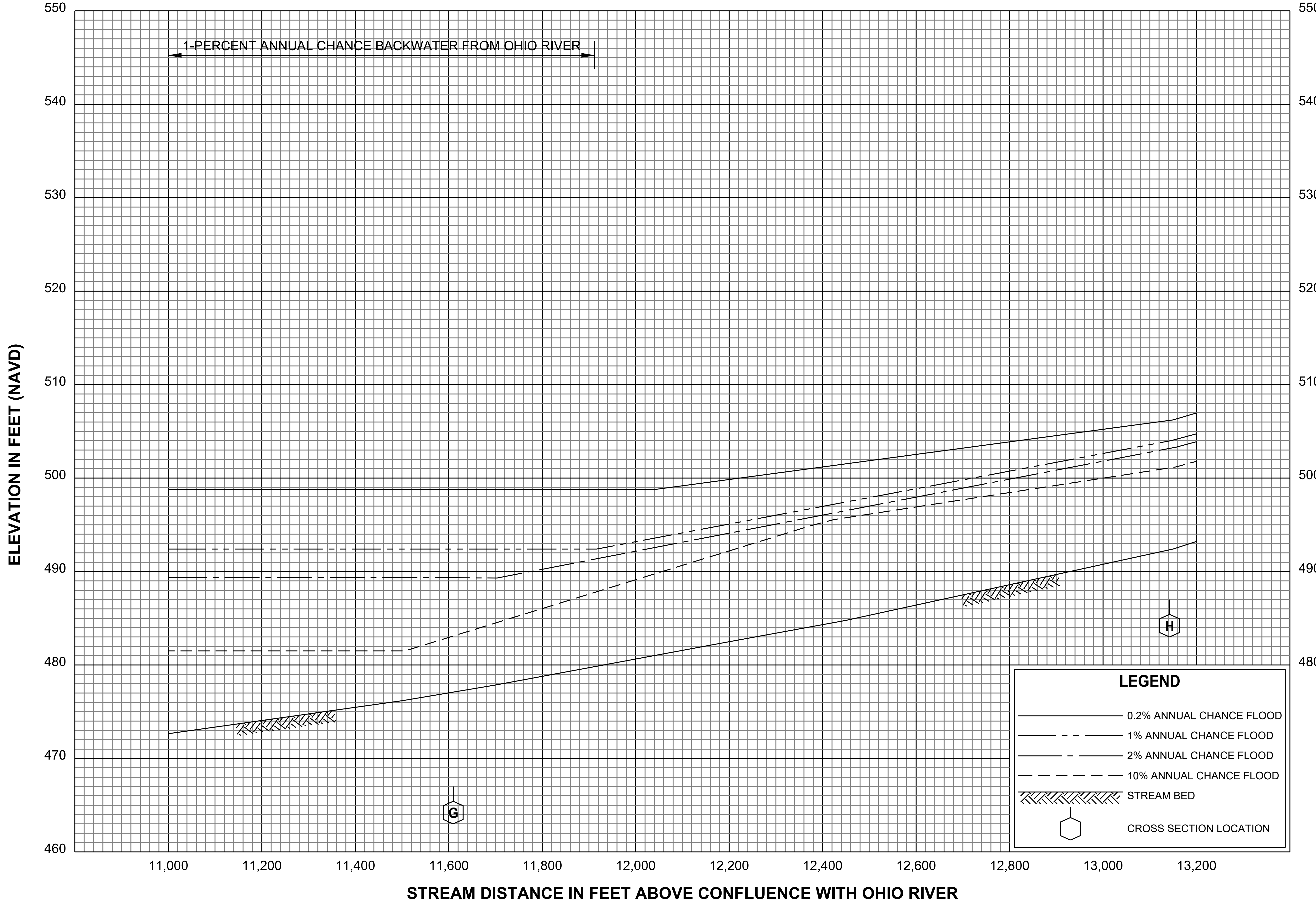

FLOOD PROFILES

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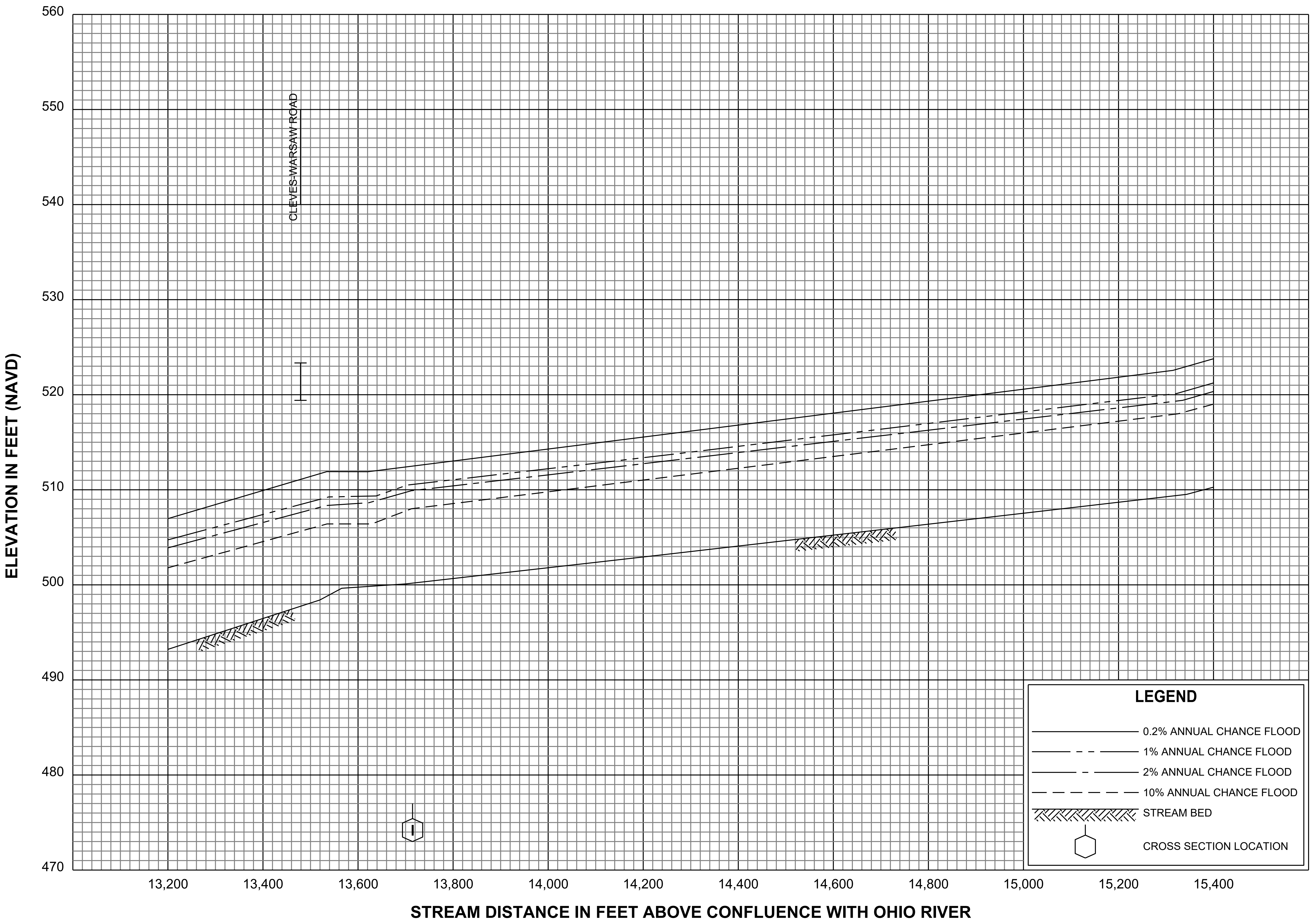

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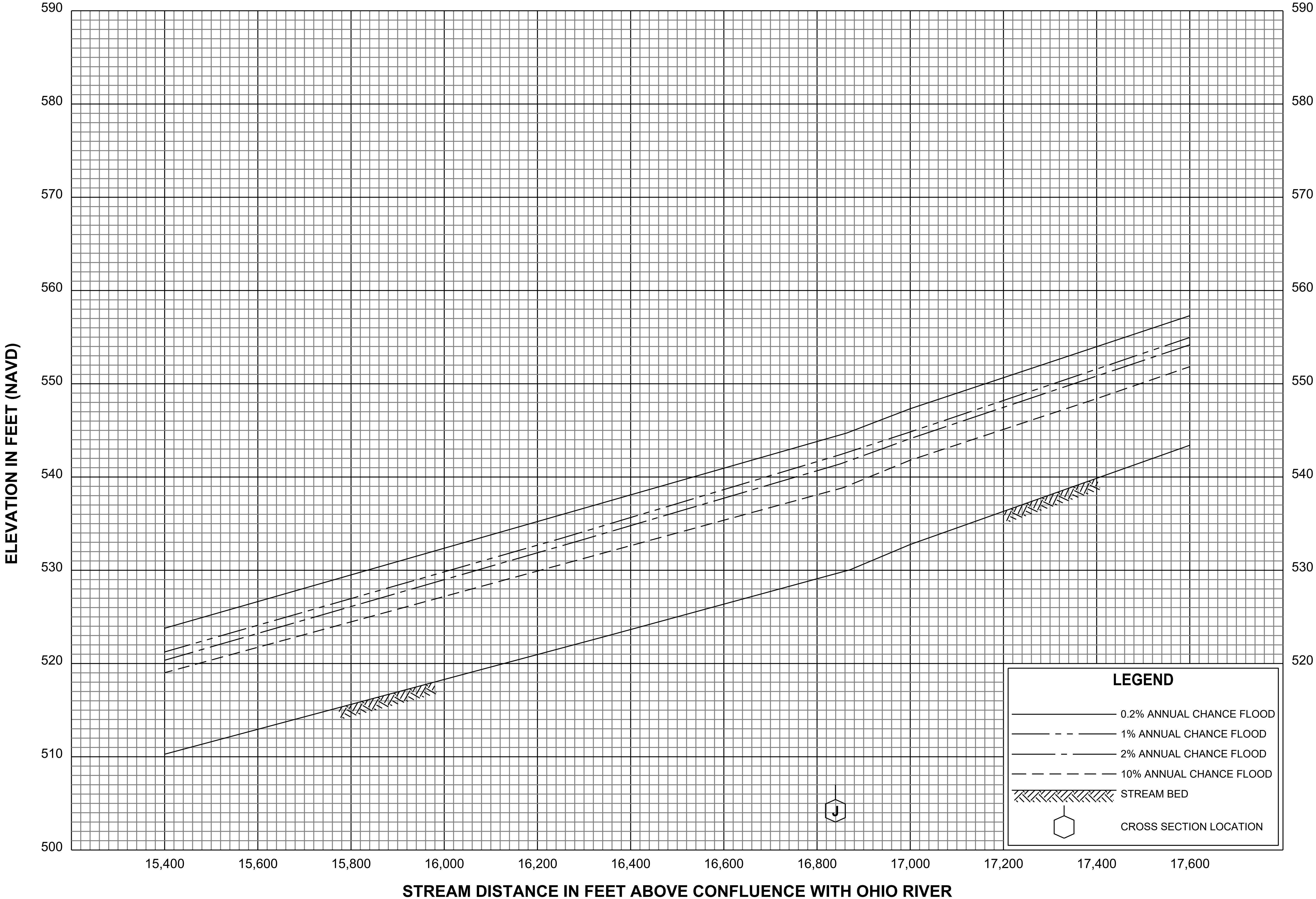

FLOOD PROFILES

MUDDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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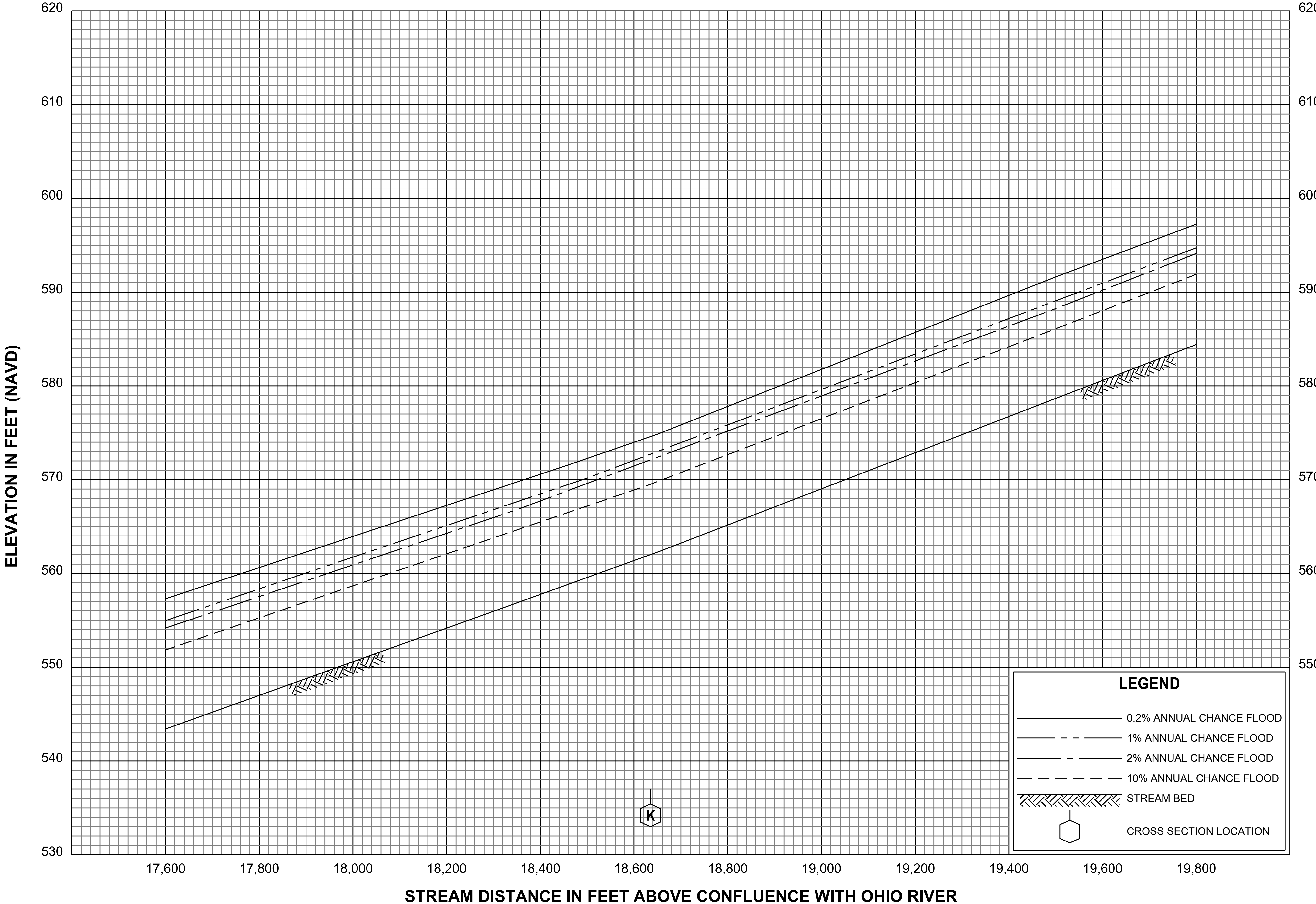

FLOOD PROFILES

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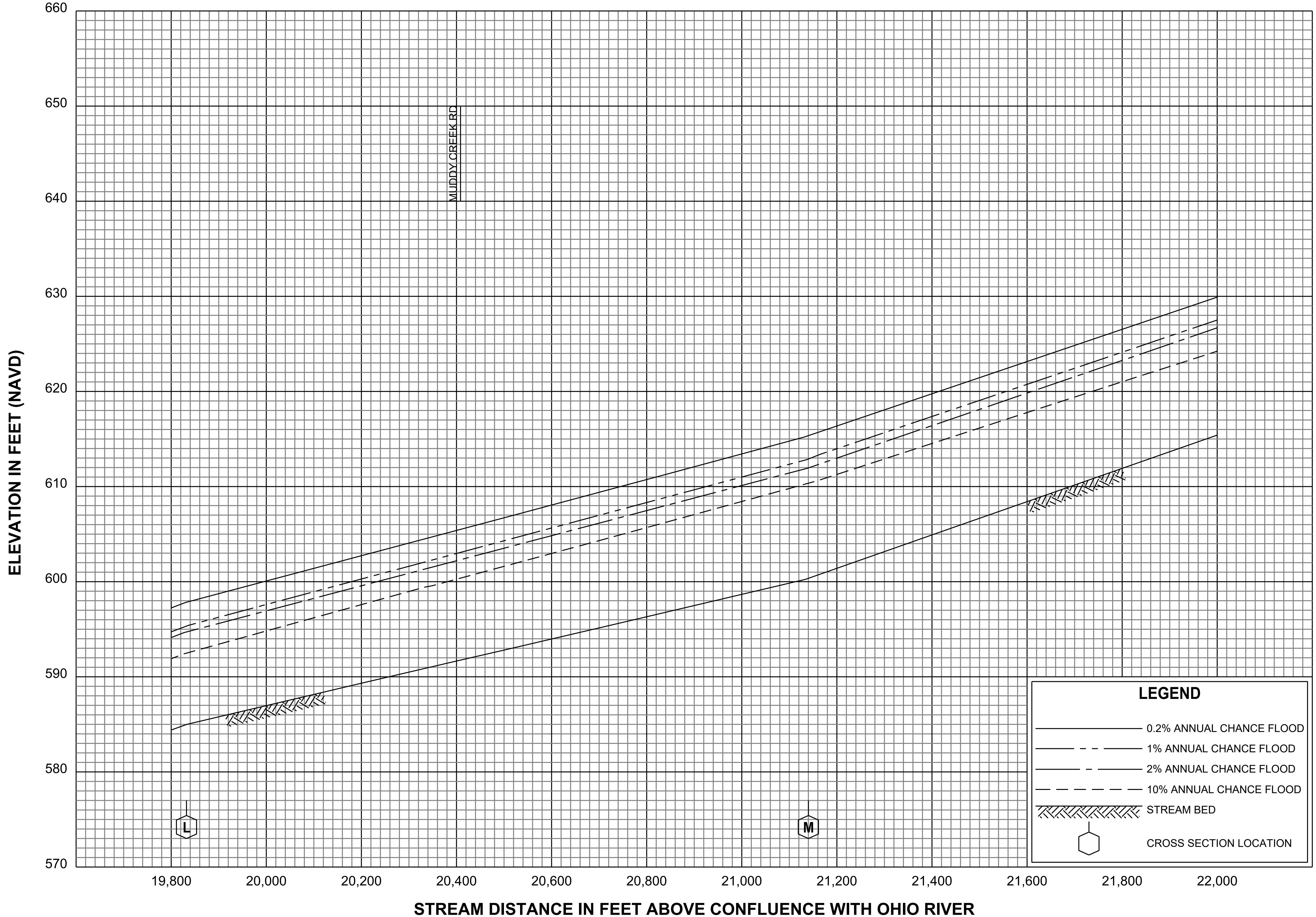

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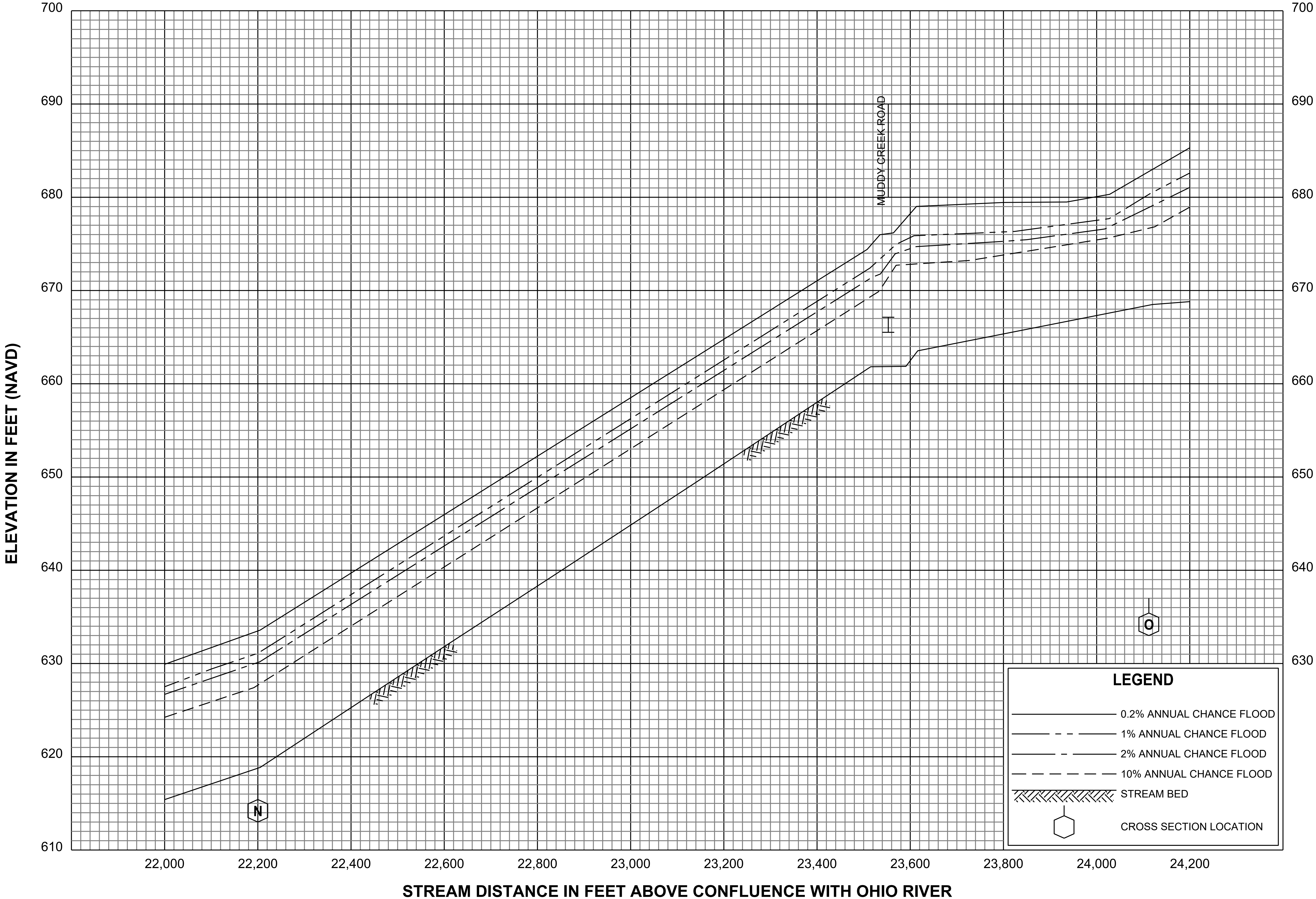

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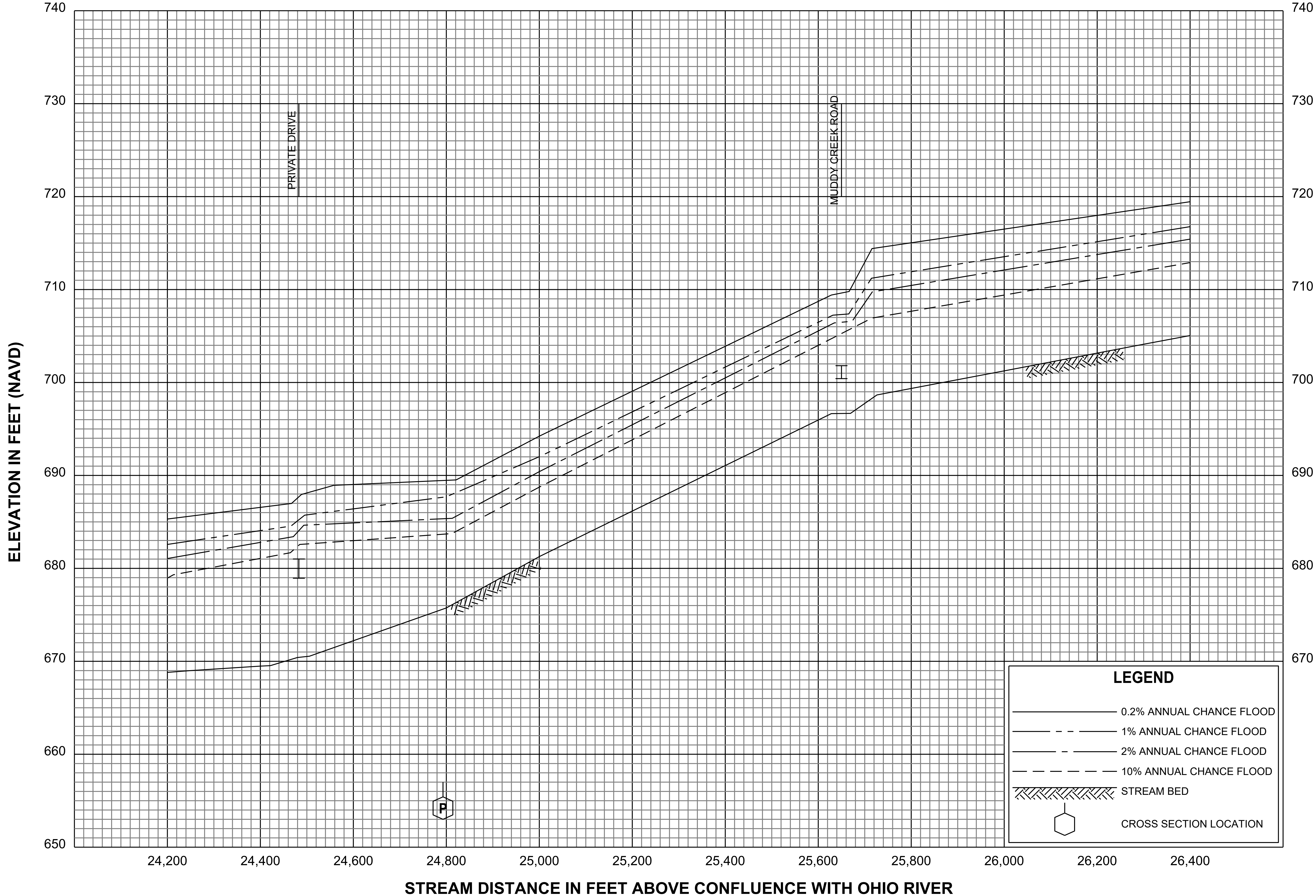

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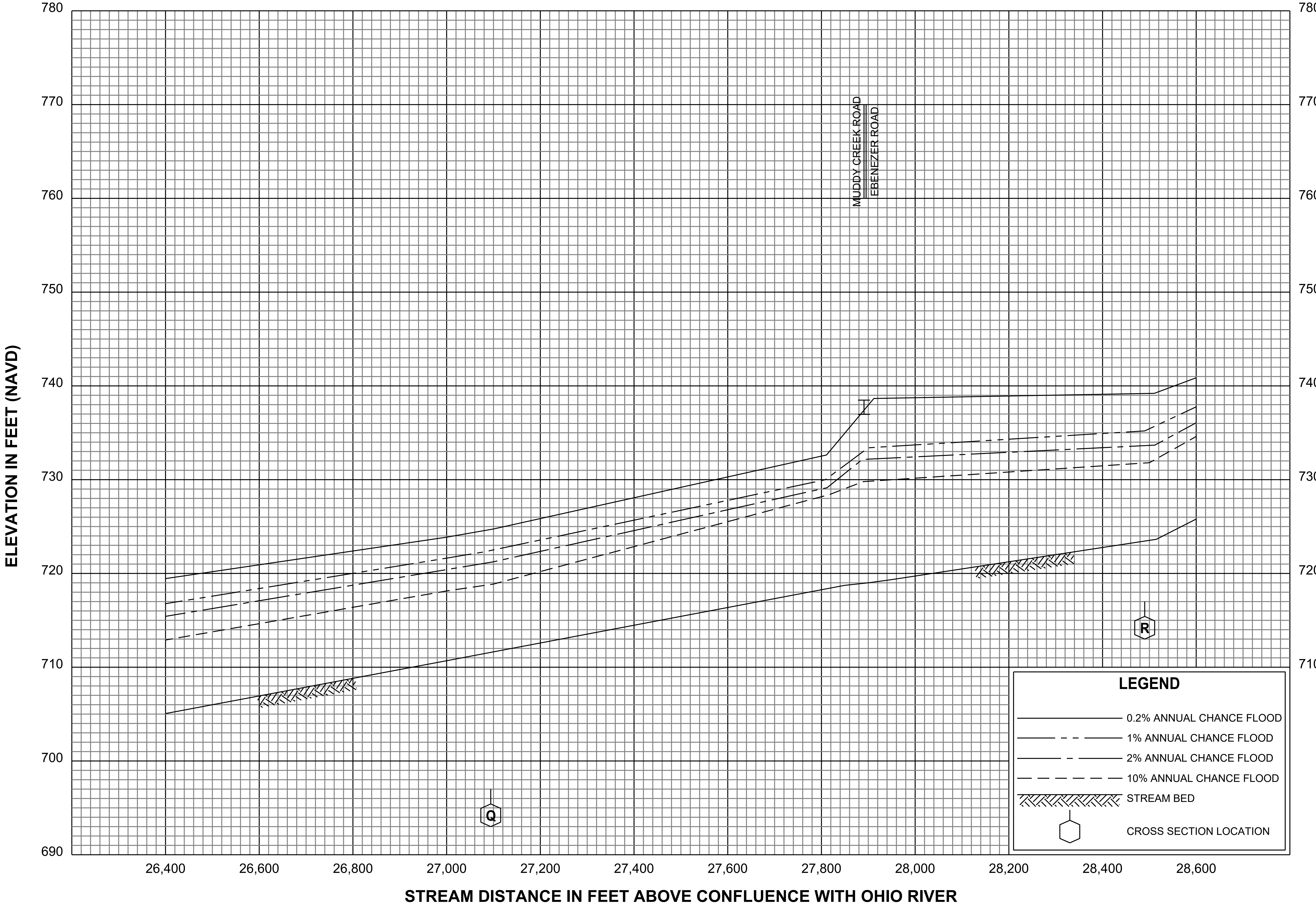

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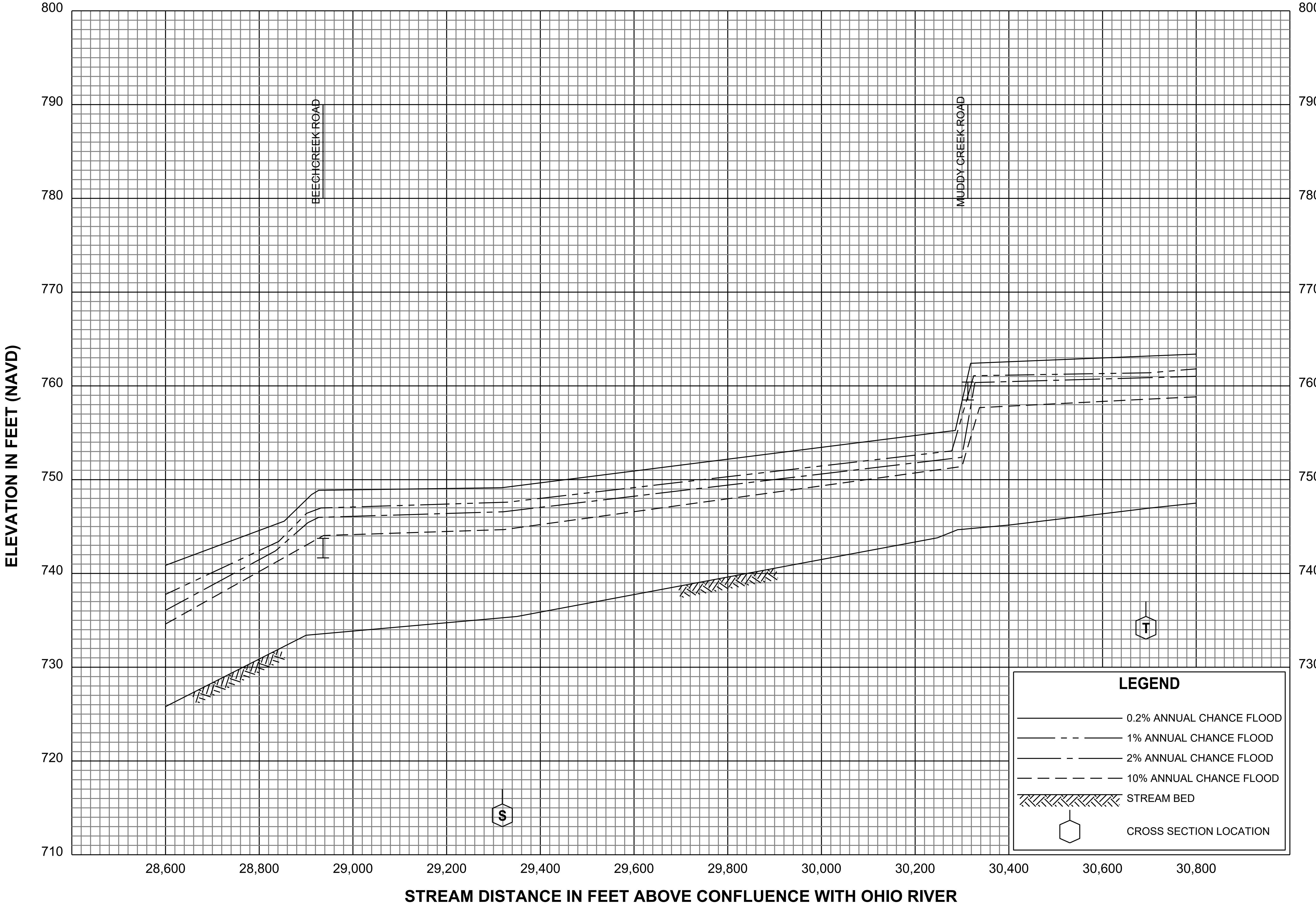

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FEDERAL EMERGENCY MANAGEMENT AGENCY

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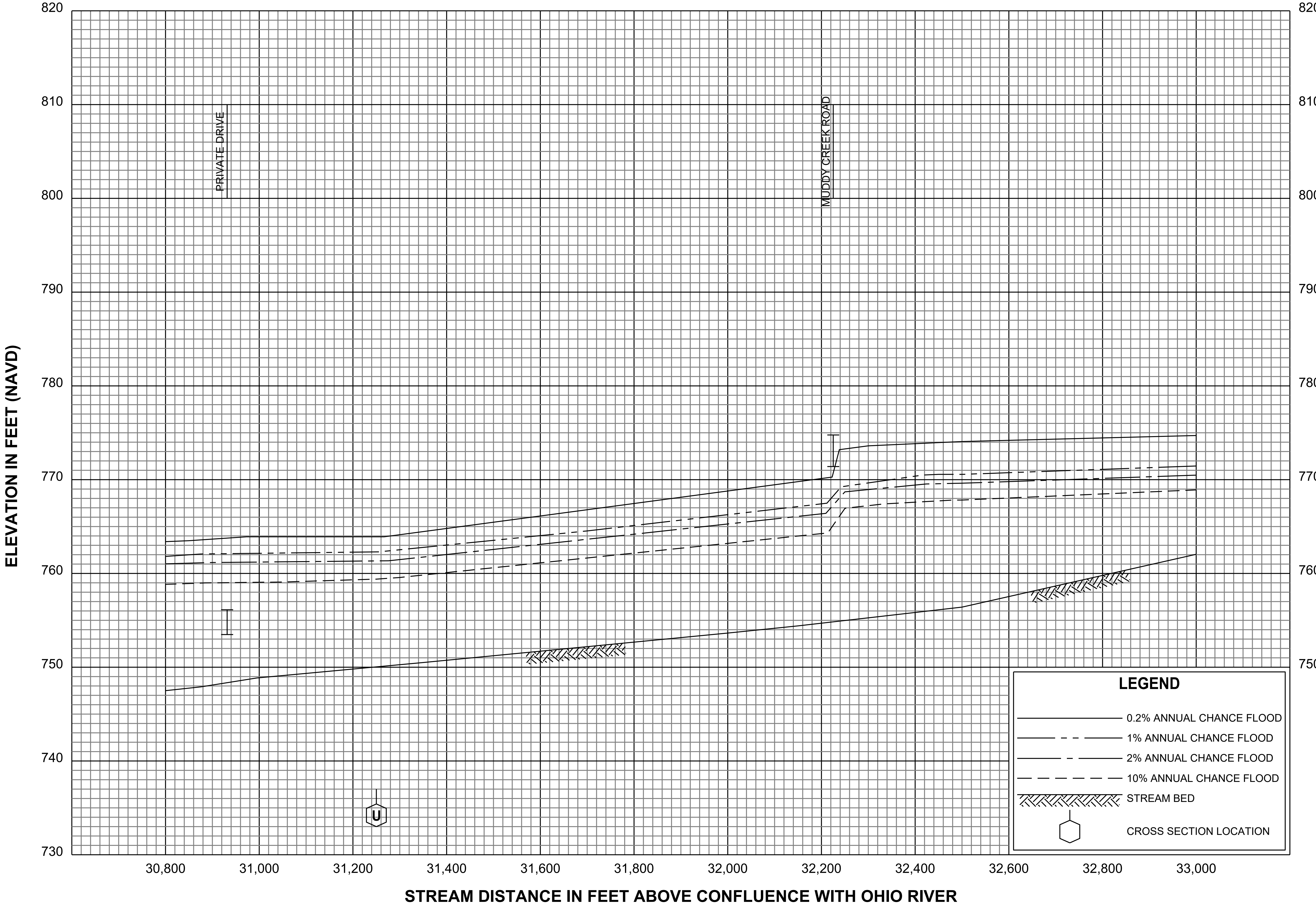

FLOOD PROFILES

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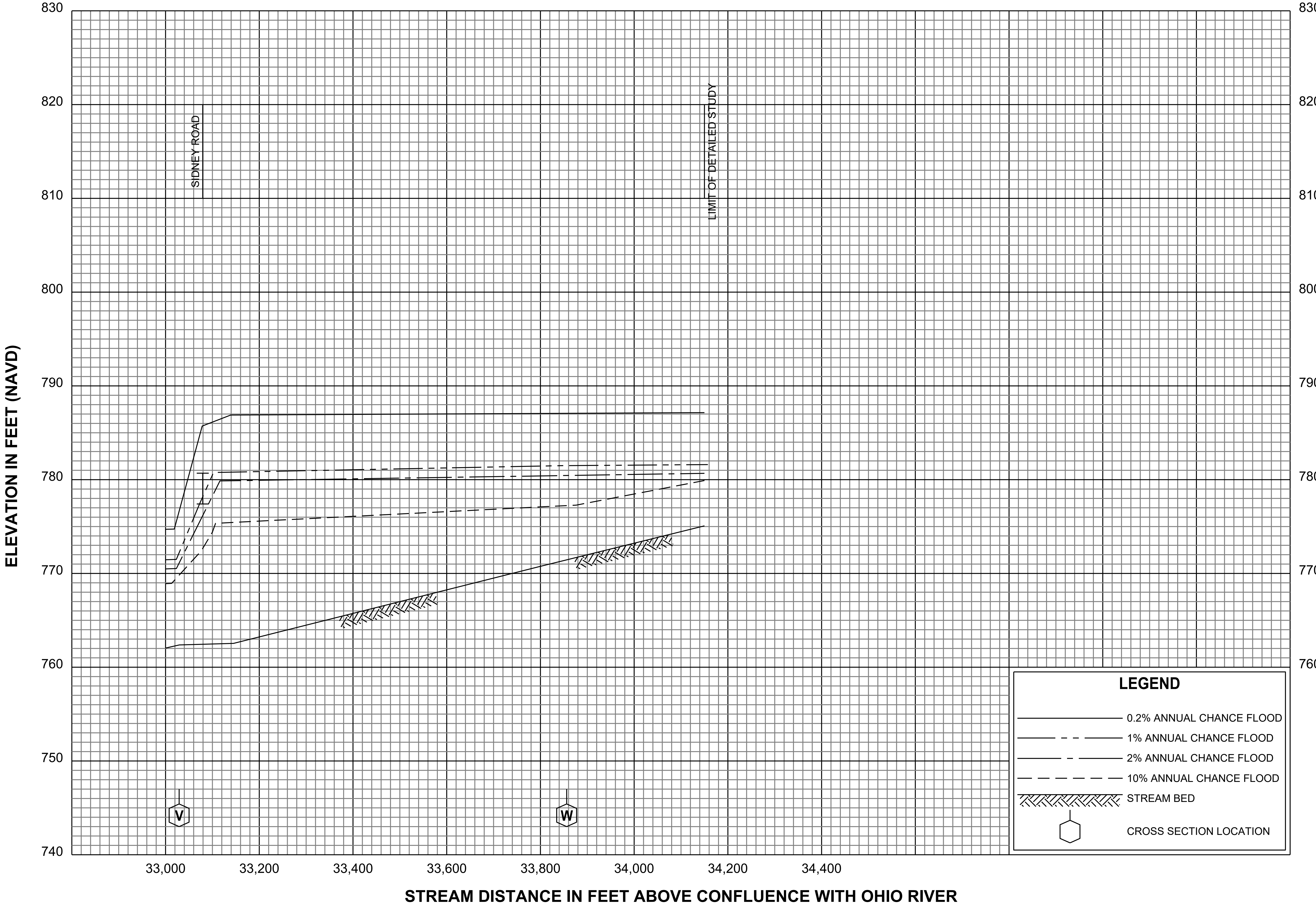

FLOOD PROFILES

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FEDERAL EMERGENCY MANAGEMENT AGENCY

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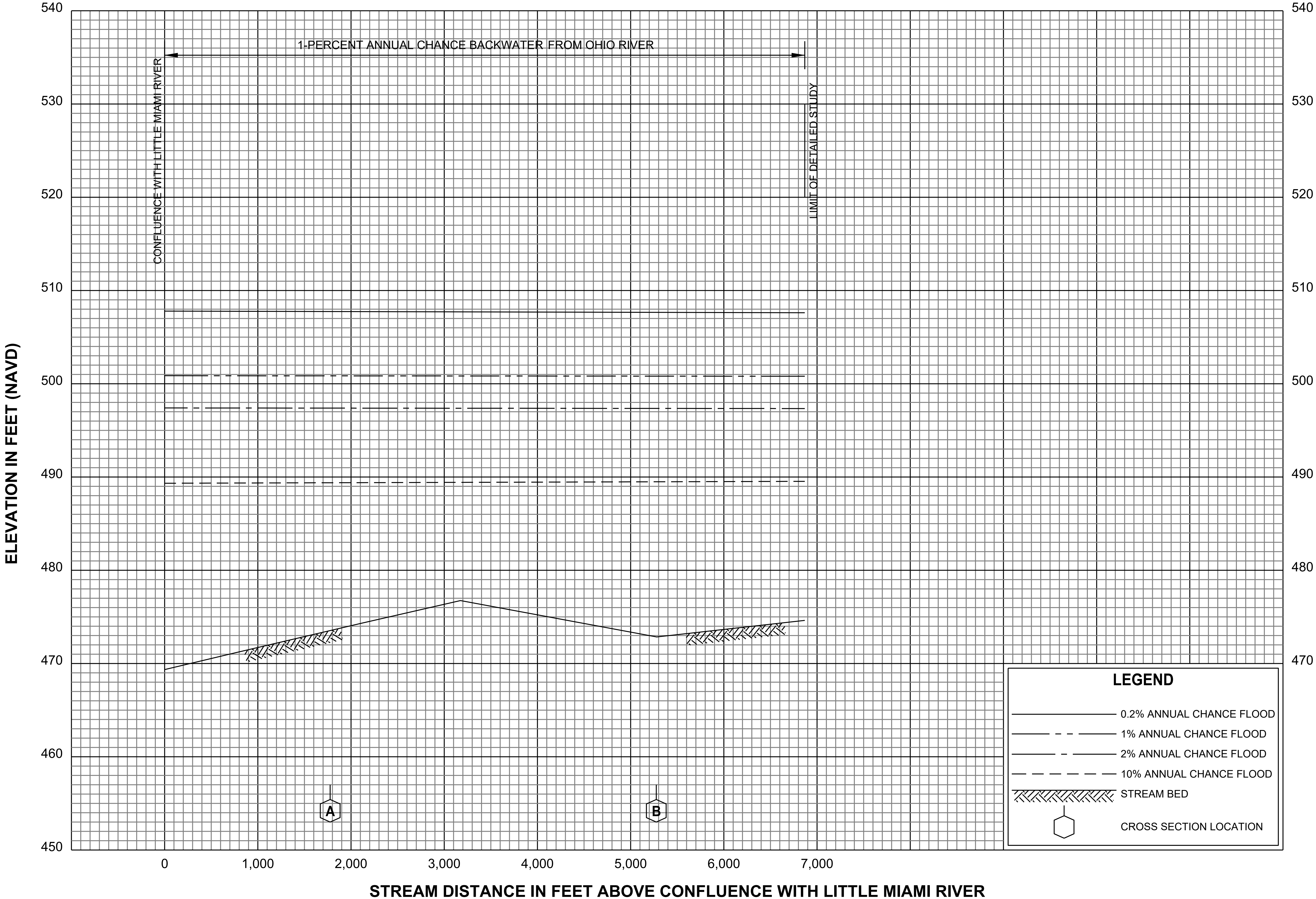

FLOOD PROFILES

NEWTON (CLEAR) CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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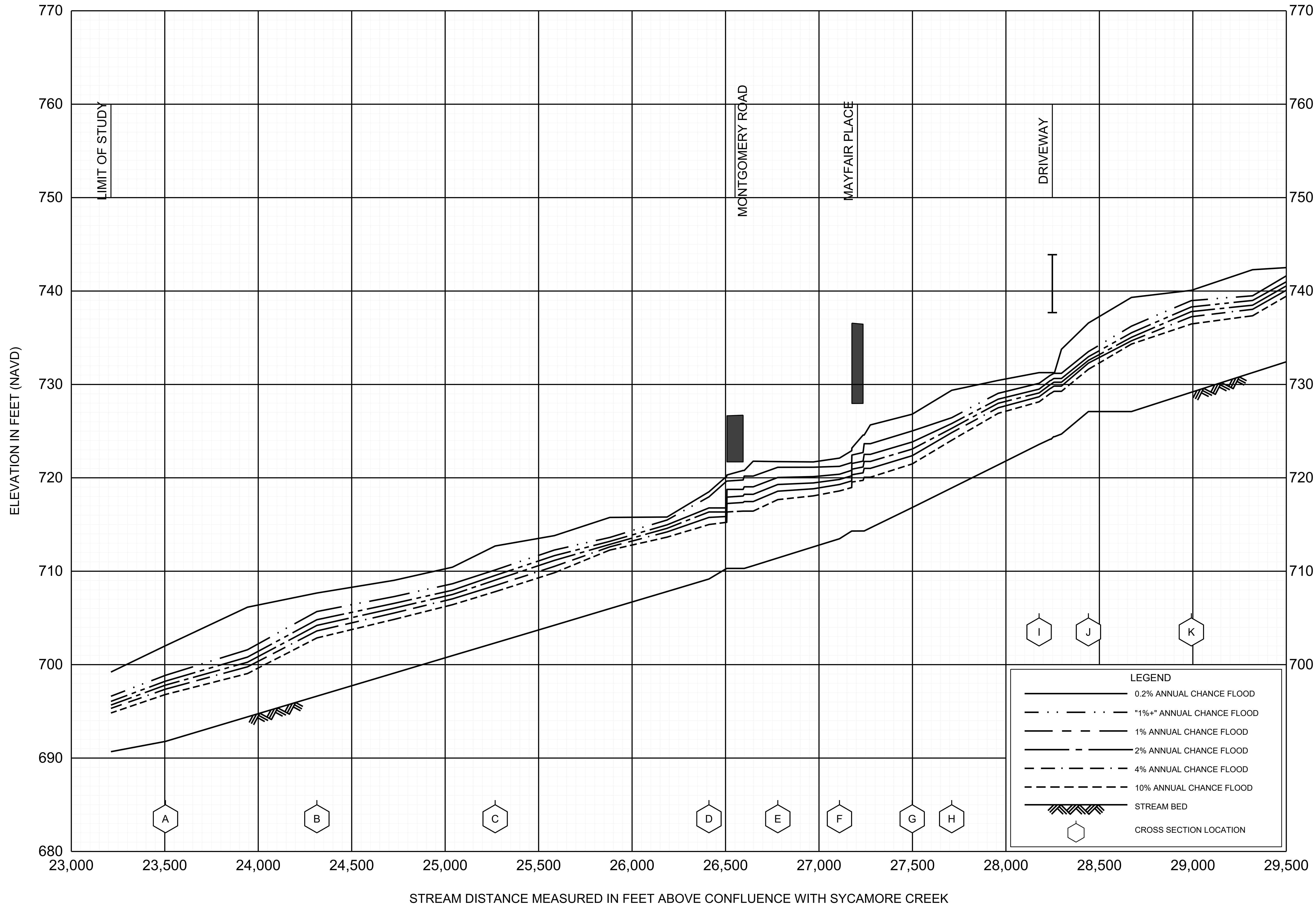

FLOOD PROFILES

NORTH BRANCH SYCAMORE CREEK

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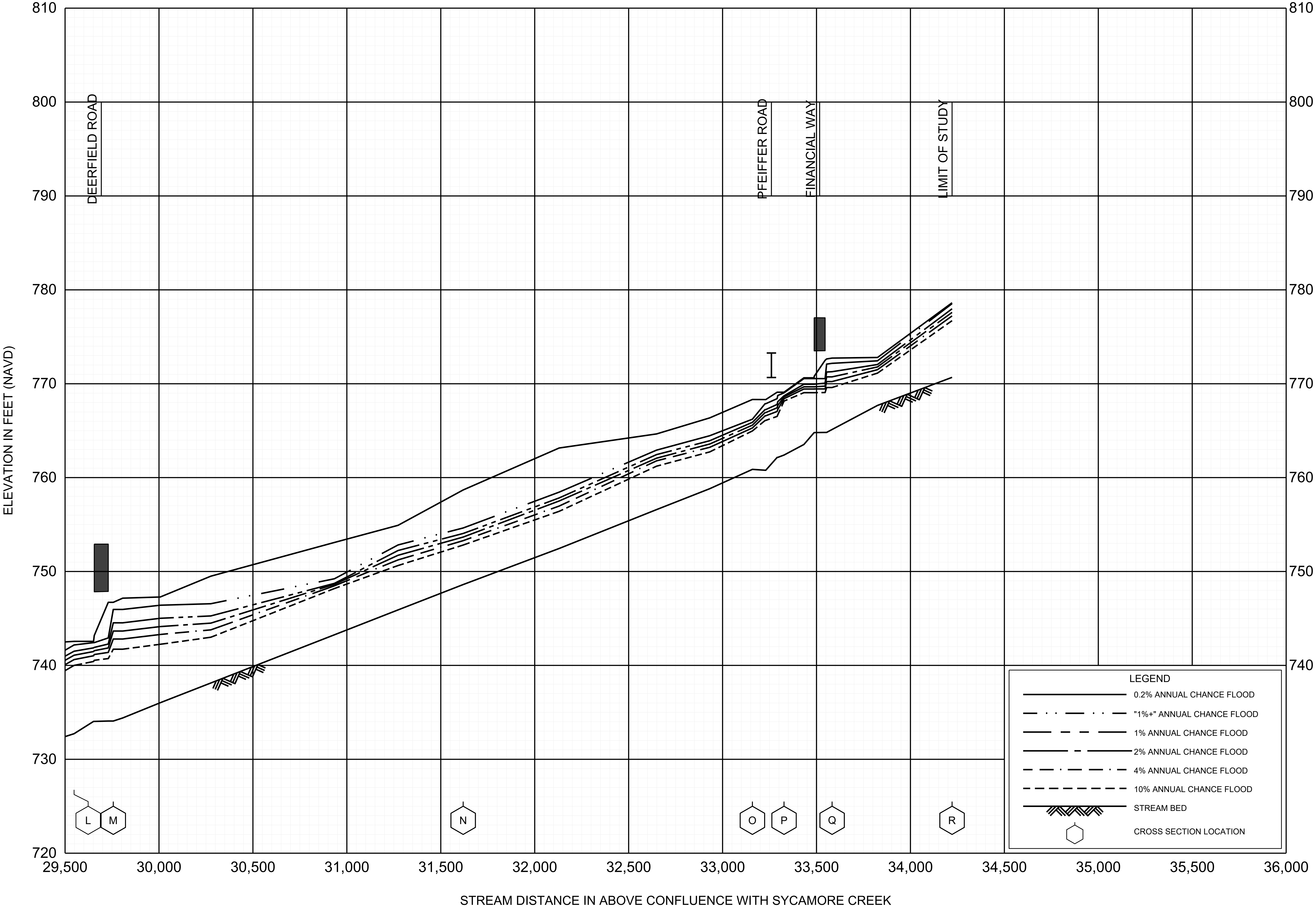

FLOOD PROFILES

NORTH BRANCH SYCAMORE CREEK

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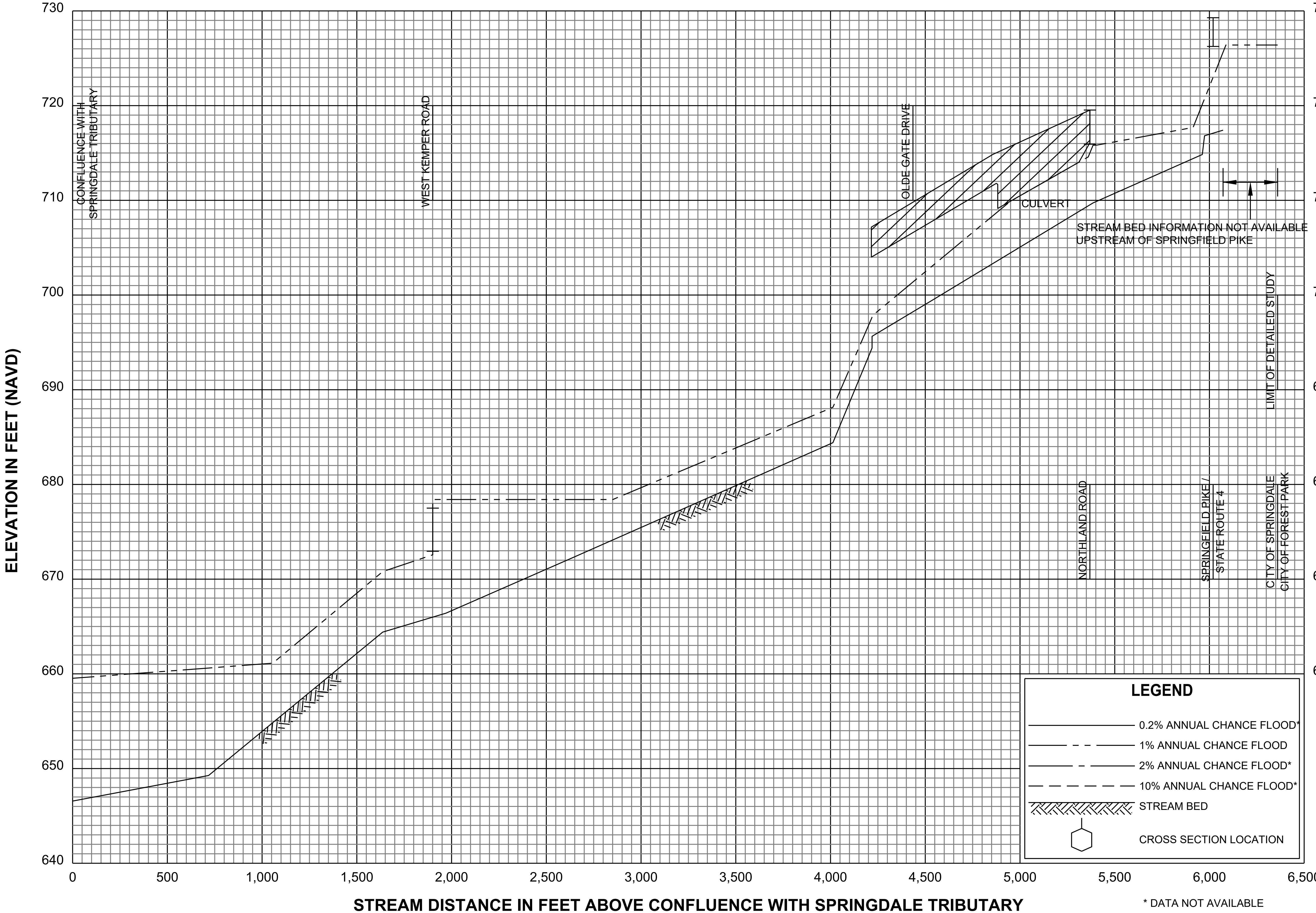
AND INCORPORATED AREAS

083P



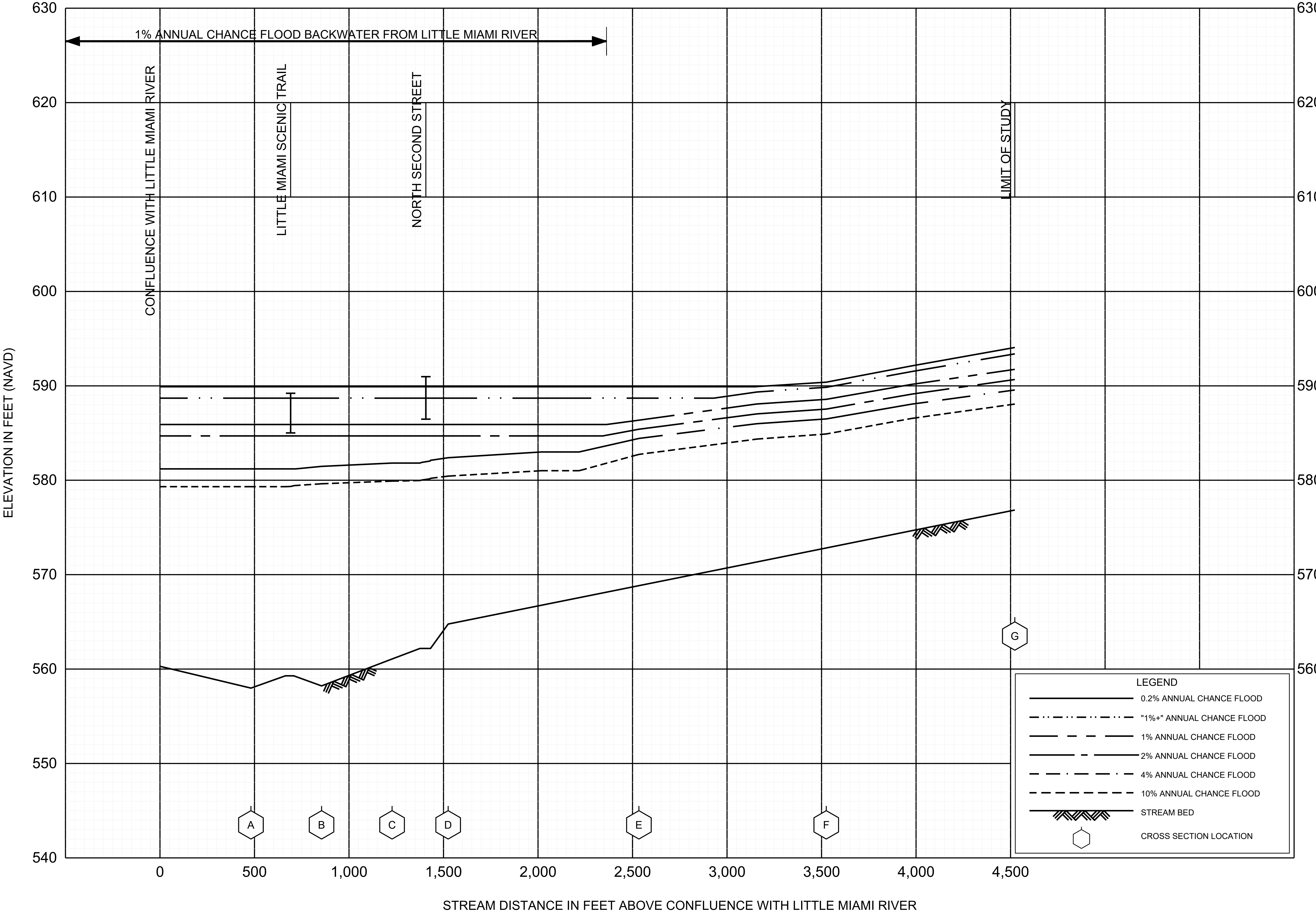
FLOOD PROFILES

NORTHLAND ROAD TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



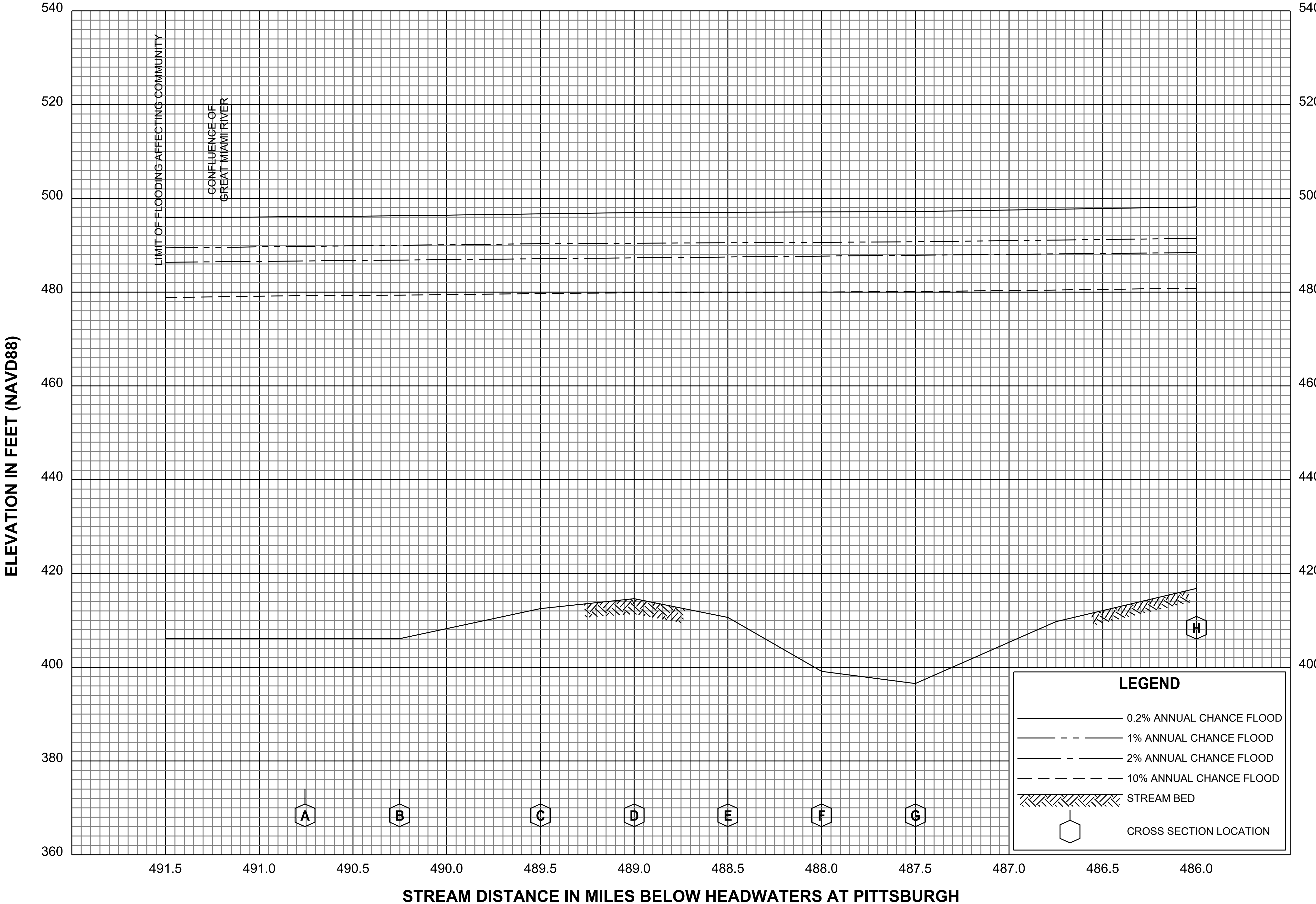
FLOOD PROFILES

O'BANNON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



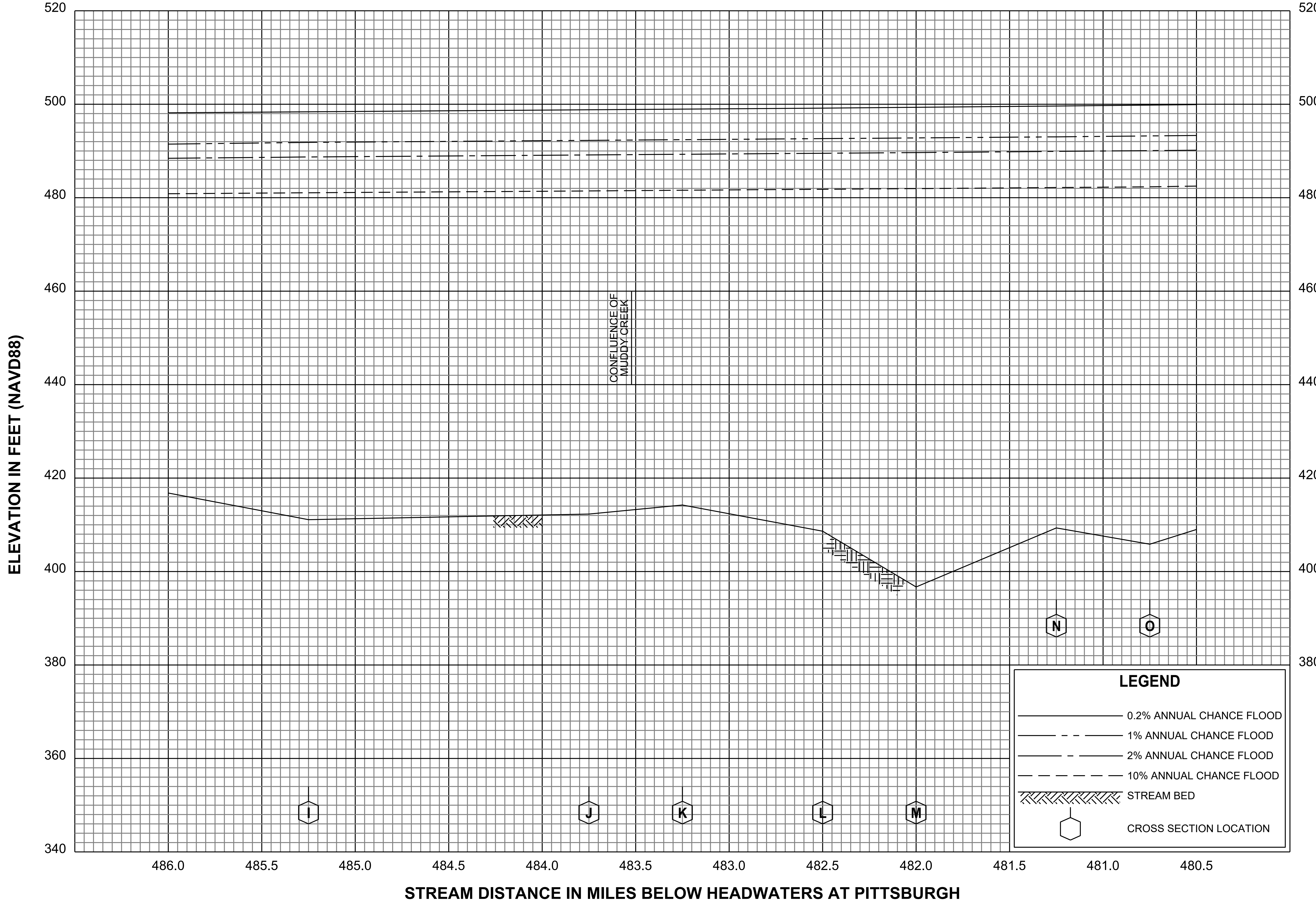
FLOOD PROFILES

OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

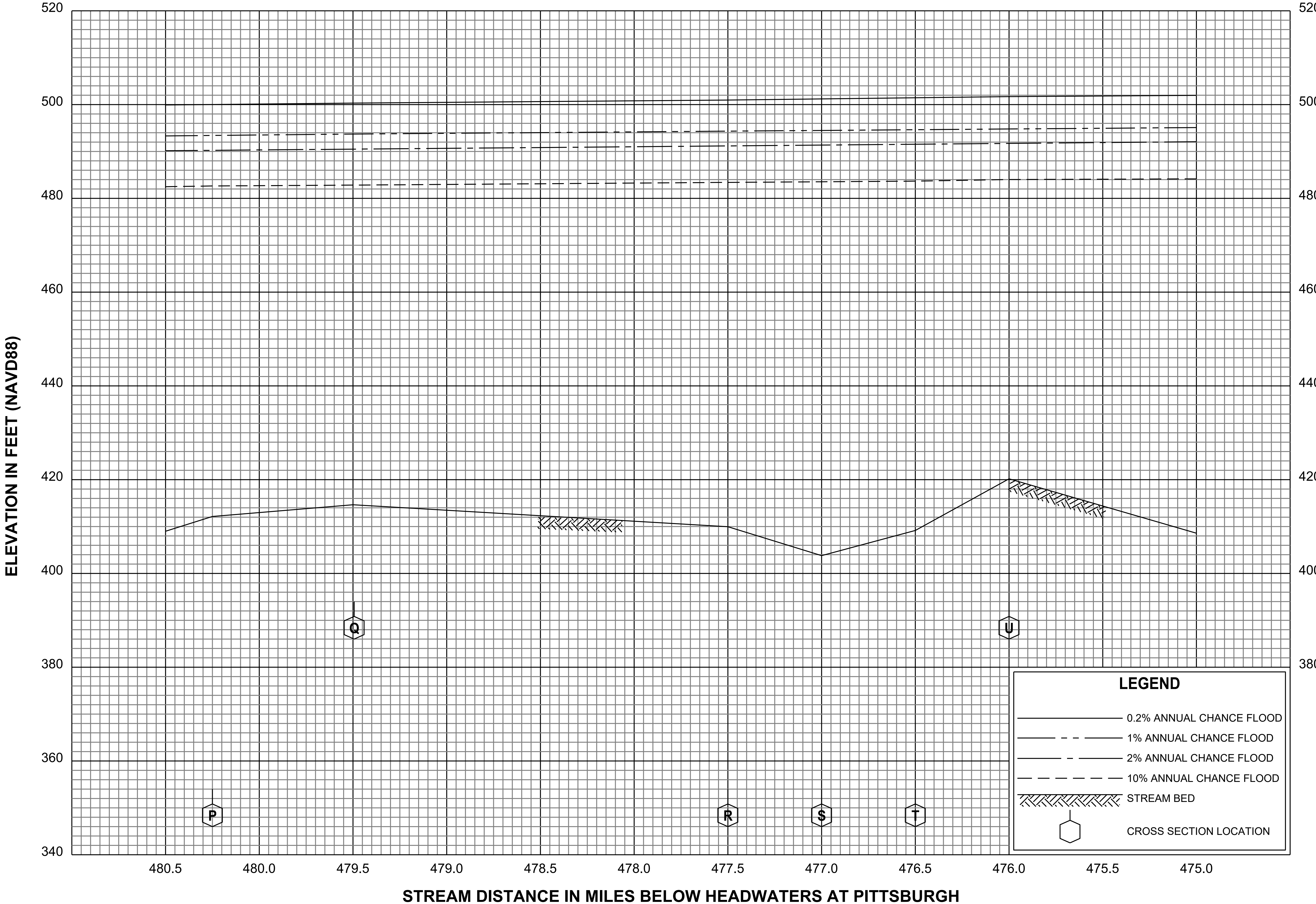
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

087P



FLOOD PROFILES

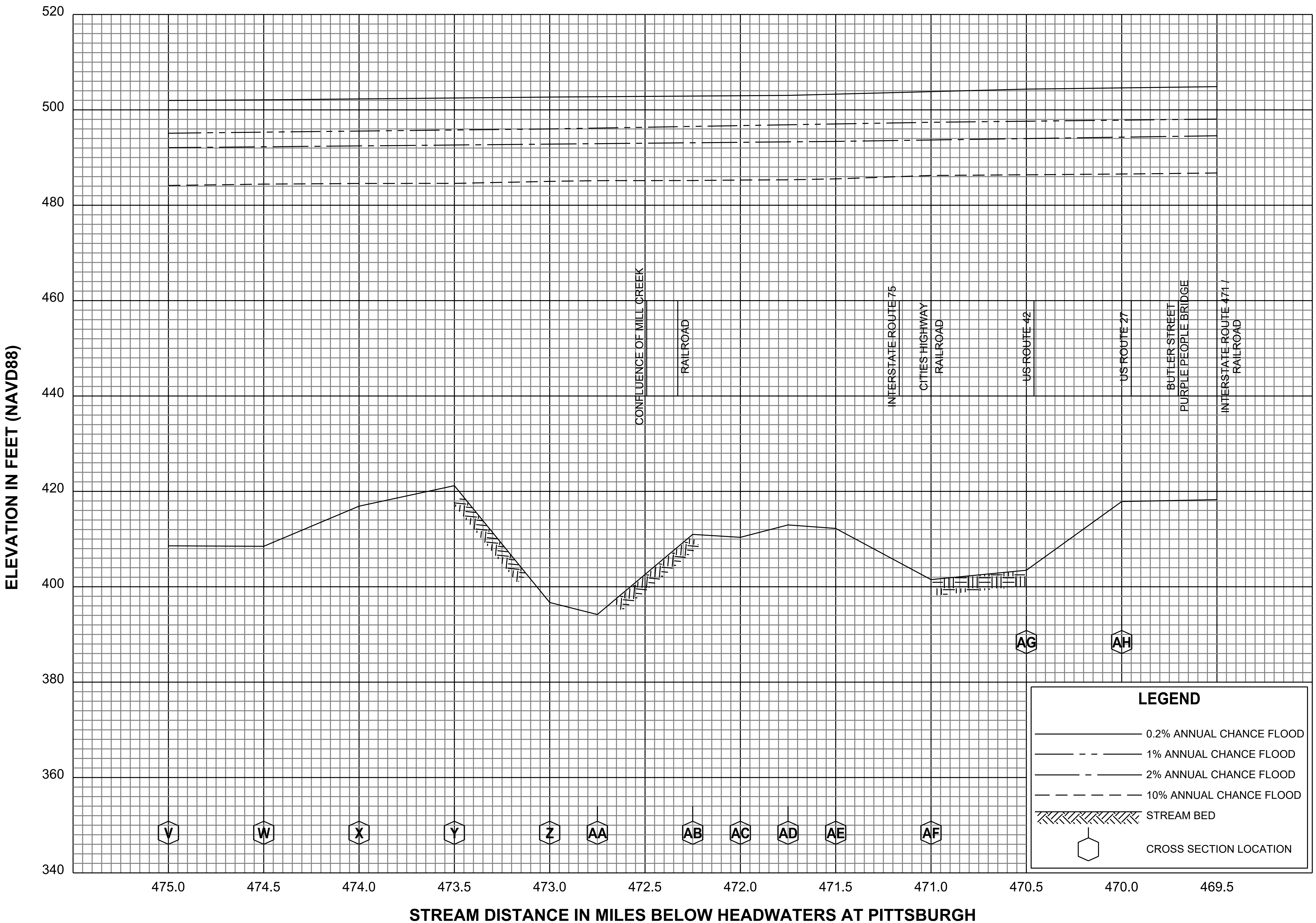
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

088P



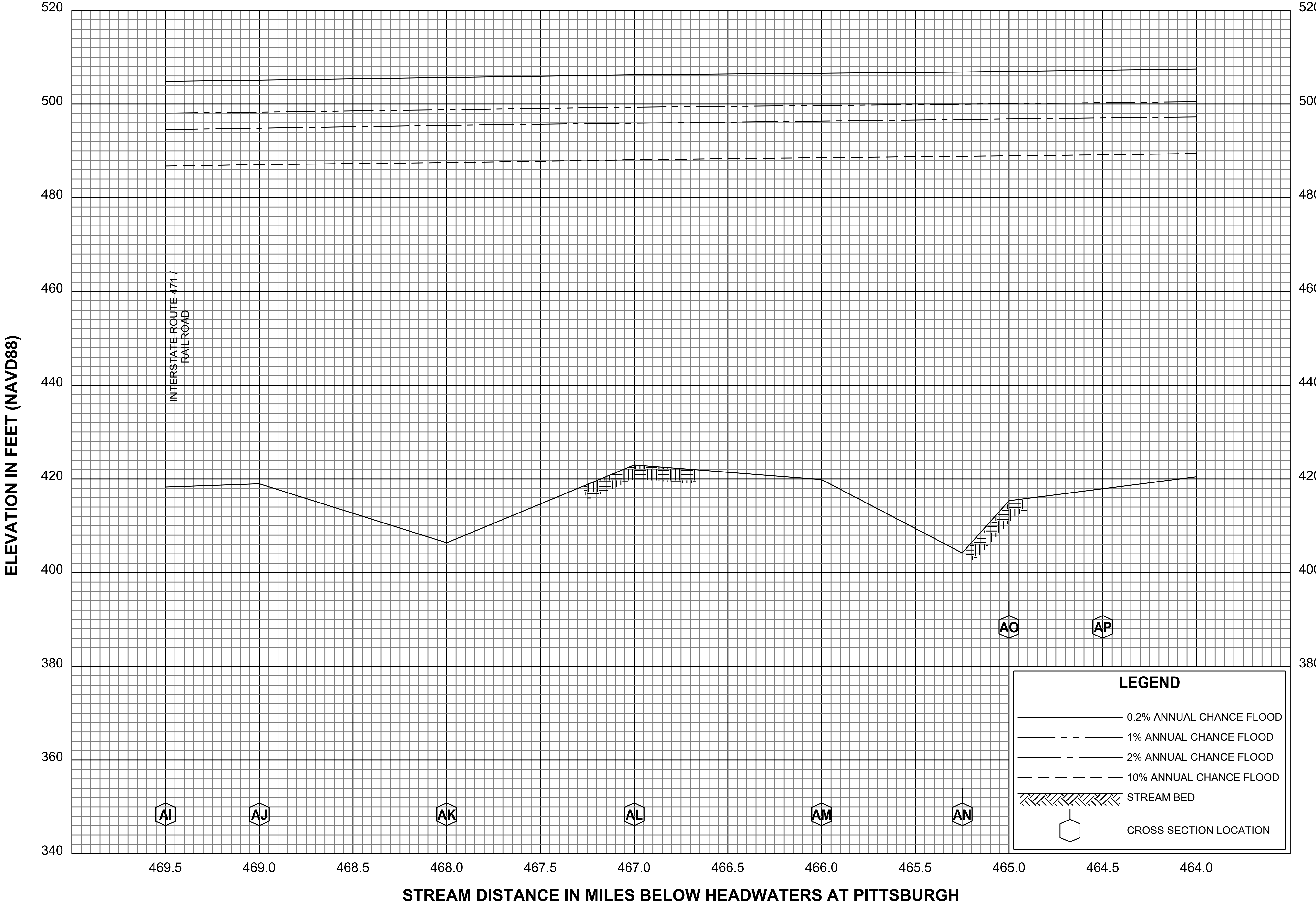
FLOOD PROFILES

OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

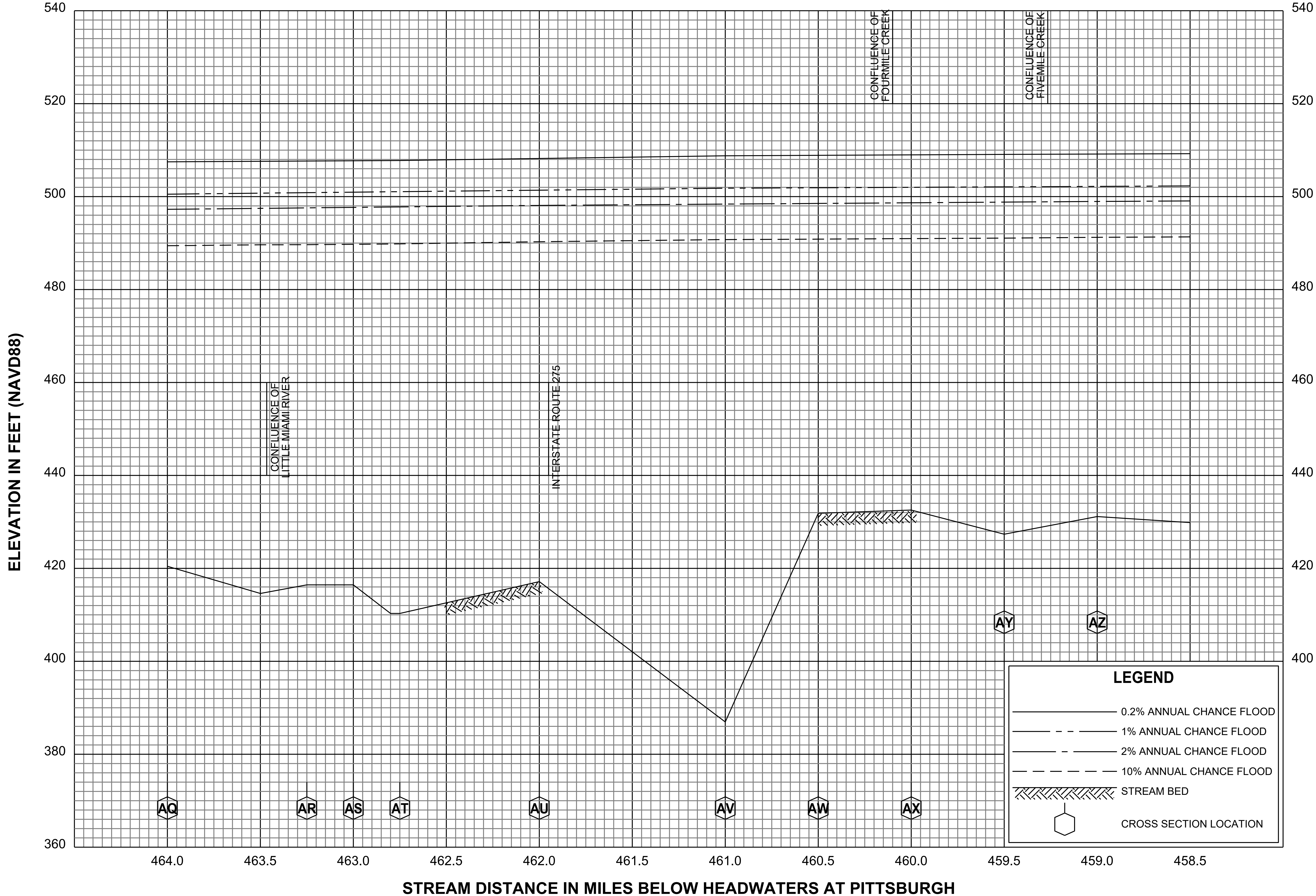
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

090P



FLOOD PROFILES

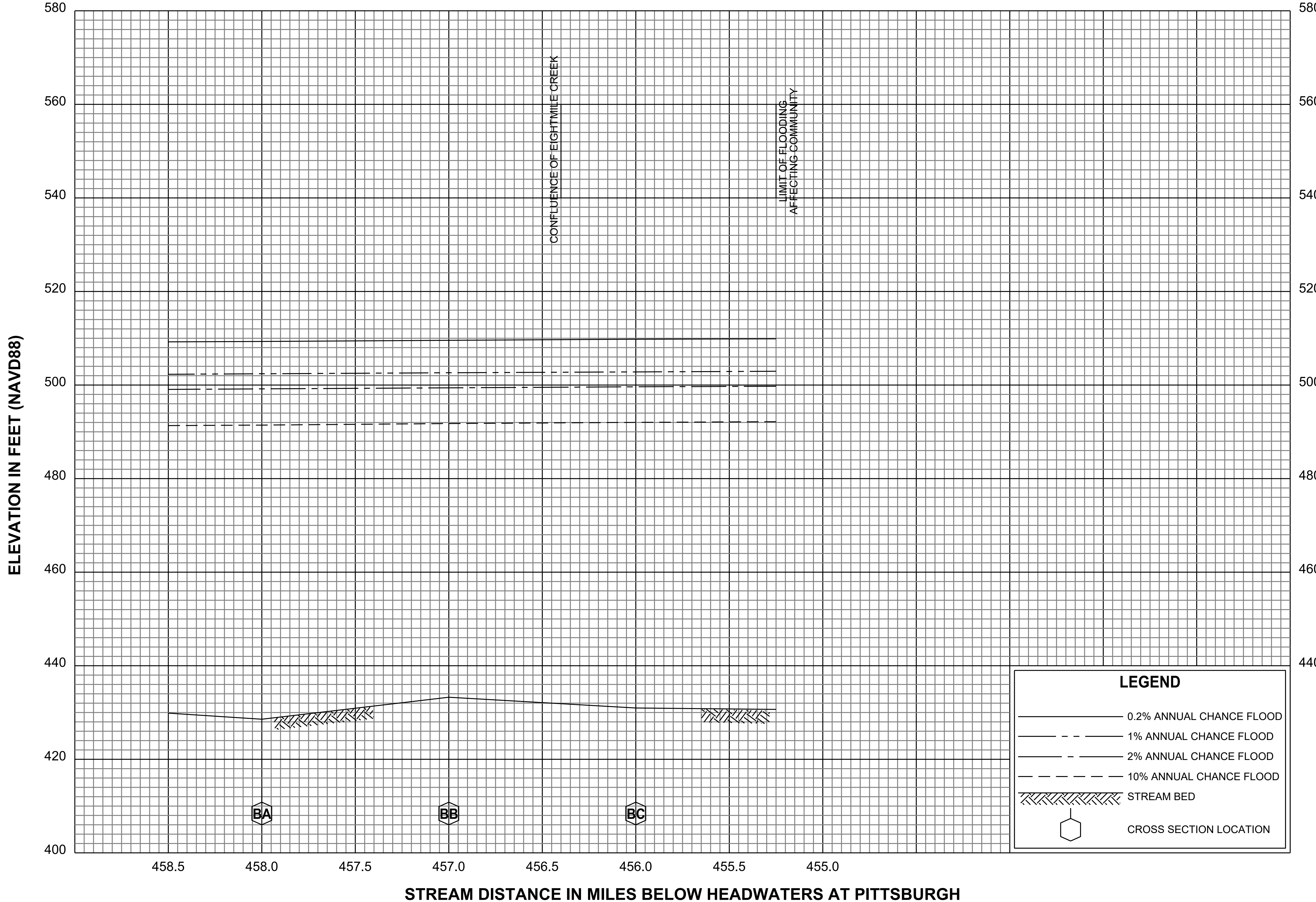
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

091P



FLOOD PROFILES

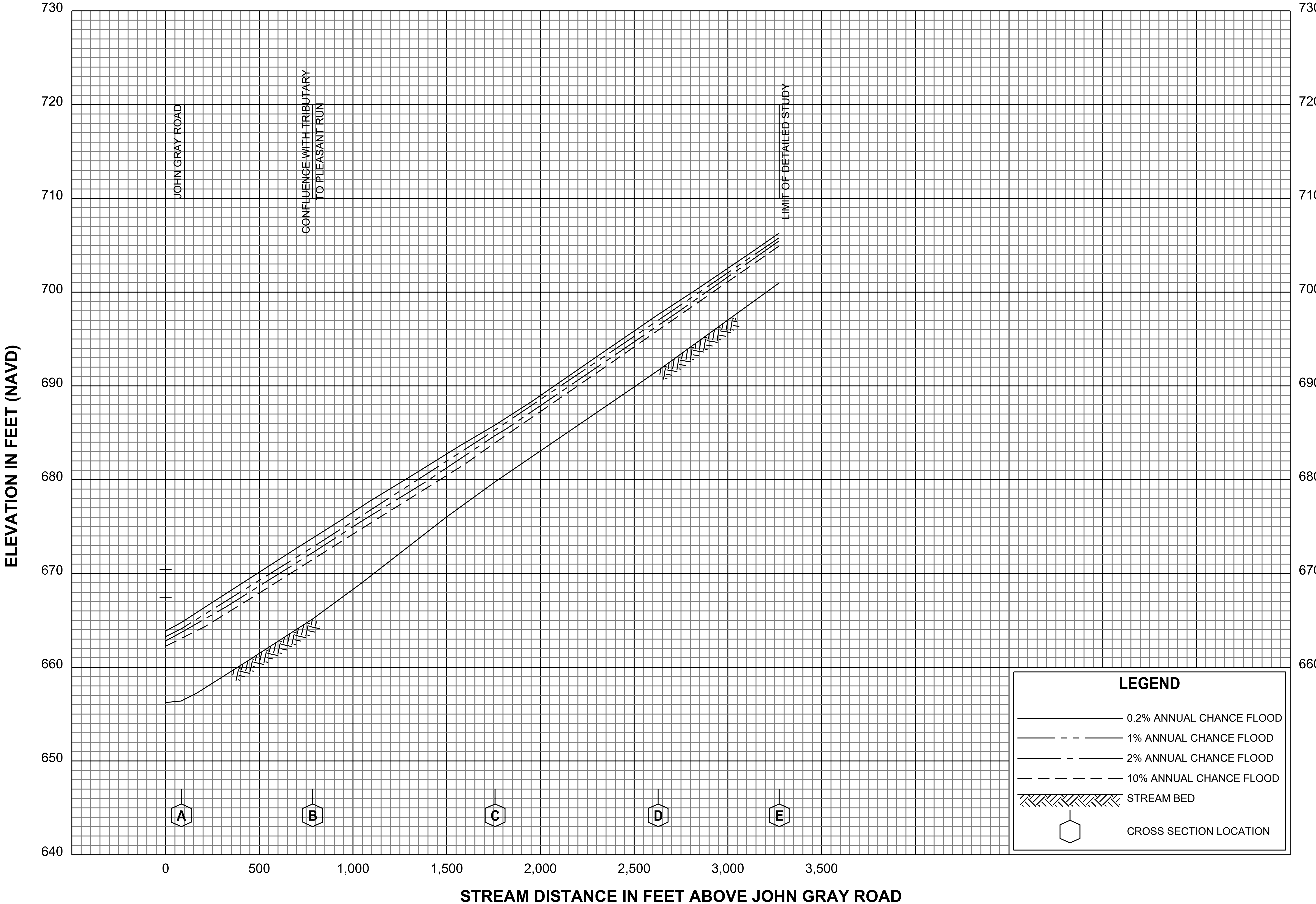
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

092P



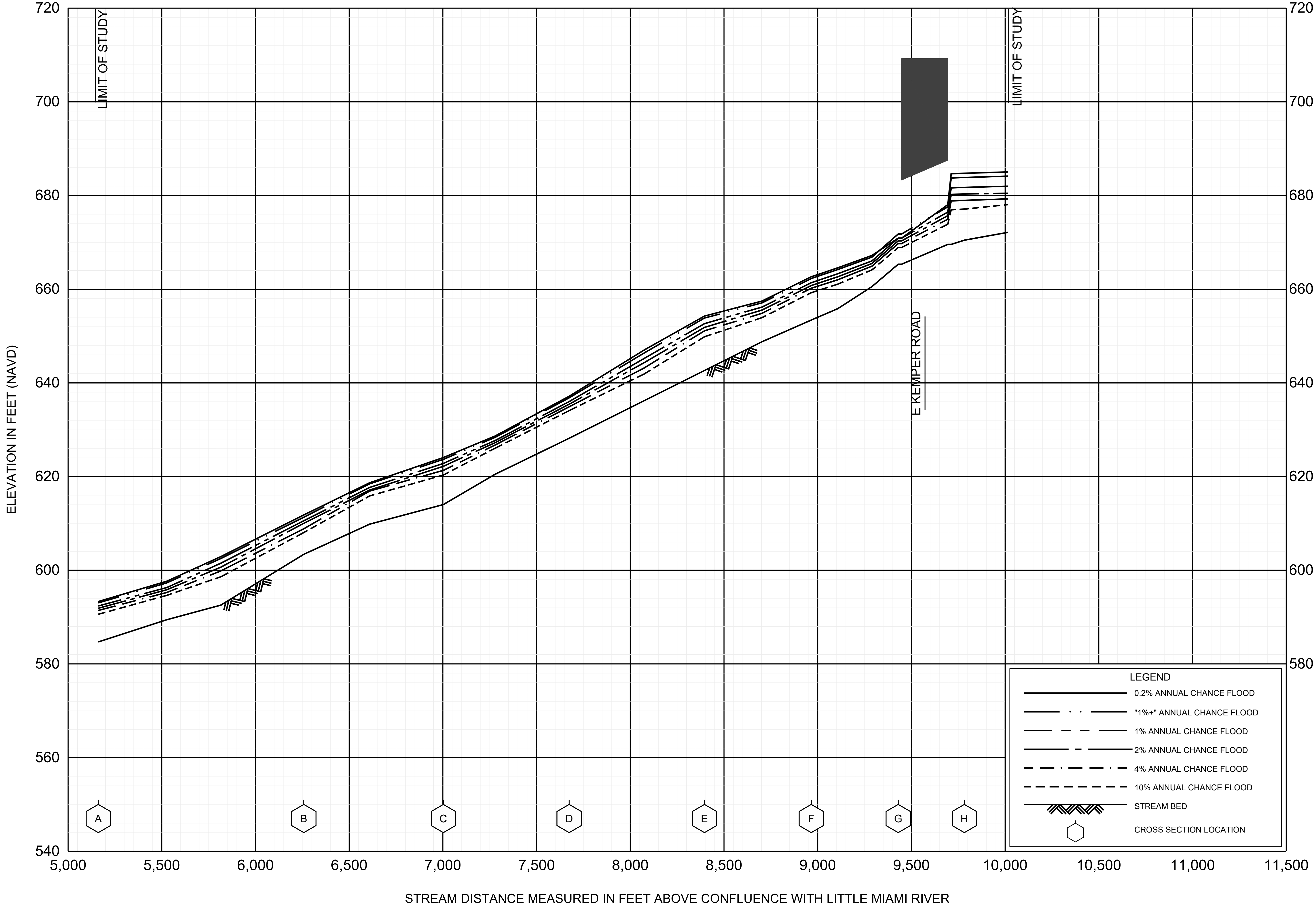
FLOOD PROFILES

PLEASANT RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

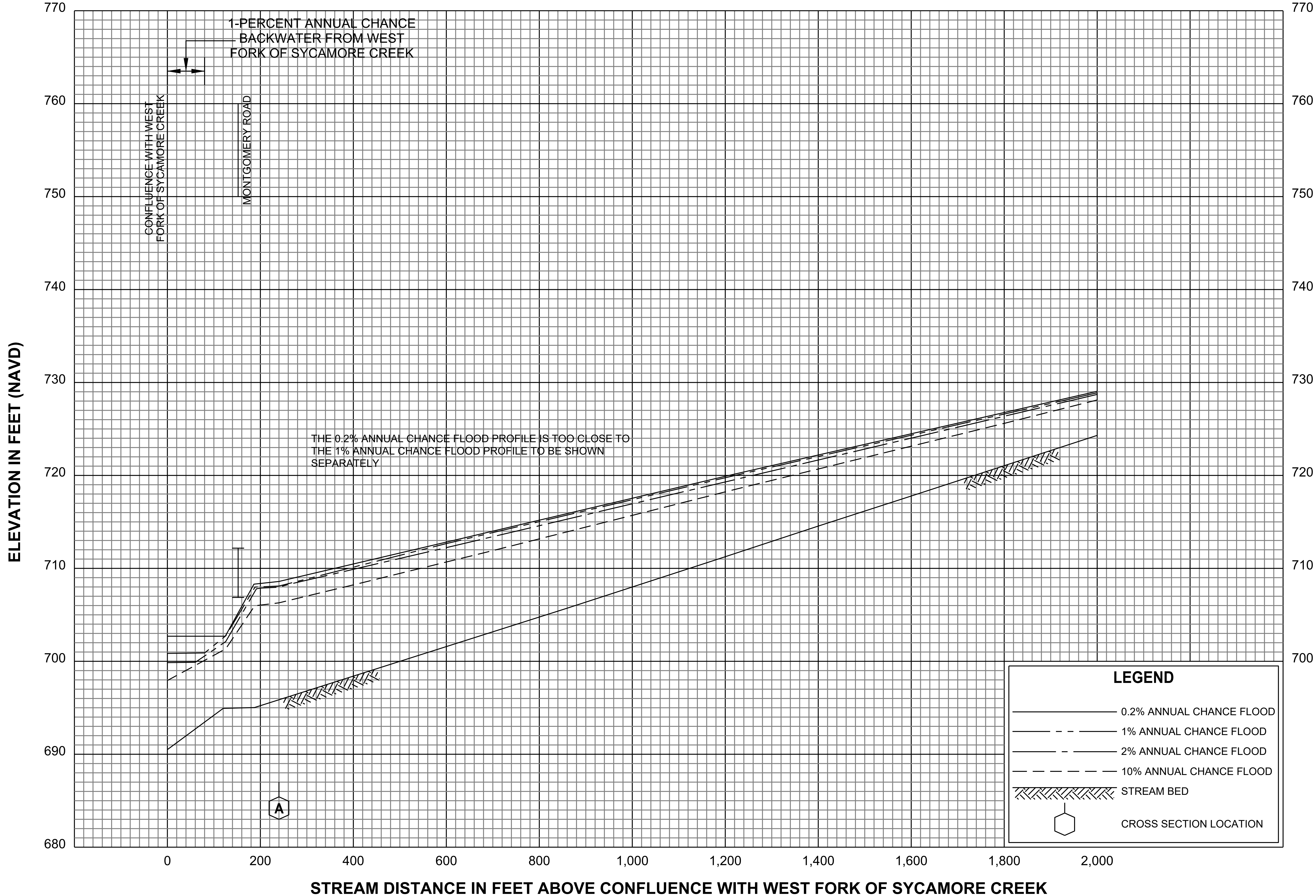
POLK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

094P



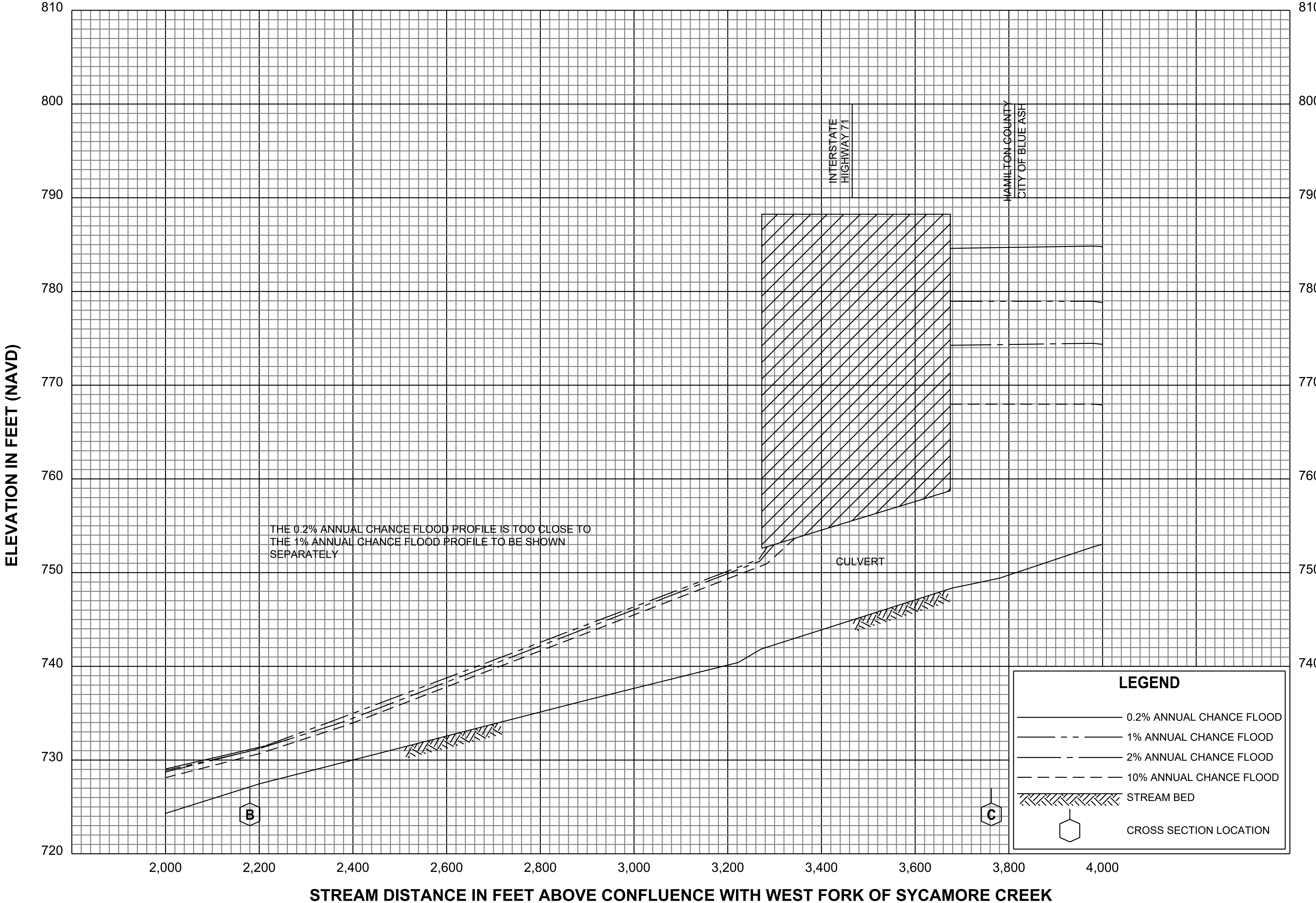
FLOOD PROFILES

RAIDERS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



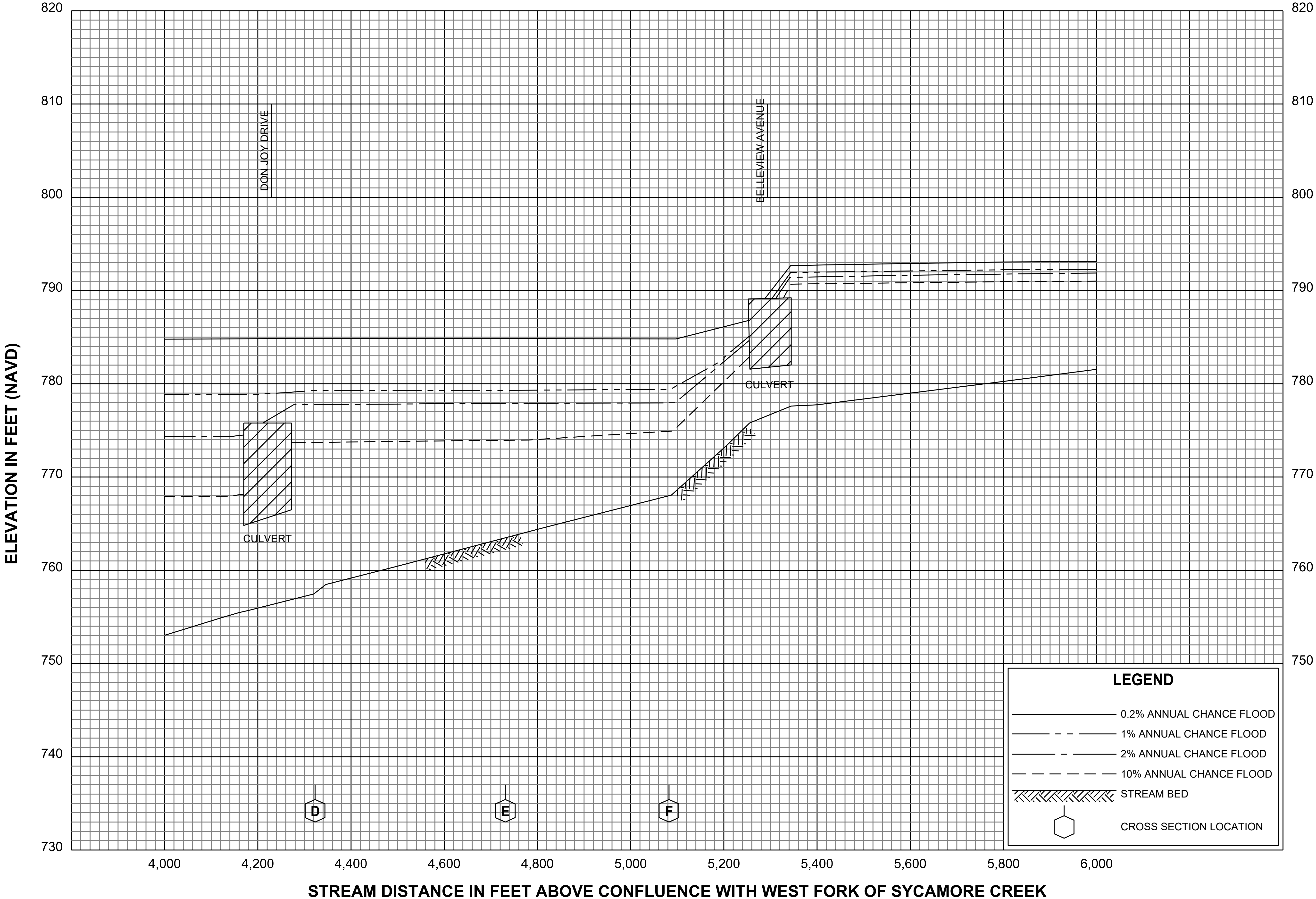
FLOOD PROFILES

RAIDERS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



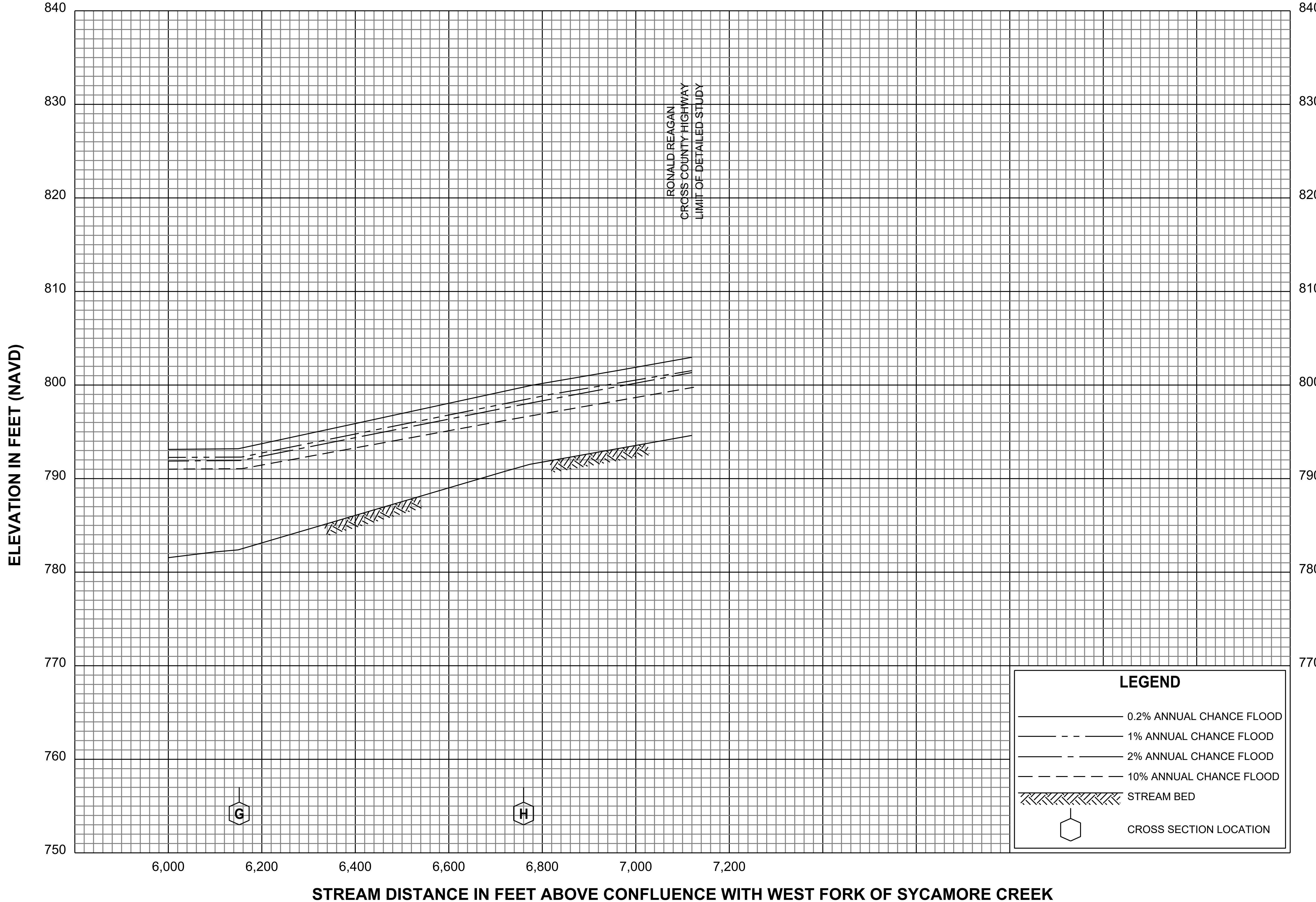
FLOOD PROFILES

RAIDERS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



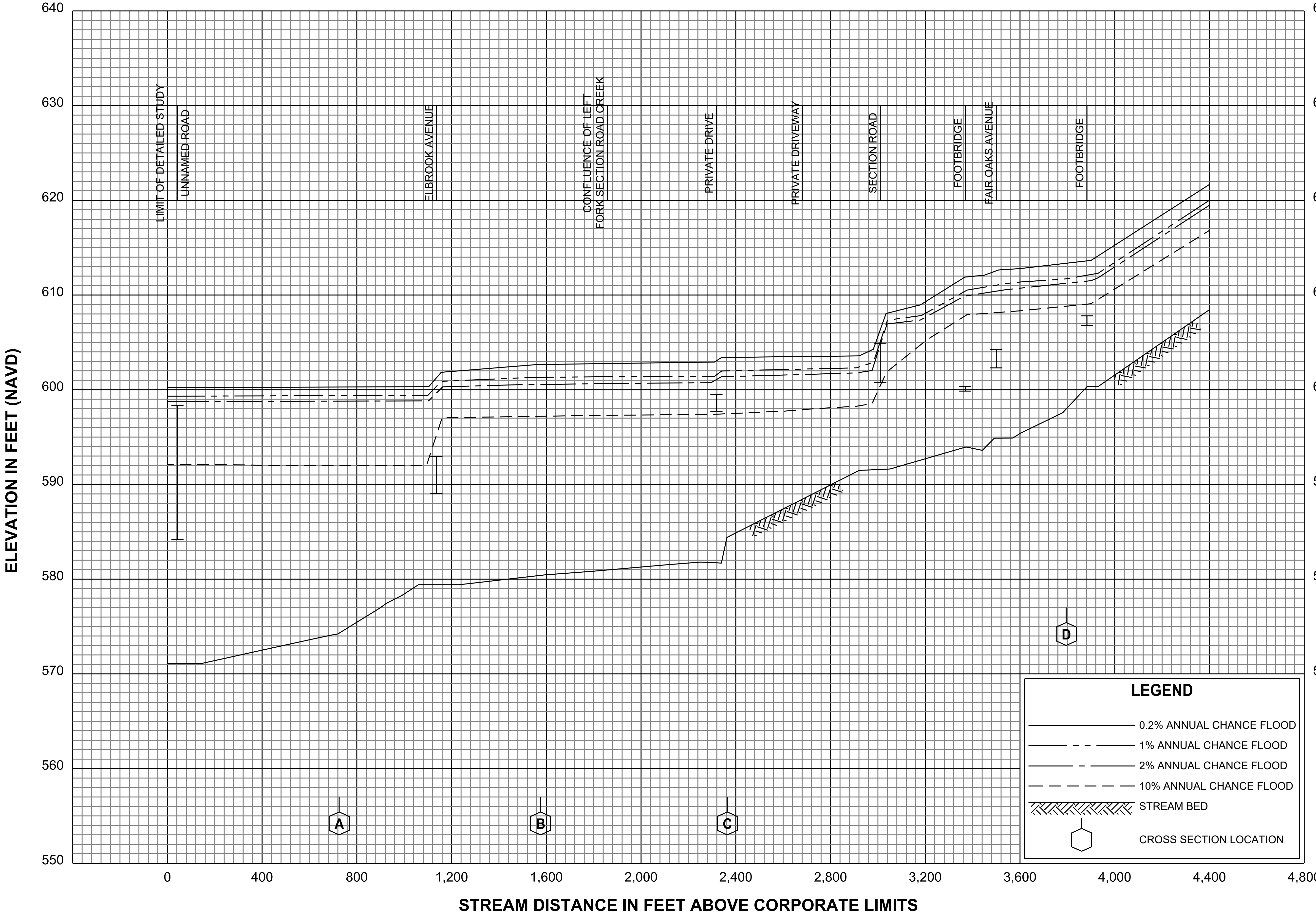
FLOOD PROFILES

RAIDERS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



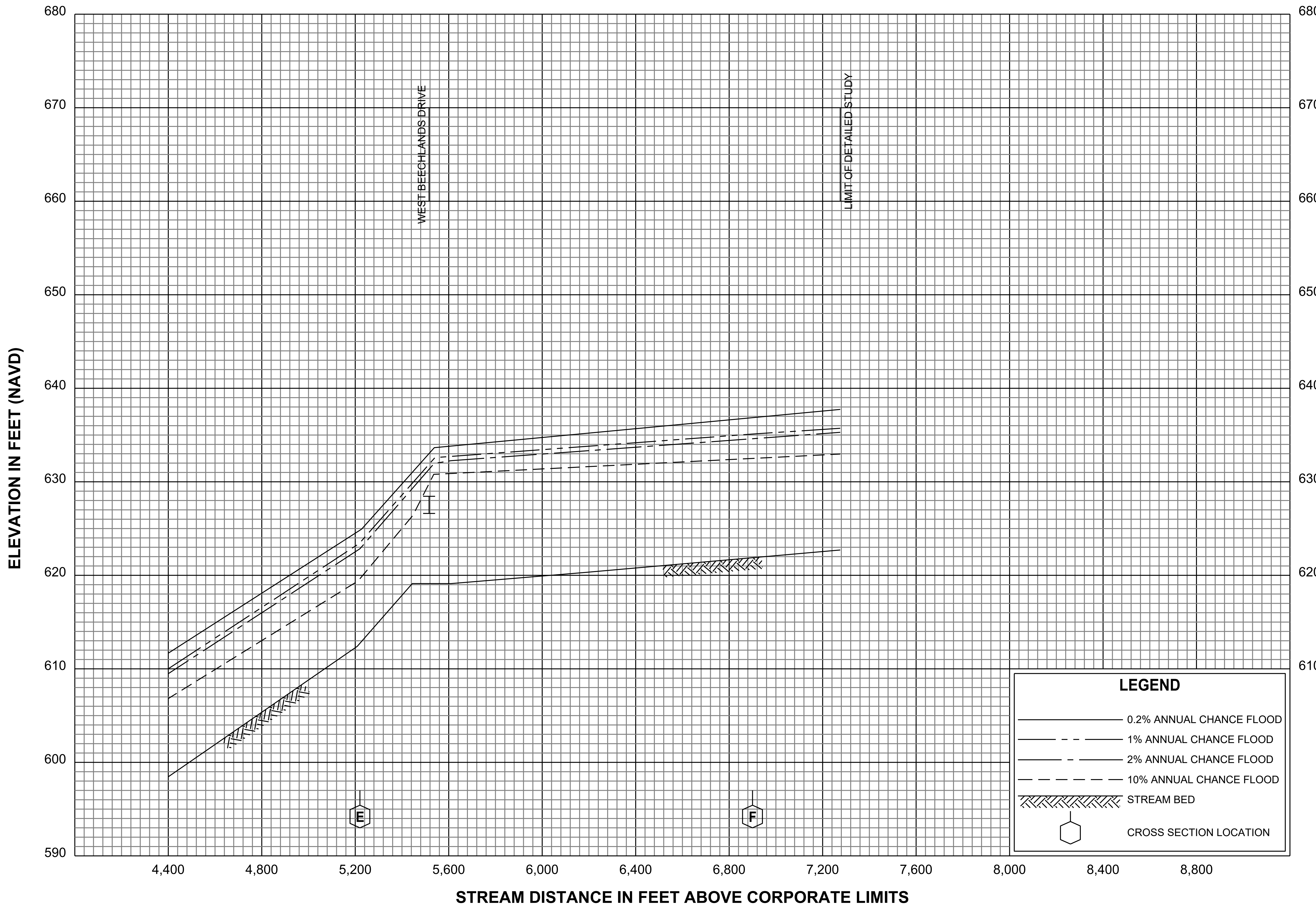
FLOOD PROFILES

SECTION ROAD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



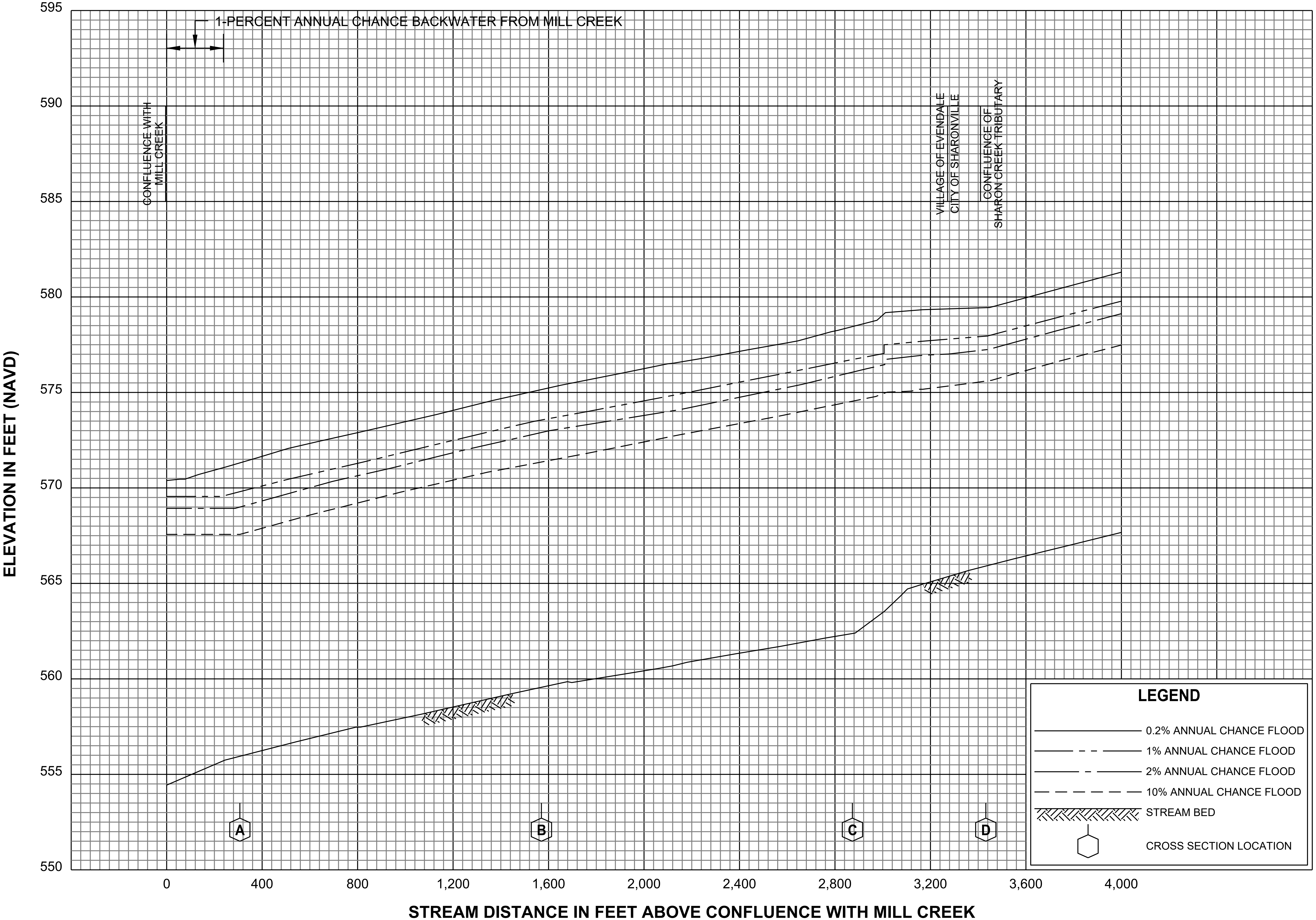
FLOOD PROFILES

SECTION ROAD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



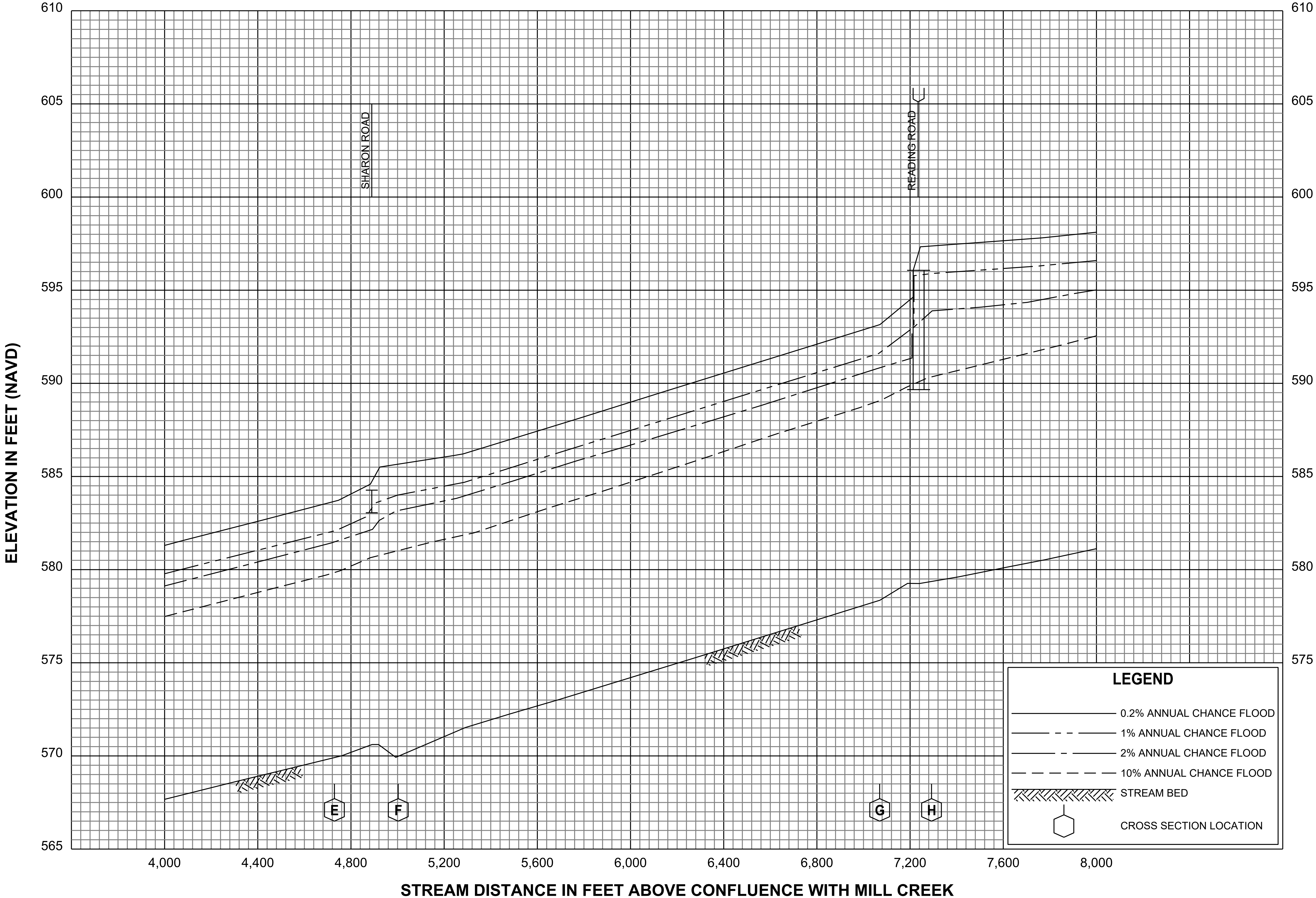
FLOOD PROFILES

SHARON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

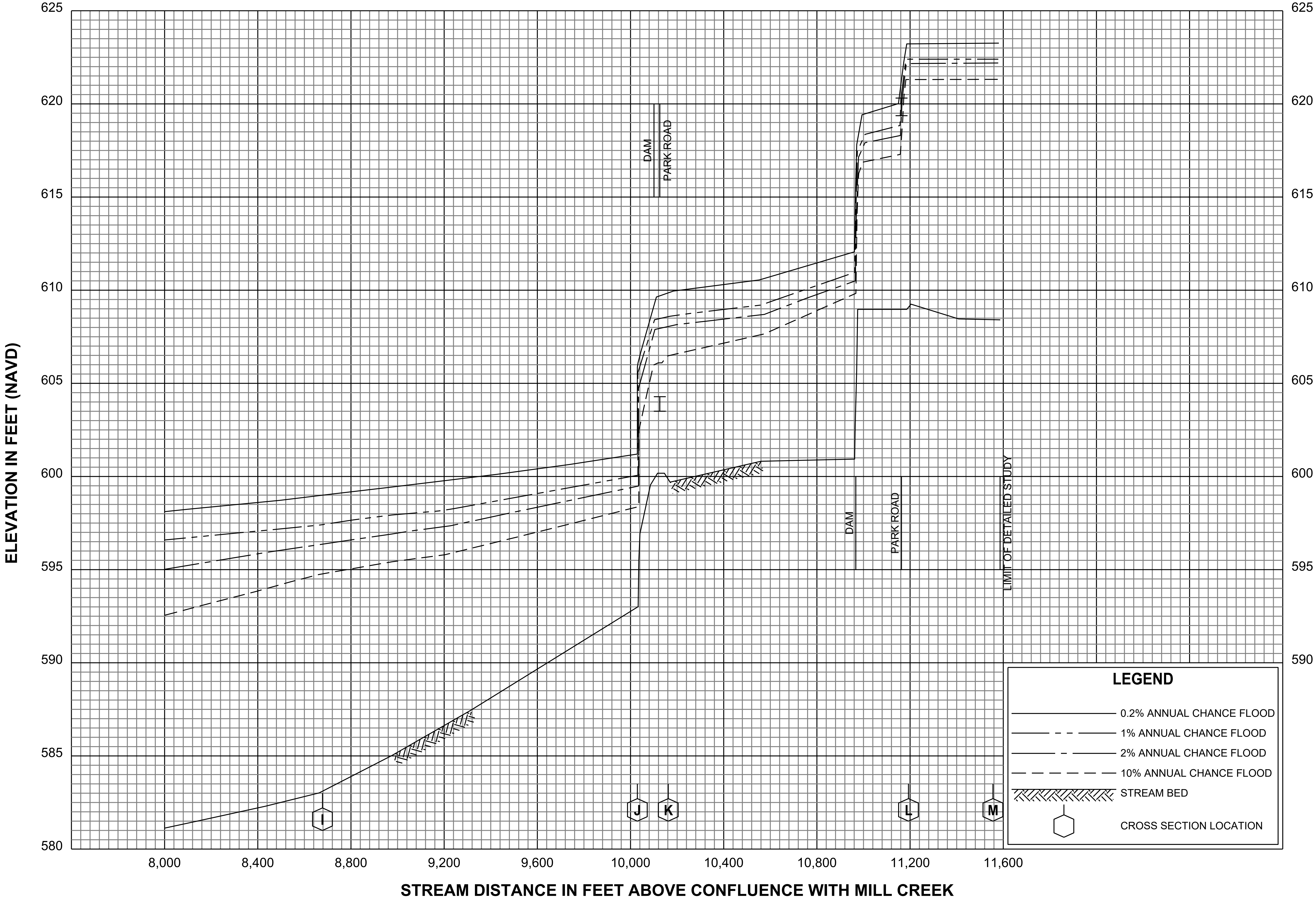
SHARON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

102P



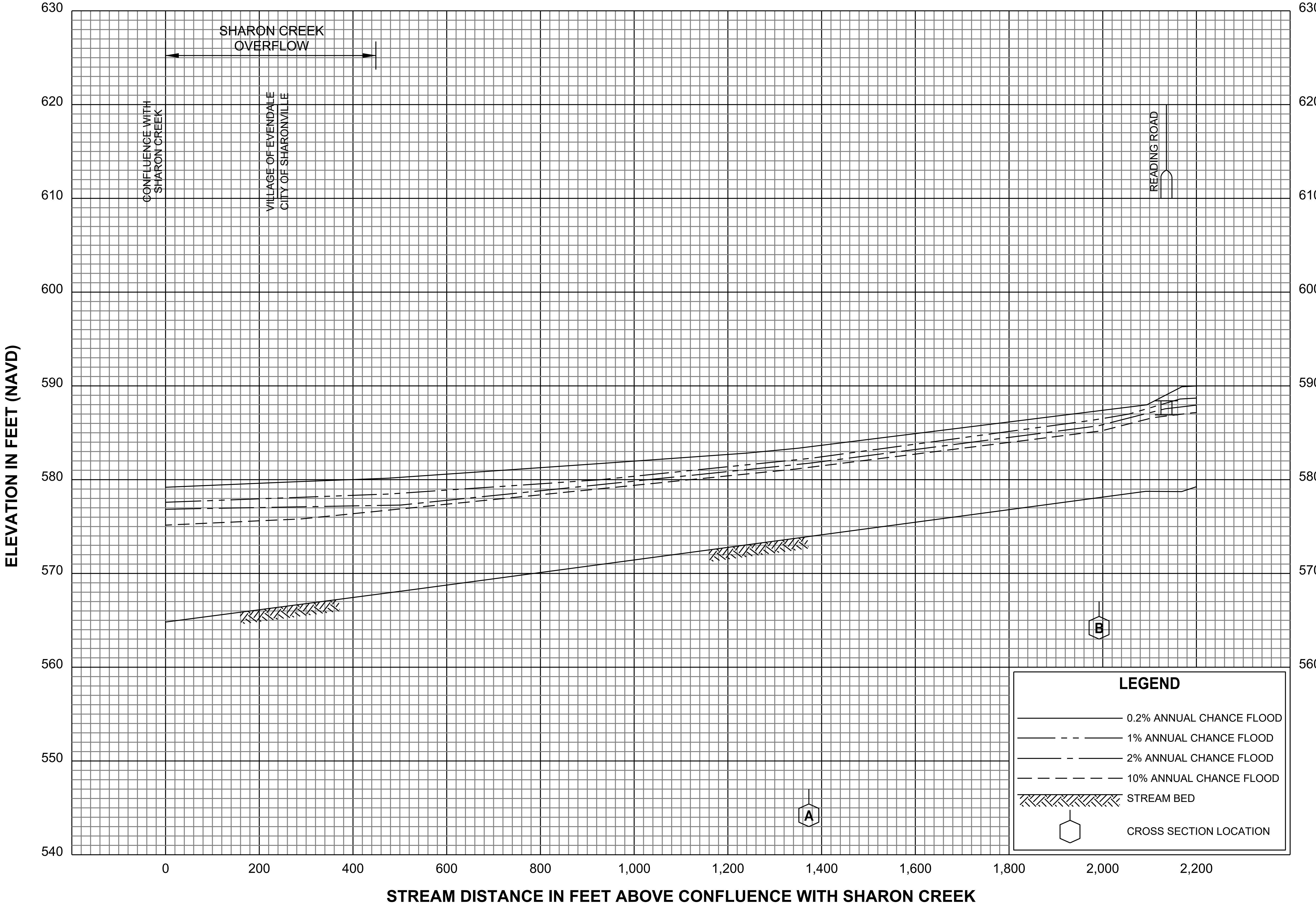
FLOOD PROFILES

SHARON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

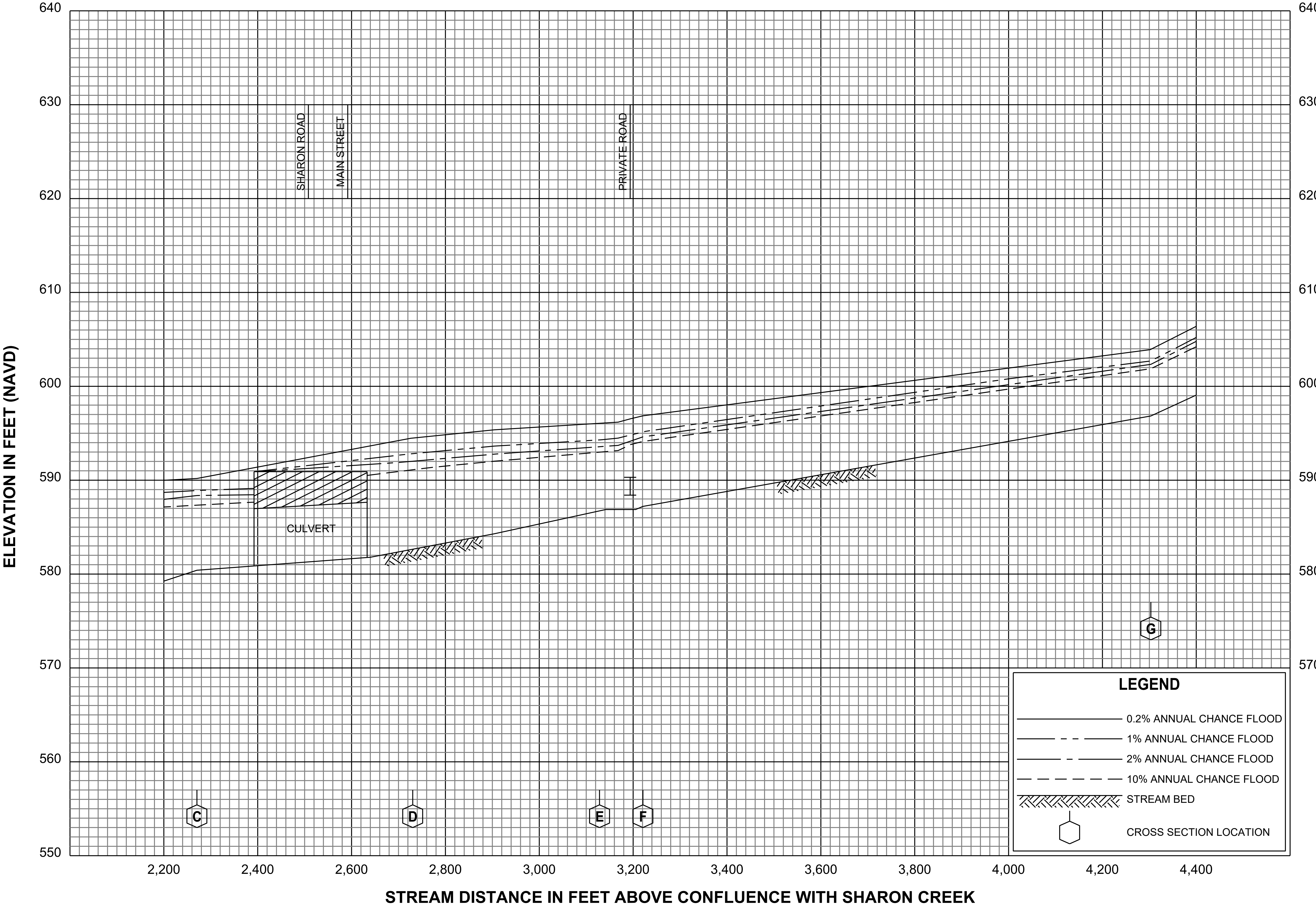
SHARON CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

104P



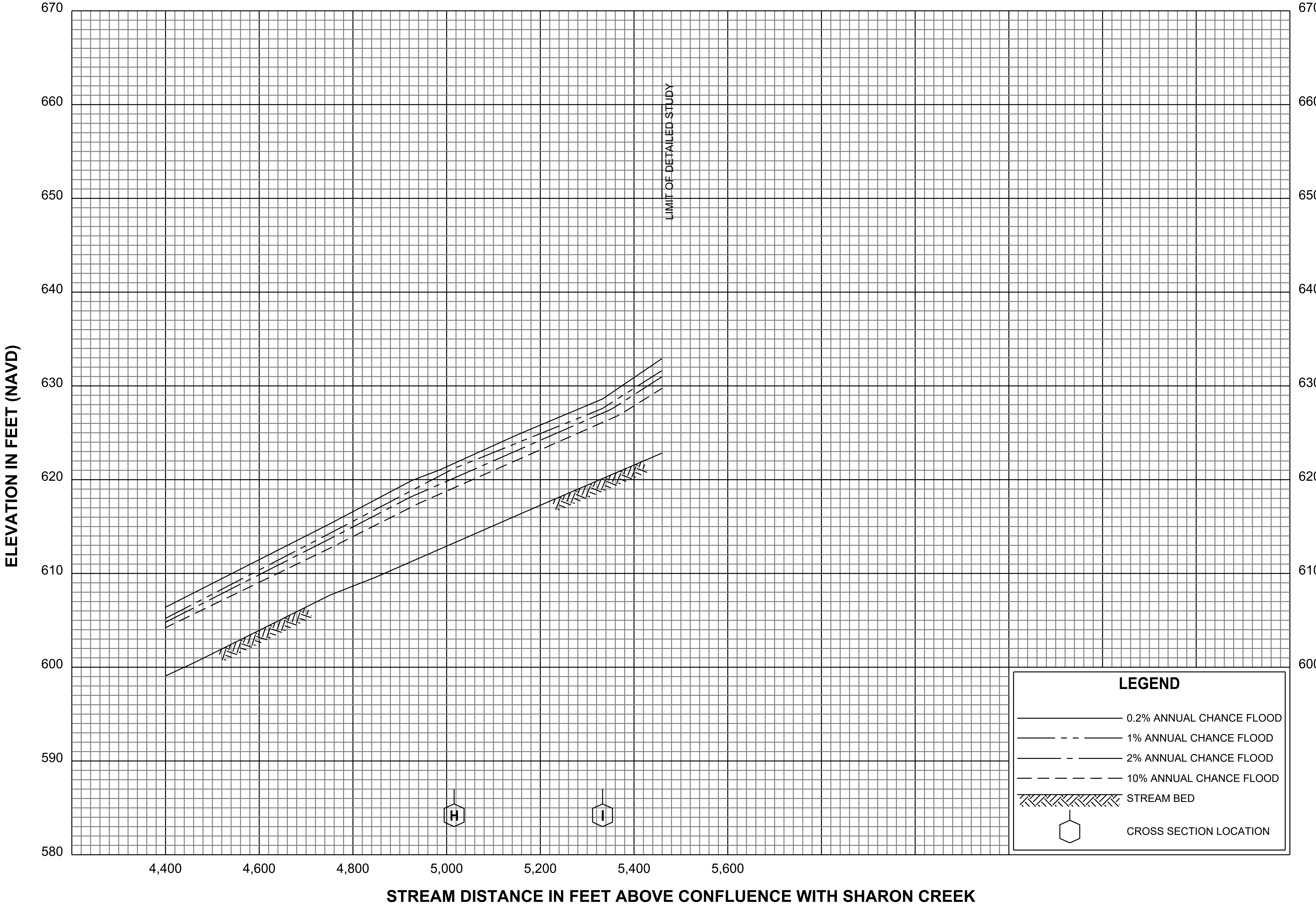
FLOOD PROFILES

SHARON CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



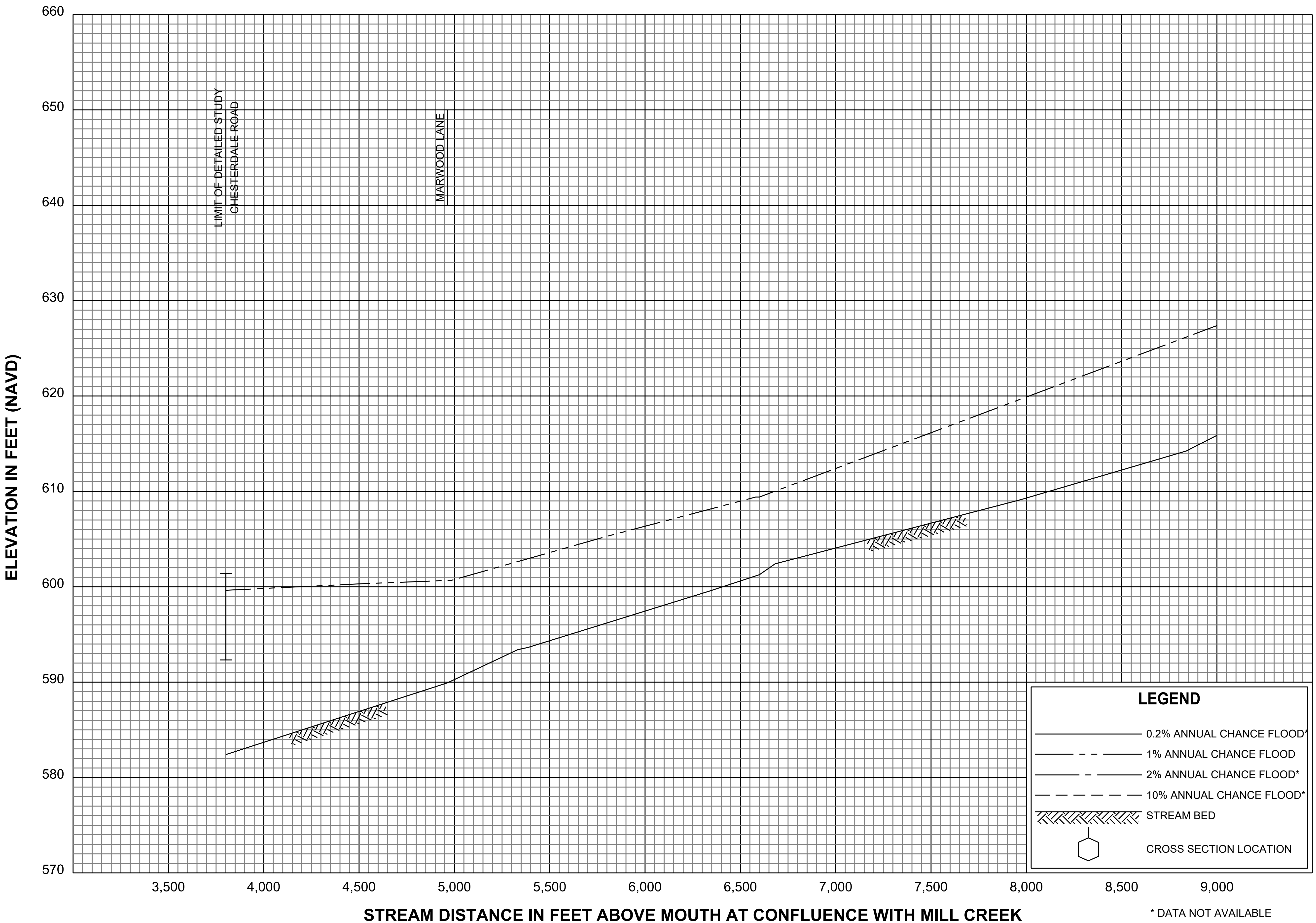
FLOOD PROFILES

SHARON CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



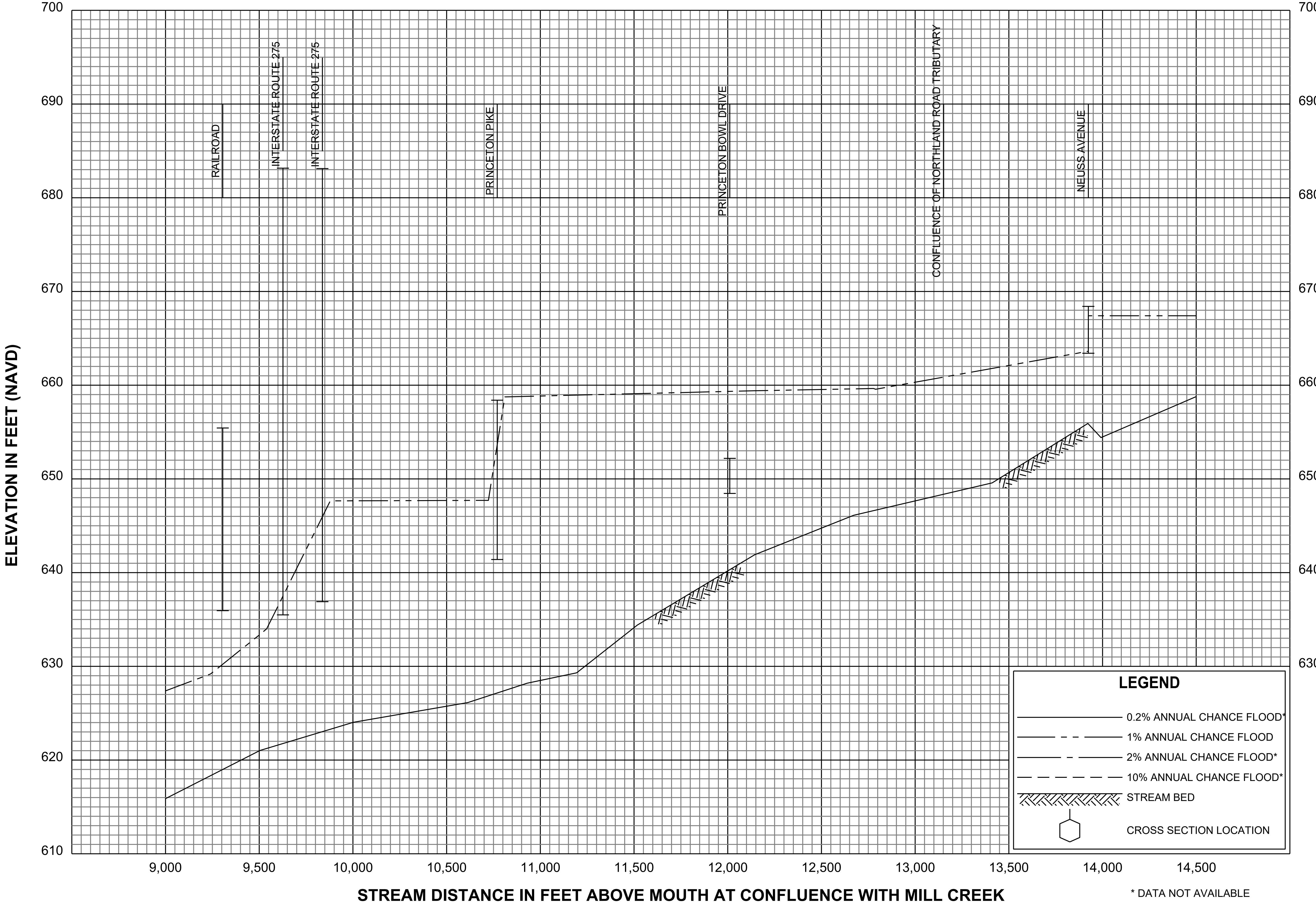
FLOOD PROFILES

SPRINGDALE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



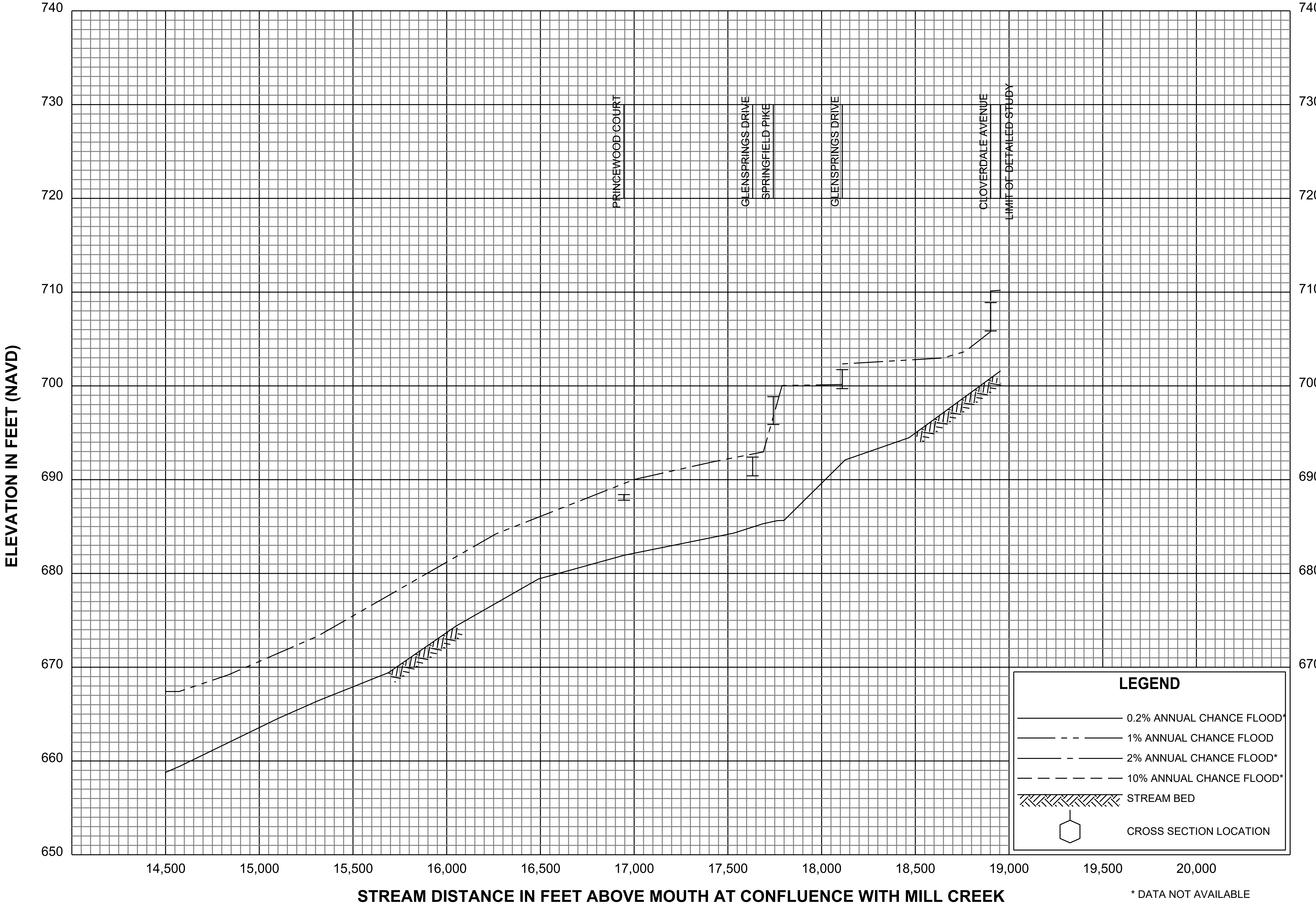
FLOOD PROFILES

SPRINGDALE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



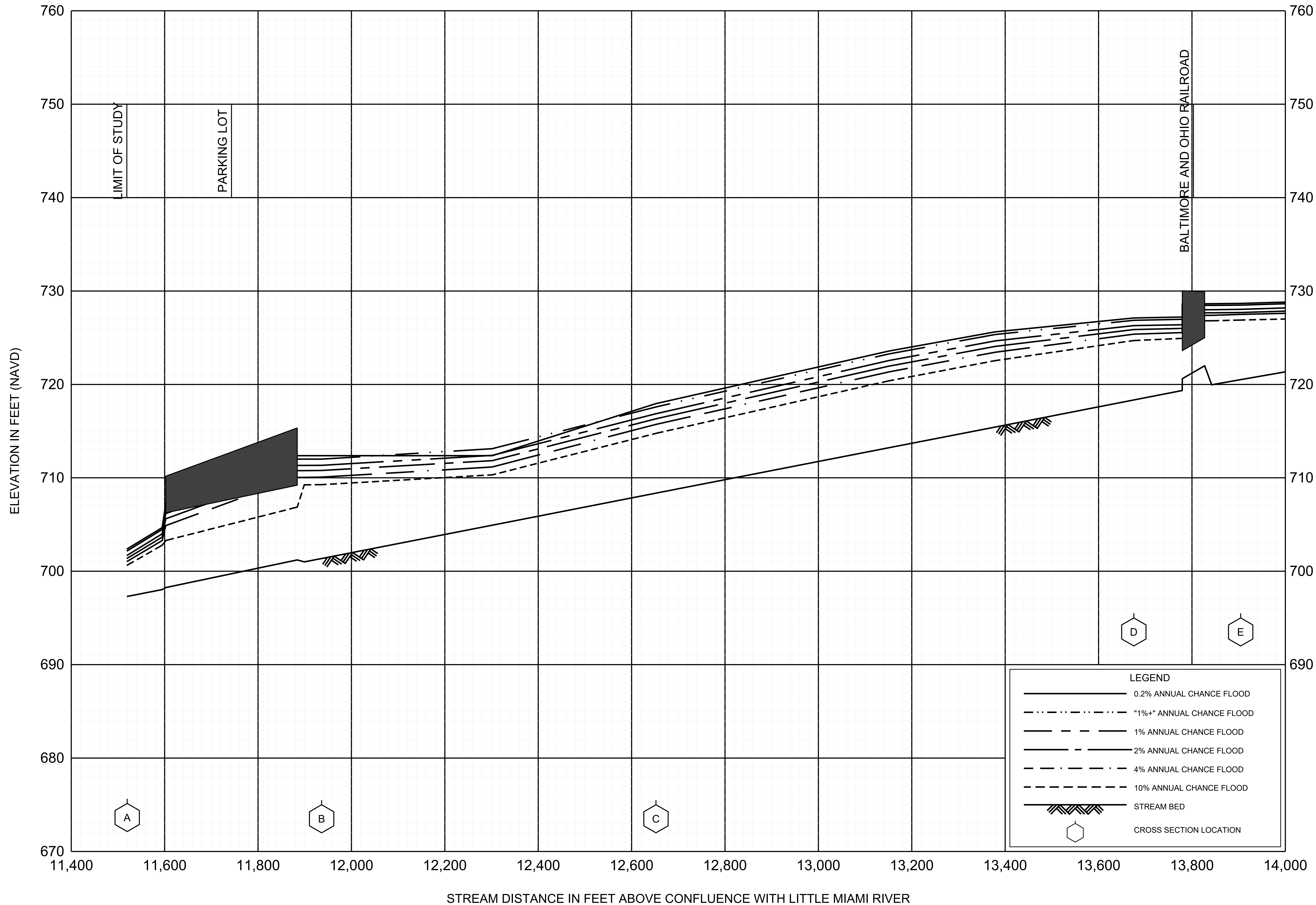
FLOOD PROFILES

SPRINGDALE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



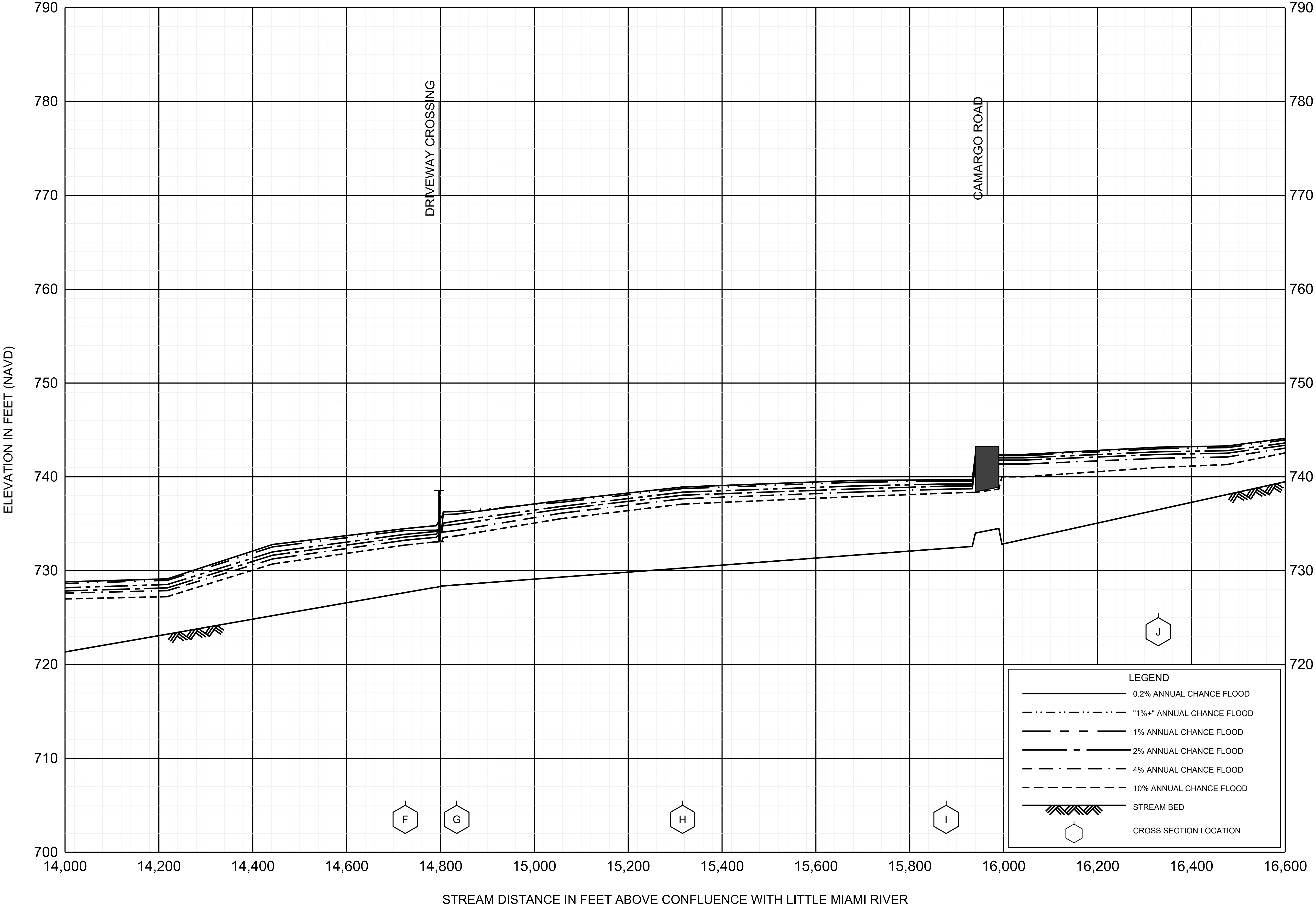
FLOOD PROFILES

SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AMD INCORPORATED AREAS



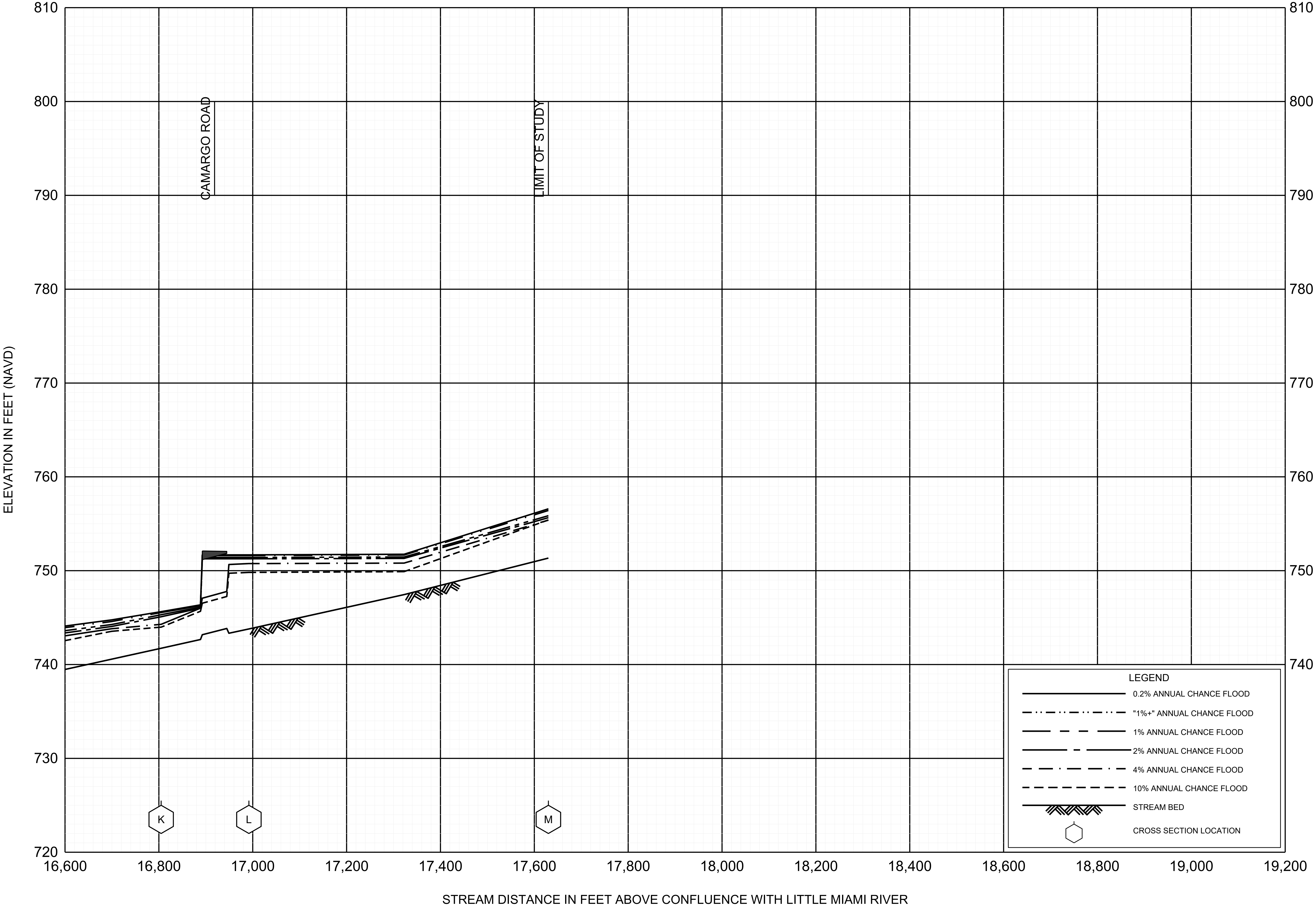
FLOOD PROFILES

SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AMD INCORPORATED AREAS



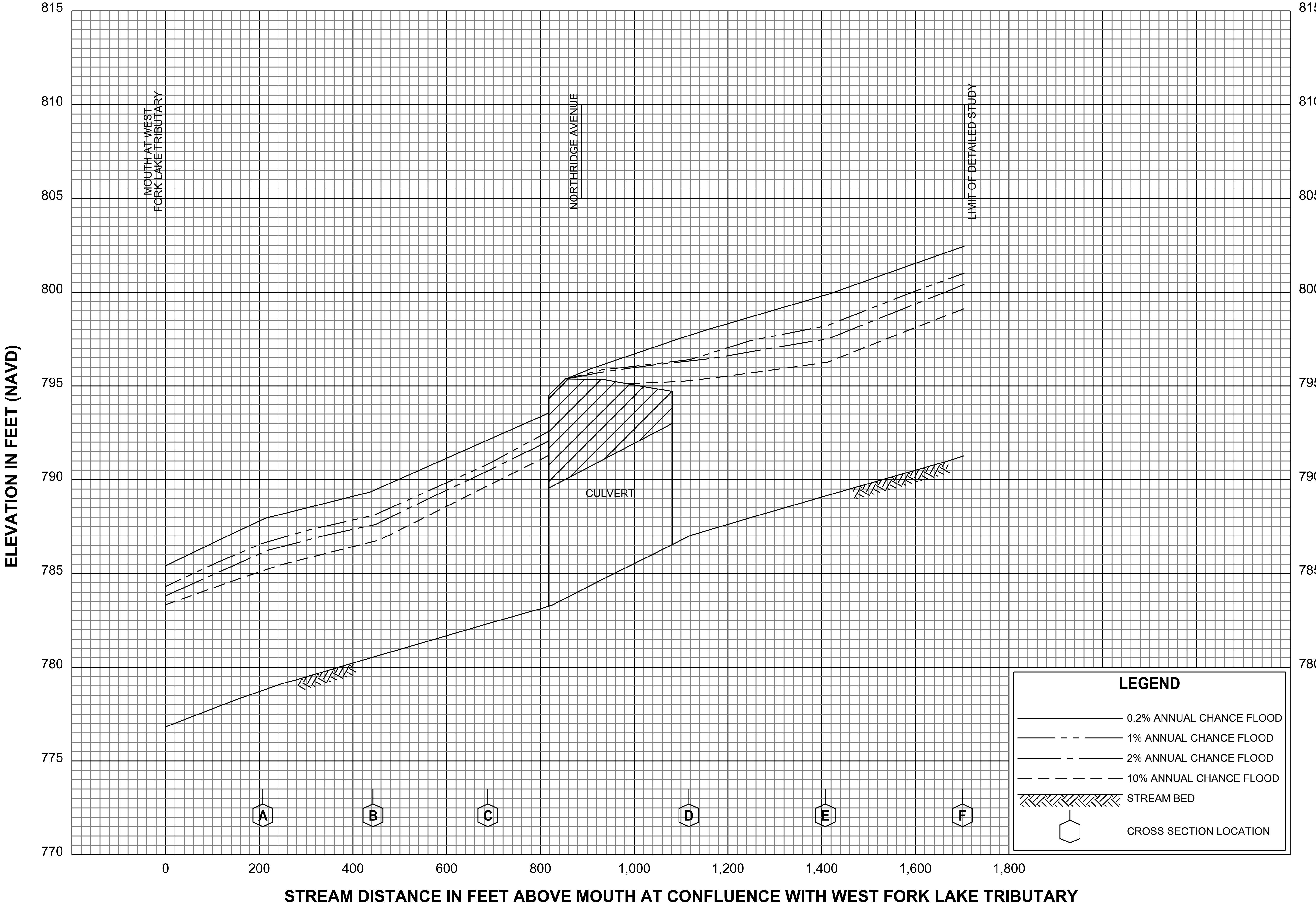
FLOOD PROFILES

SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AMD INCORPORATED AREAS



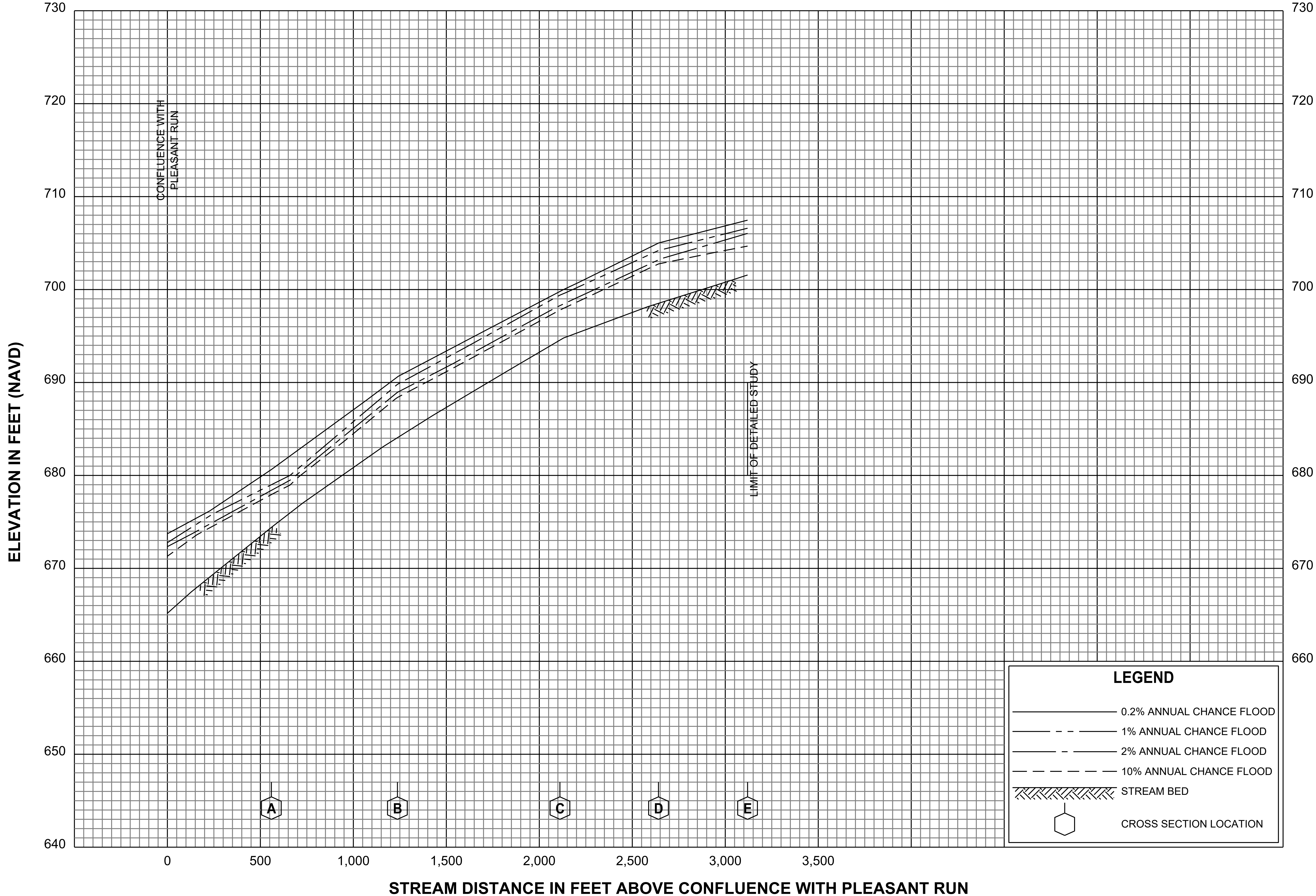
FLOOD PROFILES

TRIBUTARY A

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



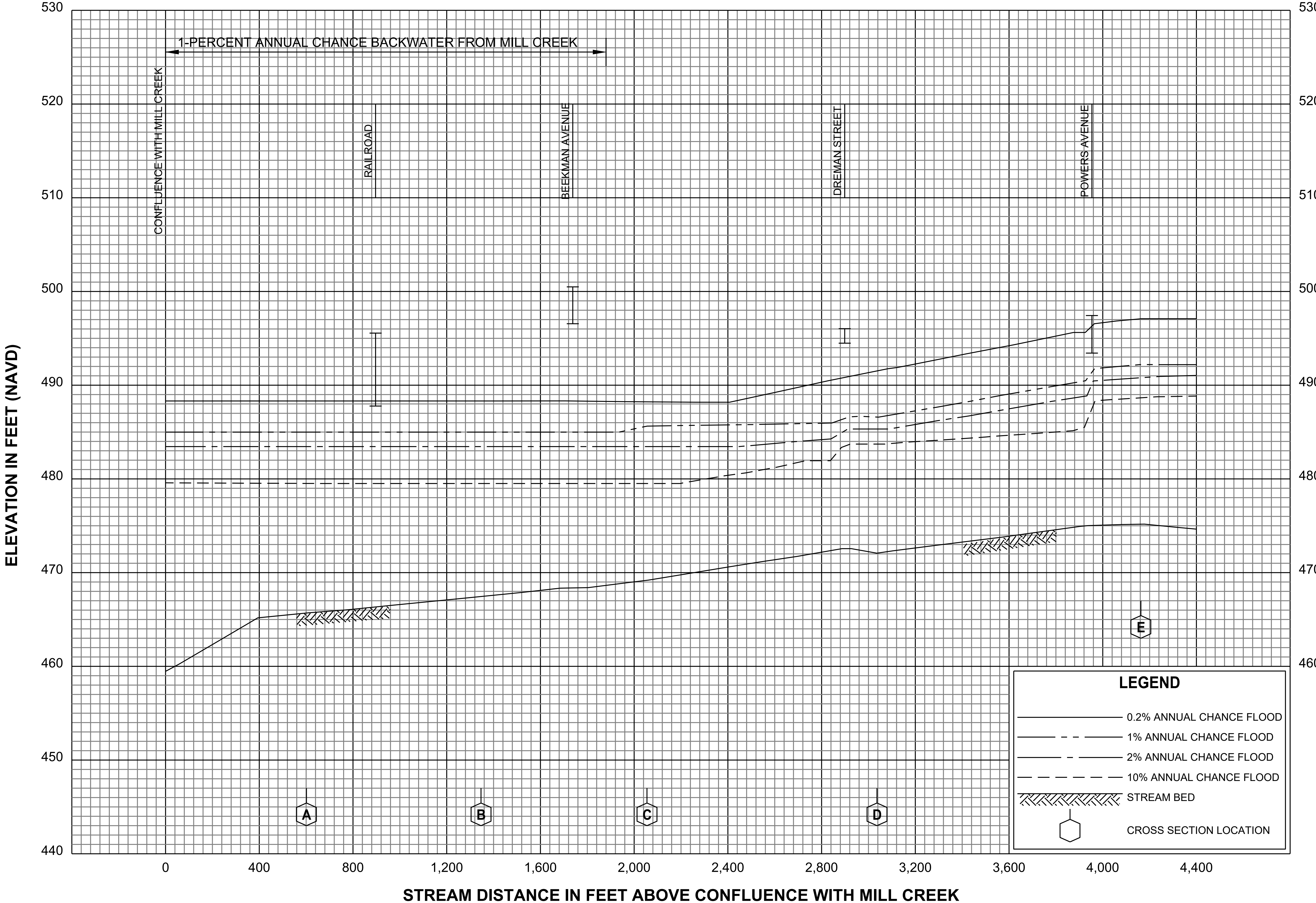
FLOOD PROFILES

TRIBUTARY TO PLEASANT RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



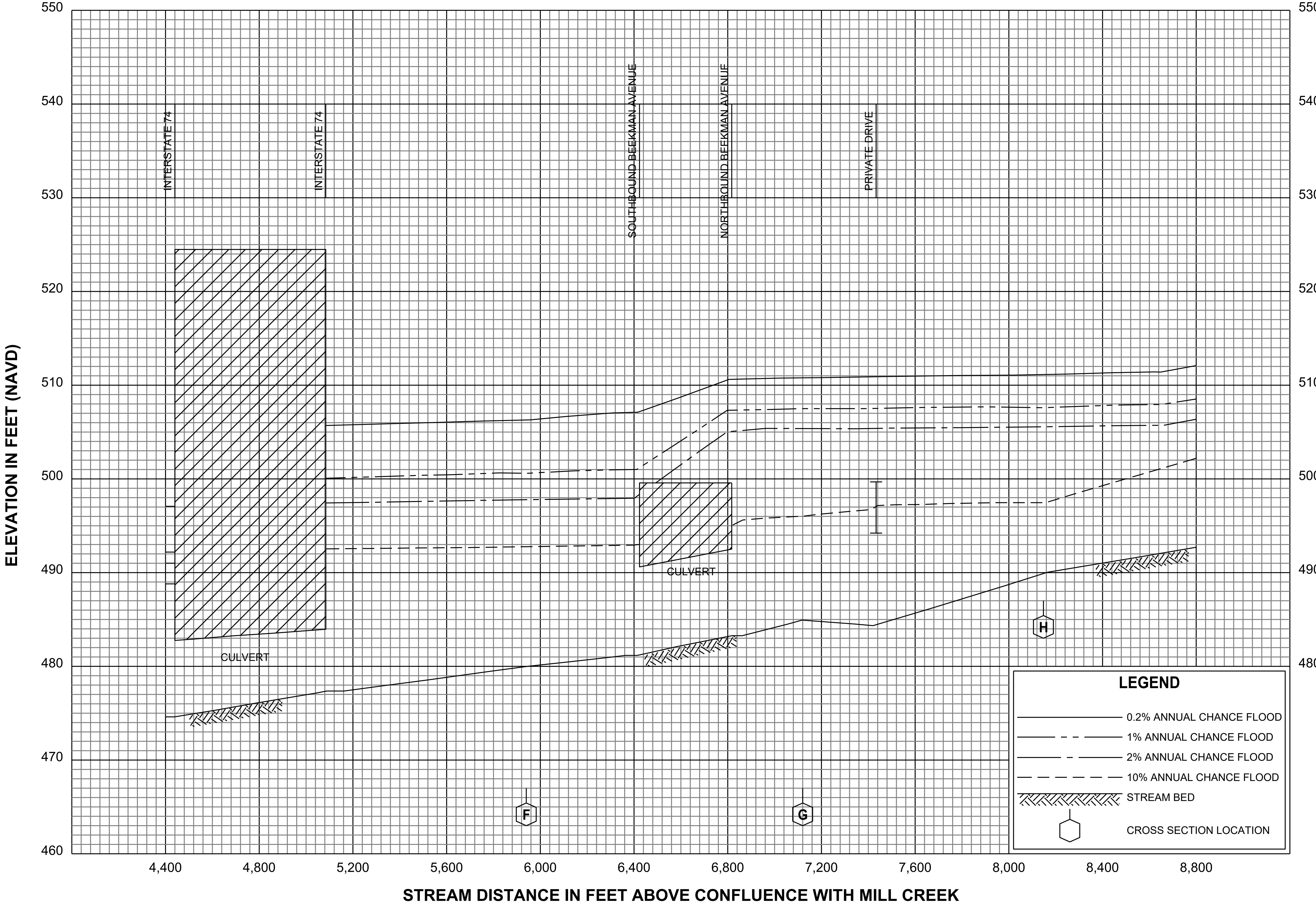
FLOOD PROFILES

WEST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



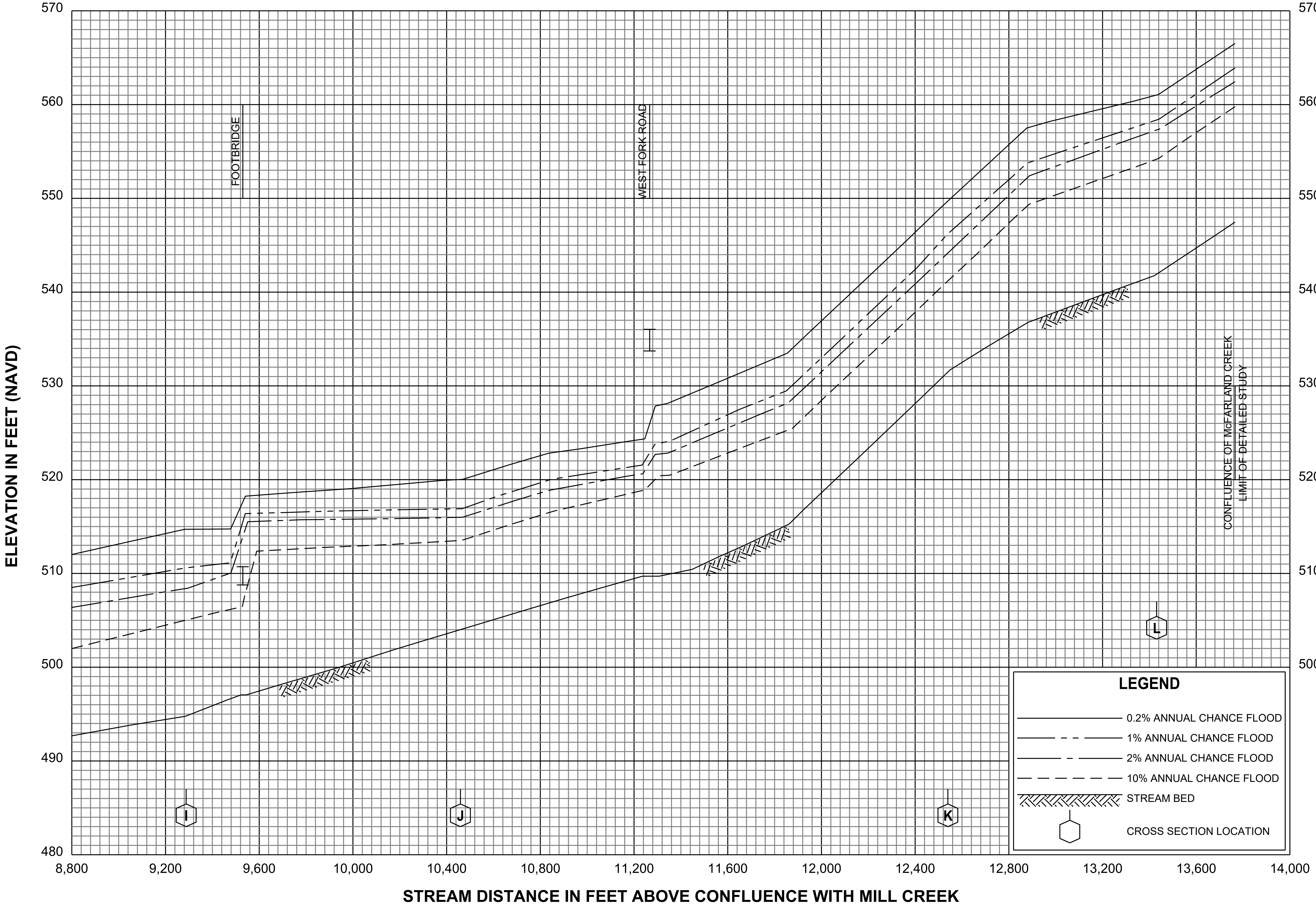
FLOOD PROFILES

WEST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



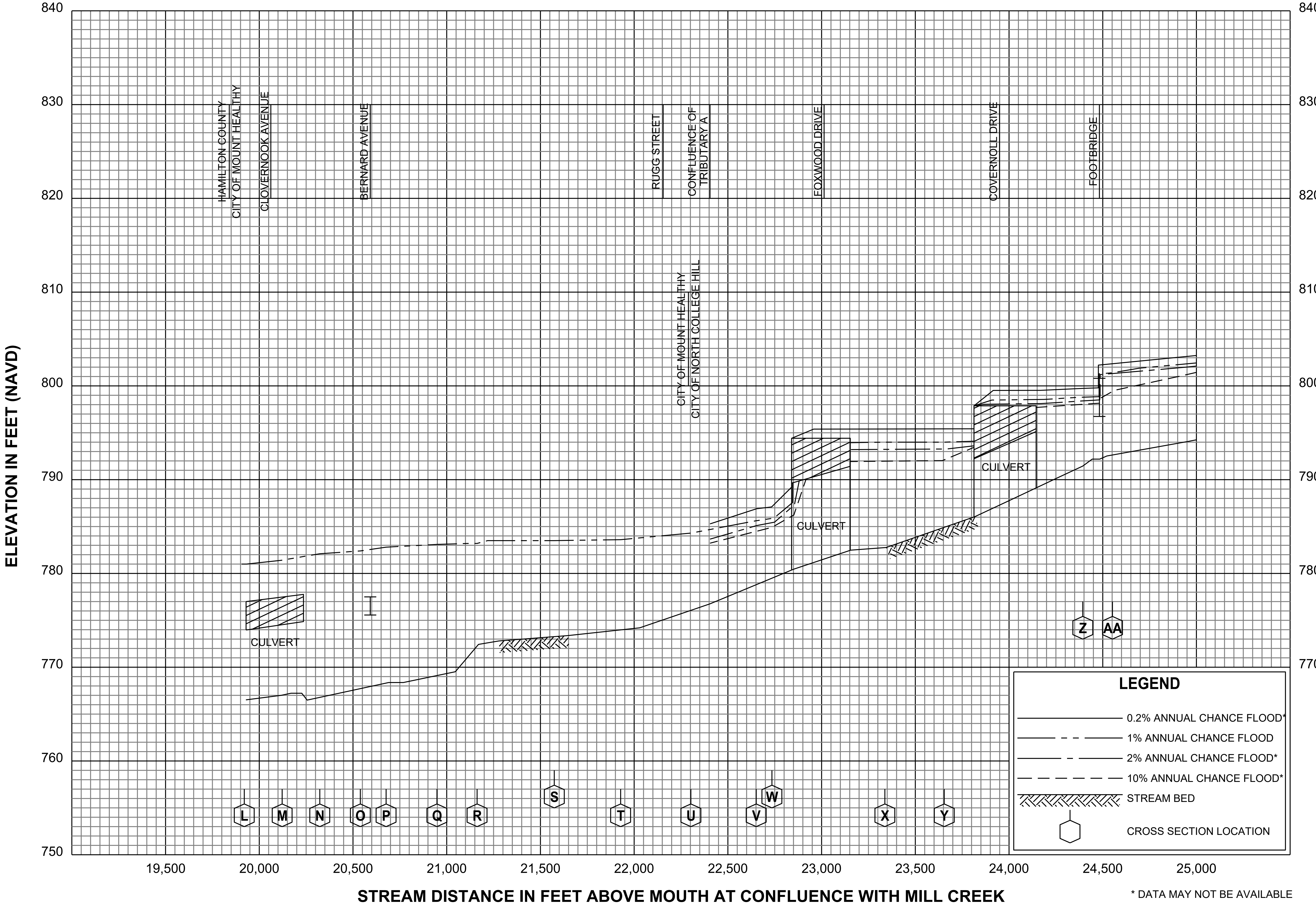
FLOOD PROFILES

WEST FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



* DATA MAY NOT BE AVAILABLE

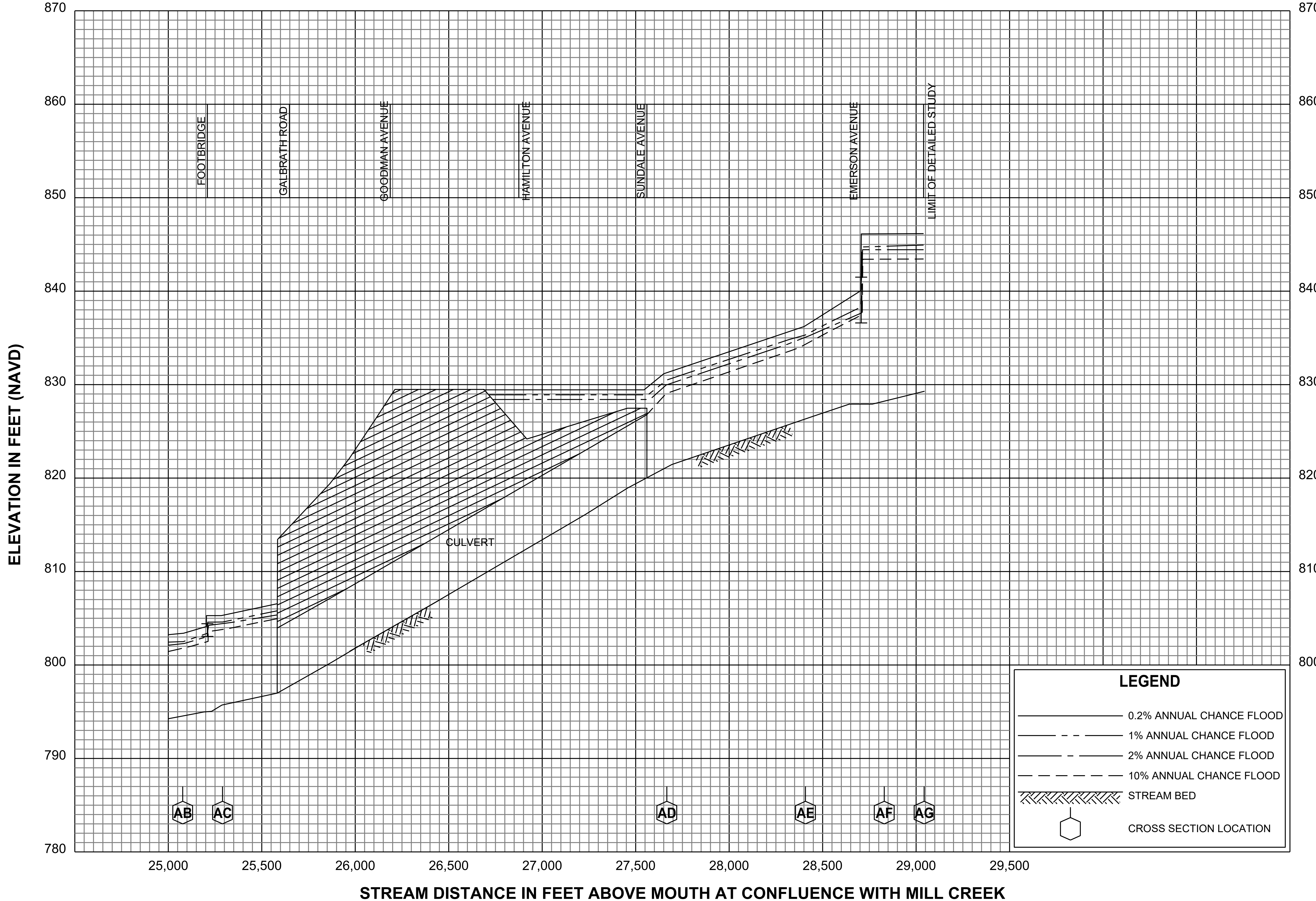
FLOOD PROFILES

WEST FORK LAKE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



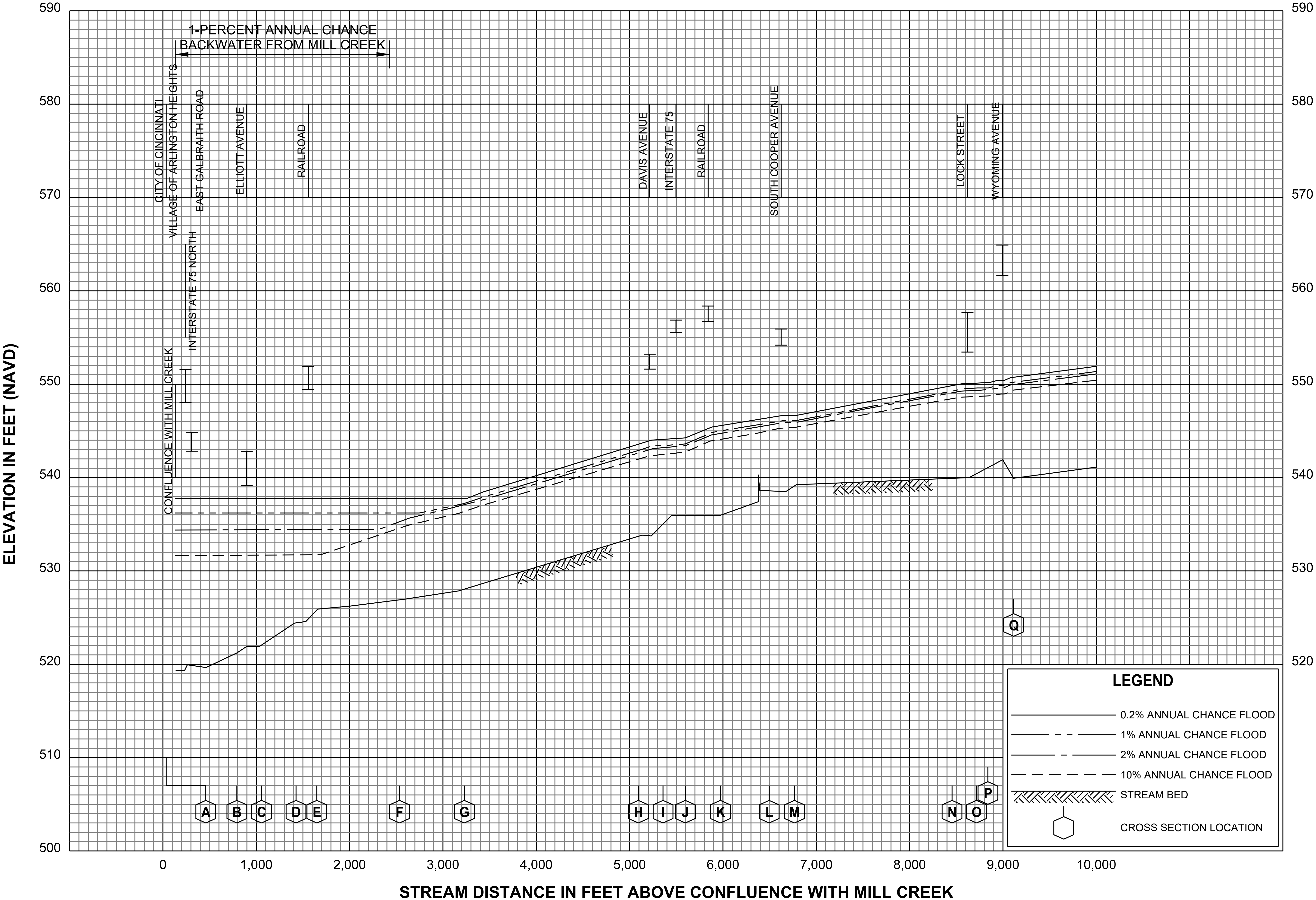
FLOOD PROFILES

WEST FORK LAKE TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



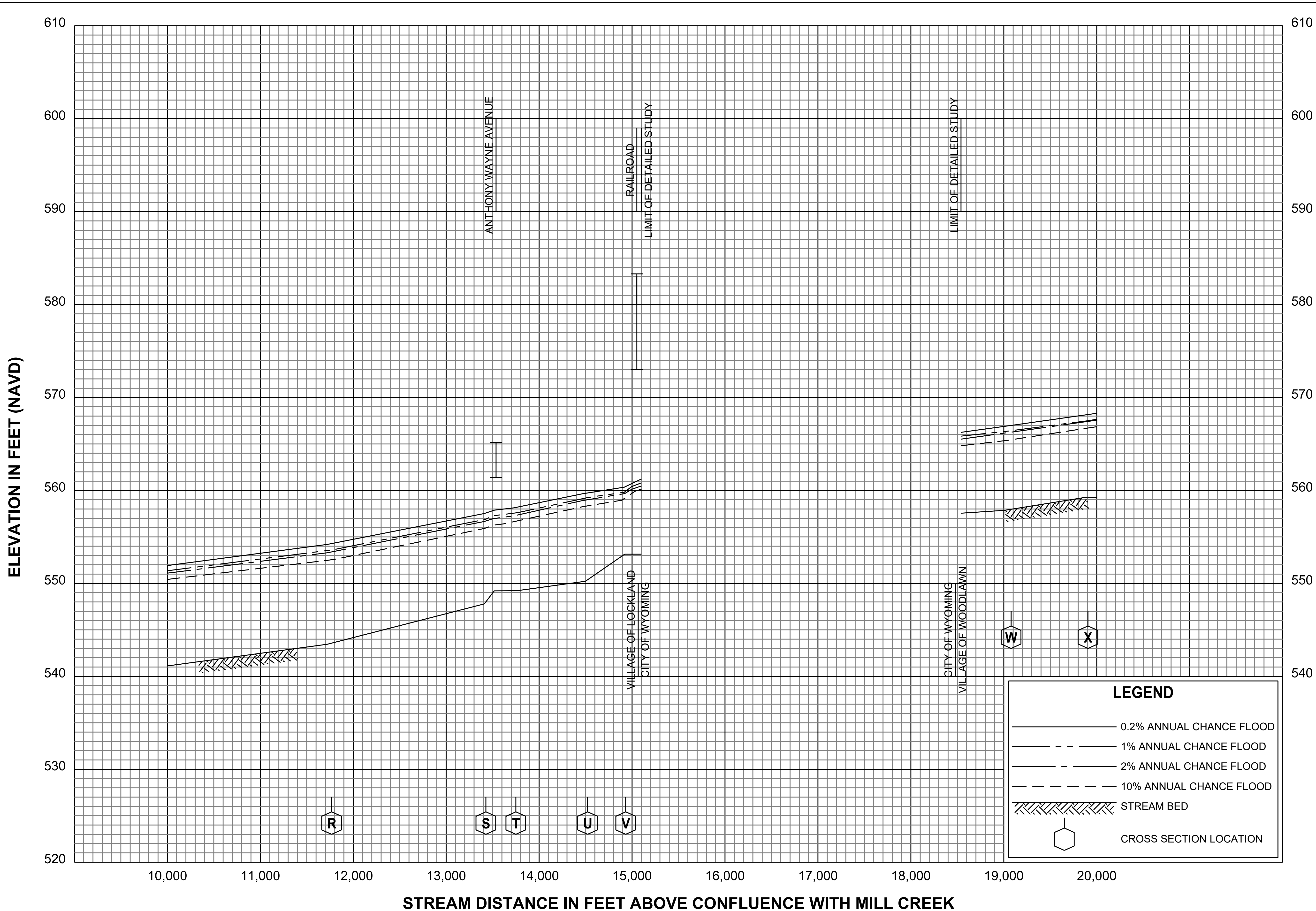
FLOOD PROFILES

WEST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



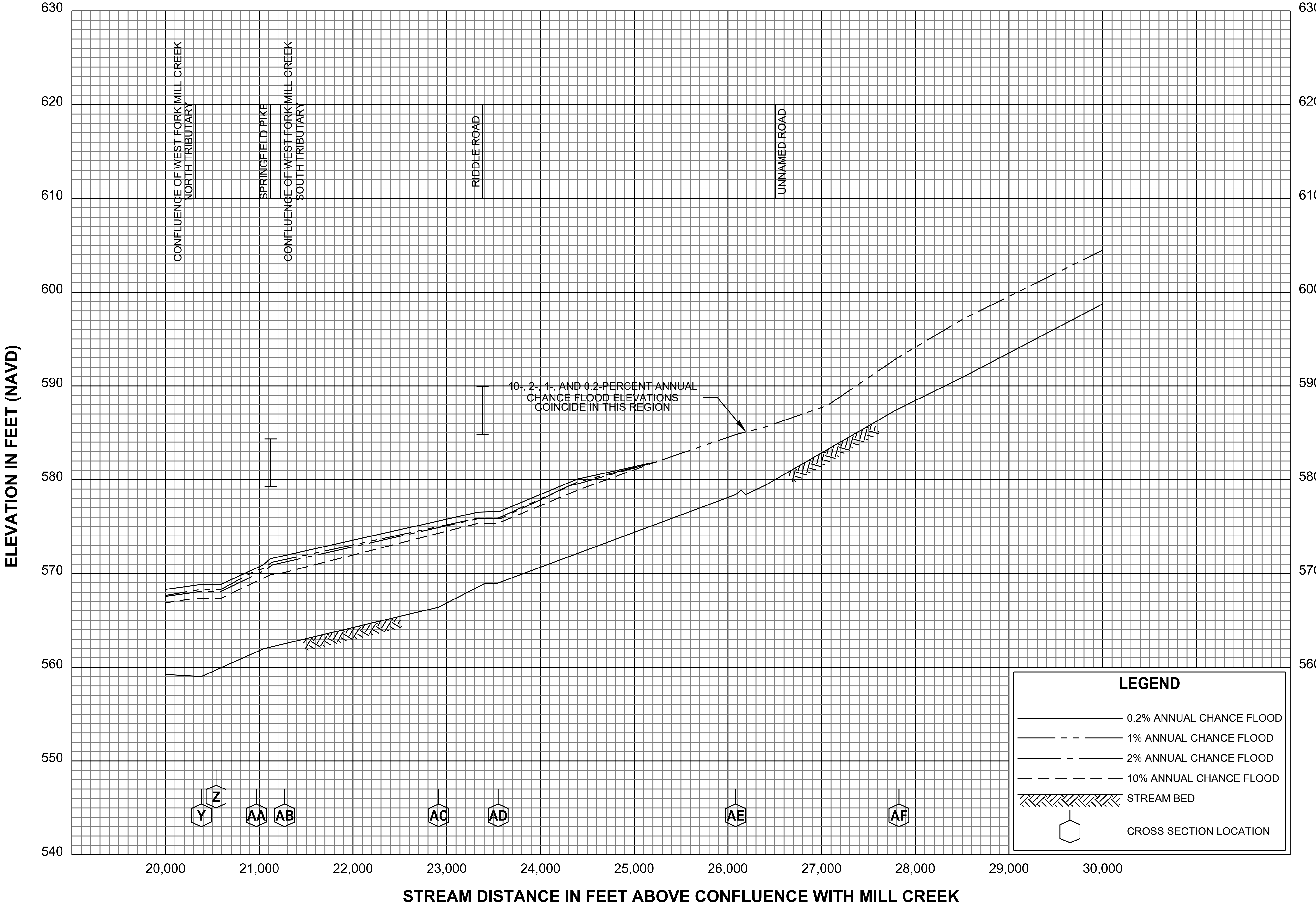
FLOOD PROFILES

WEST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



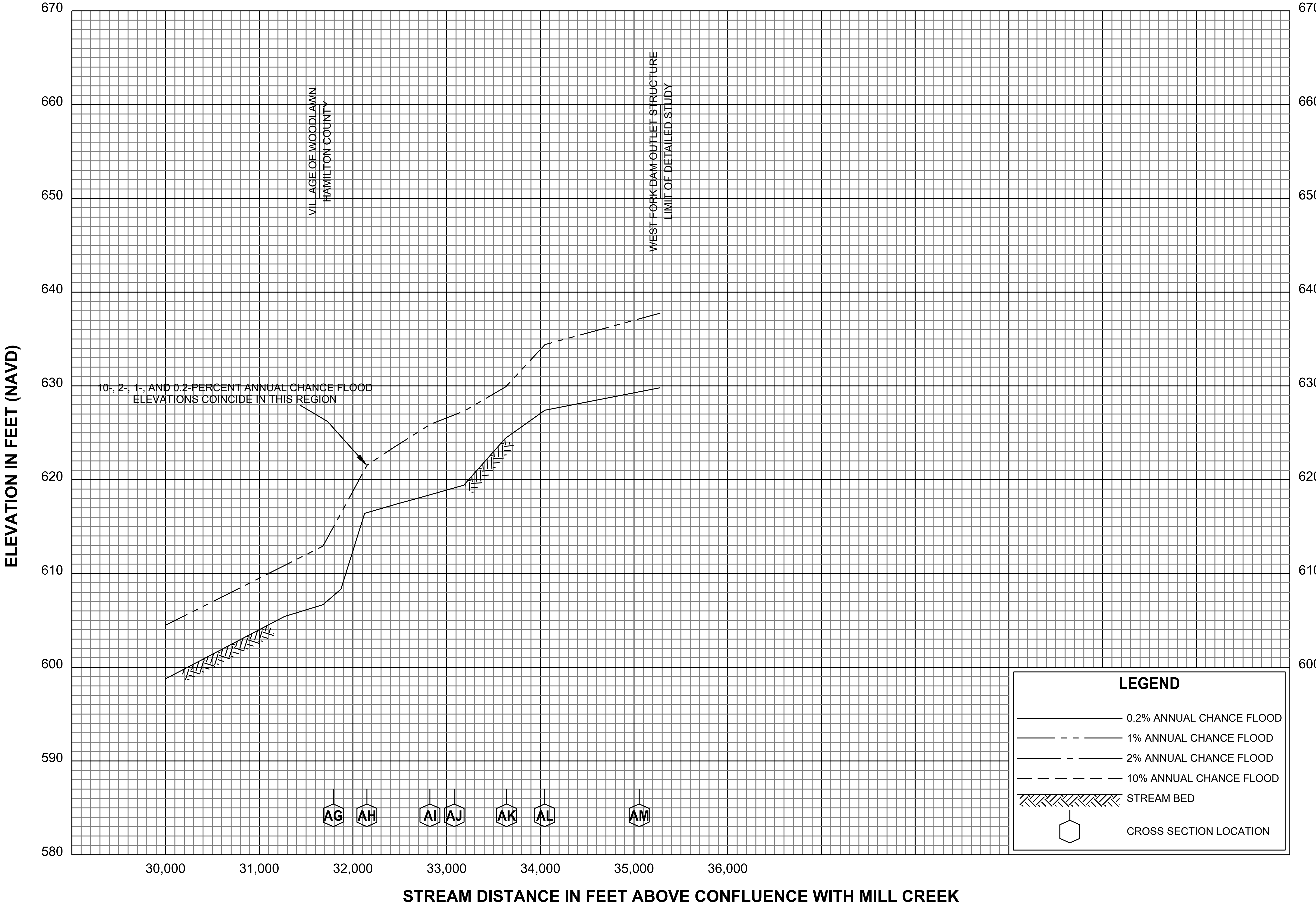
FLOOD PROFILES

WEST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



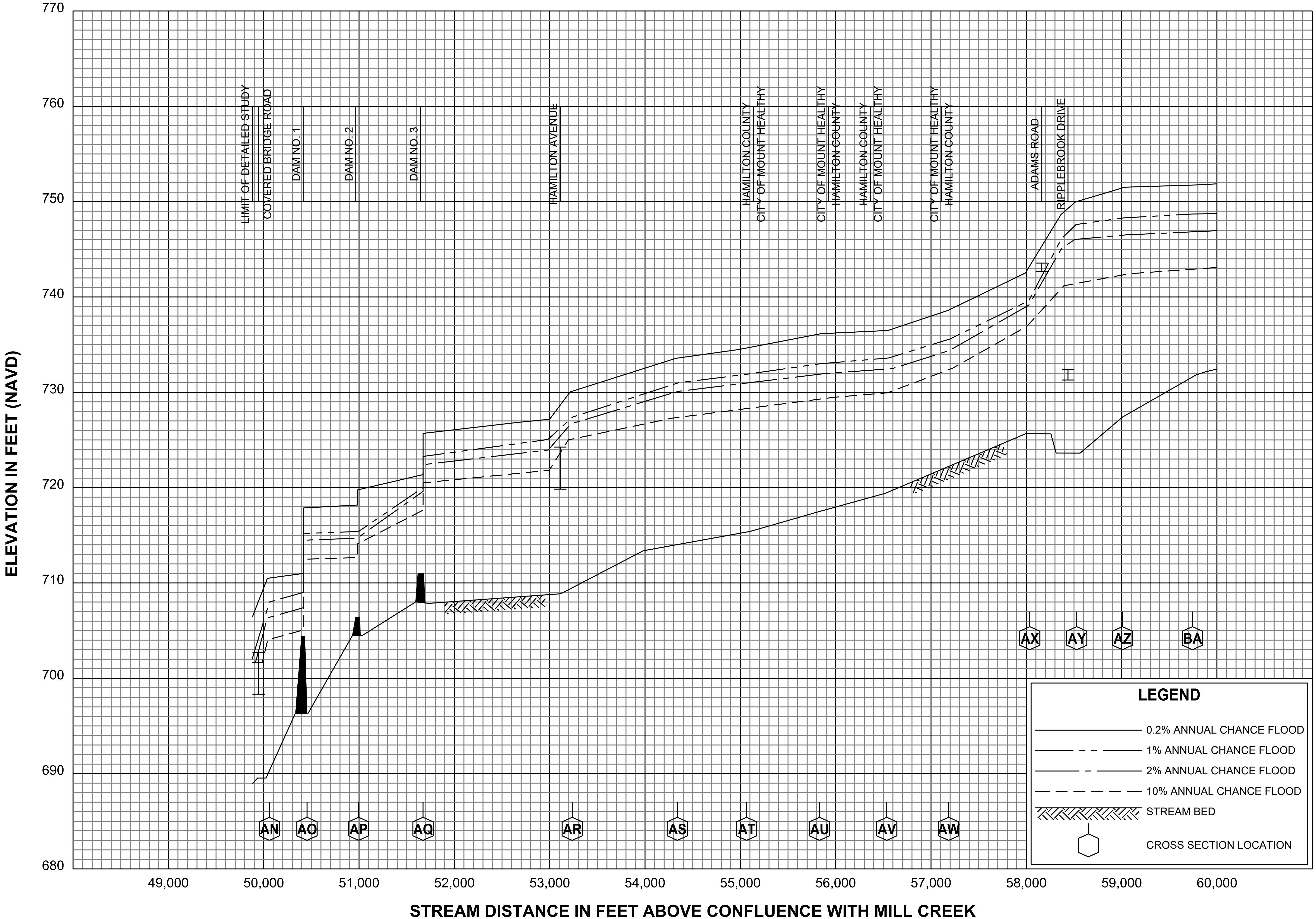
FLOOD PROFILES

WEST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



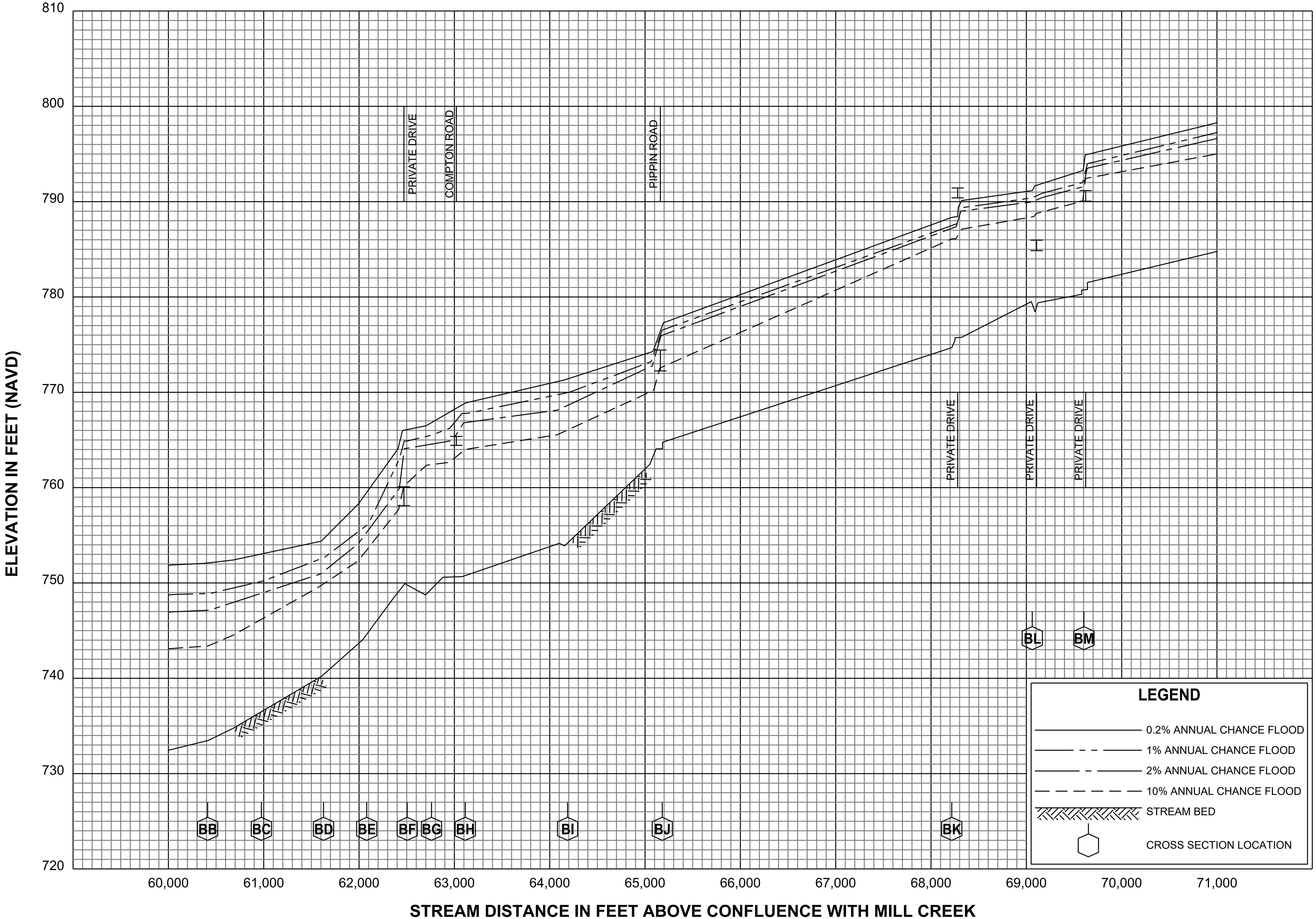
FLOOD PROFILES

WEST FORK MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



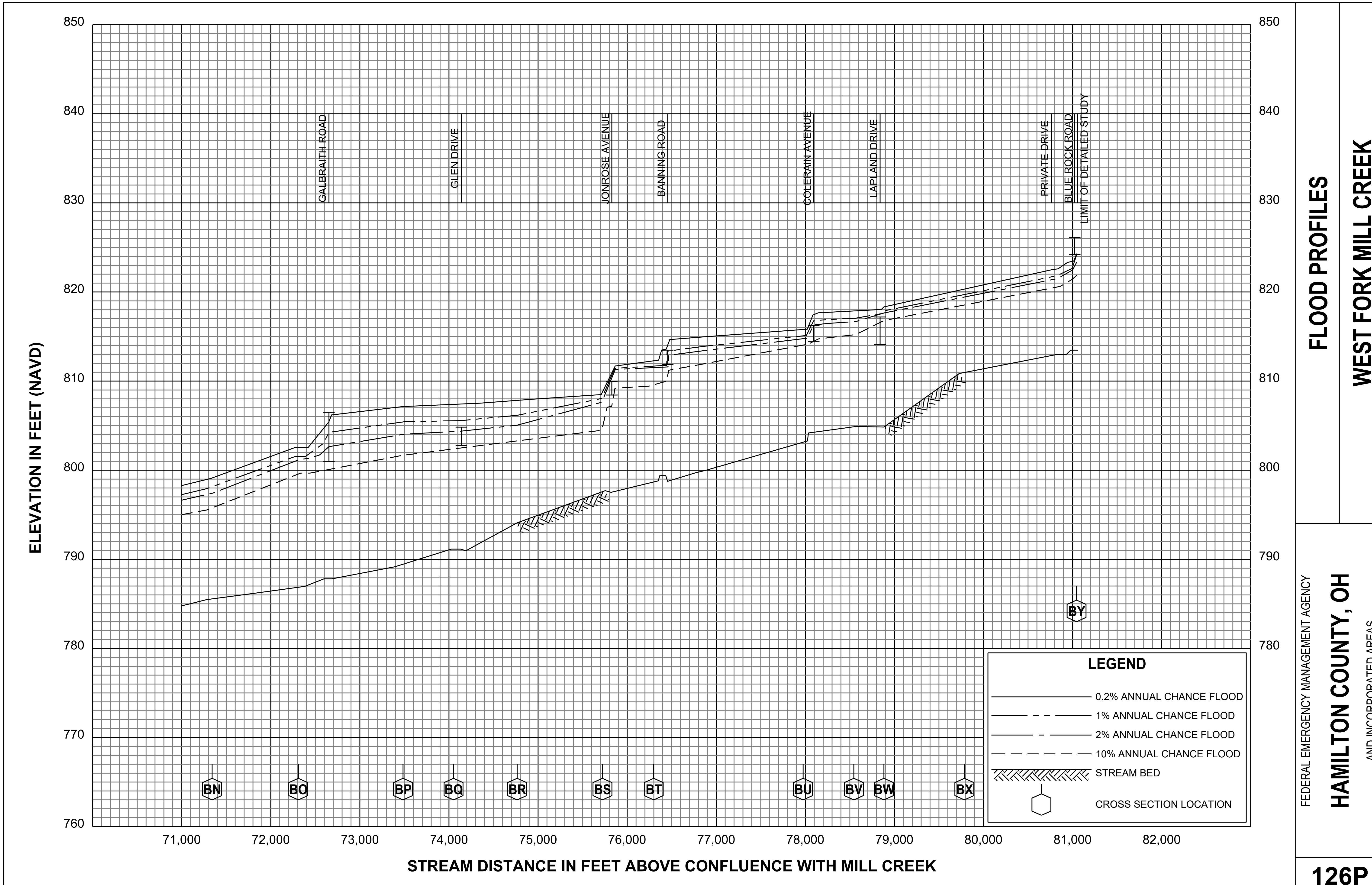
FLOOD PROFILES

WEST FORK MILL CREEK

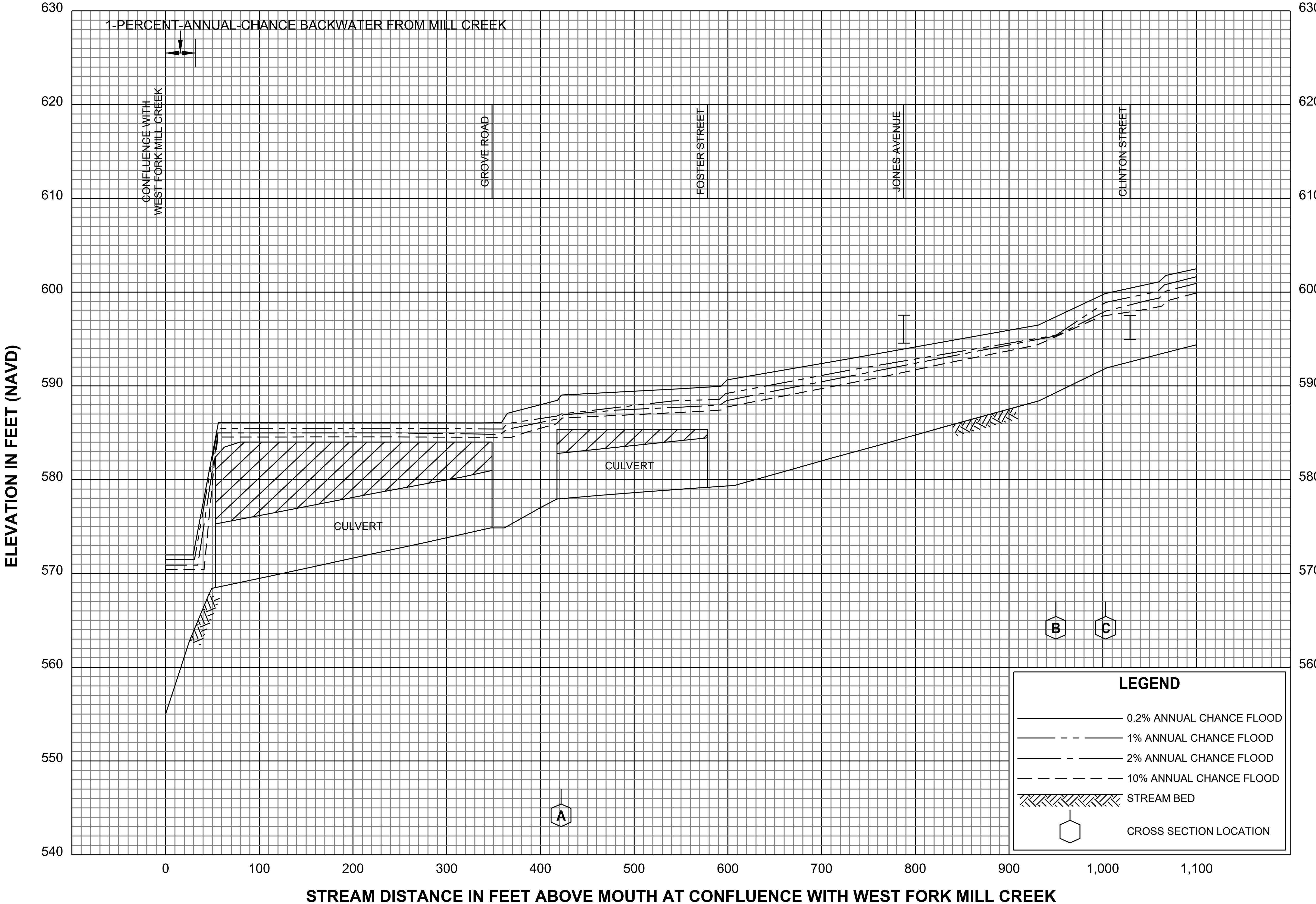
FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES
WEST FORK MILL CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
HAMILTON COUNTY, OH
AND INCORPORATED AREAS
126P
ELEVATION IN FEET (NAVD)
STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH MILL CREEK
GALBRAITH ROAD
GLEN DRIVE
JONROSE AVENUE
BANNING ROAD
COLERAIN AVENUE
LAPLAND DRIVE
PRIVATE DRIVE
BLUE ROCK ROAD
LIMIT OF DETAILED STUDY
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
BN BO BP BQ BR BS BT BU BV BW BX BY
760 770 780 790 800 810 820 830 840 850
71,000 72,000 73,000 74,000 75,000 76,000 77,000 78,000 79,000 80,000 81,000 82,000



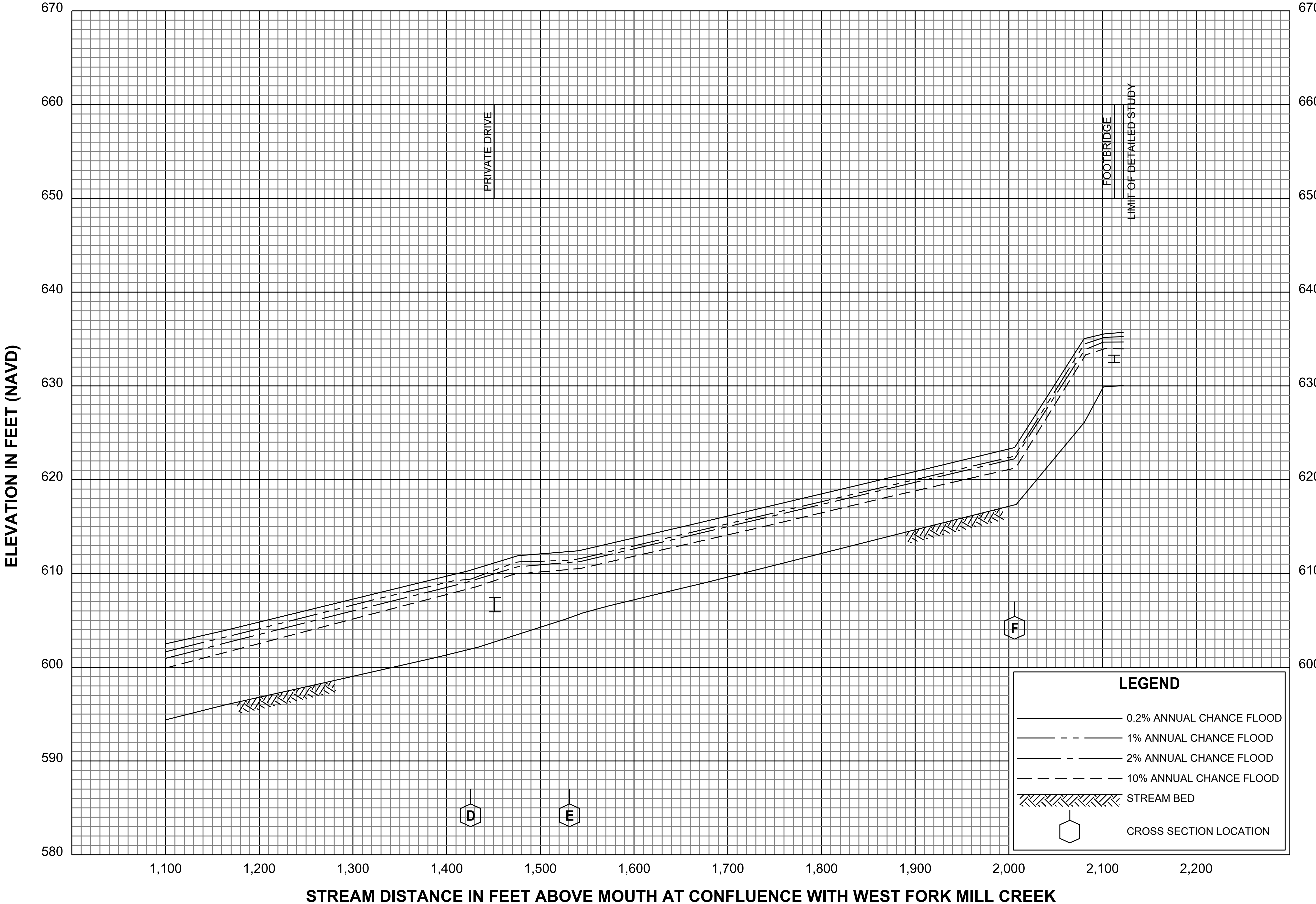
FLOOD PROFILES

WEST FORK MILL CREEK SOUTH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



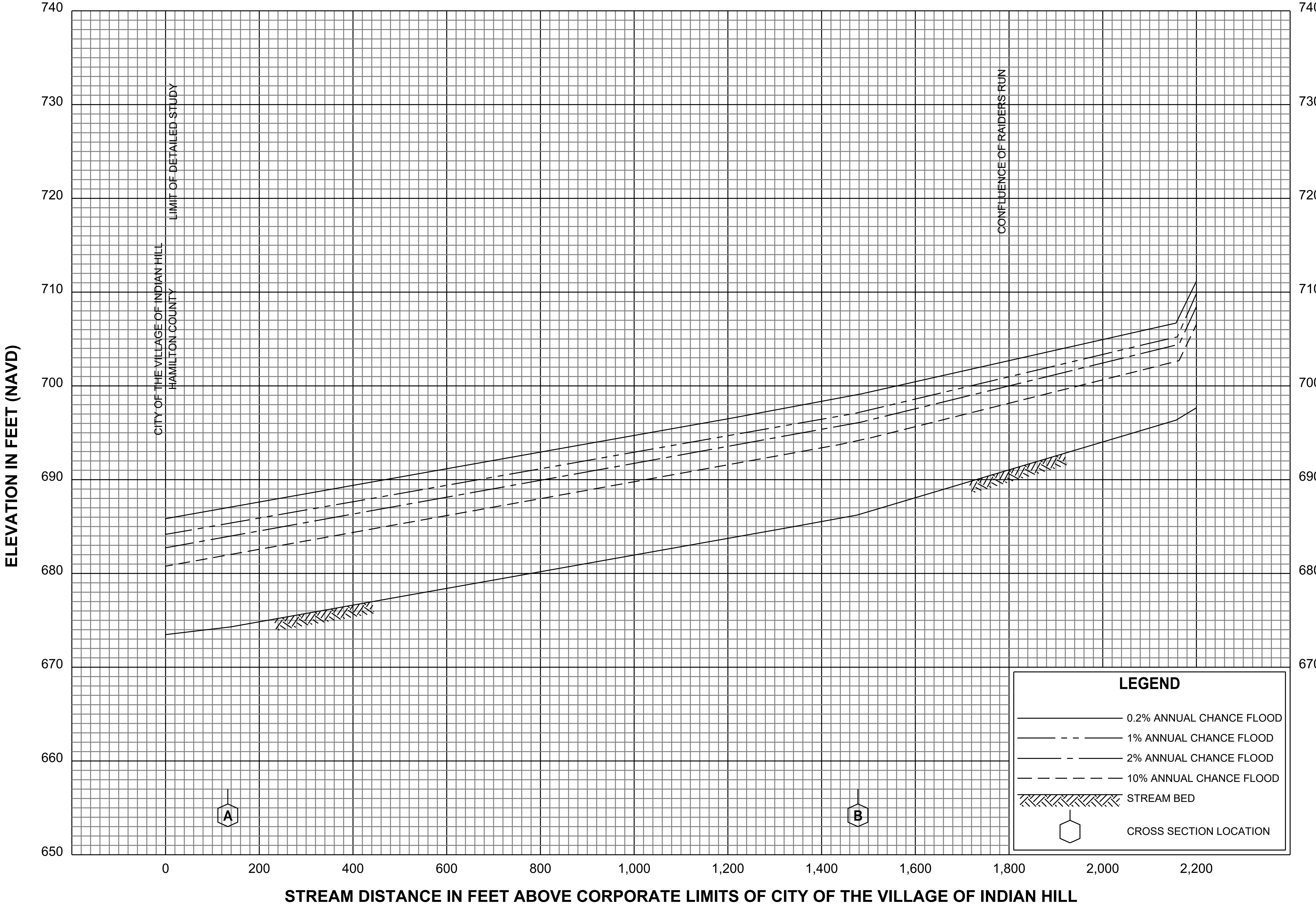
FLOOD PROFILES

WEST FORK MILL CREEK SOUTH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



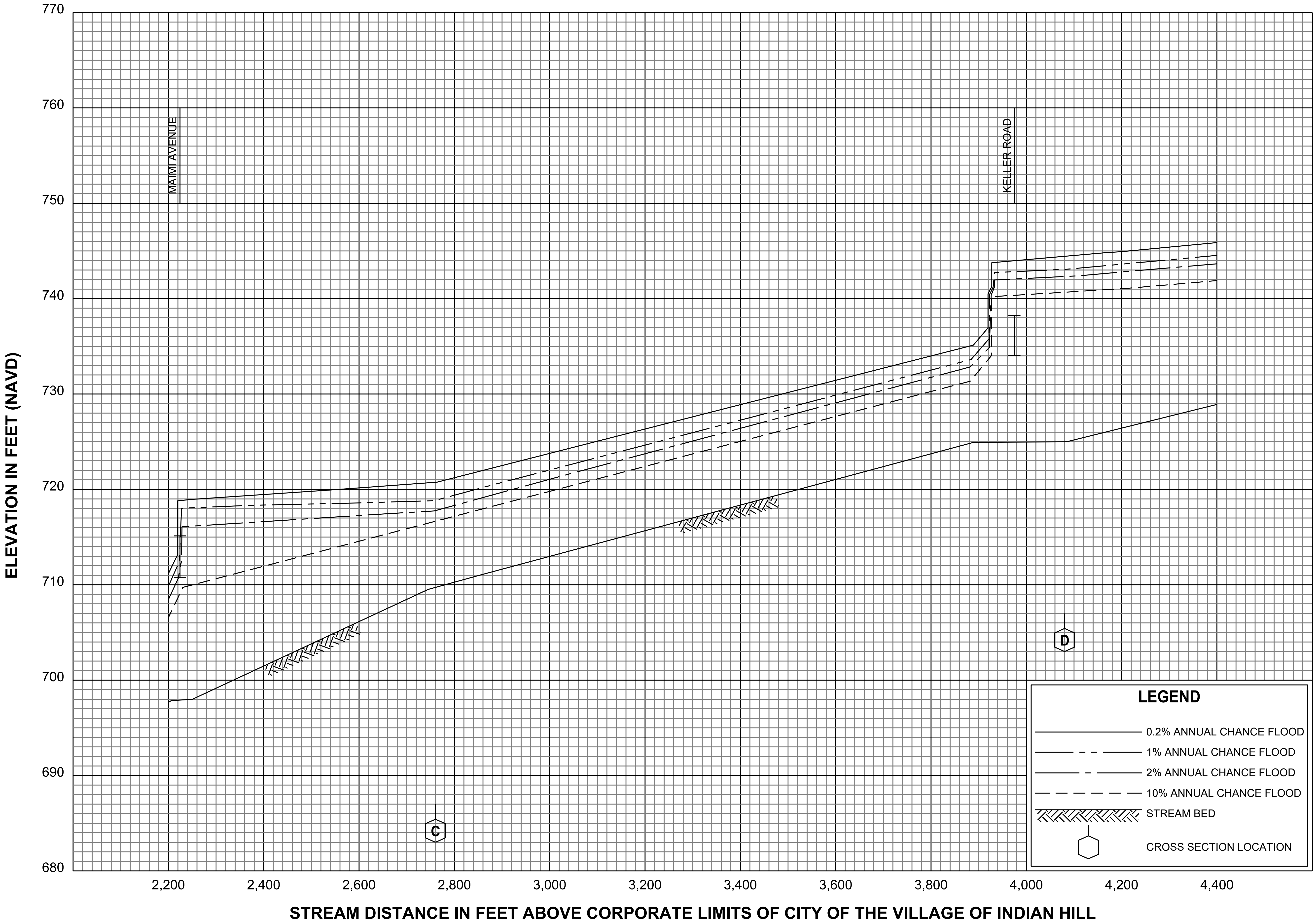
FLOOD PROFILES

WEST FORK OF SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

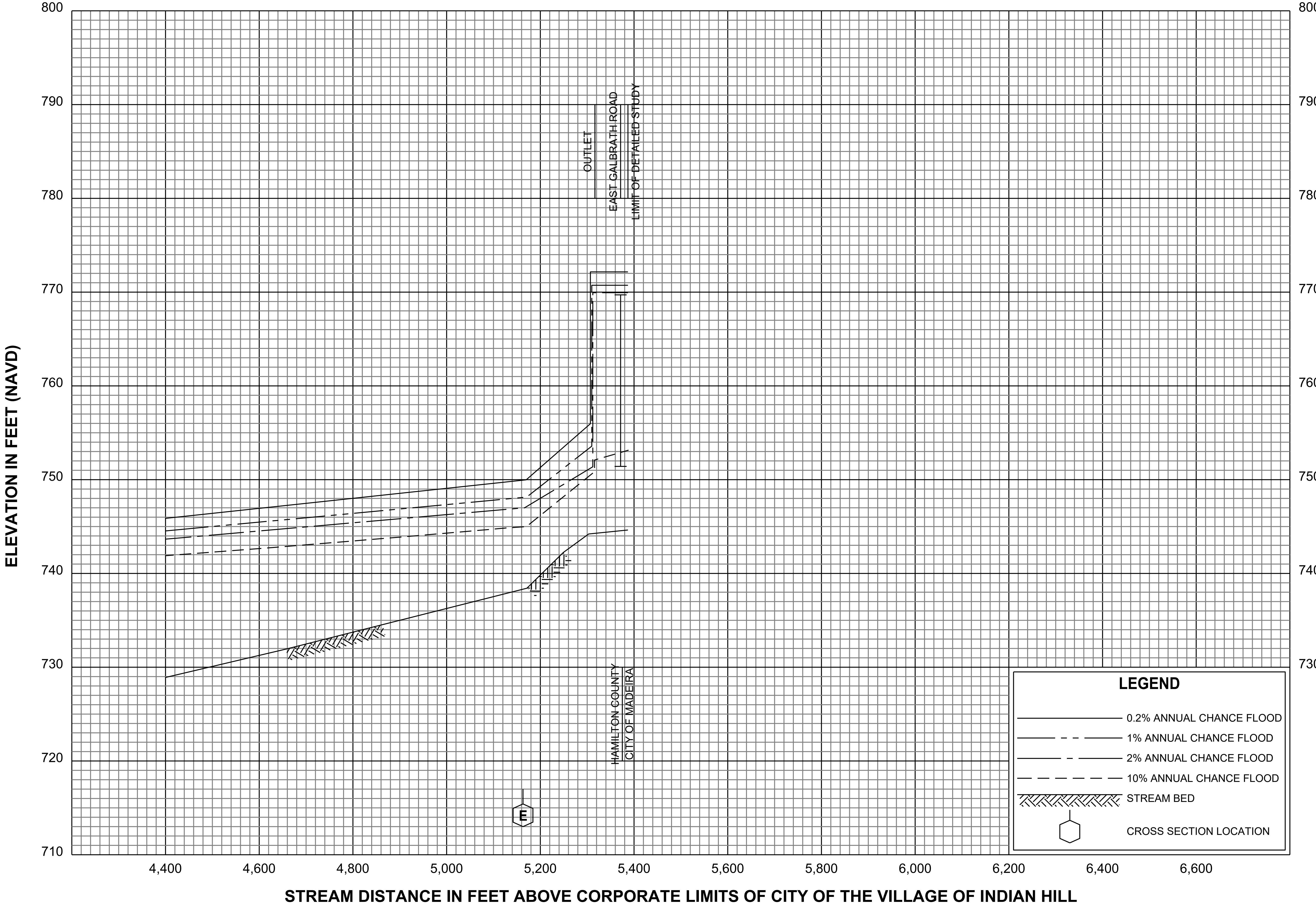
WEST FORK OF SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

130P



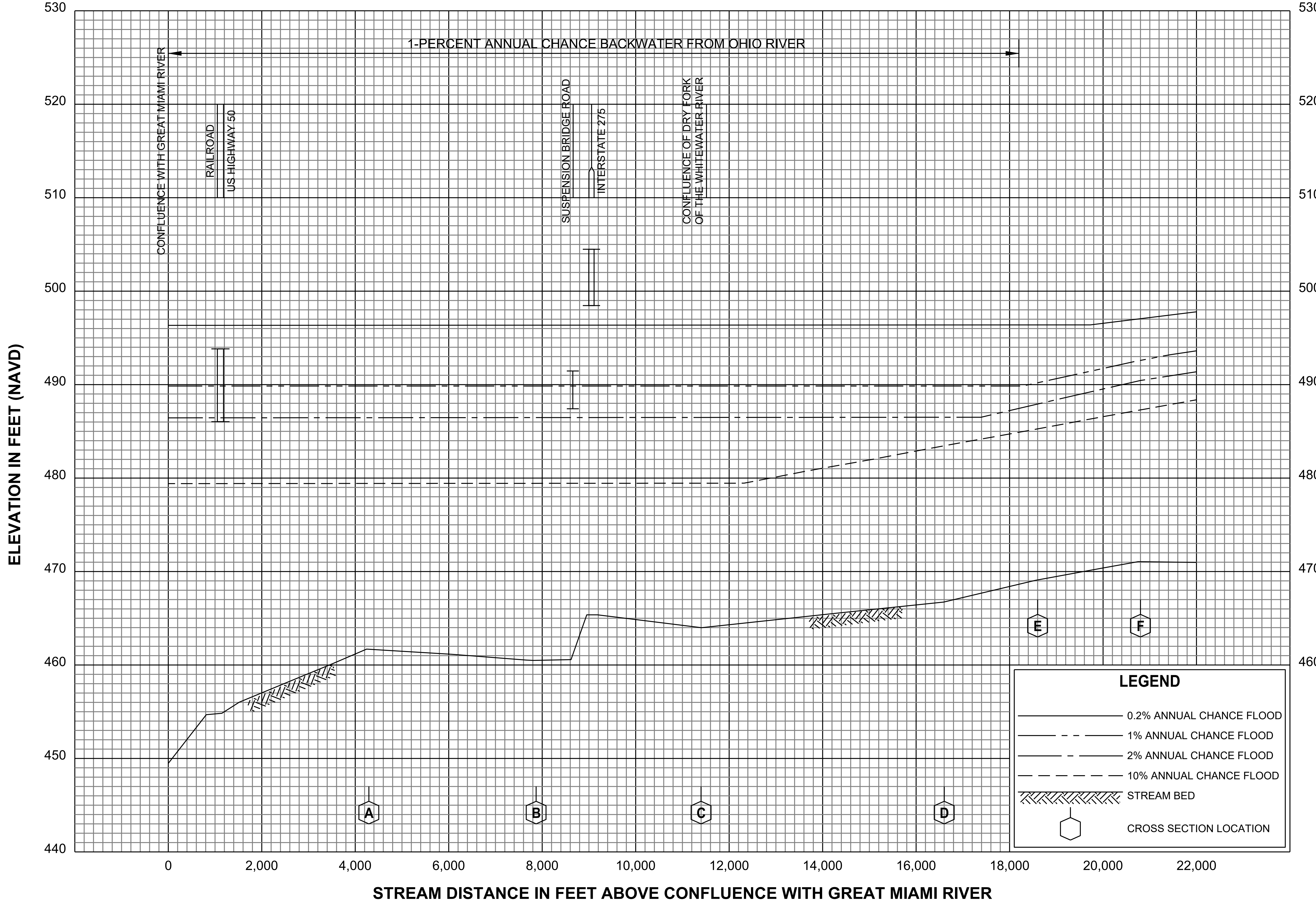
FLOOD PROFILES

WEST FORK OF SYCAMORE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



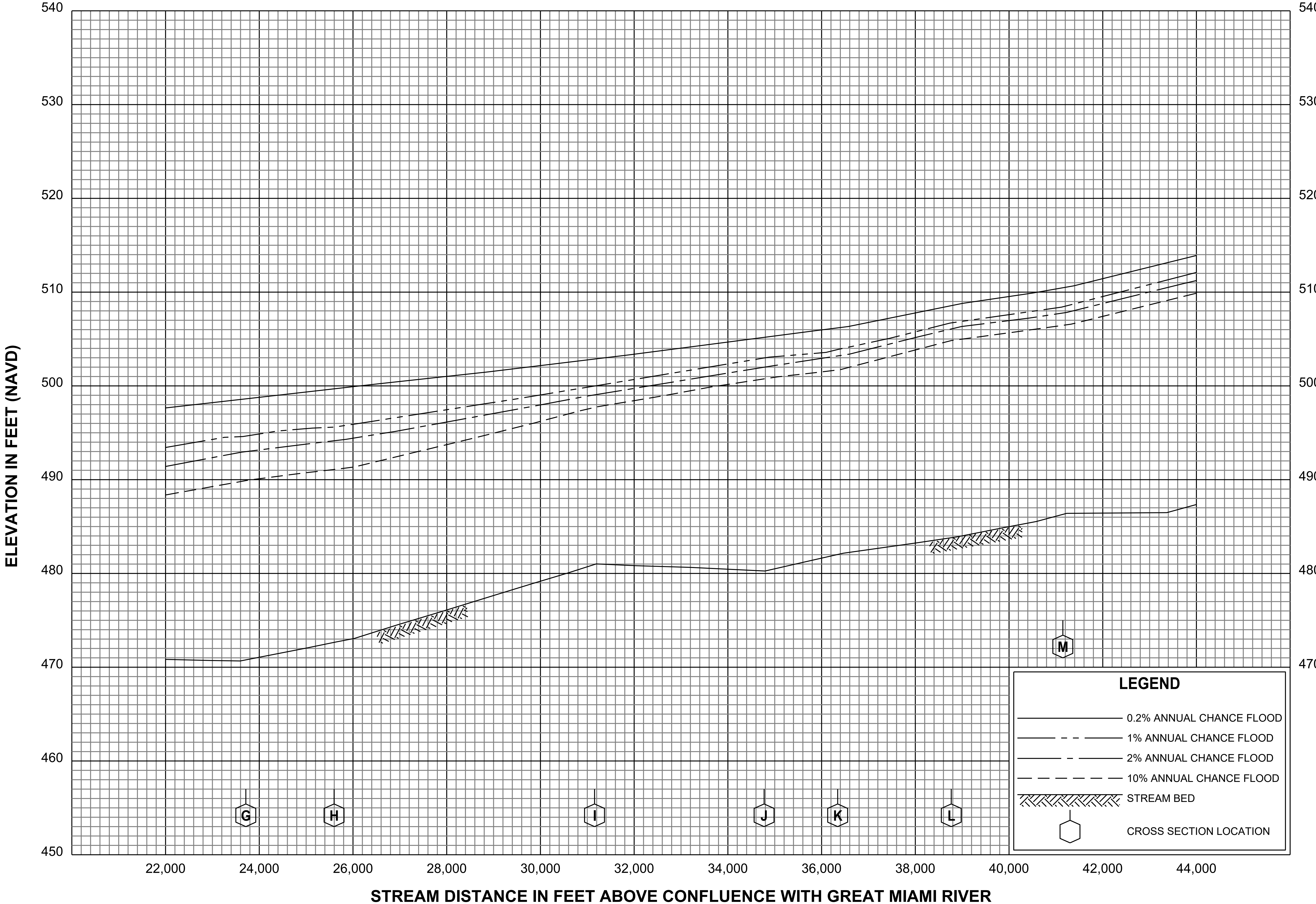
FLOOD PROFILES

WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



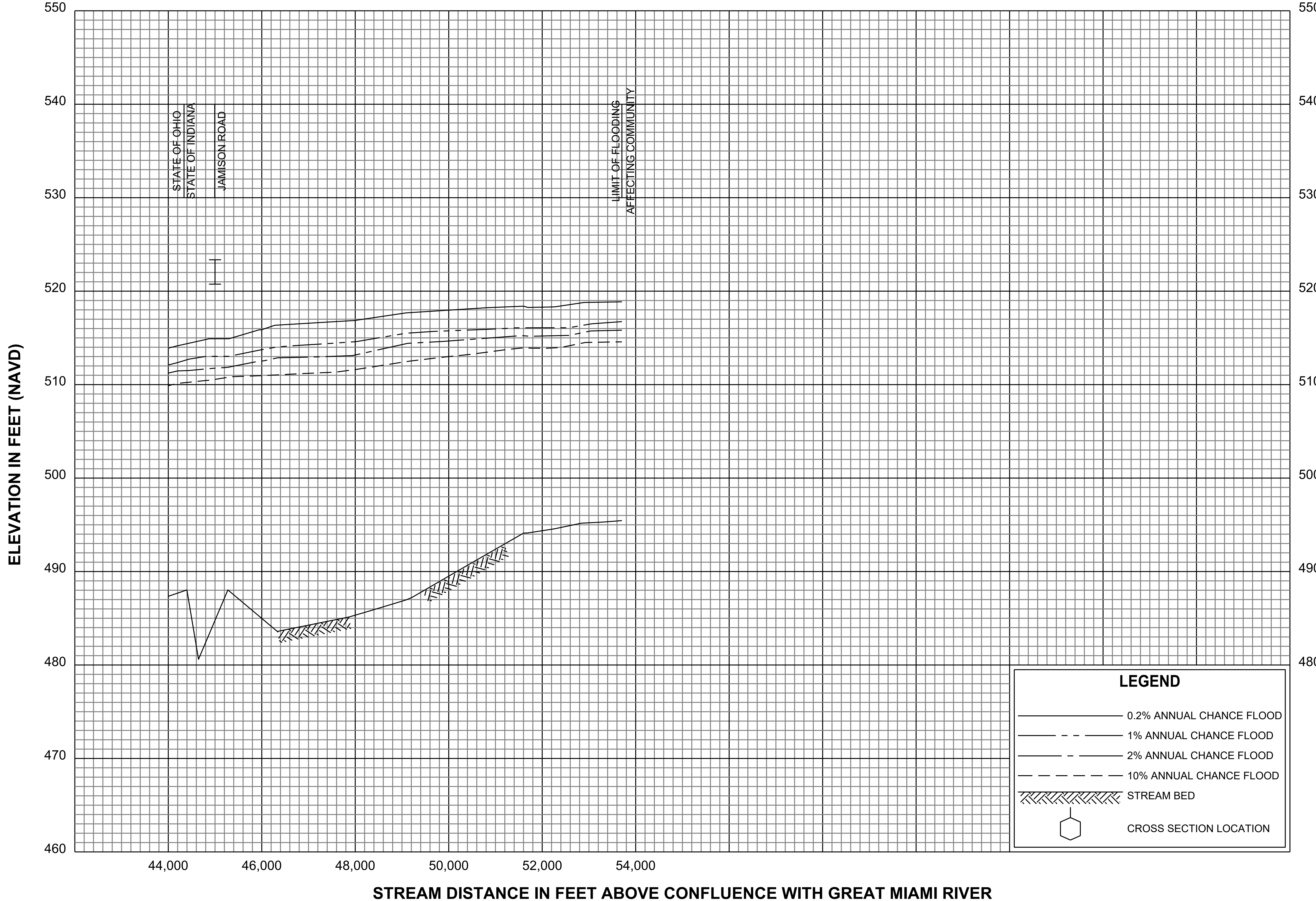
FLOOD PROFILES

WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



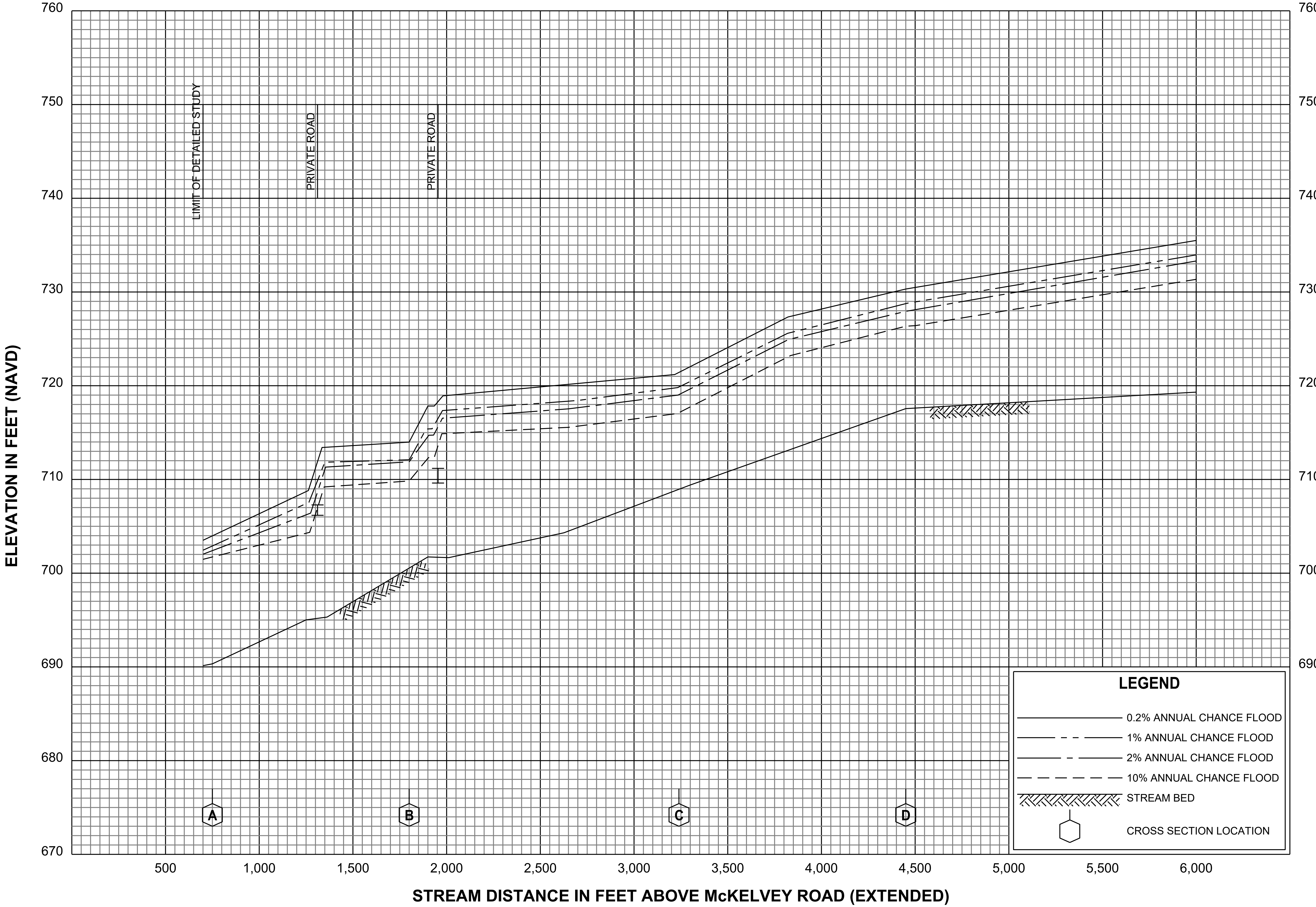
FLOOD PROFILES

WHITEWATER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



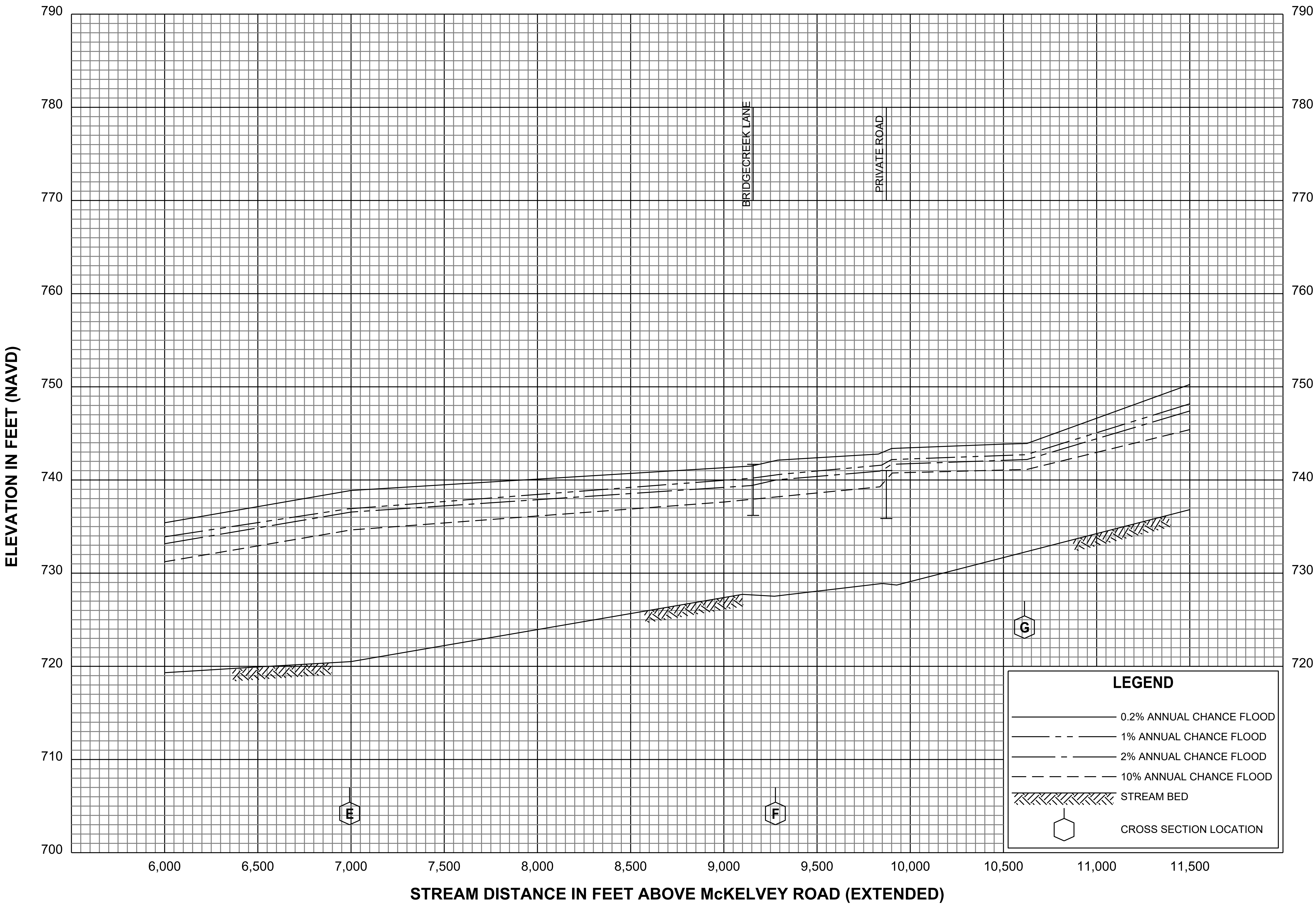
FLOOD PROFILES

WINTON WOODS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



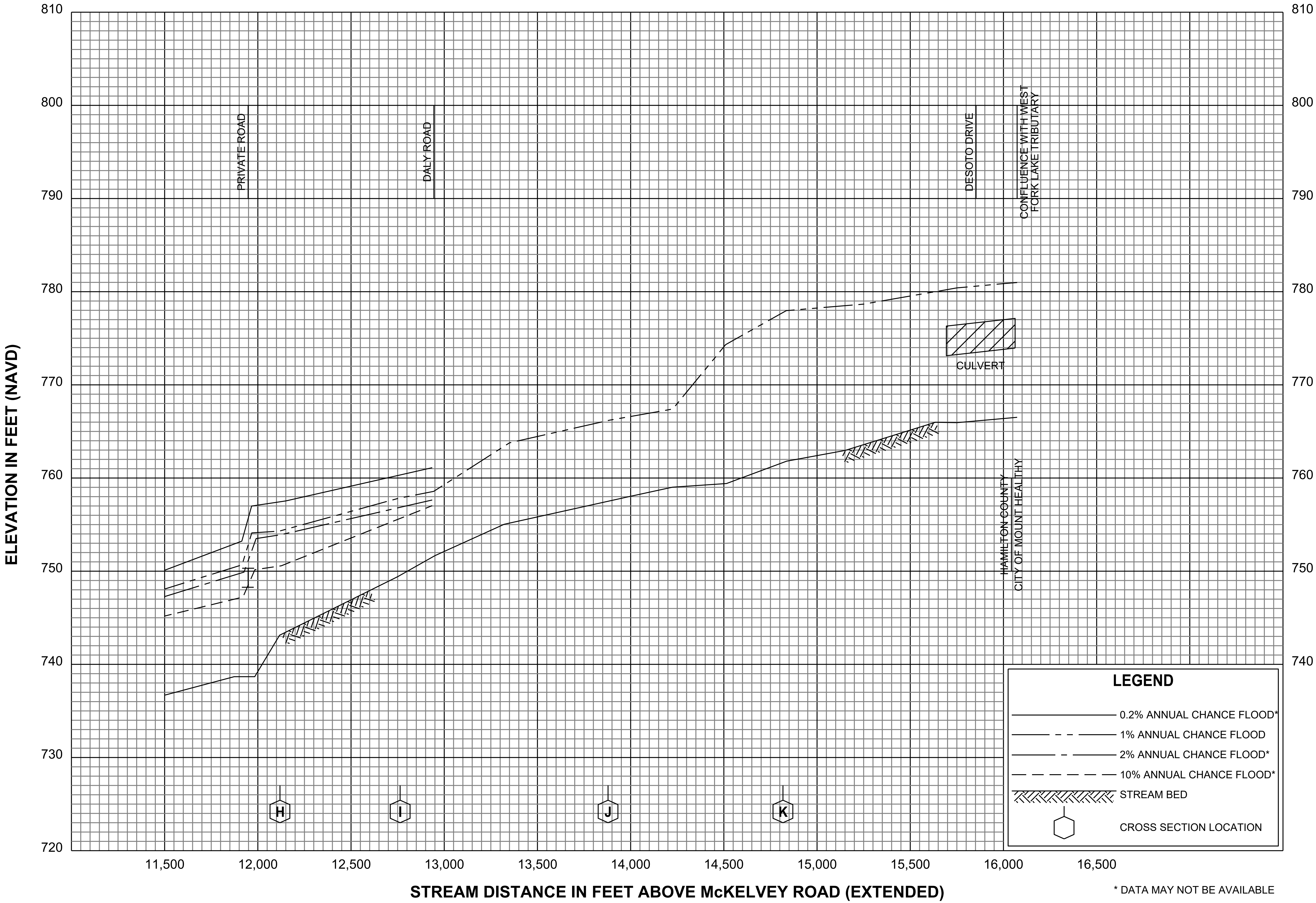
FLOOD PROFILES

WINTON WOODS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



* DATA MAY NOT BE AVAILABLE

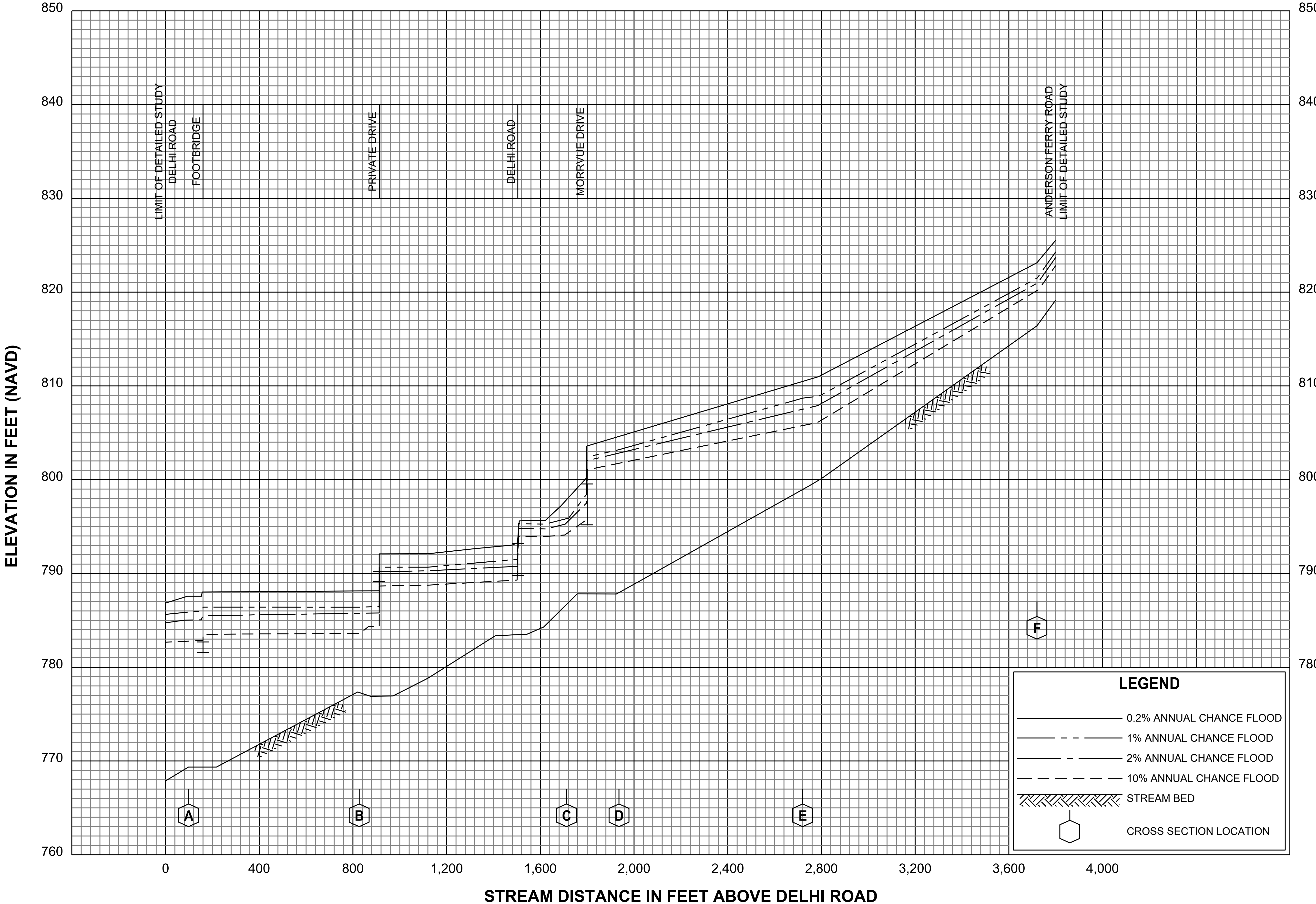
FLOOD PROFILES

WINTON WOODS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



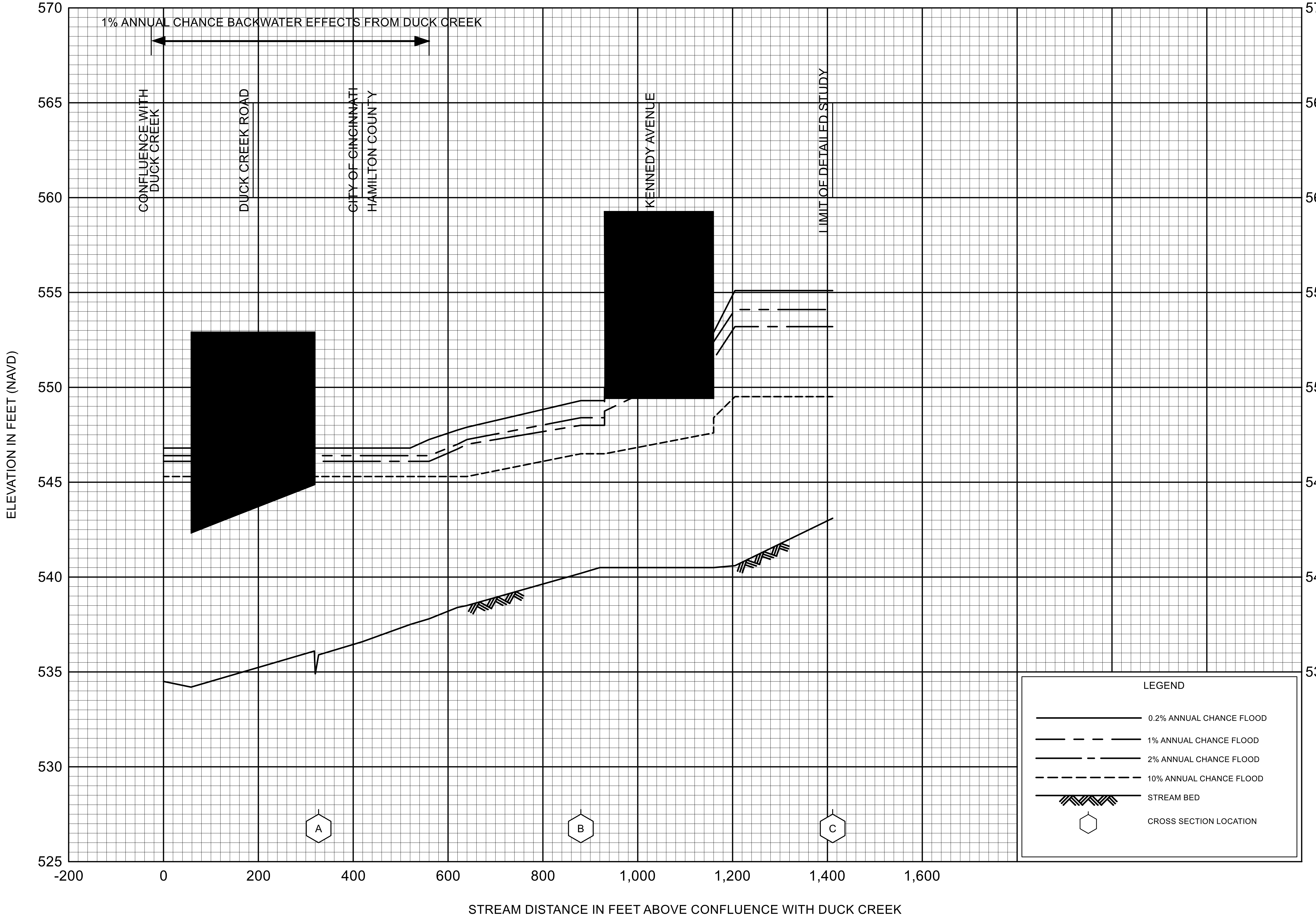
FLOOD PROFILES

WULFF RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS



FLOOD PROFILES

YONOTE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HAMILTON COUNTY, OH

AND INCORPORATED AREAS

1.7. Attachment C: Hydrologic Model

Excerpt from Original

City of Loveland, Ohio
Planning Assistance to States (PAS)
Project Report

Dated April 2023.

U.S. Army Corps of Engineers Louisville District

slopes. This indicates that the existing slopes are anticipated to be stable under the assumed steady state conditions.

4.5.4.3 Rapid Drawdown Slope Stability

Rapid drawdown slope stability occurs when flood waters recede quickly and pore water pressures within the slopes do not have sufficient time to dissipate creating a condition where the slopes have a reduced factor of safety. The soil parameters analyzed for rapid drawdown were in a drained state. For the initial rapid drawdown slope stability analyses, pore water pressure conditions were obtained from the transient seepage analysis using data from the modified hydrographs; however, the factors of safety and/or failure slip surfaces calculated were not similar in size or location to the slope failures observed during our site reconnaissance.

Provided the results of the CCTV inspection report of the storm sewer underlying E. Kemper Road, it was assumed the significant joint separations in the storm sewer lines underneath E. Kemper Road were a contributing factor in the observed slope failures. Thus, the pore water pressure conditions in the subsequent rapid drawdown slope stability models were modified to fully saturate the soils below the approximate storm sewer line elevations. The approximate storm sewer line elevations were obtained from the Storm Sewer Lines Drawings included in Appendix A. The modified groundwater conditions conservatively modeled a flood event with storm water escaping the storm sewer lines through the significant joint separations. In addition, the model accounted for anticipated perched water within the existing fill layer underneath the storm sewer lines that may be present due to the various soil types and/or sand and gravel of the existing fill and/or any void spaces near the storm sewer lines or within other areas of the existing fill mass. The calculated minimum factors of safety ranged from 0.8 to 0.9 indicating that slope failures during rapid drawdown conditions were likely under the assumed conditions. The failure slip surfaces calculated with the model were similar to the slope failures observed during our site reconnaissance.

Table 9 includes a summary of the calculated factors of safety.

Table 9. Minimum Calculated Factors of Safety for Existing Slopes

Site	Steady State	Rapid Drawdown
1	1.2	0.8
2	1.3	0.9
3	1.3	0.8

5.0 HYDRAULIC MODELING

An existing hydraulic model was created from previous studies since a FEMA model was not available. The existing hydraulic model was calibrated using the FIS Hamilton County data shapefiles to reference the floodplain water surface elevation. The modeled existing conditions was compared with the best value alternative, mentioned later in Section 7.0, to determine if the potential alternatives are compliant with the Federal Emergency Management Agencies (FEMA) regulations for flood plains. According to Federal Emergency Management Agency's (FEMA) Title 44, Emergency Management and Assistance, Chapter I, Part 60 – Criteria for Land Management and Use, Subpart A – Requirements for Flood Plain Management Regulations, Section 60.3 – Flood Plain Management Criteria for Flood-prone Areas (44 CFR 60.3), any substantial improvements should not increase the water surface elevation of the base flood more than one foot at any point within the community.

5.1 DATA COLLECTION

5.1.1 GIS Terrain Data and Layers

The Digital Elevation Model (DEM) used in this study was obtained from the 2020 Caesar Creek Mapping Modeling and Consequences (MMC) study. The DEM is a 10-meter DEM from the U.S. Geological Survey.

5.1.2 Existing Hydraulic Models

FEMA MODEL
The current effective model is a HEC-2 model from 1979 that was not available. There is an updated preliminary model that was not available at the time of this study.

MMC MODEL
A 2020 Mapping Modeling and Consequence (MMC) model for Caesar Creek Dam was used for this study. The existing conditions hydraulic model was created using this model as the base model, see Section 5.2.1 for additional details.

CWMS MODEL
A Corps Water Management System (CWMS) model for the Little Miami River was used for this study. This model was used to add more detailed areas to the hydraulic model that was not contained in the MMC model, see Section 5.2.1 for additional details.

5.1.3 Stream Gage

U.S. Geological Survey (USGS) gage No. 03245500 Little Miami River at Milford, Ohio was used for this study as the downstream boundary for the hydraulic modeling. See Section 5.2.1 for additional details.

5.1.4 Flood Insurance Study

The 2012 Hamilton County, Ohio and Incorporated areas, Flood Insurance Study (FIS) No. 39061CV001C was used for this study. The frequency flows from the report were used for the hydraulic model and the Hamilton County data shapefiles were used for calibration of the the water surface elevations with the respective locations along Little Miami River.

5.1.5 Vertical Datum

All elevations are reported in in North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

5.2 EXISTING CONDITIONS HYDRAULIC ANALYSIS

The purpose of this section is to describe the effort to develop an existing conditions one dimensional steady state hydraulic model for Loveland PAS using HEC-RAS version 6.1.

5.2.1 Hydraulic Model Setup

Initial development of the hydraulic model began using the existing MMC model with updates to the model listed below for this project.

The model was trimmed to only include approximately 1.6 miles upstream of the project area to compare with the upper extents of the FIS mentioned in Section 5.1.4, and approximately 9.6 miles downstream of the project area at USGS Gage No. 03245500 Little Miami River at Milford, OH. See Figure 16 for model extents.

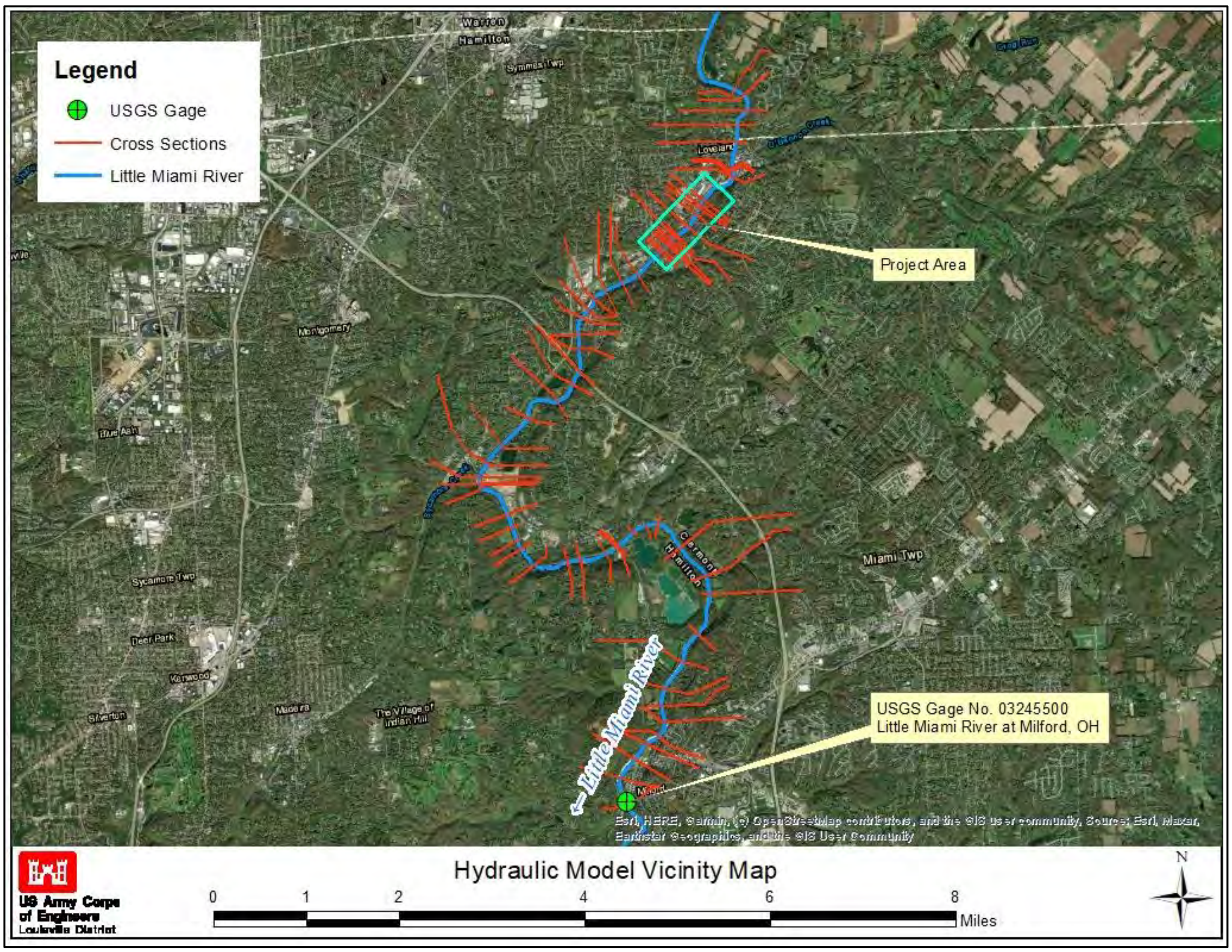


Figure 16: Hydraulic Model Vicinity Map

5.2.1.1 Bathymetry

A bathymetry terrain layer from the MMC model was created using interpolated surfaces between cross sections and combined with the existing DEM to create an updated terrain with a cut bathymetry. The MMC model's bathymetry is not deemed accurate due to lack of information confirming how bathymetry was obtained.

Note that the cross sections near the project area were adjusted based on approximate slopes estimated from visual observations, photos taken during the site reconnaissance, and information obtained from Google Earth Pro and used for the Geotechnical slope stability modeling mentioned in Section 4.4.4.3. The approximate slopes for Work Site 1 and 2 were changed from an approximate slope of 3H:1V to an assumed slope of 1.8H:1V. Work Site 3 was changed from an approximate slope of 1.5H:1V to an assumed slope of 2 H:1V to 5.5H:1V.

5.2.1.2 Cross Section Data

Cross sections were added to the project areas that will be utilized for the potential remediation alternative. Cross sections were placed approximately 160 ft to 830 ft apart throughout the project area perpendicular to the stream; The cross section spacing allowed more detail for the upstream and downstream boundaries of the respective work sites. Some cross sections were imported from the CWMS model for the upstream and downstream cross sections of bridges and inline structures. Cross sections were extended along the overbanks to inundate the 1% AEP floodplain. The cross sections imported from the CWMS model or created near the project area were adjusted to the MMC interpolated bathymetry when necessary.

Manning's "n" values were approximated by using the adjacent cross section of the existing model or aerial photograph using Table 10.

Table 10: MMC Recommended Manning's "n" Values

Land Cover ID	Land Cover Description	Manning's "n"
11	Open Water	0.025-0.03
21	Developed, Open Space	0.03-0.04
22	Developed, Low Intensity	0.04-0.06
23	Developed, Medium Intensity	0.04-0.07
24	Developed, High Intensity	0.06-0.07
31	Barren Land	0.025-0.035
41	Deciduous Forest	0.15-0.2
42	Evergreen Forest	0.14-0.18
43	Mixed Forest	0.18-0.2
52	Shrub/Scrub	0.09-0.11
71	Grassland/Herbaceous	0.06-0.08
81	Pasture/Hay	0.05-0.07
82	Cultivated Crops	0.045-0.065
90	Woody Wetlands	0.07-0.09
95	Emergent Herbaceous Wetlands	0.06-0.08

5.2.1.3 Bridges

The MMC model did not contain any bridge structures. Bridge data including the upstream and downstream cross sections from the CWMS model were imported to this study. Cross sections were trimmed to the lateral structures where applicable.

Note that the CWMS model did not include all bridges in the hydraulic model extents. Such missing bridges includes, but is not limited to, the I-275 bridge, Hopewell Road Bridge, and Loveland Avenue Bridge. These bridges were not included in this hydraulic model and future efforts should include these for more detail.

5.2.1.4 Steady Flow

Steady flows from the 2012 FIS mentioned in Section 5.1.4, were included in this study at the respective cross sections based on the Summary of Discharges for the 1% AEP in the FIS, shown in Table 11.

Table 11: Steady Flows used in the Hydraulic Model

Little Miami River Flooding Source and Location (Source: FIS*)	Drainage Area (SQMI) (Source: FIS*)	Associated HEC-RAS Cross Section	1% AEP Peak Discharge (CFS)
Below Entel Run	1,145	25.28965	79,000
At Loveland Road	1,145	24.60054	82,700
Above Sycamore Creek	1,162	19.77903	82,700
Below Glendale Milford Road	1,190	17.429	84,400
At U.S. Highway 50 bridge at Milford (USGS gage)	1,203	13.29399	85,000

***Source: FIS No. 39061CV001C, Table 6**

5.2.1.5 Reach Boundary Conditions

The downstream boundary condition was set to a rating curve based on the USGS WaterWatch rating curve for USGS Gage No. 03245500 Little Miami River at Milford, Ohio, accessed May 26th, 2022; See Figure 17. Note that the rating curve was trimmed to only include flows at or near the 100-year flood event, or 1% annual exceedance probability flows (AEP); The rating curve will need to be updated for any future studies.

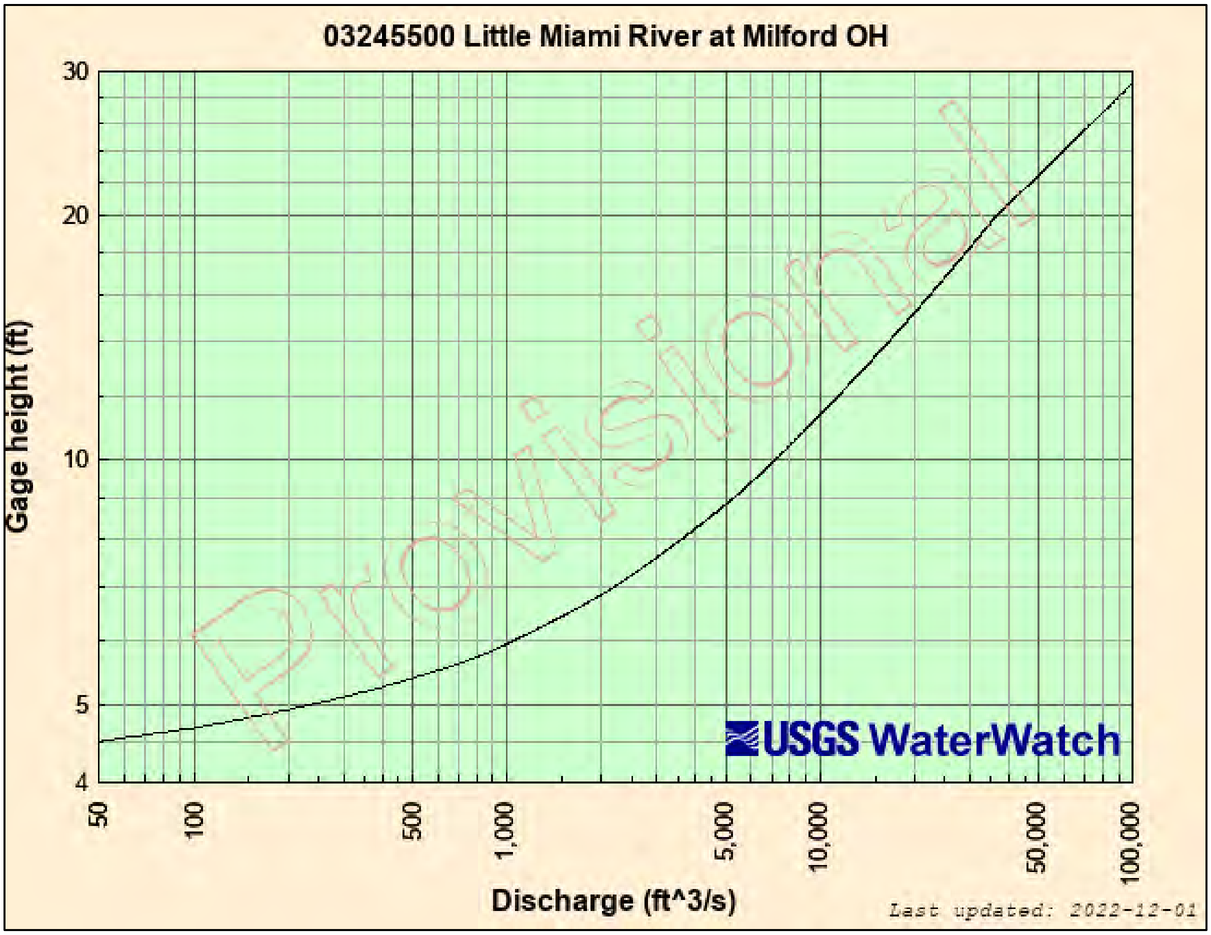


Figure 17: Rating Curve for USGS No. 03245500 (Source: USGS WaterWatch)

5.3 MODEL COMPARISON

The purpose of this section is to compare the modeled base flood elevation from the hydraulic model to the effective base flood elevation. This was accomplished by use of the effective base flood base flood elevation shapefile (S_BFE.shp) from the County National Flood Hazard Layer Data from the FEMA Flood Map Service Center. The base flood elevation shapefile was imported into HEC-RAS as cross sections to approximate the stream distance for each. The water surface elevation for the FEMA effective 1% were obtained from the effective base flood elevation shapefile attribute table (Column "ELEV"). Figure 18 shows that the modeled water surface elevation varies by approximately 1.5 foot or less when compared to the effective base flood elevation, also known as the 1% annual exceedance probability (AEP) event.

Figure 19 to Figure 21 show the approximate respective work site limits for the comparison of the effective 1% and the modeled water surface elevation. The modeled water surface elevation was found to be less than one foot difference when compared to the effective base flood elevation at the respective work sites.

This model contained credible sources of information along with reasonable judgement, thus the confidence in this conceptual model is moderate. Although the effective and preliminary FEMA model were not available at the time of this study, the model cross sections were updated to a recent DEM. The effective FEMA modeling is greater than 40 years old and modeled from an outdated software modeling method, therefore the difference in water surface elevation at the project areas are considered reasonable. The 1.5 foot or less difference in water surface elevation may be explained by the lack of bridge data, such as Loveland Avenue, which is upstream of Site 3 near approximate River Mile 24.4. Future studies beyond conceptual modeling should include bridge data for more detail.

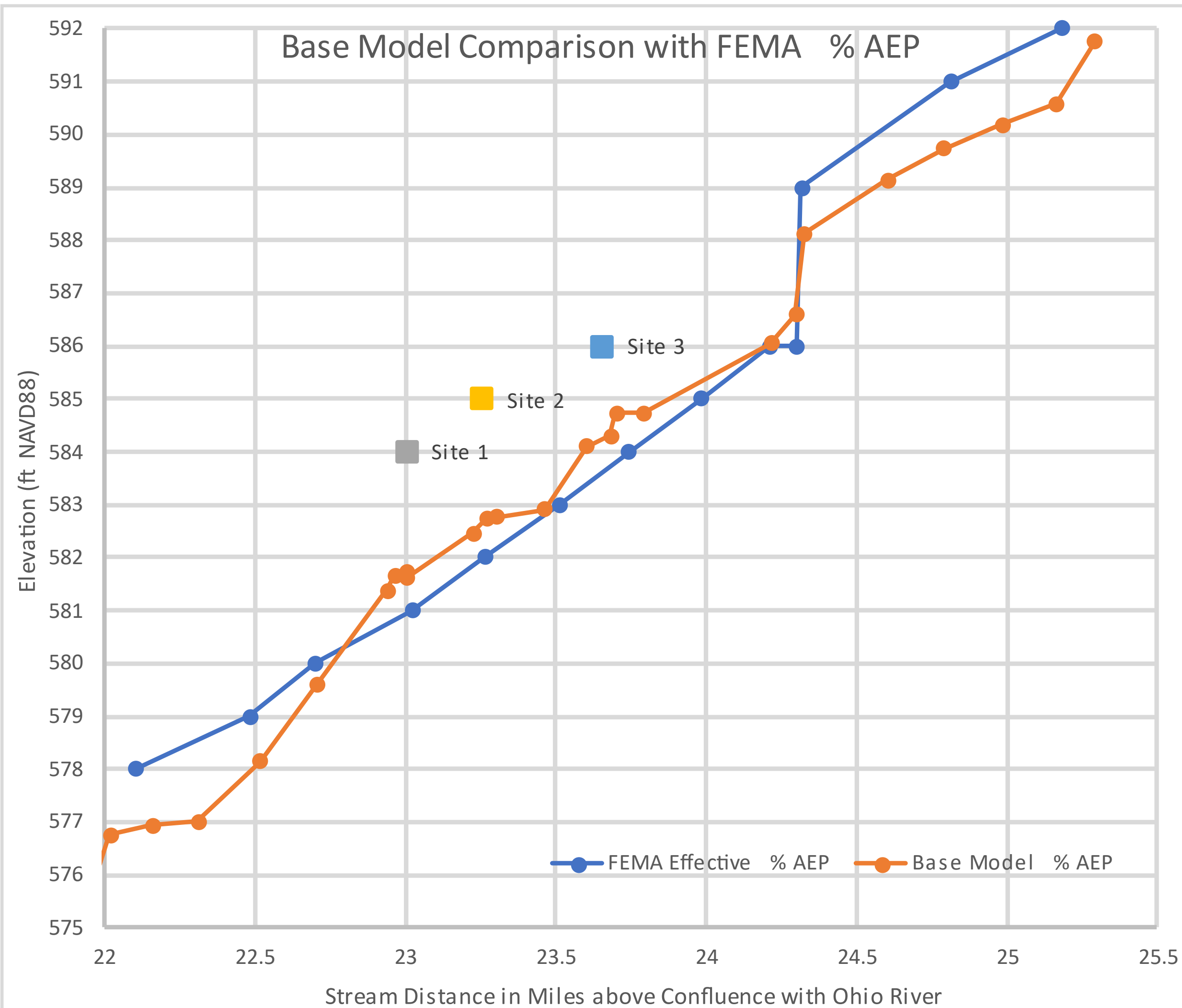


Figure 18. Model Comparison with FEMA 1% AEP

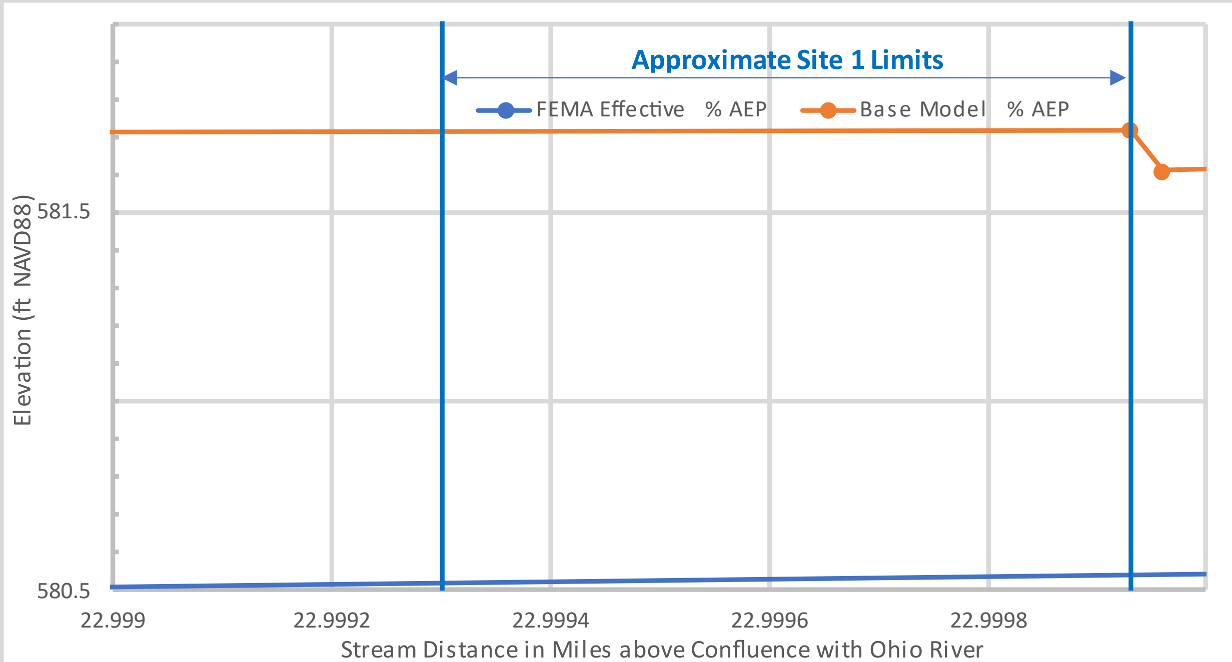


Figure 19. Water Surface Comparison at Site 1

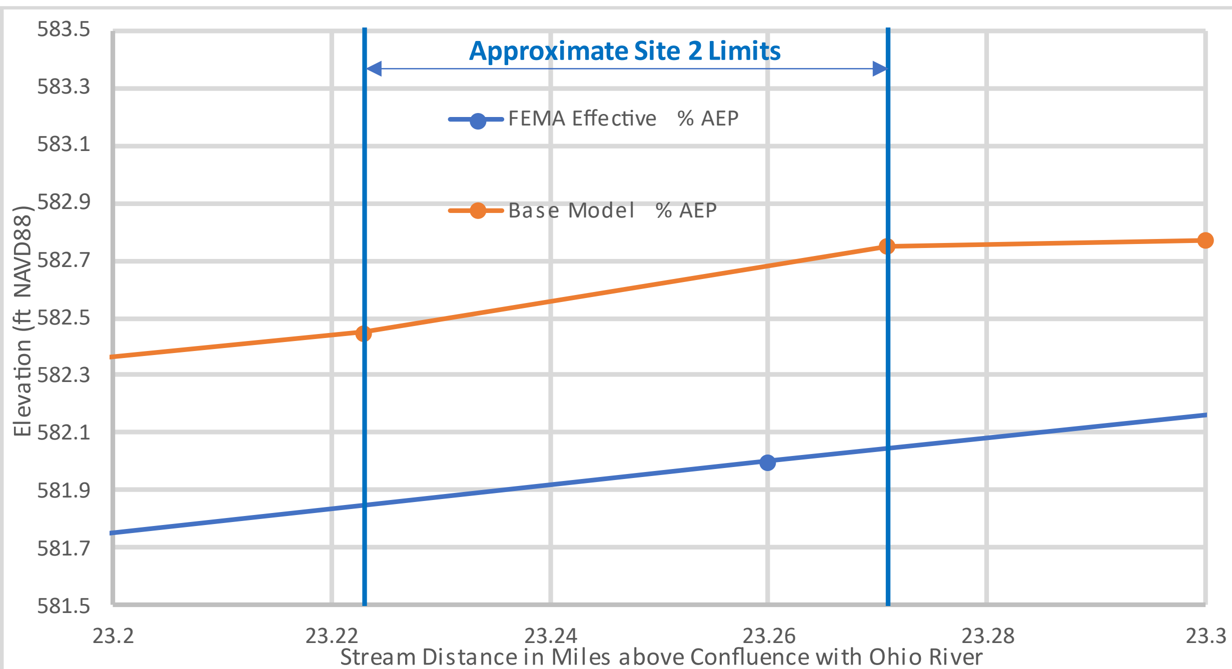


Figure 20. Water Surface Comparison at Site 2

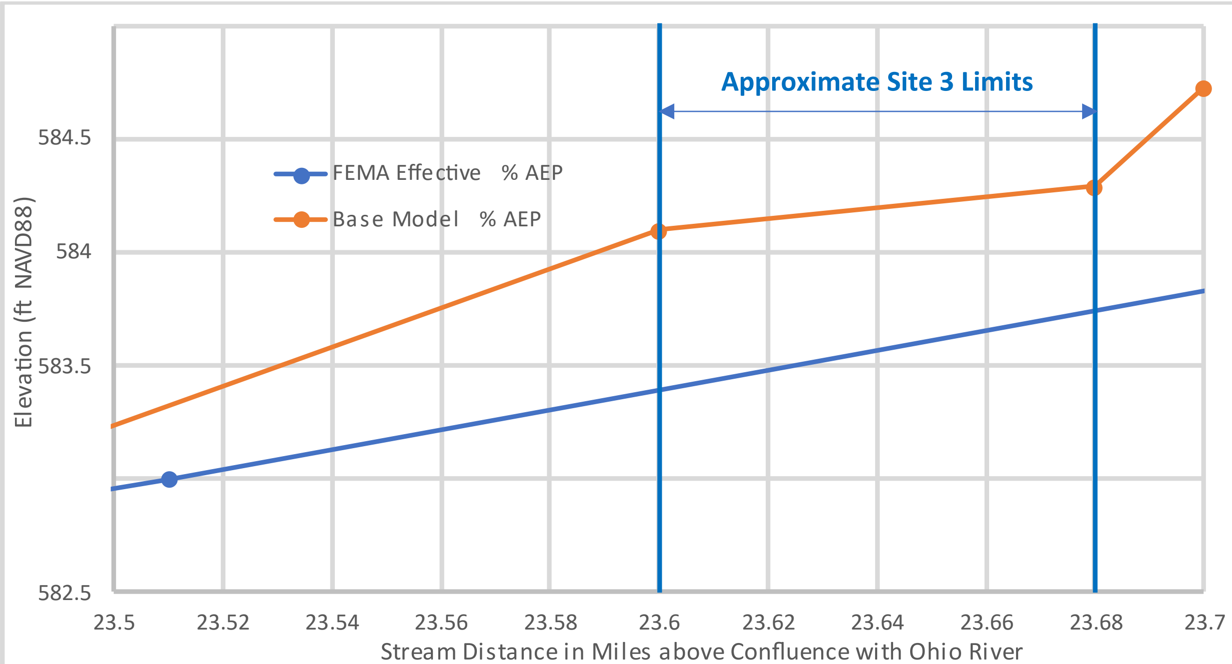


Figure 21. Water Surface Comparison at Site 3

6.0 SCREENING POTENTIAL REMEDIATION ALTERNATIVES

As mentioned in Section 1.2, PAS studies cannot include detailed design for project construction, and implementation of the plan is the responsibility of the State, Tribe, or Territory. Additionally, PAS studies cannot formulate cost estimates for potential remediation solutions.

Alternatives were qualitatively screened based on the effectiveness of the design, prior experience with similar projects, and its contribution to remediating the problem or opportunity. The relative costs were also considered during this screening based on previous experience with similar projects. The effectiveness was ranked based on the following:

- Effectiveness for stabilization of banks and protection of infrastructure
- Effectiveness for prevention of future erosion and/or slope failures
- Effectiveness for longevity of remediation
- Effectiveness for public safety

Options considered for potential remediation of the slope failures at the three sites included installation of a wall with tieback anchors (Alternative 1), soil anchor reinforcement (Alternative 2), chemical grouting (Alternative 3), or removing and replacing failed areas with riprap/shot rock (Alternative 4). The considered potential remediations included repairing the significant joint separations in the storm sewer lines underneath E. Kemper Road. See proceeding sections for more detail of the respective potential remediation alternative. Table 12 shows the comparison of potential remediation alternatives.

1.8. Attachment D: WOTS Draft Report

City of Loveland, Ohio
Little Miami River
Water Operations Technical Support (WOTS)
Draft - Trip Report

Overview: A field site visit was completed on August 10, 2023, to assess erosion issues along the Little Miami River in Loveland, OH. This report describes field conditions encountered during the site visit. Findings and Summary are described at the end of the report.

The plan for the site visit was originally to include kayaking the sites to be able to see the locations from the river view. The water level was too high for safely navigating the river so land access along the narrow road corridor was completed. There are three main Work Sites located in the reach and are identified in Figure 1.

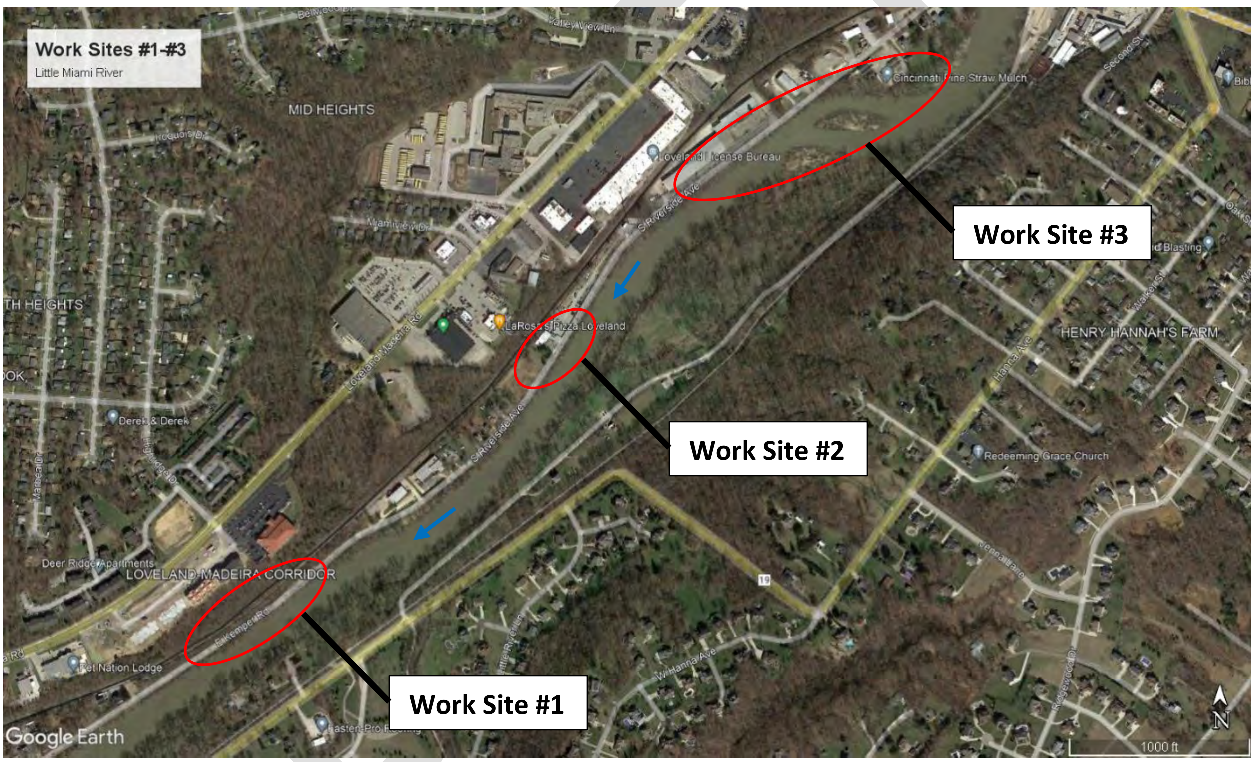


Figure 1: Little Miami River, Loveland, OH Works Sites 1-3 (all RT Bank erosion). Work Site 3 extends upstream into channel bendway (Rt Bank).

Work Site 3 (Upstream): This site originates upstream of the center channel bar and ends where stable vegetation and rock materials are present in the right bank margins (Figure 2). The total extent of the upstream erosion was not field verified due to high water. However, based on previous experience this is likely the location to tie in a revetment to stable channel conditions. The downstream extent is also estimated due to high water conditions and should be field verified once water levels are low enough to verify.

Figure 2: Little Miami River, Loveland, OH Work Site 3 (RT Bank erosion). Work Site 3 extends upstream into channel bendway (Rt Bank).

Additional length may be added downstream as needed, however stable trees and rock materials were identified on the right bank (Figure 3). The overall Work Site 3 length is estimated (based on Google Earth imagery and the field site visit at approximately 1,450 ft.

Figure 3: Little Miami River, Loveland, OH Work Site 3 (RT Bank erosion). Downstream erosion extent, likely stable tie-in location for revetment (Rt Bank).

Work Site 2 (Middle Site): The site was accessed immediately downstream of College Hunks Hauling (Figure 4). The roadway has sunk at guardrail edge and the erosion appears to be a result of the storm sewer that outlets at this location. The sinking areas are indicative of pipe separation and winnowing out of materials that surround the conduits. As the winnowing out of materials continue the overlying infrastructure (roadway) bevels out and fails with lack of foundations support.

Figure 4: Little Miami River, Loveland, OH Work Site 2 (**College Hunks Hauling parking lot).**

The right bank showed no signs of erosion as illustrated in Figure 5. The erosion issue at this site is being caused by the local storm sewer conduit.

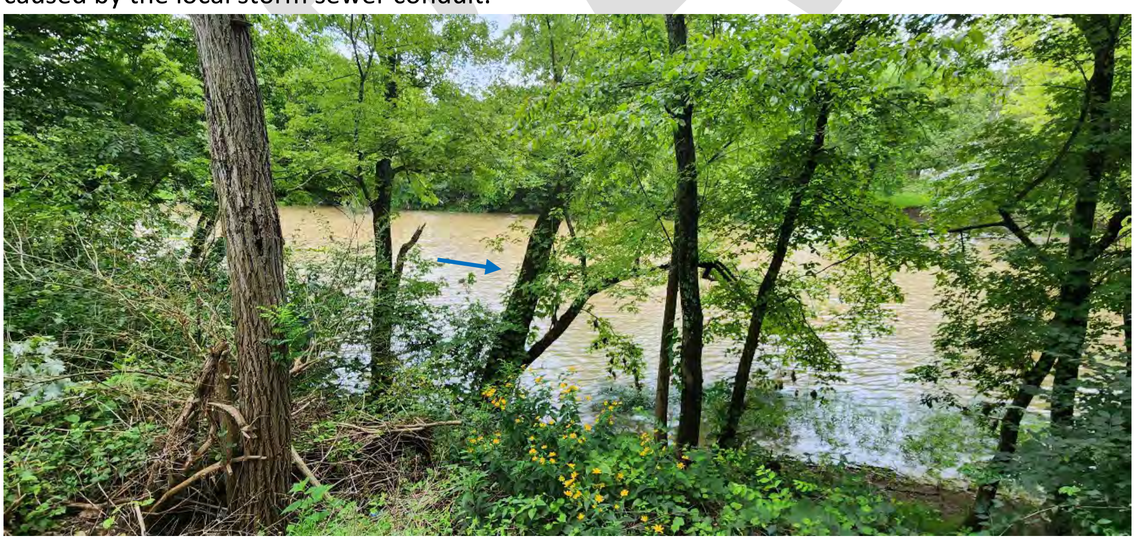


Figure 5: Little Miami River, Loveland, OH Work Site 2 illustrating stable right bank conditions.

Work Site 1 (Downstream Site): At this site access was very difficult. The roadway occupies most of the width from the bluff line to the right bank of the Little Miami River (Figure 6). The team parked downstream at the Fire Dawgs Junk Removal parking lot and walked along the road edge to access the site.

Figure 6: Little Miami River, Loveland, OH Work Site 1 (Downstream site).

Tension cracks in the soil parallel with the roadway and guardrail were identified as illustrated in Figure 7. This area of roadway appears to have recent curb and gutter repairs and roadway drainage may be causing the local instability (Storm Sewer outlets?). The location appears to be a low point in the roadway drainage which may be causing road shoulder erosion and settling of the shoulder materials as drainage moves through the substrate like Work Site 2.

Figure 7: Little Miami River, Loveland, OH Work Site 1 (Downstream site) illustrating tension cracks at the edge of the roadway/guardrail.

Figure 8: Little Miami River, Loveland, OH Work Site 1 (Downstream site) illustrating uneven roadway edge and guardrail.

The channel at this location was accessed and did not appear to be actively eroding. However, the high water at this location was covering much of the lower bank. Verification of bank erosion at this location needs to be reevaluated during low flow conditions.

In addition, a review of Google Earth aerial photography shows that there was a River Ridge Apartment complex constructed in 2018 at the top of the bluff, immediately upslope of this location. The team is unaware of exactly when this site began to experience erosion and what appears to be geotechnical shoulder and roadway failure but that should be investigated further.

Findings/Summary: The following bulleted list is provided to summarize the field site visit and provide information for further studies and potential stabilization/restoration activities.

Work Site 1 (Downstream):

- This site appears similar to Work Site 2 in that it may be storm sewer or local roadway drainage that is exacerbating the roadway embankment instability.
- The potential for right bank erosion from the Little Miami River should be reevaluated and investigated during low flows to verify that there are no fluvial caused erosion issues at this site.
- USACE Geotechnical engineers should access the causes of the subsidence/erosion at this site. This should include investigation with the sponsor on watershed changes (storm water routing) that occurred since 2018 (upslope of site).

Work Site 2 (Middle):

- The issues at this site are caused by storm sewer drainage issues and do not appear to fit with any USACE authorized project. A storm sewer contractor or consultant should be used to further assess the issues at this site.

Work Site 3 (Upstream):

- Fluvial erosion is occurring at this site and a revetment plan to stabilize the channel should be further developed. This fits within the USACE CAP-Section 14 program.
- The Little Miami River at this location is designated as part of the Wild & Scenic Rivers waterway (WSR). Coordination with the US Fish & Wildlife Service (USFWS) is required for any stabilization/restoration projects in designated river systems.
- A previous USACE Planning Assistance to States (PAS) study identified 4 main alternatives with Riprap/Shot Rock having the lowest cost with similar benefits. This concept can be expanded upon to develop a plan using well-graded riprap and constructing a toe protection revetment. This could be constructed from upstream access and minimize disturbance to the existing bank line and mature vegetation. It could also be supplemented with wood structures for habitat and large landscape type rocks strategically placed to provide fishing access. These conditions would likely be favorable to the USFWS and the WSR designation. Example plans can be provided and help further develop and refine the Riprap/Shot Rock design information from the USACE PAS study.
- The length of revetment is approximately 1450 ft but should be field verified during low flow conditions.

2. Appendix A2 Civil Engineering

2.1. Introduction

This appendix covers civil engineering topics that were considered to develop this feasibility study as well as topics that will need to be covered in more detail as the project moves into Preconstruction Engineering and Design (PED) phase. Assumptions used to develop this appendix and the civil plan sheets are stated in their respective sections.

2.2. Site Description and Project Development

In April 2021, the City of Loveland, Ohio issued a Letter of Intent (LOI) requesting assistance from the United States Army Corps of Engineers (USACE) under the Planning Assistance to States (PAS) Program for bank stabilization of the Little Miami River adjacent to portions of Riverside Drive and E. Kemper Road. Erosion and distress are occurring in three areas on the right (northwestern) bank of the Little Miami River along the streambank and E. Kemper Road (Figure 7) The issue is affecting the public utilities and the public roadway.

Figure 7: Project Site Area

Section 22 of the Water Resources Development Act of 1974, as amended (42 U.S.C. 1962d-16) authorizes the Secretary of the Army, acting through the Chief of Engineers, to provide assistance in the preparation of comprehensive water resources plans to a State, group of States, or non-Federal interest working with a

State. Planning Assistance to States (PAS) studies only provide planning level detail and cannot include detailed design for project construction. Implementation would require additional data collection and cost development. Implementation is the responsibility of the State, Tribe, or Territory.

For more information on alternative development and plan selection, see the main body of the detailed project report.

2.3. Survey, Mapping and Existing Conditions

The horizontal coordinates used in development of the included civil plan sheets reference the Ohio State Plane Coordinate System, South Zone. The horizontal datum is the North American Datum of 1983 (NAD83), units of U.S. survey feet. The vertical datum used is the North American Vertical Datum of 1988 (NAVD88), units of U.S. survey feet.

A site topographic survey was not performed for this feasibility study. Ground elevations used for preliminary quantities were obtained from publicly available Digital Elevation Models (DEM). The DEM used was developed using Light Detection and Ranging (LiDAR) by the state of Ohio and was measured for this area in 2013. The resolution of the DEM is specified at 2 feet.

2.4. Design and Quantity Estimation

Without a topographical survey performed for this feasibility study, design development, assumptions, and quantities relied on existing available information. A base LiDAR DEM was modified with some failure assumptions to create an existing ground surface.

A preliminary design was jointly developed by the hydraulics, geotechnical, and civil engineering disciplines. To prepare the site for the repair, topsoil would be stripped from any existing areas in the repair footprint. If the topsoil is deemed suitable, it would be stockpiled for re-use in the repair. The over steepened failure surfaces would then be prepared for backfill by excavating benches into the side slope. The bench excavation would remove loose, unsuitable material, stabilize the failure slope, and provide a prepared surface to tie the new backfill into. After surface preparation, the primary backfill material would be placed.

The top of the slope protection will be set at a designed elevation during the design and implementation phase of this project. The top of slope elevation and alignment was set in this feasibility phase based on the elevations and alignment of nearby slope protection. The width of the repair was set to provide slope protection on the exposed failure face, terminating where the existing riverbank is parallel with the Little Miami River.

The bank is to be graded at a maximum of 1.5H:1V slope. At the toe of the slope protection, a trench filled with stone would be installed to key in the repair to existing ground. For stone gradations, refer to Appendix A1 Hydraulics Engineering. Engineered vegetated additions are to be added within the rip rap for aesthetic purposes. Focusing on successful surface growth to obscure rip rap as quickly as possible will include filling interstitial spaces of rip rap with soil to promote vegetated rooting to take hold, watering to promote soil contact with rock, watering after placement if weather requires, hydro mulching and seeding to enhance vegetated growth, and requiring maintenance by sponsor.

Using the assumptions, material layers, and slopes stated above, preliminary quantities were developed. Cross sectional area's were developed. The volumes of the material layers were then adjusted from the total volume with areas and depths. Excavation quantities were calculated using the average end-area method.

2.5. Access Roads and Construction Laydown

No temporary construction access roads or haul routes will be needed for this project. The repair site can be accessed directly from E. Kemper Road with construction equipment. During construction, the work area will be congested with construction equipment and haul trucks entering and leaving the site. The laydown area is located to the southwest of the 3 worksites off E. Kemper Road: approximately 1.25 miles at its furthest point (Worksite 3)1365. The laydown area is to be restored to pre-construction condition at the end of the project.

2.6. Construction Procedures and Water Control Plan

2.6.1. Clearing and Grubbing

Clearing and grubbing will be required on this project. A review of available aerial imagery and site visit photos shows that all the vegetation present on site is grass, weeds, brush, and various tree sizes. Topsoil will be stripped and stockpiled for re-use, if deemed suitable.

In addition to quality topsoil that will be stripped and stockpiled, there will also be over excavation of failed soil material and benching excavation at the failure edge. This low-quality soil can be re-used in the repair by placing the material above the stone backfill layer and below the final topsoil lift. This will reduce the amount of material that needs to be hauled off project. The final soil layer above the stone backfill will vary in thickness based on how much material is over excavated. The final soil lift will be 6-12" of high-quality topsoil. The high-quality topsoil will be re-used from what is available on site and will likely need to be supplemented with imported material.

2.6.2. River Level

This project is located on the shore of the Little Miami River. All work is planned above the ordinary high-water mark. Construction can be timed for the portion of the year when water levels are low. However, high water events are possible that could affect construction.

2.6.3. Erosion and Sediment Control

The primary repair areas and staging areas combined cover more than 1 acre of ground disturbance and would require a Construction General Permit from the National Pollutant Discharge Elimination System (NPDES) and Stormwater Pollution and Prevention Plan (SWPPP). Erosion control measures will need to be installed and maintained during construction. These might include silt fence and fiber rolls.

2.6.4. Construction Impacts to Facilities

This project is in a multi-use zoning area. Access to the site will require heavy truck traffic to travel approximately .7 mi to Worksite 1, .86 mi to Worksite 2, and 1.25 mi to Worksite 3. The City of Loveland routinely repairs sections of E. Kemper Road due to the slope failures at the three worksites, therefore, the condition of the road on the route is unknown. Truck traffic over the course of construction will likely have some impact on the remaining service life of the overlay. During the site survey, the condition of the haul route should be documented. This information will be used by the design team to mitigate any potential road impacts. A reduced weight limit on haul trucks will be evaluated during the design phase to reduce wear on the road. This weight limit may not be necessary and will be determined based on the condition of the road. The design team may consider other mitigation strategies to preserve the road surface.

2.7. Borrow and Disposal Sites

No material borrow area is expected for this project. The proposed backfill materials are stone that will be sourced from a quarry. No spoils or disposal area is expected for this project. Some of the excavated material is expected to be re-used at the site. Any remaining quantity of unsuitable material that will need to be off hauled is too small to need a disposal site.

2.8. Utilities

A review of utility and construction drawings indicate several underground utilities along and under the Project Area. Utilities include water, sanitary sewer, storm sewer, and natural gas. In addition to the underlying utilities, storm sewer outfalls were observed along the bank of the river near some of the areas of concern.

At Site 1, an existing storm drain, and concrete headwall outfall were observed.

At Site 2, an exposed clay tile sewer pipe runs along the northwestern side of the road just outside of the curb (southbound lane), indicating that at least portions of this sanitary sewer line are at a shallow depth.

At Site 3, silty sand soils in a storm sewer pipe at a headwall located on the slope between E. Kemper Road and the Little Miami River seem to indicate erosion through the existing utilities.

Existing utility locations will be fully explored during the design phase of this project with the completion of a full site investigation and topographic survey.

2.9. Real Estate

Real estate acquisition is expected to be straightforward and uncomplicated. The Project will require the NFS to make four acquisitions from four private landowners along the bank of the Little Miami River totaling approximately 0.67 acres of shoreline. The standard estate Bank Protection Easement will be used for the acquisitions along the bank. The NFS owns sufficient real estate interests in the remaining project land to support Project construction, operation, and maintenance without further acquisitions. The NFS owns E Kemper Road as well as the laydown area. The laydown area is located on E Kemper Road approximately 0.75 miles southwest from Worksite 1 and is an approximately 1.31-acre open field adjacent to a municipal water treatment plant with direct access to E Kemper Road. Electrical, telecom, storm sewer, and sanitary sewer lines are located within the project area. It is unlikely that these utilities will need to be permanently relocated outside of the project area; however, they will may require protection and/or be impacted in some other way by project construction. Any such impacts would be considered a utility relocation and will be the responsibility of the NFS.

2.10. Maintenance of Traffic

There will be traffic impacts to E. Kemper Road. A Traffic Control Plan is to be developed in the Design phase of this project and any closures or traffic impediments are to be coordinated with the city of Loveland. There will be frequent truck traffic entering and leaving the site. Construction on the Little Miami bank is to be done from the westbound lane. The lane will need to be temporarily closed at the 3 specific sites as work is completed. The Manual on Uniform Traffic Control Devices (MUTCD) will be followed.

2.11. Operations and Maintenance

There are minimal ongoing operation and maintenance needs for the project once construction is completed. The backfill and slope protection will not need maintenance. The repair should be monitored for stability and further erosion.

2.12. Attachment E: Plan Sheets

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LOUISVILLE DISTRICT

SECTION 14 CAP
LOVELAND, OHIO
P2#: 483652, FY24

SHEET NUMBER	SHEET DESCRIPTION
GENERAL	
G-001	COVER SHEET AND SHEET INDEX
G-002	AREA, VICINITY, AND LOCATION MAPS
GR401	LOCATION PHOTOGRAPHS
GR402	LOCATION PHOTOGRAPHS
SURVEY	
VA101	AERIAL PHOTOGRAPHY AND CONTRACTOR WORK LIMITS
CIVIL	
CS101	OVERALL CIVIL SITE PLAN
CS102	CIVIL SITE PLAN WORKSITE 1
CS103	CIVIL SITE PLAN WORKSITE 2
CS104	CIVIL SITE PLAN WORKSITE 3

SOLICITATION NO.:
CONTRACT NO.:
ISSUE DATE: JANUARY 2024
VOLUME #

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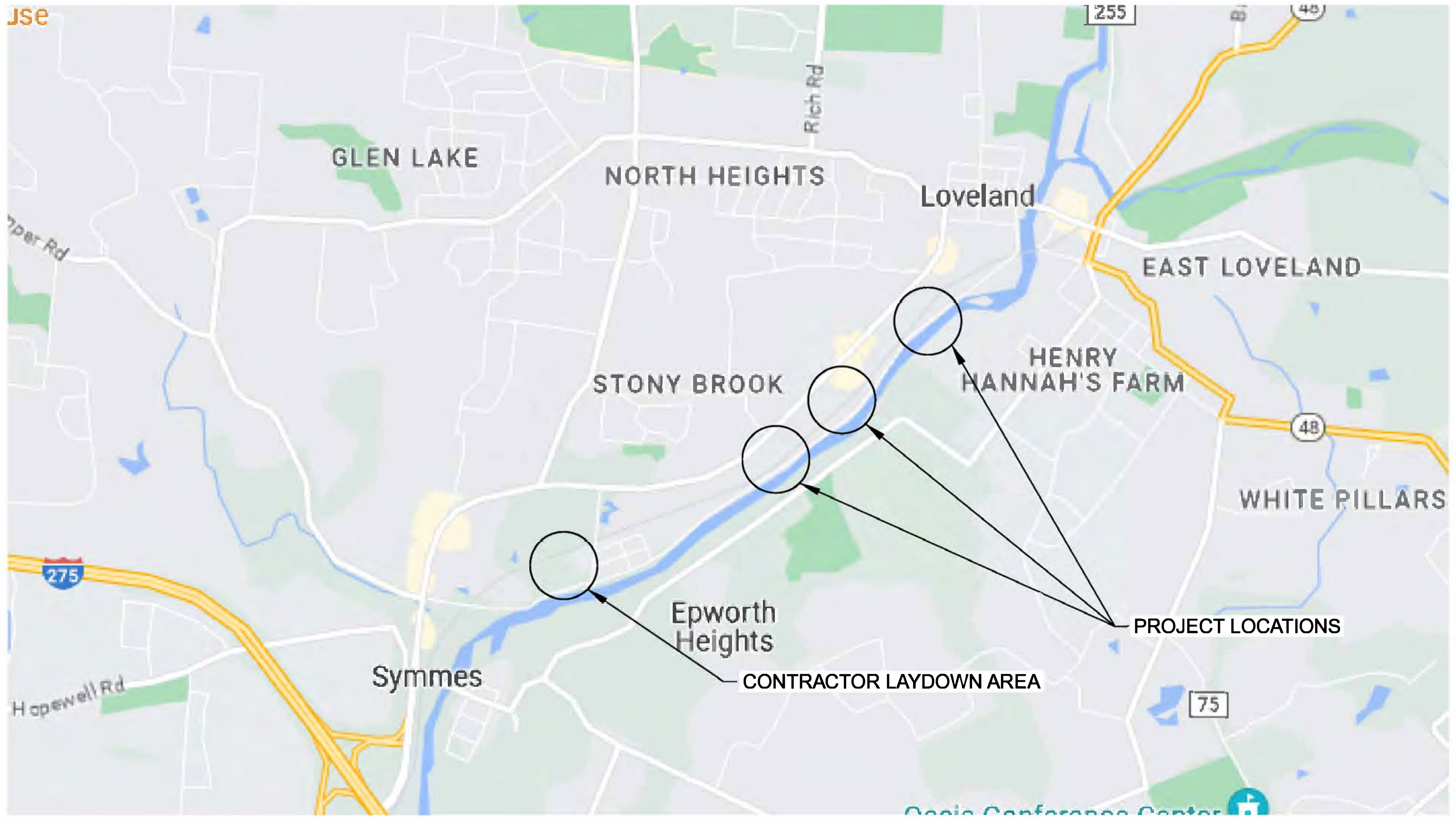
LOUISVILLE KY, 40202

SECTION 14 CAP
LOVELAND, OHIO
P2#: 483652, FY24

COVER SHEET AND SHEET INDEX

SHEET ID
G-001

A1 AREA MAP
SCALE: NTS



H11 VICINITY MAP
SCALE: NTS

A11 LOCATION MAP
SCALE: NTS

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AREA, VICINITY, AND LOCATION MAPS

SHEET ID
G-002

H1 LAYDOWN AREA FACING NORTH
SCALE: NTS

H11 LAYDOWN GRAVEL FACING WEST
SCALE: NTS

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LOCATION PHOTOGRAPHS

SHEET ID
GR401

H1 RIGHT OF WAY OF ROAD AND RIVERBANK AT EAST END OF WORKSITE 1 FACING SOUTHWEST
SCALE: NTS

H11 DRAIN AND RIVERBANK IN WORKSITE 1 AT EAST END FACING SOUTHWEST
SCALE: NTS

A1 RIVERBANK SHOWING WEST END OF WORKSITE 1 FACING NORTHEAST
SCALE: NTS

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LOCATION PHOTOGRAPHS

SHEET ID
GR402

H1 SHORELINE RIVERBANK WORKSITE 2 STANDING AT SOUTHWEST END FACING NORTHWEST

SCALE: NTS

H11 DRY LAID LIMESTONE TERRACE AT NORTHEAST END OF WORKSITE 2 FACING NORTH

SCALE: NTS

A1 LAID LIMESTONE TERRACE AT NORTHEAST END OF WORKSITE 2 FACING SOUTHWEST

SCALE: NTS

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LOVELAND, OHIO
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LOCATION PHOTOGRAPHS

SHEET ID
GR403

H1 OVERVIEW SLOPED TERRAIN IN WORKSITE 3 AT NORTH END FACING SOUTHWEST
SCALE: NTS

H11 CONCRETE DRAIN NEAR CENTER OF WORKSITE 3 FACING NORTHWEST
SCALE: NTS

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LOCATION PHOTOGRAPHS

SHEET ID
GR404

PLAN NORTH

A1 AERIAL PHOTOGRAPHY AND CONTRACTOR WORK LIMITS

SCALE: 1"=300'

0 300' 600'

LEGEND

CONTRACTOR WORK LIMITS

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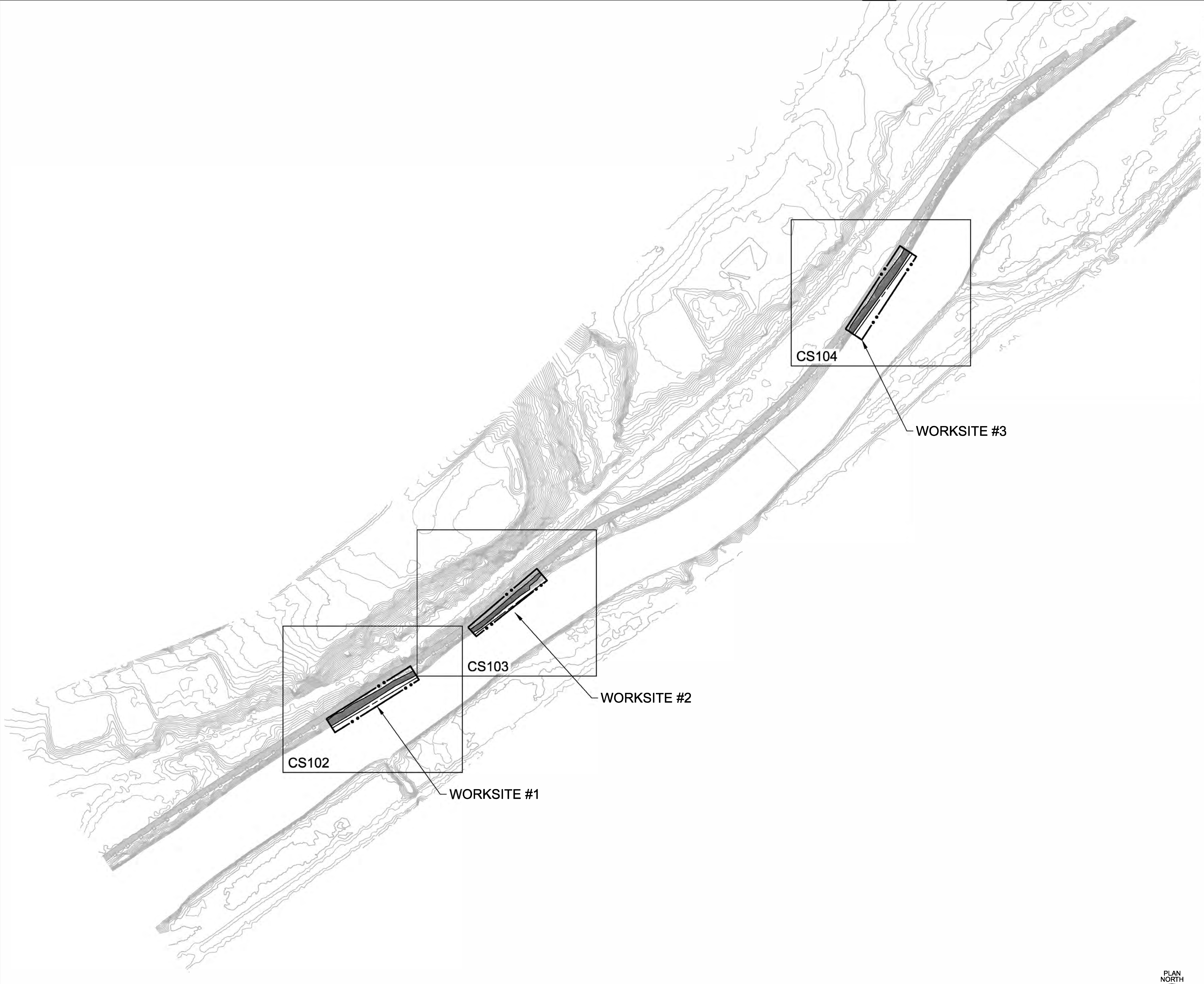
AERIAL PHOTOGRAPHY AND CONTRACTOR WORK LIMITS

SHEET ID

VA101



A1 OVERALL CIVIL SITE PLAN
SCALE: 1"=200'

GENERAL SHEET NOTES

1. HORIZONTAL DATUM IS OHIO STATE PLANE, SOUTH ZONE (NAD83).
2. VERTICAL DATUM IS NAVD88.
3. PROJECT COORDINATE LOCATIONS ARE APPROXIMATE
4. WORKSITE 1 IS APPROXIMATELY .58 ACRES
5. WORKSITE 2 IS APPROXIMATELY .44 ACRES
6. WORKSITE 3 IS APPROXIMATELY .70 ACRES
7. TOPOGRAPHICAL CONTOUR INTERVAL IS ONE FOOT.
8. EXTENT OF WORK SHOWN IS APPROXIMATE.
9. ROADWAY AND GUARDRAIL LOCATIONS ARE APPROXIMATE.
10. PARTIAL OR FULL ROAD CLOSURE OF E. KEMPER ROAD WILL BE REQUIRED TO COMPLETE CONSTRUCTION.
11. EXISING GUARDRAIL ON THE SOUTHSIDE OF E. KEMPER ROAD WILL HAVE TO BE REPAIRED OR REPLACED IF DAMAGED DURING CONSTRUCTION.
12. ALL VEGETATION WITHIN THE PROJECT AREA IS TO BE CLEARED AND GRUBBED UNLESS OTHERWISE MARKED TO REMAIN.
13. RIP RAP IS TO BE VEGETATED.
14. LOCATIONS OF ALL EXISTING SITE FEATURES ARE APPROXIMATE. A FULL TOPOGRAPHICAL SURVEY WILL BE NEEDED IN DESIGN.

LEGEND

- CONTRACTOR WORK LIMITS
- ALIGNMENT
- VEGETATED RIP RAP
- EXISTING GUARDRAIL
- SD EXISTING STORM PIPE
- CB EXISTING CATCH BASIN
- EXISTING ELECTRICAL POWER POLE

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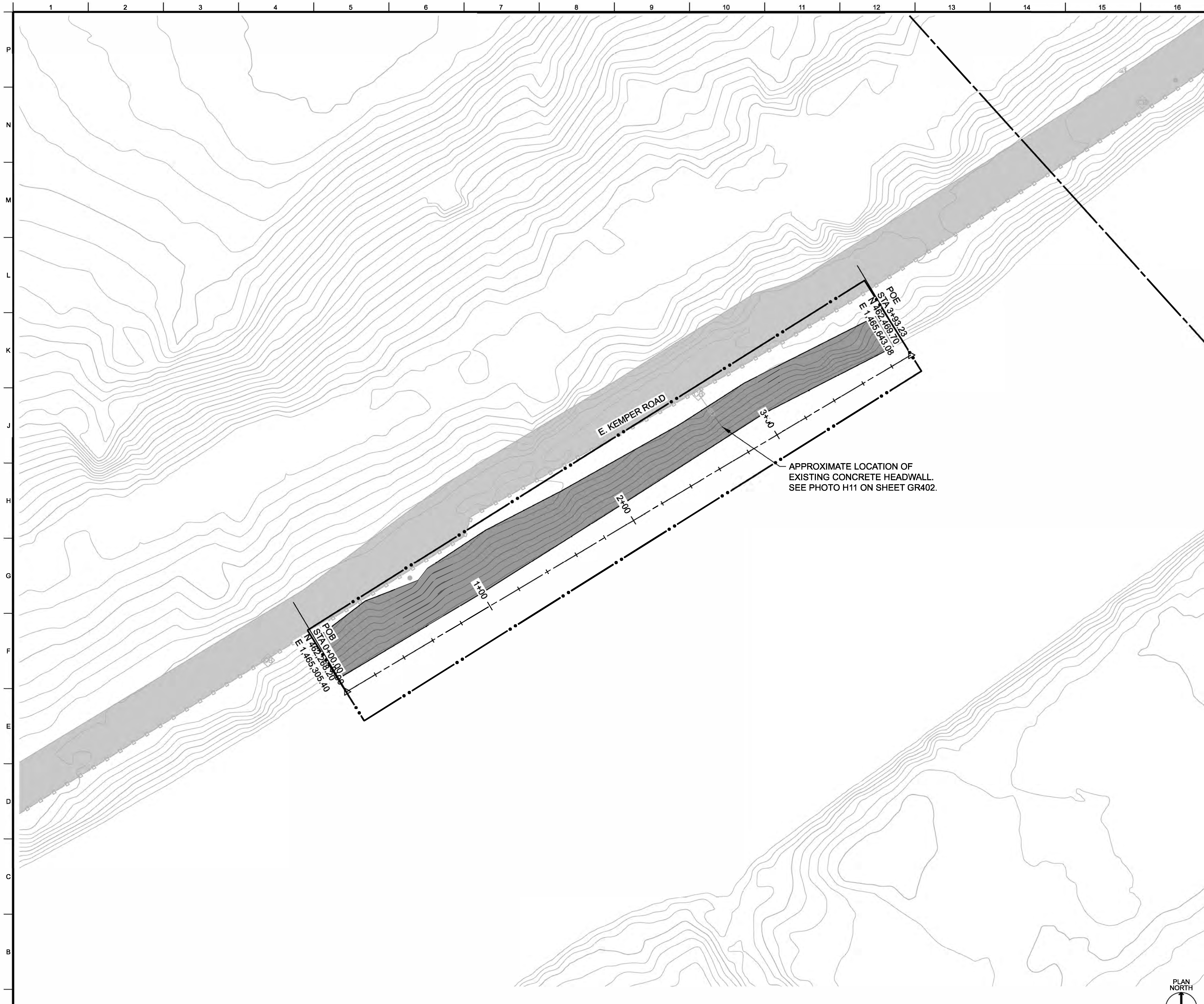
LOVELAND, OHIO
P2#: 483652, FY24

OVERALL CIVIL SITE PLAN

SHEET ID
CS101



A1 CIVIL SITE PLAN - WORK SITE 1

SCALE: 1"=30'

PLAN NORTH

0 30' 60'

GENERAL SHEET NOTES

1. HORIZONTAL DATUM IS OHIO STATE PLANE, SOUTH ZONE (NAD83).
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6. WORKSITE 3 IS APPROXIMATELY .70 ACRES
7. TOPOGRAPHICAL CONTOUR INTERVAL IS ONE FOOT.
8. EXTENT OF WORK SHOWN IS APPROXIMATE.
9. ROADWAY AND GUARDRAIL LOCATIONS ARE APPROXIMATE.
10. PARTIAL OR FULL ROAD CLOSURE OF E KEMPER ROAD WILL BE REQUIRED TO COMPLETE CONSTRUCTION.
11. EXISING GUARDRAIL ON THE SOUTHSIDE OF E KEMPER ROAD WILL HAVE TO BE REPAIRED OR REPLACED IF DAMAGED DURING CONSTRUCTION.
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13. RIP RAP IS TO BE VEGETATED.
14. LOCATIONS OF ALL EXISTING SITE FEATURES ARE APPROXIMATE. A FULL TOPOGRAPHICAL SURVEY WILL BE NEEDED IN DESIGN.

LEGEND

Symbol	Description
—•—•—	CONTRACTOR WORK LIMITS
— — —	ALIGNMENT
(shaded)	VEGETATED RIP RAP
-□-□-□-	EXISTING GUARDRAIL
— SD —	EXISTING STORM PIPE
CB	EXISTING CATCH BASIN
○	EXISTING ELECTRICAL POWER POLE

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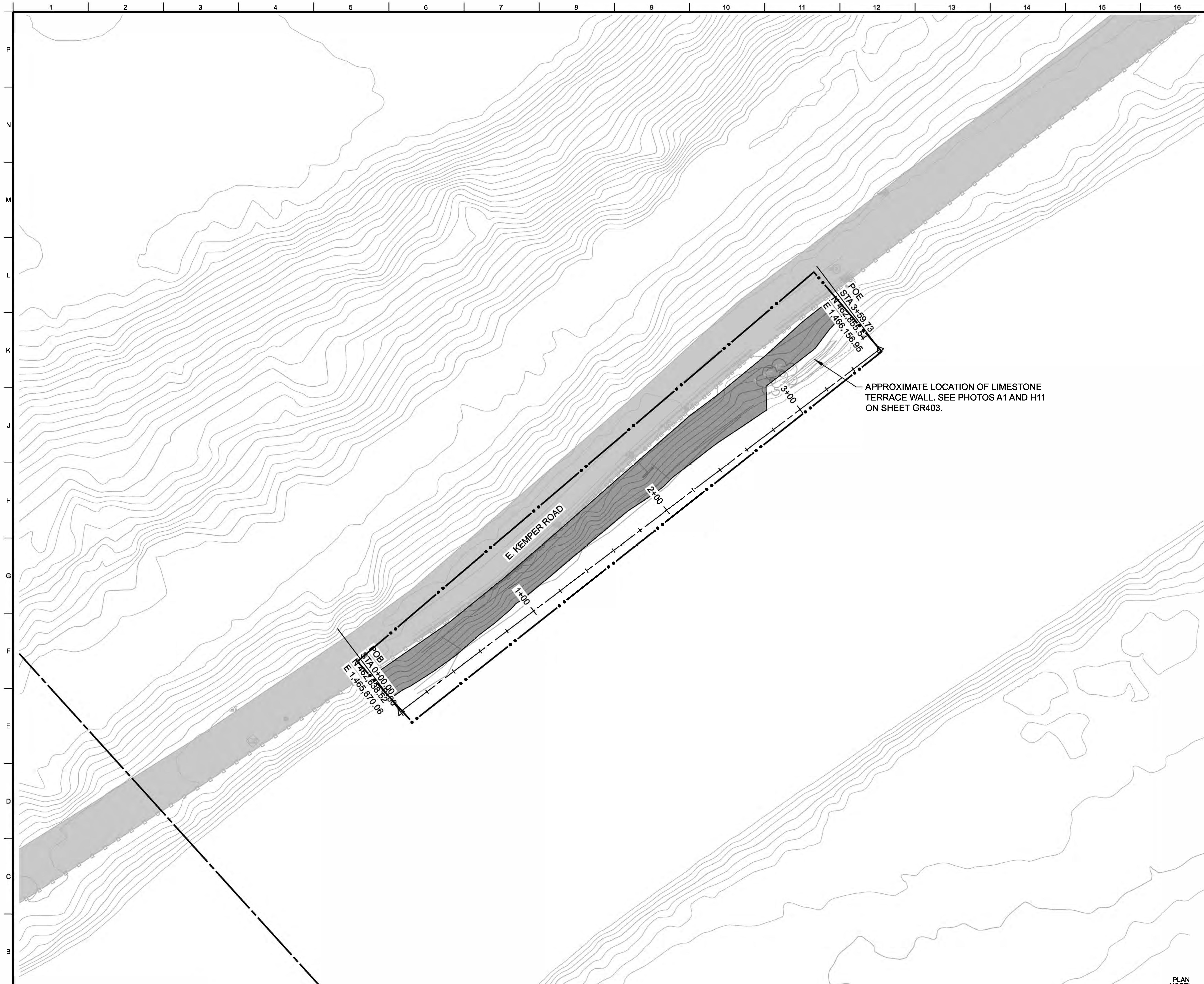
CIVIL SITE PLAN
WORK SITE 1

SHEET ID
CS102



A1 CIVIL SITE PLAN - WORK SITE 2

SCALE: 1"=30'

GENERAL SHEET NOTES

1. HORIZONTAL DATUM IS OHIO STATE PLANE, SOUTH ZONE (NAD83).
2. VERTICAL DATUM IS NAVD88.
3. PROJECT COORDINATE LOCATIONS ARE APPROXIMATE
4. WORKSITE 1 IS APPROXIMATELY .58 ACRES
5. WORKSITE 2 IS APPROXIMATELY .44 ACRES
6. WORKSITE 3 IS APPROXIMATELY .70 ACRES
7. TOPOGRAPHICAL CONTOUR INTERVAL IS ONE FOOT.
8. EXTENT OF WORK SHOWN IS APPROXIMATE.
9. ROADWAY AND GUARDRAIL LOCATIONS ARE APPROXIMATE.
10. PARTIAL OR FULL ROAD CLOSURE OF E. KEMPER ROAD WILL BE REQUIRED TO COMPLETE CONSTRUCTION.
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12. ALL VEGETATION WITHIN THE PROJECT AREA IS TO BE CLEARED AND GRUBBED UNLESS OTHERWISE MARKED TO REMAIN.
13. RIP RAP IS TO BE VEGETATED.
14. LOCATIONS OF ALL EXISTING SITE FEATURES ARE APPROXIMATE. A FULL TOPOGRAPHICAL SURVEY WILL BE NEEDED IN DESIGN.

LEGEND

- CONTRACTOR WORK LIMITS
- ALIGNMENT
- VEGETATED RIP RAP
- EXISTING GUARDRAIL
- SD EXISTING STORM PIPE
- CB EXISTING CATCH BASIN
- EXISTING ELECTRICAL POWER POLE

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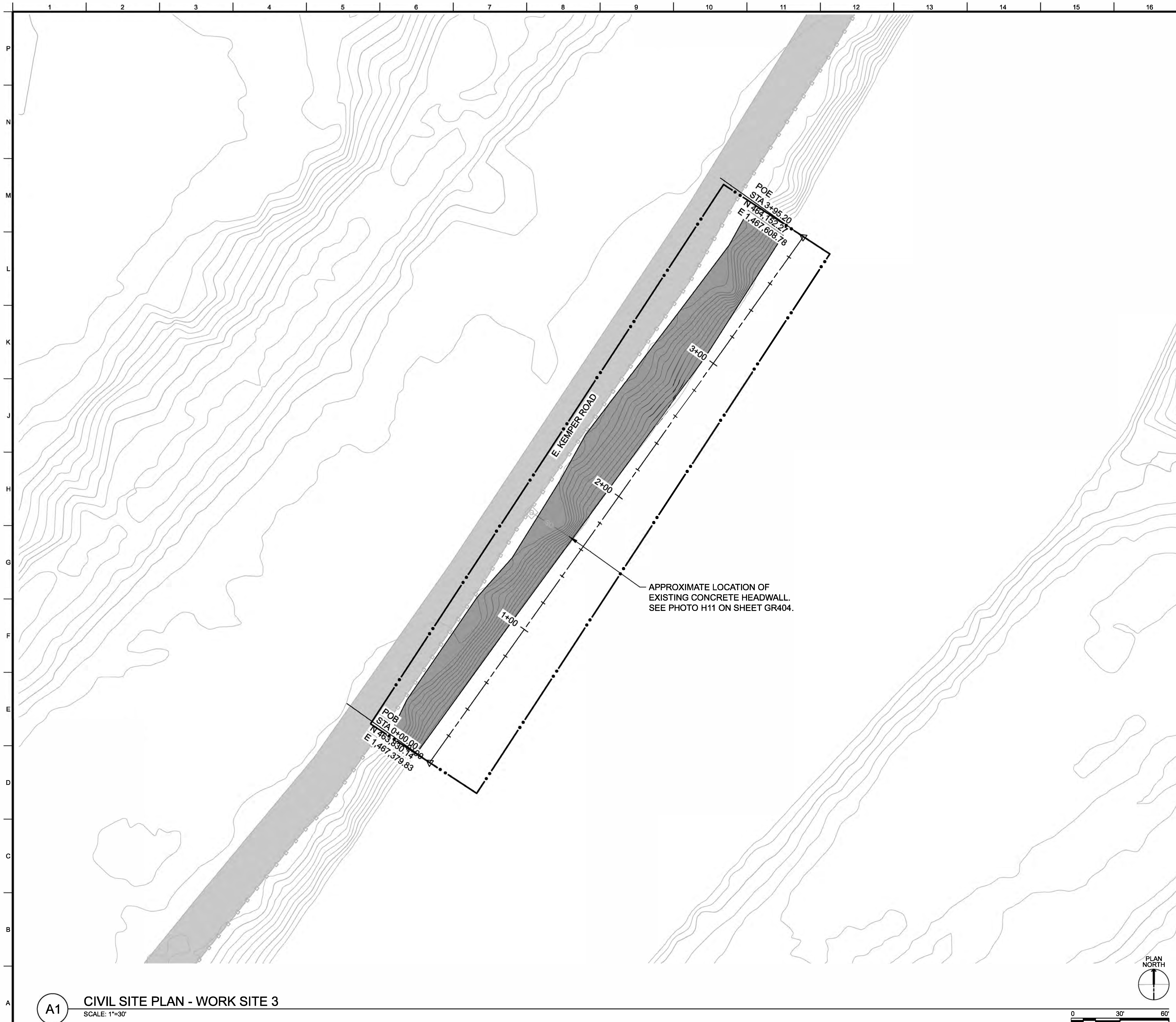
CIVIL SITE PLAN
WORK SITE 2

SHEET ID

CS103



A1 CIVIL SITE PLAN - WORK SITE 3

SCALE: 1"=30'

GENERAL SHEET NOTES

1. HORIZONTAL DATUM IS OHIO STATE PLANE, SOUTH ZONE (NAD83).
2. VERTICAL DATUM IS NAVD88.
3. PROJECT COORDINATE LOCATIONS ARE APPROXIMATE
4. WORKSITE 1 IS APPROXIMATELY .58 ACRES
5. WORKSITE 2 IS APPROXIMATELY .44 ACRES
6. WORKSITE 3 IS APPROXIMATELY .70 ACRES
7. TOPOGRAPHICAL CONTOUR INTERVAL IS ONE FOOT.
8. EXTENT OF WORK SHOWN IS APPROXIMATE.
9. ROADWAY AND GUARDRAIL LOCATIONS ARE APPROXIMATE.
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LEGEND

- CONTRACTOR WORK LIMITS
- ALIGNMENT
- VEGETATED RIP RAP
- EXISTING GUARDRAIL
- SD — EXISTING STORM PIPE
- CB — EXISTING CATCH BASIN
- EXISTING ELECTRICAL POWER POLE

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LOVELAND, OHIO
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CIVIL SITE PLAN
WORK SITE 3

SHEET ID
CS104

Appendix A3 Geotechnical Engineering

2.13. Project Information

General project information was provided by Cindy Klopfenstein, P.E. of the City of Loveland Public Works Department. The project included an analysis of previous slope failures which occurred at three (3) different sites in Loveland, OH between E. Kemper Road and Little Miami River. The locations of the sites are shown on the Project Location Map, Vicinity Map, and Boring Location Plans included in Attachment F (each map progressively zooming in on the sites).

The following documents were provided for review:

- Closed-Circuit Television Video (CCTV) inspection videos and photos, provided by Cindy Klopfenstein, P.E. of the City of Loveland Public Works Department in an email dated May 11, 2022.

- Cross-Section Geometry (Microsoft Excel file format), provided by Kevin Norman, P.E. of CELRL-EDT-H in an email dated September 15, 2022.

- Stage Hydrographs (Microsoft Excel file format), provided by Kevin Norman, P.E. of CELRL-EDT-H in an email dated December 8, 2022.

- Drawings for The Metropolitan Sewer District of Greater Cincinnati, prepared by R.D. Zande & Associates, dated June 23, 1995.

- CAD file and RAW points of survey data from Choice One Engineering, provided by Lacey Gabbard of CELRL-PMC-P in emails dated January 16 and 17, 2024.

The information discussed in the following sections was used in conjunction with results of the field and laboratory testing and experience with similar analyses in similar geologic conditions to develop the geotechnical analysis.

2.14. Site Information

2.14.1. Site Conditions

A site reconnaissance was conducted on April 29, 2021, by Jeremy Hudson, P.E. of CELRL-EDT-G and Kevin Norman, P.E. of CELRL-EDT-H to observe and document surface conditions at the site. The information gathered was used to help interpret the subsurface data and to detect conditions that could affect the geotechnical analysis.

The three sites for this reconnaissance included a total area of approximately 1.5 acres with each site covering approximately 0.5 acres. Slope failures were observed along steep, heavily wooded slopes at the three sites immediately southeast of E. Kemper Road along the Little Miami River. At Sites 1 and 2, E. Kemper Road runs along a hillside with steep, wooded slopes to the northwest leading up to railroad tracks. Near Site 3, a structure and parking lot were present on the northwest side of E. Kemper Road with a wooded slope leading up to railroad tracks beyond.

The sites were moderately to poorly drained with areas of ponded water along the southeast side of E. Kemper Road at the time of the site reconnaissance.

Evidence of past slope failure at Site 1 included leaning trees, guard rail movement approximately 1 to 2 feet to the southeast toward the Little Miami River (Figure 8), asphalt settlement, asphalt resurfacing, and stone placement for erosion repair along the outer edge of E. Kemper Road.

Figure 8: Displaced Guardrail and Asphalt Overlays at Site 1

Evidence of past slope failure at Site 2 included leaning trees, settlement of the outer portion of E. Kemper Road, and stone/concrete debris placement for assumed repair attempt(s) on the slope between E. Kemper Road and Little Miami River. Small drainage pipes penetrating the curb on the southeast side of East Kemper Road were reportedly installed to help prevent ponding of water on the road due to localized settlement (Figure 9).

Figure 9: Small Drainage Pipes Penetrating the Curb on the Southeast Side of E. Kemper Road

A cultural resources survey was conducted on December 14, 2023, by Jared Barrett of CELRL-PMC-WPL. A dry laid limestone terrace approximately two and half feet high and 46 feet long was discovered on the northeastern edge of Site 2 near the Little Miami River (Figure 10). It was assumed that the terrace was near or below the Little Miami River water elevation at the time of the site reconnaissance conducted on April 29, 2021.

Figure 10: Dry laid limestone terrace at northeast edge of Site 2 (looking southwest)

Evidence of past slope failure at Site 3 included leaning trees, guard rail movement approximately 1 to 2 feet to the southeast toward the Little Miami River, a leaning light pole, and stone placement for erosion repair on the southeast side of E. Kemper Road. Silty sand soils in a storm sewer pipe at a headwall located on the slope between E. Kemper Road and the Little Miami River seem to indicate erosion through the existing utilities.

The Site Photos included in Attachment F depict the general site conditions at the time of the site reconnaissance.

A review of utility and construction drawings indicate several underground utilities along and under the project area. Utilities include water, sanitary sewer, storm sewer, and natural gas. In addition to the underlying utilities, storm sewer outfalls were observed along the bank of the river near some of the areas of concern. At Site 2, an exposed clay tile sewer pipe runs along the northwestern side of the road just outside of the curb (southbound lane), indicating that at least portions of this sanitary sewer line are at a shallow depth.

Tele-Vac Environmental conducted Closed-Circuit Television Video (CCTV) and Pipeline Assessment and Certification Program (PACP) inspections on the storm sewer lines at the three erosion sites on May 9, 2022. The inspections revealed significant joint separations and movement within the storm sewer lines and indicated there may be significant loss of material from joint separations and offsets, which also gave roots the opportunity to penetrate the storm sewer. The captured images also indicated that significant erosion near the open/damaged sections of the storm sewer had taken place. The presence of voids at these areas shows a significant loss of material around the pipe joints, although it is not an indicator of absolute material loss as there may be voids behind the material shown that cannot be determined without some form of investigation or ground penetrating radar. The locations of the storm sewer lines are shown on the Storm Sewer Lines Location Map included in Attachment F. CCTV Inspection Photos are included in Attachment F and selected photos for Sites 1, 2, and 3 are shown in Figure 11, Figure 12, and Figure 13, respectively.

Figure 11: Joint Separation at Site 1

Figure 12: Joint Separation with hole Visible to Surface at Site 2

Figure 13: Joint Separation at Site 3

2.14.2. Site History

Historical aerial photos dating back to 1952 were reviewed from the United States Geological Survey (USGS) Earth Explorer website. Historical aerial photos dating back to 1994 were reviewed from Google Earth Pro. Copies of selected aerial photos from these reviews are included in Attachment G.

Based on the historical documents reviewed, it appears no significant changes to the road alignment have occurred at the three sites since 1952.

2.14.3. Site Geology and Seismicity

2.14.3.1. Geology

According to the Ohio Geology Interactive Map of the Ohio Department of Natural Resources, the three sites were underlain by the Kope Formation that belongs to the Ordovician Age and includes shale and limestone interbedded with an average of 75% shale and 25% limestone. The shale and limestone are gray to bluish gray and weathers light gray to yellowish gray. Refer to Figure 14 below.

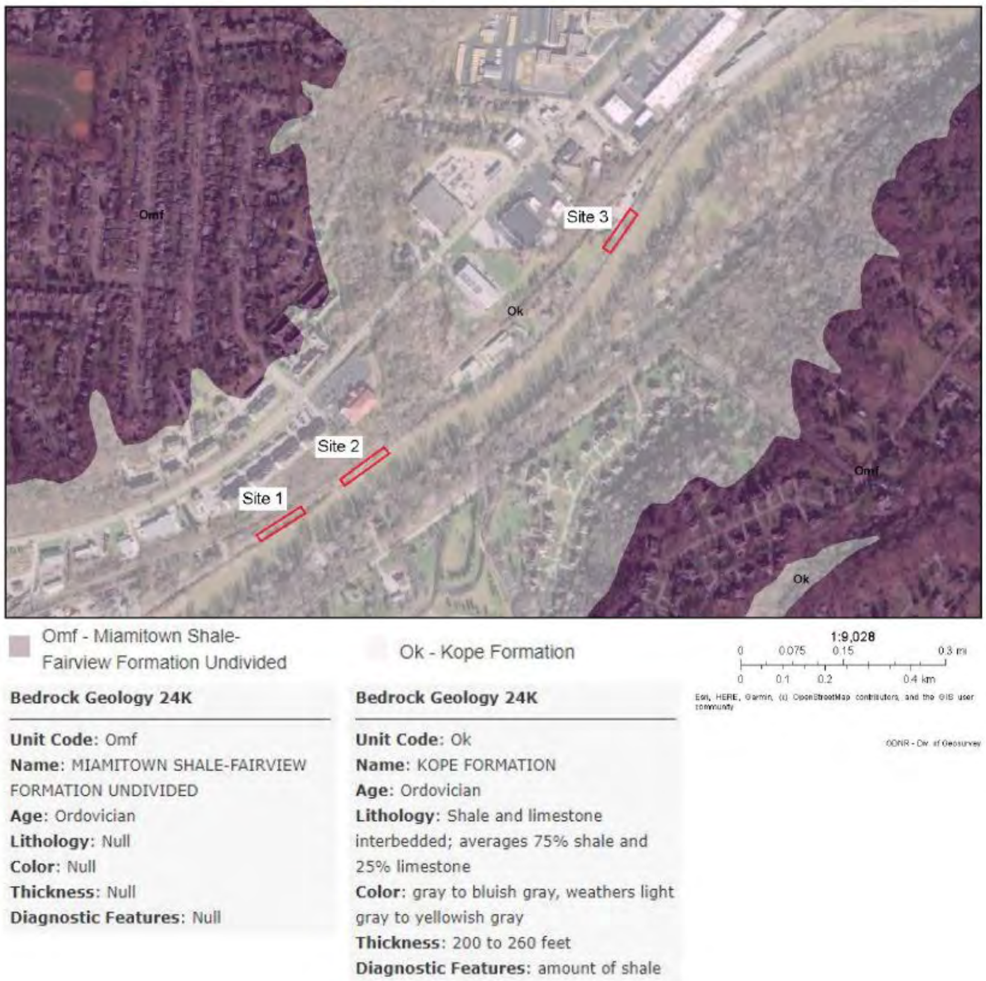


Figure 14: Bedrock Geology Map

The Cincinnati area (Hamilton and Clermont counties) comprises the southwestern corner of Ohio and is one of the most landslide-susceptible areas in the United States. Most of the landslides occur in the Kope Formation and the overlying colluvial soil during late winter and early spring. Rotational and translational slides are the most frequently occurring slope movements associated with the Kope Formation and the overlying colluvial soil. Rapid earthflows, rockfalls, and complex slides (combination of rotational and translational slides), although present, are infrequent. Rotational slides are common where thick colluvium covers the bedrock. They are generally 6.6–49.2 ft (2–15 m) thick, 98.4–984.3 ft (30–300 m) wide (measured perpendicular to the direction of sliding), and 98.4–492.1 ft (30–150 m) long (measured along the direction of sliding). Many rotational slides are associated with springs or marshy areas either beneath or within the slope toes. Translational slides are common where thin colluvial soils (6.6–9.8 ft, 2–3 m thick) cover relatively steep slopes (15°–30°). They occur along the colluvium–bedrock contact, are generally 32.8–492.1 ft (10–150 m) wide and 98.4–426.5 ft (30–130 m) long, and vary in shape from long and narrow to wide and short. Translational slides generally occur during spring because the slide material is almost saturated between the months of January and May. The dominant form of deformation in translational slides is longitudinal stretching resulting in a series of scarps. Complex landslides in the Cincinnati area consist of more than one layer of slide material. They are thinner near the slope crest and become thicker near the toe. Rapid earth flows in the Kope Formation (locally known as mudslides) occur on steeper slopes along the Columbia Parkway. They occur during wet periods in areas where the colluvium is less than 6.6 ft (2 m) thick and is clayey in nature. Rapid earthflows involve movement of the entire thickness of the colluvium, exposing the bedrock (Glassmeyer & Shakoor, 2001).

2.14.3.2. Seismicity

Seismic hazards include ground shaking, collapse, liquefaction, landslides, retaining structure failures, and lifeline failures. Seismic hazards for the project sites primarily can be attributed to ground shaking and landslides resulting from earthquakes. Effects of local soil conditions on strong ground motion must be considered since soil deposits may attenuate or amplify motion at certain frequencies. A detailed study of potential source locations, source characteristics, and site-specific ground motion was beyond the scope of this study.

The Structural Load Data Tool for UFC 3-301-01, published by Whole Building Design Guide (WBDG), was used to develop the seismic parameters, "Loveland, OH, USA" was designated as the U.S. Address. The seismic maps from 2016 ASCE 7 Standard, Risk Category II, and Site Class D were selected to develop the parameters provided in Table 3: Seismic Design Parameters.

Table 3: Seismic Design Parameters

Parameter	Return Period	Value
PGA	2% in 50 years	0.07g
S_s	1% in 50 years	0.14g
S_1	1% in 50 years	0.074g
S_{MS}	1% in 50 years	0.225g
S_{M1}	1% in 50 years	0.177g

2.15. Field Exploration

2.15.1. Geophysical Exploration

A geophysical investigation of the three sites was conducted by Hager-Richter Geosciences, Inc. from May 5-6, 2022. The purpose of the investigation was to identify subsurface anomalies such as changes in geologic conditions and existing and abandoned utilities.

Hager-Richter Geosciences completed a multi-staged geophysical survey using utility locators, an EM61-MK2A metal detector, and EM38-MK2 terrain conductivity meter. A detailed description of each of the methods used is included in the Geophysical Results included in Attachment H. The integrated interpretation plan of anomalies and report of geophysical investigation are included in the Geophysical Results included in Attachment H. Below is a pertinent summary of the findings for both areas.

Geophysical results for the southern area (Sites 1 and 2) indicated several possible underground utilities and an area of possible disturbed soils. Geophysical results for the northern area (Site 3) also indicated possible underground utilities. Based on the available information, it was concluded that the indicated underground utilities appear to be the existing underground water line on the northwest side of E. Kemper Road and storm sewer lines underneath E. Kemper Road leading to Little Miami River. The area of possible disturbed soils may be related to backfill from utilities, existing fill placed for E. Kemper Road, or from the observed slope failures.

2.15.2. Soil Test Borings

A total of 14 soil test borings were drilled across the three sites. The approximate locations of the borings are shown on the Boring Location Plans included in Attachment F. The conditions encountered in each boring are summarized on the Boring Logs included in Attachment I.

Boring locations and depths were selected by CELRL-ED-T-G (the USACE Geotechnical Design Section). Boring locations were initially placed with the aid of a handheld Global Positioning System (GPS) unit. Boring locations were later adjusted in the field due to drilling limitations. Boring elevations are considered approximate and were based on information obtained from Google Earth Pro.

A description of the subsurface conditions encountered with pertinent available physical properties based on visual observations and laboratory testing is presented in the following sections.

2.15.2.1. Field Sampling and Testing

Field sampling and testing was performed in general accordance with current USACE and/or American Society for Testing and Materials (ASTM) procedures and established geotechnical engineering practice. Samples obtained during the exploration included driven (split-spoons), bulk (bag), undisturbed (Shelby tube), and rock core sampling.

Samples were visually classified in the field by the Contractor’s geotechnical engineer and were returned to the Contractor’s laboratory for testing. A description of the general field methods employed are provided on the Field Procedures included in Attachment I. The location and depths of the samples obtained are summarized on the Boring Logs included in Attachment I.

2.15.2.2. Stratigraphy

The subsurface conditions discussed in the following paragraphs and those shown on the boring records represent the field engineer’s interpretation of the subsurface conditions based on the visual classification of field samples and laboratory tests of selected field samples. The interface between various strata on the boring logs represents the approximate interface location. Transitions between strata may be more gradual than shown. The Borings Logs and selected Soil Profiles are provided in Attachment I.

The soil stratigraphy described below is generalized and does not include the actual conditions in all borings. Some layers may be missing in some borings while other layers may be present in other borings. All depths are approximate. Refer to the individual Boring Logs in Attachment I for a detailed description of the conditions encountered in each boring. In general, the subsurface conditions encountered at the three sites consisted of the predominant layer types summarized in Table 4: Summary of Stratums Encountered, except for Clayey Sand that was only encountered within Site 3.

Table 4: Summary of Stratums Encountered

Stratum	Type	Material Description
1	Asphalt	E. Kemper Road asphalt ranging from 9 to 16 inches thick.
2	Existing Fill	Various soil types including but not limited to lean clay (CL), sandy lean clay (CL), and poorly graded gravel (GP). Depth below ground surface ranged from 4 to 9.4 feet.
3	Clay	Predominantly lean clay (CL) and fat clay (CH). Some samples contained trace gravel.
4	Clayey Sand (Site 3 only)	Clayey Sand (SC) with various degrees of silt and gravel.
5	Upper Kope Zone	Weakest shale layer sampled from Standard Penetration Test (SPT).
6	Weathered Shale	Weathered shale layer sampled from rock coring and tested for direct shear strength in the laboratory.
7	Bedrock	Intact shale below weathered shale layer.

2.15.2.3. Standard Penetration Test Refusal

Standard Penetration Test (SPT) refusal is defined as 50 blows during any one of the three 6-inch increments with the split-spoon sampler. Table 5: Boring Termination ad SPT Refusal Summary provides the termination and SPT refusal depths of each boring.

Table 5: Boring Termination ad SPT Refusal Summary

Boring No.	Termination Depth (feet)	SPT Refusal	SPT Refusal Depth(s) (feet)
B-1	29.5	No	---
B-1A*	13.9	Yes	12.0**, 13.9**
B-2	30.0	No	---
B-2A*	13.0	Yes	10.0**
B-3	25.7	Yes	1.7***, 4.2***, 6.7***, 15.2, 19.7

Boring No.	Termination Depth (feet)	SPT Refusal	SPT Refusal Depth(s) (feet)
B-3 Offset	15.3	Yes	15.3
B-3A*	5.0	No	---
B-3B*	5.0	Yes	4.2***
B-4	24.7	Yes	19.7
B-4 Offset	14.9	Yes	14.7
B-4A*	11.0	Yes	3.0**
B-5	26.8	No	---
B-6	25.8	No	---
B-6 Offset	16.1	Yes	10.2
Notes	*Additional boring for sample collection **Shelby tube refusal ***Refusal within existing fill		

2.15.2.4. Rock Coring

Core samples of the bedrock were obtained from six (6) borings during the geotechnical exploration drilling. A cumulative total of approximately 52.1 linear feet of bedrock core was obtained from the borings, with rock cored at individual borings ranging from approximately 5.0 to 11.3 feet. A summary of the amount of rock cored per location is provided in Table 6: Rock Coring Summary.

Table 6: Rock Coring Summary

Boring Location	Amount of Rock Cored (feet)
B-1	10.0
B-2	10.5
B-3	5.0
B-4	5.0
B-5	11.3
B-6	10.3

2.15.2.5. Groundwater

Groundwater was not encountered at the time of drilling for the three sites. Borings were immediately backfilled (i.e., groundwater was not allowed to stabilize) for safety reasons. Based on the proximity of the borings to the Little Miami River, groundwater conditions at the three sites are anticipated to be near the water level of the Little Miami River. Groundwater levels may fluctuate throughout the year and may produce widely varying seepage durations and rates depending on recent rainfall activity.

2.16. Laboratory Testing

Laboratory tests were performed on representative soil and rock samples obtained from the soil test borings to assist in soil and rock classifications and to quantify and correlate engineering properties. General descriptions of the laboratory testing conducted for this project are provided on the Laboratory Procedures included in Attachment J. The results of all laboratory testing conducted for this project are included in Attachment J. Table 7: Laboratory Testing Summary summarizes all the laboratory testing conducted on the soil and rock samples from this project.

Table 7: Laboratory Testing Summary

Laboratory Test	Standard	Quantity
Moisture Content	ASTM D 2216-19	46
Sieve & Hydrometer Analyses	ASTM D 422-63	18
Atterberg Limits	ASTM D 4318-17	24
Modified Proctor Laboratory Compaction of Soil	ASTM D1557-12	2
UU Triaxial "Q" Compression Test	ASTM D 2850-15	4
CU Triaxial “R-Bar” Compression Test	ASTM D 4767-11	3
Rock Direct Shear	ASTM D 5607	3
Rock Moisture and Density	ASTM D 2216 and ASTM D 7263	3

2.17. Geotechnical Analysis

2.17.1. Existing Site Conditions

Topographic data for the existing slopes between E. Kemper Road and Little Miami River was provided by Kevin Norman, P.E. of CELRL-EDT-H. This information was found to have some inaccuracies based on visual observations and photos taken during the site reconnaissance. Therefore, existing slopes, ground surface elevations, and Little Miami River assumed gage zero elevations were roughly estimated based on the provided topographic information and adjusted based on visual observations, photos taken during the site reconnaissance, and information obtained from Google Earth Pro. Refer to Table 8: Cross-Section Geometry Key Information for a summary of the key elevations and information used to generate the cross-section geometry for preliminary analysis of the three sites. It should be noted that this information should not be used for a full geotechnical design without verification of the data with a survey at each site location. The purpose of this study was to do a limited exploration of the site to evaluate the existing slope failures for potential cause(s) related to the site geometry and subsurface conditions.

Table 8: Cross-Section Geometry Key Information

Site	E. Kemper Road EL	Little Miami River Assumed Gage Zero EL	Existing Slope
1	569	555	1.8H:1V
2	566	555	1.8H:1V
3	575	557	2H:1V to 5.5H:1V
Note	All elevations and slopes are estimates and should not be used for design purposes without verification with current survey data at the specific locations.		

Due to limitations of the drilling equipment used and limited access to the adjacent slopes, no subsurface information was collected along the slope between E. Kemper Road and Little Miami River or along the uphill slope to the northwest of E. Kemper Road at Sites 1 and 2. Therefore, nearby soil surveys and well logs were used with engineering judgement and experience with similar projects to estimate the stratigraphy to create the cross-section geometry of the soil and rock layers at the three sites. Actual cross-section stratigraphy of soil and rock layers may vary from the cross-section geometry assumed for the geotechnical analysis. Additional subsurface information is needed to fully develop more accurate cross-section stratigraphy representative of the actual field conditions.

2.17.2. Hydrograph

The nearest Little Miami River stream gage to the three sites is USGS Gage No. 03245500 Little Miami River at Milford, OH, approximately 9.6 miles downstream. Three relatively high stage hydrographs, mentioned in Table 9: USGS Gage No. 03245500 Maximum Gage Stage, were analyzed.

Table 9: USGS Gage No. 03245500 Maximum Gage Stage

Event	Maximum Gage Stage (ft)
19MAR2008	21.28
01MAR2017	19.91
25FEB2018	20.43

Figure 15 below compares the hydrographs from the three events.

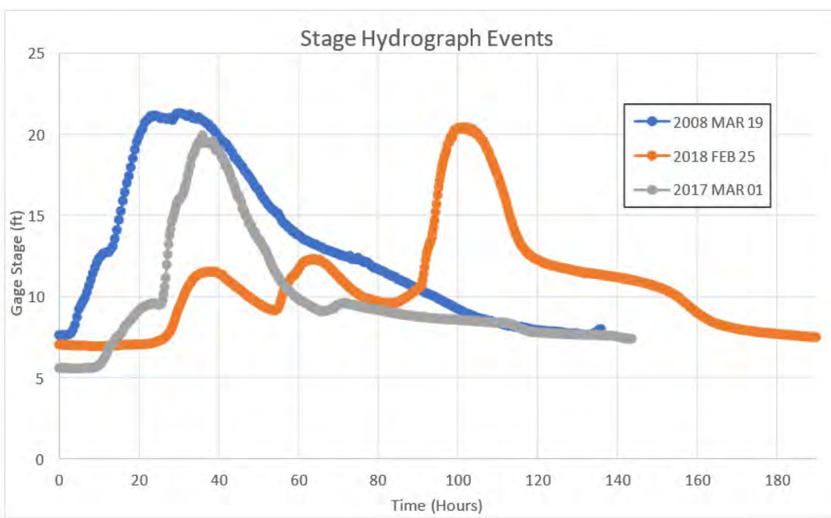


Figure 15: Comparison of the Three Stage Hydrograph Event.

The hydrograph from a rainfall event on March 19, 2008, was selected for the geotechnical analysis since it had the highest water surface elevation (WSE) that was sustained for the longest duration compared to the other hydrographs provided. A modified hydrograph was developed for the three sites that represented the March 19, 2008, hydrograph with slightly higher stages to compensate for the location of the gage. The starting stage from the modified hydrograph was set to the assumed Little Miami River gage zero elevations at each of the three sites for the seepage and slope stability analyses. Due to the Little Miami River elevation difference and distance between the three sites and stream gage, the modified hydrograph is only an approximation used for the seepage analyses. Refer to Figure 16 for the comparison between the selected hydrograph and modified hydrograph used during the analysis.

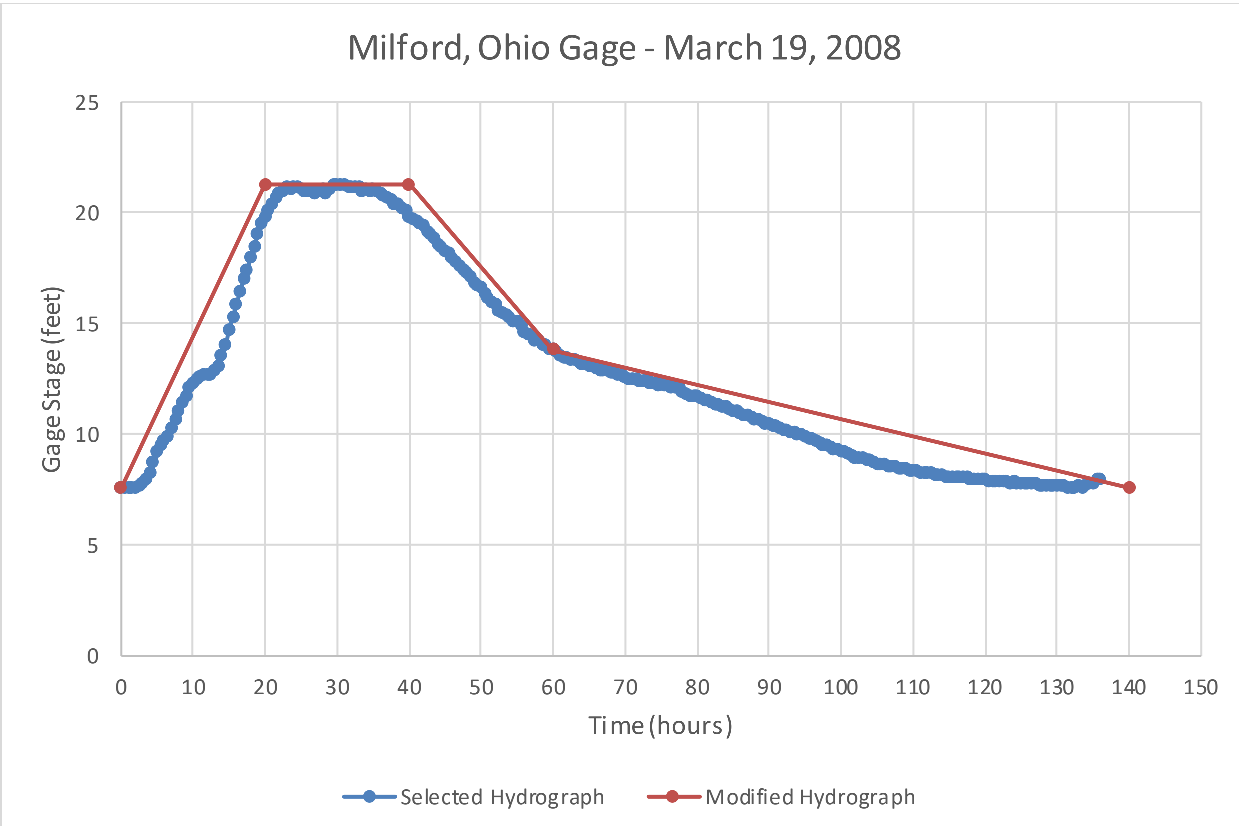


Figure 16: Selected Hydrograph and Modified Hydrograph

2.17.3. Seepage Analyses

Seepage analyses were performed using Seep/W from the 2021.4 GeoStudio software package. The purpose of the seepage analyses was to model the anticipated groundwater levels within the slopes during rapid drawdown events. Soil permeability parameters used for the seepage analyses were estimated from available sources including “Soil Properties and Their Correlations Second Edition” by Michael Carter and Stephen P. Bentley (2016) and references within the GeoStudio software. Laboratory testing for permeability of the on-site soils was not conducted for this study. The seepage analyses included steady state seepage using Little Miami River assumed gage zero elevations and transient seepage using the modified hydrographs previously mentioned.

In addition to modeling the transient groundwater conditions from the hydrograph information, the seepage analyses were used to model the effects of the damaged storm sewer lines within the existing fill zone under E. Kemper Road. The seepage analyses included adding water to the model during an estimated time period that related to precipitation for the high-water event. The seepage analyses were used to better understand how to model the groundwater conditions for the rapid drawdown slope stability analyses.

2.17.4. Slope Stability Analyses

The purpose of the slope stability analyses was to use available laboratory data, subsurface information, and cross-section geometry to back-calculate anticipated subsurface conditions and soil parameters that would generate a similar slope failure as the failures observed on-site. The slope stability was modeled and calculated using Slope/W from the 2021.4 GeoStudio software package. Slope/W is a 2D modeling program that calculates slope stability based on limit equilibrium method of slices. The Spencer method for calculating both force and moment limit equilibrium slope stability was utilized for the analysis of the cross-sections. The slope stability of steady state and rapid drawdown conditions were analyzed for the three sites. The results of the slope stability analyses are included in Attachment K.

2.17.4.1. Selection of Parameters

The drained and undrained soil strength parameters for the existing fill, clay, and clayey sand soils used for the slope stability analyses were back calculated through an iterative process by determining the parameters that produced factors of safety less than 1.0 and created failure slip surfaces representative of the slope failures observed at each of the three sites. Strength parameters to represent the upper portion of the Kope formation (heavily weathered shale) and the underlying weathered shale were determined from laboratory testing and information available in “Factors Contributing to Landslide Susceptibility of the Kope Formation, Cincinnati, Ohio” by Michael P. Glassmeyer and Abdul Shakoor (2001). The laboratory test performed on the weathered shale sampled on-site produced similar results reported in the paper by Glassmeyer and Shakoor. Refer to Table 10: Slope Stability Parameters for the slope stability parameters used for the geotechnical analyses.

Table 10: Slope Stability Parameters

Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)	Total Friction Angle (°)
Existing Fill	125	50	22	800	0
Clay	130	200	23	1000	0
Clayey Sand (Site 3 only)	120	100	27	500	15
Upper Kope Zone	140	140	13	---	---
Weathered Shale	140	200	15	---	---
Riprap	135	10	40	---	---

2.17.4.2. Steady State Slope Stability

Steady state slope stability conditions for this project occur when the soils are in a drained state and Little Miami River is at the assumed gage zero elevation. The calculated minimum factors of safety ranged from 1.2 to 1.3 for the approximate 1.8 horizontal (H) to 1 vertical (V) to 2H:1V existing slopes. This indicates that the existing slopes are anticipated to be stable under the assumed steady state conditions.

2.17.4.3. Rapid Drawdown Slope Stability

Rapid drawdown slope stability occurs when flood waters recede quickly and pore water pressures within the slopes do not have sufficient time to dissipate creating a condition where the slopes have a reduced factor of safety. The soil parameters analyzed for rapid drawdown were in a drained state. For the initial rapid drawdown slope stability analyses, pore water pressure conditions were obtained from the transient seepage analysis using data from the modified hydrographs. However, the factors of safety and/or failure slip surfaces calculated were not similar in size or location to the slope failures observed during our site reconnaissance.

Provided the results of the CCTV inspection report of the storm sewer underlying E. Kemper Road, it was assumed the significant joint separations in the storm sewer lines underneath E. Kemper Road were a contributing factor in the observed slope failures. Thus, the pore water pressure conditions in the subsequent rapid drawdown slope stability models were modified to fully saturate the soils below the approximate storm sewer line elevations. The approximate storm sewer line elevations were obtained from the Storm Sewer Lines Drawings included in Attachment F. The modified groundwater conditions conservatively modeled a flood event with storm water escaping the storm sewer lines through the significant joint separations. In addition, the model accounted for anticipated perched water within the existing fill layer underneath the storm sewer lines that may be present due to the various soil types and/or sand and gravel of the existing fill and/or any void spaces near the storm sewer lines or within other areas of the existing fill mass. The calculated minimum factors of safety ranged from 0.8 to 0.9 indicating that slope failures during rapid drawdown conditions were likely under the assumed conditions. The shape and position of the failure slip surfaces calculated with the model were similar to the slope failures observed during our site reconnaissance. Table 11: Minimum Calculated Factors of Safety for Existing Slope includes a summary of the calculated factors of safety.

Table 11: Minimum Calculated Factors of Safety for Existing Slope

Site	Steady State	Rapid Drawdown
1	1.2	0.8
2	1.3	0.9
3	1.3	0.8

2.18. Screening Potential Remediation Alternatives

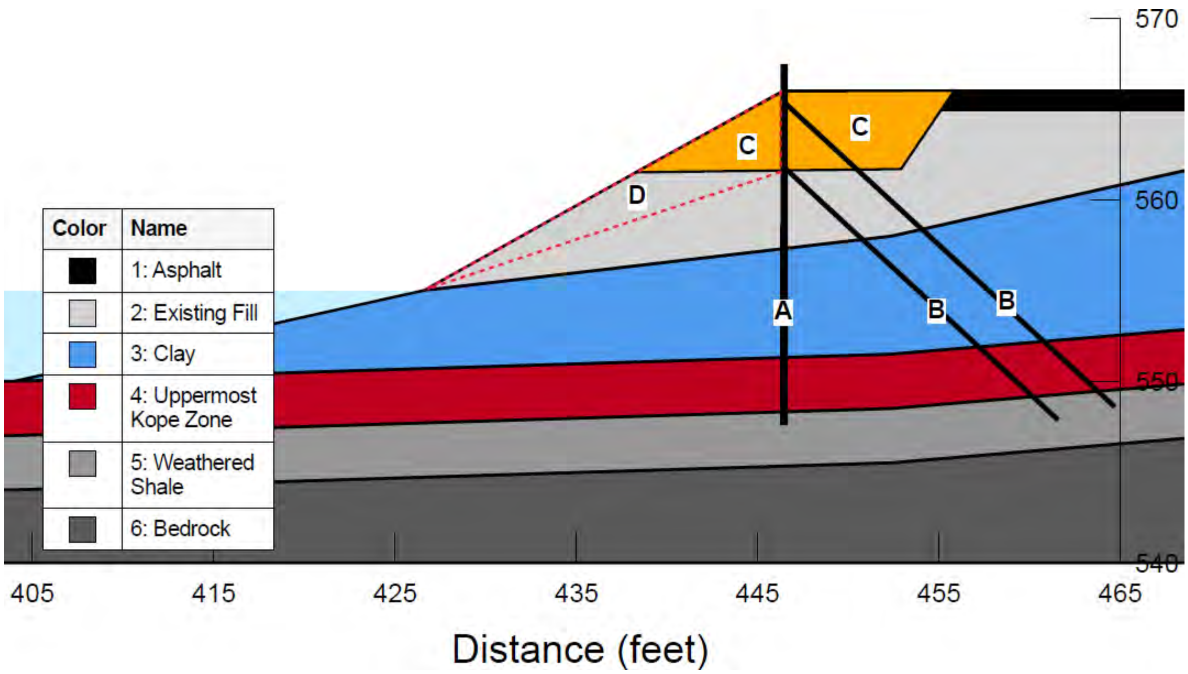
Alternatives were qualitatively screened based on the effectiveness of the design, prior experience with similar projects, and its contribution to remediating the problem or opportunity. The relative costs were also considered during this screening based on previous experience with similar projects. The effectiveness was ranked based on the following:

- Effectiveness for stabilization of banks and protection of infrastructure
- Effectiveness for prevention of future erosion and/or slope failures
- Effectiveness for longevity of remediation
- Effectiveness for public safety

Options considered for potential remediation of the slope failures at the three sites included installation of a wall with tieback anchors (Alternative 1), soil anchor reinforcement (Alternative 2), chemical grouting (Alternative 3), or removing and replacing failed areas with riprap/shot rock (Alternative 4). The considered potential remediations included repairing the significant joint separations in the storm sewer lines underneath E. Kemper Road. See proceeding sections for more detail of the respective potential remediation alternative. Table 12: Comparison of Potential Remediation Alternatives shows the comparison of potential remediation alternatives.

2.18.1. Alternative 1 – Wall with Tieback Anchors

Wall with Tieback Anchors



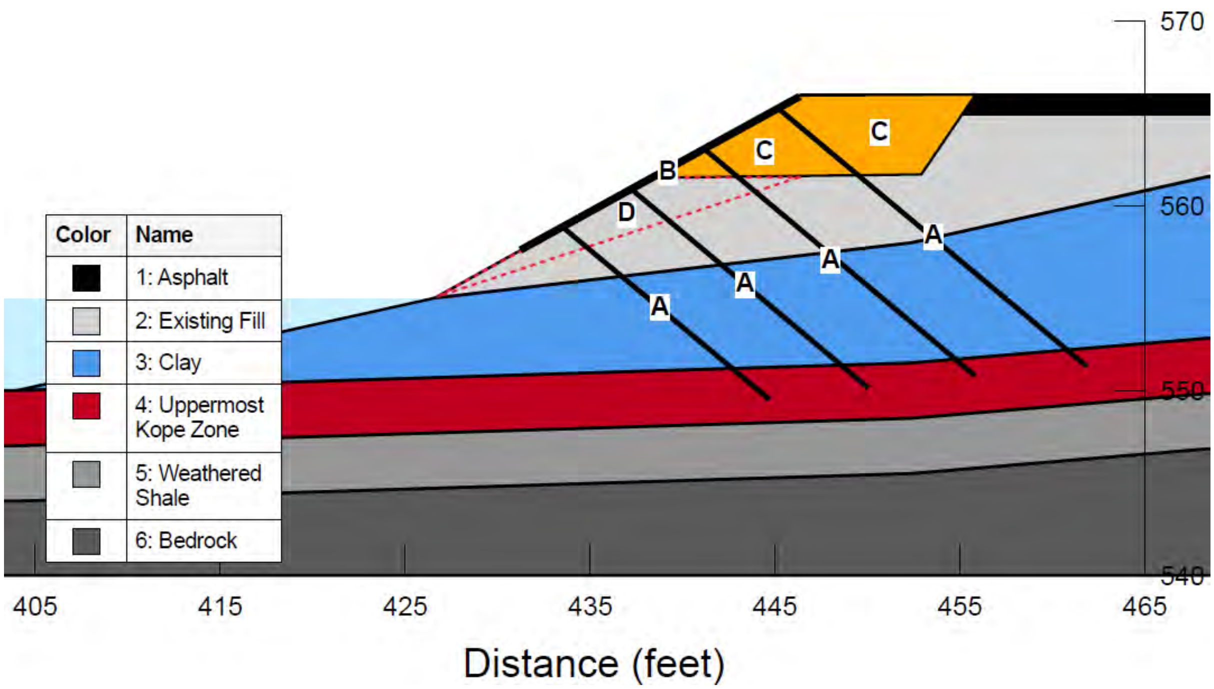
A – Wall (sheet pile or post and panel).
B – Tieback Anchors.
C – Minimum zone of material anticipated to be removed for the repair of the storm sewer.
D – Weakened zone of soils in residual strength due to past failure(s).

Options including a wall system, either post and panel or sheet pile, were considered as potential remediation methods. Several factors would impact the design of a wall system. It is assumed that if this option was selected that only the soils needing to be removed and replaced for the damaged storm sewer would be removed and replaced with controlled fill. This means that the weaker residual strength soils in Zone D would remain.

Assuming that the riverside soils in Zone C were replaced during construction, the wall design still must account for the erosional losses in Zones C and D (area included in the red dashed line), the weakened properties of Zone D, and the steep slope on the river side of the wall. This with the relatively thin layer of soils (approximately 10 feet of existing fill and native clay) and uppermost Kope zone (approximately 3 feet) overlying the weathered shale would likely require the wall to be reinforced with anchors. The resulting wall system would be very expensive. In addition, portions of the system (anchors and or sheet piles) would be susceptible to material loss over time from corrosion. This method of repair would only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope formation would damage the wall system and require reconstruction of the wall.

2.18.2. Alternative 2 – Soil Anchor Reinforcement

Soil Anchor Reinforcement

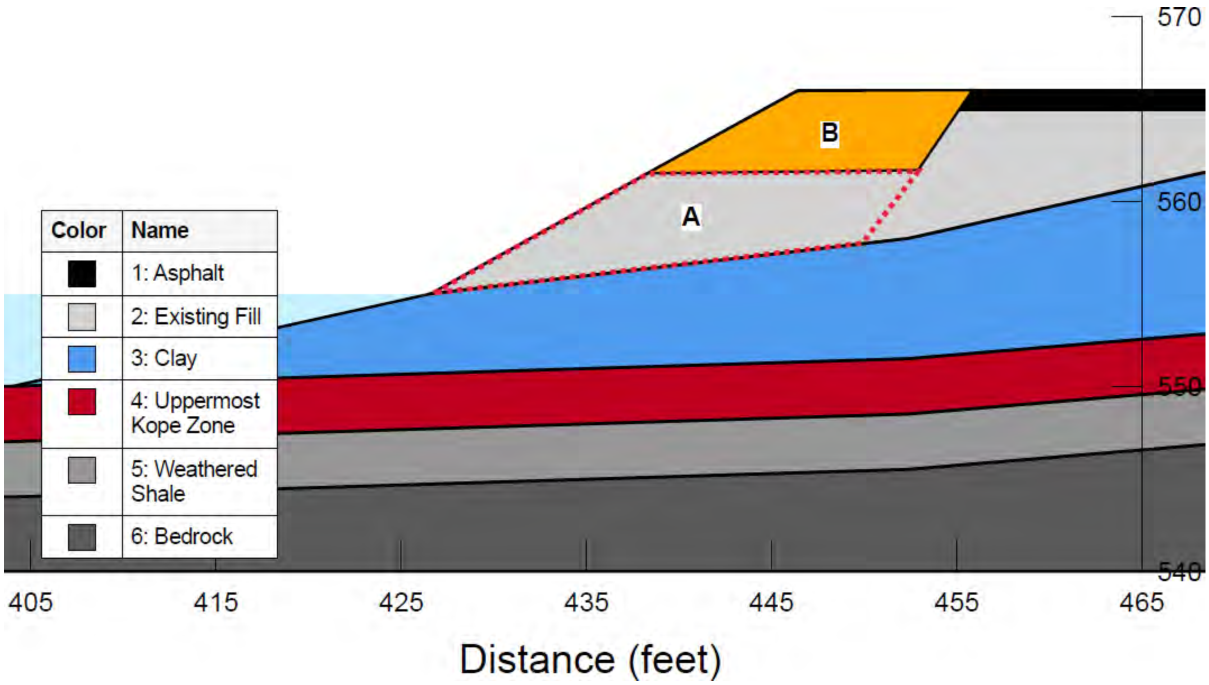


A – Soil Anchor.
B – Reinforcing Mat.
C – Minimum zone of material anticipated to be removed for the repair of the storm sewer.
D – Weakened zone of soils in residual strength due to past failure(s).

A soil anchor system with a reinforcing mat was a system of remediation considered for this project. It is assumed that if this option was selected that only the soils needing to be removed and replaced for the damaged storm sewer would be removed and replaced with controlled fill. This means that the weaker residual strength soils in Zone D would remain. The anchors and reinforcing mat would be used to stabilize the soils of the upper slope. While soil anchors would be less expensive than a wall system, it would still be a relatively expensive remediation option. As with the wall system, portions of the system (anchors and reinforcing mat) would be susceptible to material loss over time from corrosion. This method of repair would also only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope formation would damage the anchor system and require reconstruction.

2.18.3. Alternative 3 – Chemical Grouting

Chemical Grouting



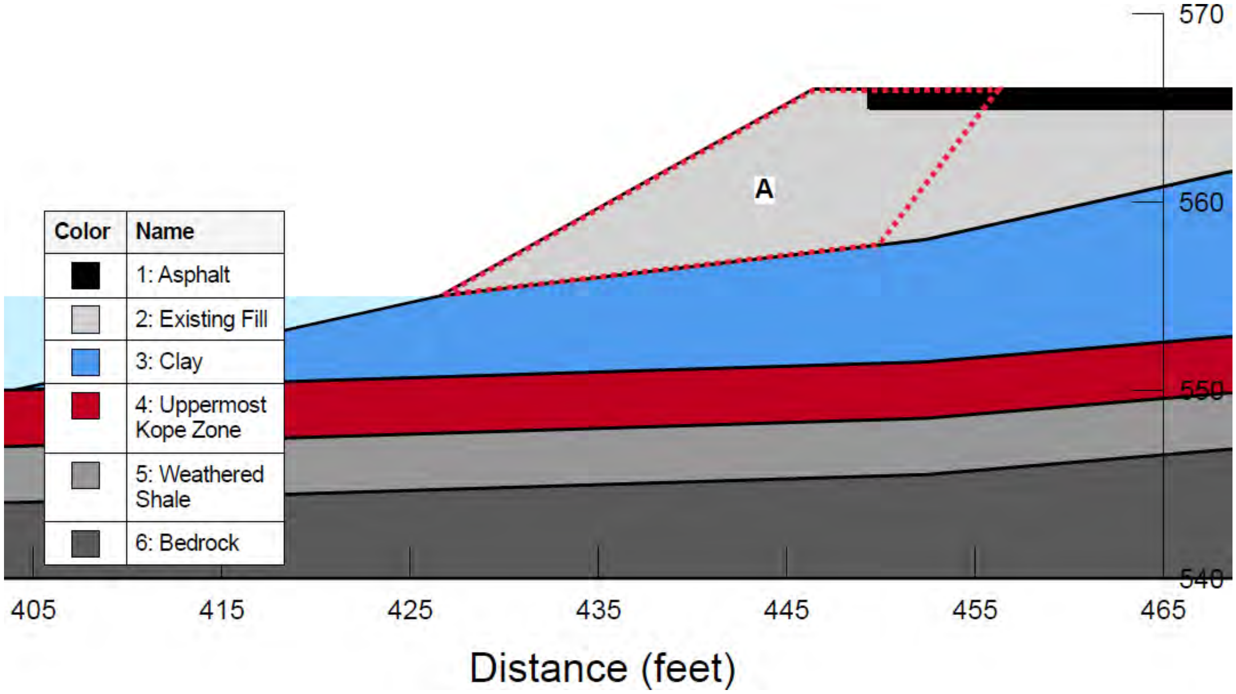
A – Chemically Grouted Soils.
B – Minimum zone of material anticipated to be removed for the repair of the storm sewer.

Chemical grouting is a method of slope remediation that injects chemical bonding agents into the soil matrix to stabilize the soils and provide additional strength. Chemical grouting is relatively expensive and requires a specialty contractor that is very experienced for a successful project. For the existing fill soils underlying the road, the grouting process is anticipated to be difficult due to the variability in the soil composition (clay/silt, with sand and gravel).

It is assumed that if this option was selected that only the soils needing to be removed and replaced for the damaged storm sewer would be removed and replaced with controlled fill. This means that the weaker residual strength soils and the remaining existing fill in Zone A would remain. The soils in Zone A would be later chemically stabilized to improve the overall slope stability. This method of repair would also only address the upper slope adjacent to the road. Potential future failures within the underlying low strength zone of the Kope Formation would likely damage the matrix of the chemically grouted soils and require additional chemical grouting, or other remediation methods, to restore the stability of the slope.

2.18.4. Alternative 4 – Riprap/Shot Rock

Riprap/Shot Rock Stabilization



A – Minimum zone of soils replaced with riprap/shot rock.

The riprap/shot rock remediation alternative would include at a minimum removing all the existing fill in the area contained within the observed slope failure and the material surrounding the damaged storm sewer to expose the underlying undisturbed clay. The failure zone (Zone A) would likely be defined as being a minimum of five feet beyond the tension crack observed along the road and extend downward at an approximate 1 horizontal to 1 vertical (1H:1V) slope until undisturbed native soils are encountered. For constructability, Zone A would likely be extended to include the materials supporting the storm sewer. The removed materials in Zone A would be replaced with riprap and shot rock to restore the slope. Potential future failures within the underlying low strength zone of the Kope Formation would disturb the remediated stone slope. However, crushed stone such as riprap and shot rock used to initially remediate the slope should be suitable to be used to reconstruct the slope. Additionally, depending on the nature of a slope failure, the resulting slope and residual strength of the crushed stone may be sufficient that only a slight modification of the disturbed slope would be necessary to restore stability.

Table 12: Comparison of Potential Remediation Alternatives

Alternative ID	Alternative Description	[1]Effectiveness				[2]Relative initial construction cost
		Stabilization of banks and protection of infrastructure	Prevention of future erosion and/or slope failures	Longevity of remediation	Public safety	
1	Wall with Tieback Anchors	High	High	High	High	High
2	Soil Anchor Reinforcement	High	High	High	High	Medium
3	Chemical Grouting	High	High	High	High	Very High
4	Riprap/Shot Rock	High	High	High	High	Low

Effectiveness Key
High
Low

Relative initial construction cost Key
Very High
High
Medium
Low

Note 1: Effectiveness does not include potential future failures within the underlying low strength zone of the Kope formation.
Note 2: Initial construction costs are relative to each other. Relative initial construction costs are not on a linear scale.

2.19. Tentatively Selected Plan

Using riprap and shot rock to reconstruct the upper slope is the Tentatively Selected Plan for the three areas included in this study. It is assumed that during the remediation of the slopes that the significant joint separations and damage to the storm sewer lines underneath E. Kemper Road would be repaired as part of the remediation. This is anticipated to require the removal and replacement of at least one lane of E. Kemper Road. Depending on the extents of the repair area, additional utility removal/relocation may be required.

The removed region of material from the slope and under the road (assumed to consist of existing fill based on the boring data) would begin beyond the observed tension cracks (typically 5 feet in most cases but must be confirmed during the design phase) and include the vertically and laterally displaced areas observed along E. Kemper Road. The removed region of the existing fill would be cut to a 1H:1V slope to a depth to expose the underlying undisturbed soils. A 2H:1V outer slope between E. Kemper Road and Little Miami River would be created for the three sites with crushed stone consisting of riprap and shot rock properly benched into the underlying undisturbed soils (sizes of the benches will depend on the grade revealed when removing the existing fill) and the 1H:1V existing fill slope (typical benches would be 1H:1V, but will be determined during the design phase). Shot rock will be used to reconstruct most of the remediated areas with riprap placed on the outer slopes along the Little Miami River. The riprap should be sized to the anticipated velocities of the Little Miami River to protect the slope from erosion. A choke stone should be placed over the shot rock to provide a working surface for the stone base course of E. Kemper Road. In utility areas, consider bedding utilities and backfilling utility trenches with controlled low-strength material (CLSM). CLSM is a low strength concrete material. Use of this as bedding and backfill of utilities reduces the risk of loss of support of the utility through material loss within the utility and into the surrounding crushed stone. Refer to the GeoStudio models in Attachment K for the example cross-sections of the Tentatively Selected Plan section.

Implementation of Tentatively Selected Plan must comply with the requirements associated with the Little Miami River's designation as a Recreational River Area. Vegetated riprap was chosen to accomplish this by limiting the visibility of the riprap surface and preserving the aesthetic value of the Project Area. The following paragraph describes the vegetated riprap.

After placement of the riprap, slurry comprised of a mixture of water and topsoil will be pumped into the surface voids of the riprap. After placement of the slurry, topsoil will be placed to create a smooth surface that will support vegetative growth. The topsoil will be hydroseeded with native grasses and plants suitable for the application and site conditions.

Due to the presence of the dry laid limestone terrace (discovered during the cultural resource survey) at Site 2, USACE reached out to the City of Loveland to ask if they had capacity to perform a survey of Site 2. This would allow USACE to better understand the topography and potentially exclude the terrace from the project area. Choice One Engineering performed a survey for the City of Loveland at Site 2. The existing slope immediately above the terrace was found to be flat enough to be reconstructed with riprap and shot rock at a 2H:1V outer slope without encountering the terrace. The terrace and approximately five feet behind the terrace were tentatively removed from the project area. The construction limits for all three of the sites will be further studied during the final design.

The survey performed at Site 2 by Choice One Engineering also revealed that portions of the slope to the southwest of the terrace between E. Kemper Road and Little Miami River may be as steep as 1.75H:1V and may not allow for the slope to be reconstructed with riprap and shot rock at the 2H:1V outer slope mentioned above without placing riprap in the Little Miami River. To avoid placing riprap in the Little Miami River, additional slope stability analyses were conducted for Site 2 with a 1.75H:1V outer slope.

Steady state, rapid drawdown, seismic, and post construction slope stability were analyzed for the Tentatively Selected Plan option for the three sites. The results of the slope stability analyses are included in Attachment K. Table 13: Best Value Alternatives Minimum Calculated Factors of Safety includes a summary of the calculated minimum factors of safety for the Best Value Alternative.

Table 13: Best Value Alternatives Minimum Calculated Factors of Safety

Site	**Steady State**	**Rapid Drawdown**	**Seis mic**	**Post Construction**
1	1.3	1.3	1.1	1.7
2 (Terrace Area)*	1.4	1.4	1.2	1.9
2 (Other Areas)**	1.4	1.4	1.2	1.7
3	1.4	1.3	1.1	1.6
Recommended***	1.5	1.3	1.0	1.3

* Analyzed at 2H:1V slopes for the slopes immediately above the terrace.

** Analyzed at 1.75H:1V slopes for the slopes southwest of the terrace.

*** Recommended minimum factors of safety are provided in EM 1110-2-1902.

Steady state conditions were analyzed with the soils in a drained state and Little Miami River at an assumed gage zero elevation. The calculated minimum factors of safety ranged from 1.3 to 1.4 and were slightly higher than minimum factors of safety calculated for the existing conditions. It should be noted that the minimum factors of safety calculated for the steady state conditions had failure slip surfaces occurring within the upper Kope zone. The Kope formation is a well-known geologic hazard for the region and will likely be the limiting factor for the overall slope stability of the system.

Rapid drawdown conditions were analyzed with soils in a drained state and pore water pressure conditions obtained from the transient seepage analysis using data from the modified hydrographs. For this model, it is assumed that the significant joint separations in the storm sewer lines underneath E. Kemper Road had been repaired. Therefore, the groundwater conditions were not modified to fully saturate the soils below the approximate storm sewer line elevations. The calculated minimum factors of safety ranged from 1.3 to 1.4, indicating that the Best Value Alternative cross-sections were stable under rapid drawdown conditions.

Seismic conditions were analyzed with the soils in a drained state and Little Miami River at assumed gage zero elevation. A peak ground acceleration (PGA) of 0.07g was used for the analyses. The calculated factors of safety ranged from 1.1 to 1.2 indicating that the Tentatively Selected Plan cross-sections were stable under seismic conditions.

Post construction conditions exist at the end of construction prior to the pore water pressures in the fine-grained soil having time to dissipate. Post construction conditions were analyzed with the soils in an undrained state and Little Miami River at and assumed gage zero elevation. The calculated factors of safety ranged from 1.6 to 1.9 indicating that the Tentatively Selected Plan cross-sections were stable under post construction conditions.

The Tentatively Selected Plan section presented was done as a proof-of-concept example and is not a final design. Depending on the actual site conditions encountered in a full geotechnical investigation, a different design remediation system may be more beneficial.

2.20. Limitations

The limited geotechnical exploration and study were performed using the degree of care and skill ordinarily exercised under similar conditions by geotechnical engineers and geologists practicing in the area or similar localities. The analyses provided in this report are based on the previously described project information, the subsurface conditions encountered, results of laboratory testing, empirical correlations for the soil types encountered, and experience.

This study applies to the specific project and site discussed within. If the project information is incorrect, if additional information is available, or if there is any change in the project criteria (including location or orientation on the site, structural loading, or plan dimensions), the appropriate information shall be conveyed to the project geotechnical engineer. The information contained in this report shall be considered invalid unless the project design geotechnical engineer reviews the new data and determines if any modifications are required. The findings of such a review must be presented in writing.

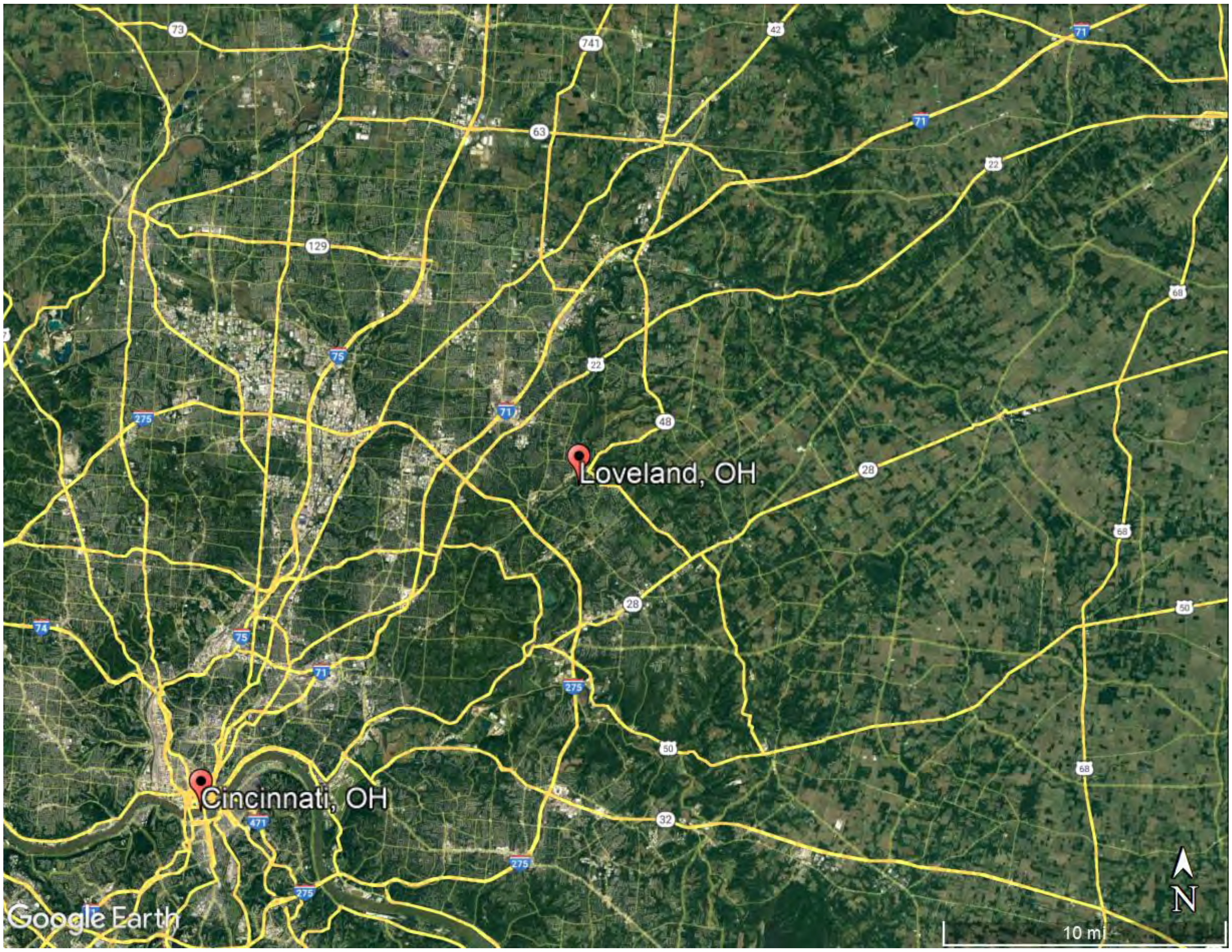
Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings will be different from those at specific boring locations, and that conditions will not be as anticipated by the designers or contractors.

This was a limited geotechnical exploration and slope stability analysis. The information in this study should not be used for design purposes unless it is confirmed by a full geotechnical investigation and detailed slope stability analyses. The cross-section geometry and soil and rock stratigraphy used in the models for this study were estimated from the limited information at the time of the study. Actual conditions at each site location may vary from those analyzed for the basis of this study.

2.21. Attachment F: Site Information

Attachment F:
Site Information

Project Location Map
Vicinity Map
Boring Location Plans
Site Photos
Storm Sewer Lines Drawings
Storm Sewer Lines Location Maps
CCTV Inspection Photos



PROJECT LOCATION MAP

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

VICINITY MAP

Loveland, OH CAP Section 14 Feasibility

Loveland, Ohio

BORING LOCATION PLAN (SITE 1)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

BORING LOCATION PLAN (SITE 2)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

BORING LOCATION PLAN (SITE 3)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

Photo 1 (Site 1): Guard rail movement, asphalt settlement and resurfacing, and stone placement for erosion repair on the southeast side of E. Kemper Road (looking southwest).

Photo 2 (Site 1): Water ponding on the southeast side of E. Kemper Road (looking southwest).

Photo 3 (Site 1): Leaning trees on slope between E. Kemper Road and Little Miami River (looking northeast).

Photo 4 (Site 2): Water ponding on the southeast side of E. Kemper Road (looking southwest). Note inserted PVC drain in curb.

Photo 5 (Site 2): Stone/concrete debris placement on slope between E. Kemper Road and Little Miami River (looking northeast).

Photo 6 (Site 2): Small drainage pipes penetrating the curb on the southeast side of E. Kemper Road and leaning tree (looking southwest).

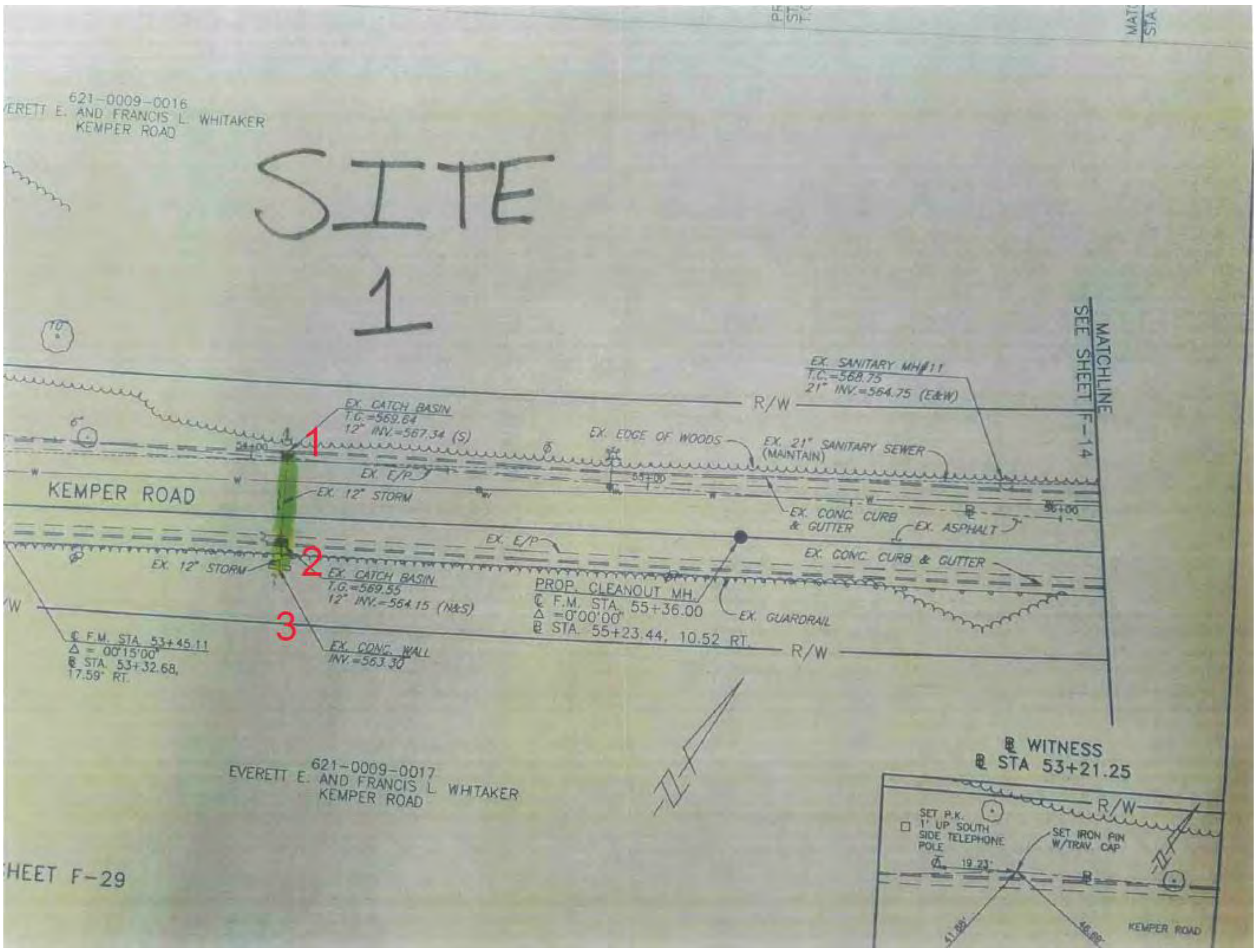
Photo 7 (Site 2): Dry laid limestone terrace at northeast edge of Site 2 (looking southwest).

Photo 8 (Site 3): Guard rail movement, leaning light pole, and stone placement for repair on the southeast side of E. Kemper Road (looking northeast).

Photo 9 (Site 3): Leaning tree on slope between E. Kemper Road and Little Miami River (looking northeast).

Photo 10 (Site 3): Bottom of slope between E. Kemper Road and Little Miami River (looking northeast).

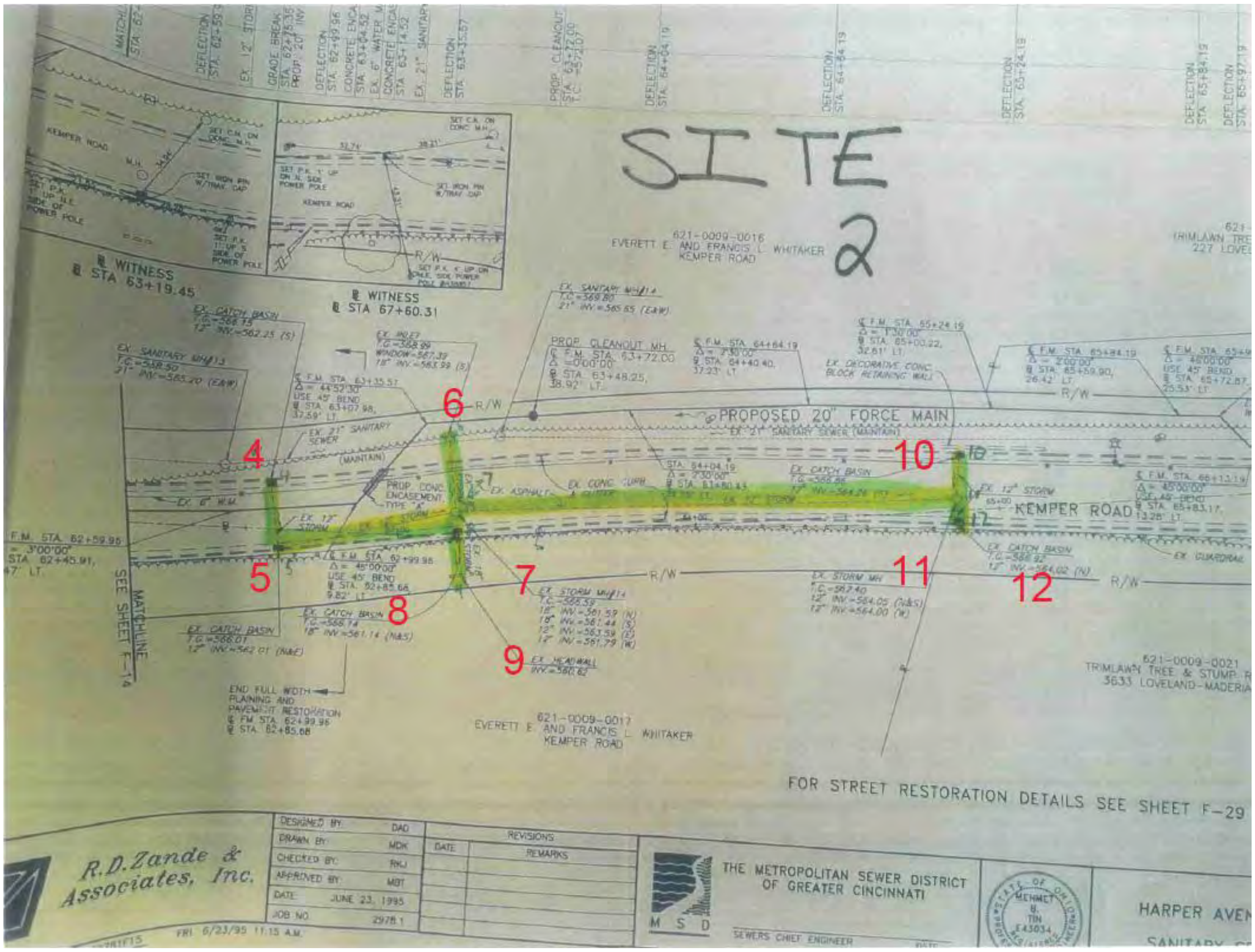
Photo 11 (Site 3): Silty sand soils observed in a storm sewer pipe at a headwall located on the slope between E. Kemper Road and Little Miami River (looking northwest).



STORM SEWER LINES DRAWING (SITE 1)

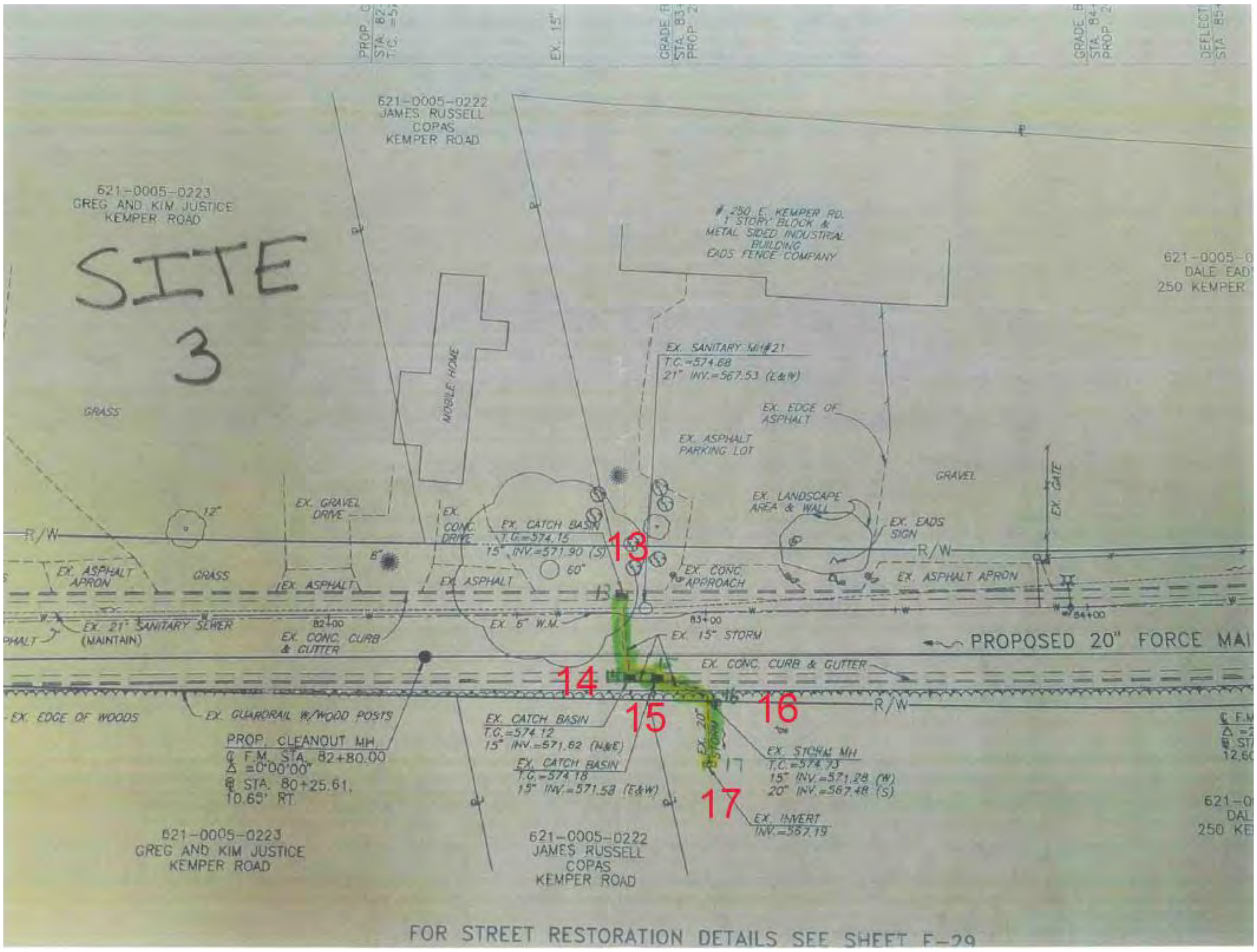
Loveland, OH CAP Section 14 Feasibility

Loveland, Ohio



STORM SEWER LINES DRAWING (SITE 2)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio



STORM SEWER LINES DRAWING (SITE 3)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

STORM SEWER LINES LOCATION MAP (SITE 1)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

STORM SEWER LINES LOCATION MAP (SITE 2)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

STORM SEWER LINES LOCATION MAP (SITE 3)

Loveland, OH CAP Section 14 Feasibility
Loveland, Ohio

Photo 1 (Site 1): Joint separated at 17.7 feet between CB-1 and CB-2.

Photo 2 (Site 1): Joint separated at 5.1 feet between CB-2 and HW-3.

Photo 3 (Site 2): Roots tap joint at 2.4 feet between IN-6 and MH-7.

Photo 4 (Site 2): Roots tap joint at 11.1 feet between IN-6 and MH-7.

Photo 5 (Site 2): Hole void visible at 19.5 feet between IN-6 and MH-7.

Photo 6 (Site 2): Roots tap joint at 19.5 feet between IN-6 and MH-7.

Photo 7 (Site 2): Joint offset at 6.9 feet between CB-8 and HW-9.

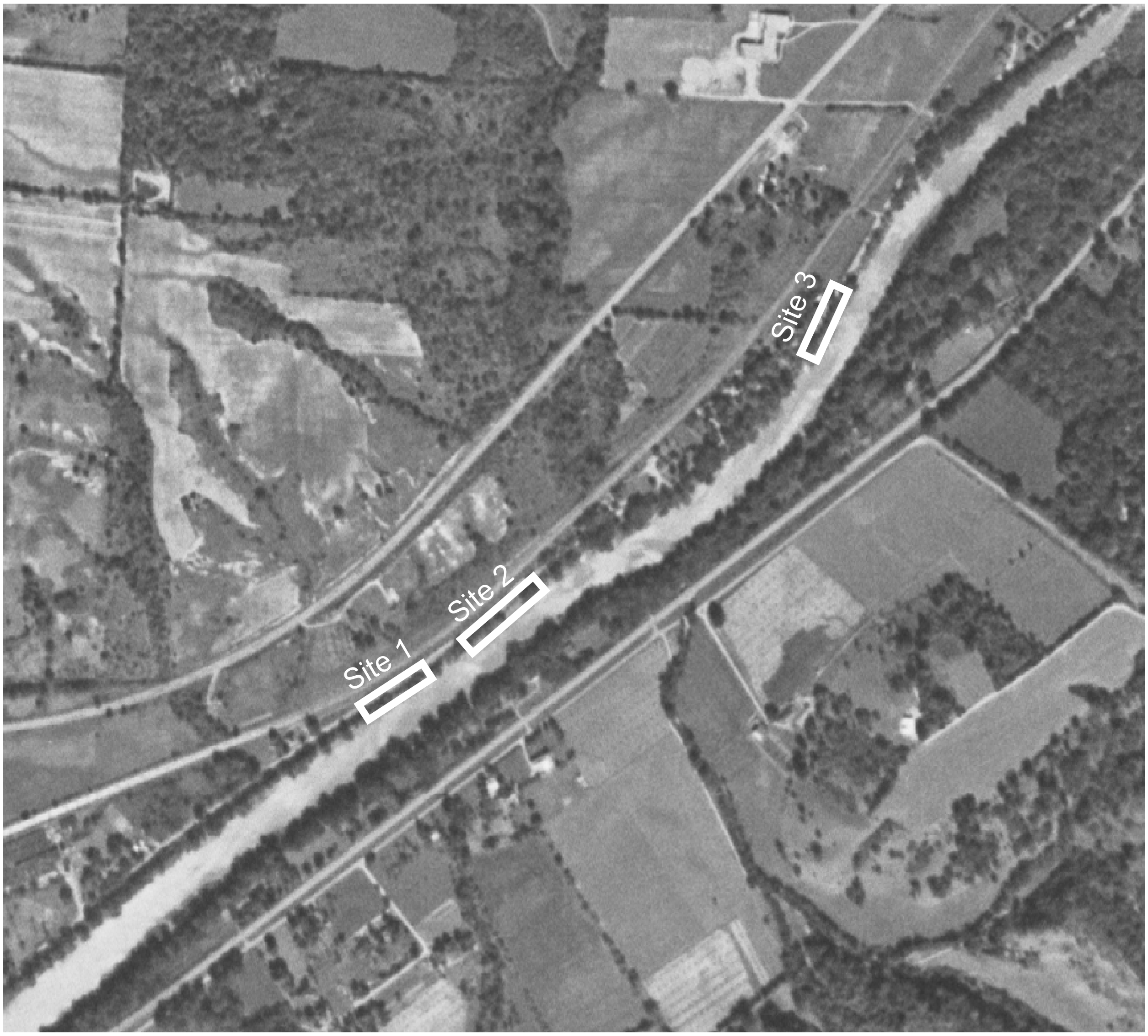
Photo 8 (Site 3): Joint separated at 2.0 feet between MH-16 and HW-17.

Photo 9 (Site 3): Joint separated at 8.7 feet between MH-16 and HW-17.

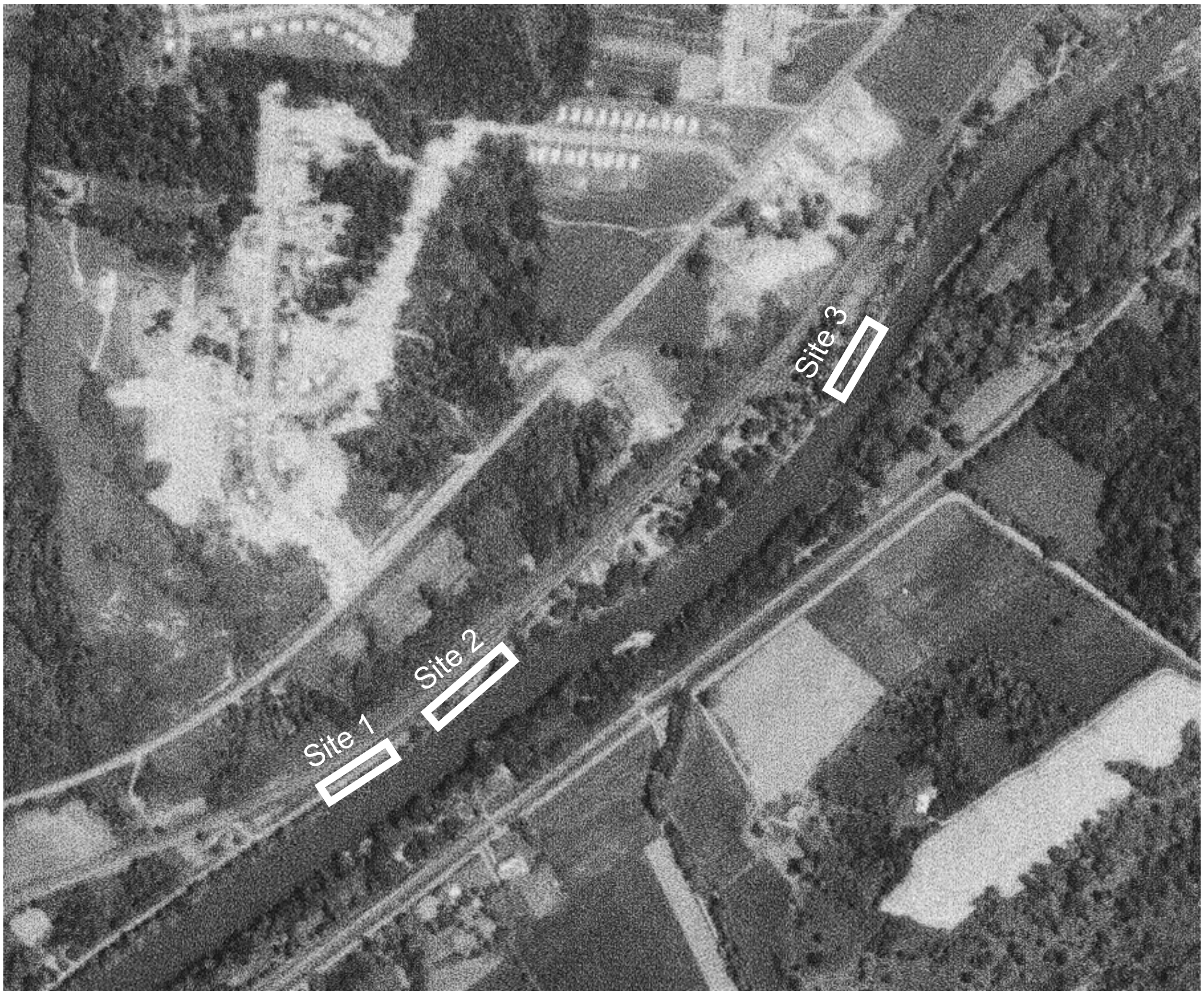
2.22. Attachment G: Historical Information

Attachment G:
Historical Information

Aerial Photos

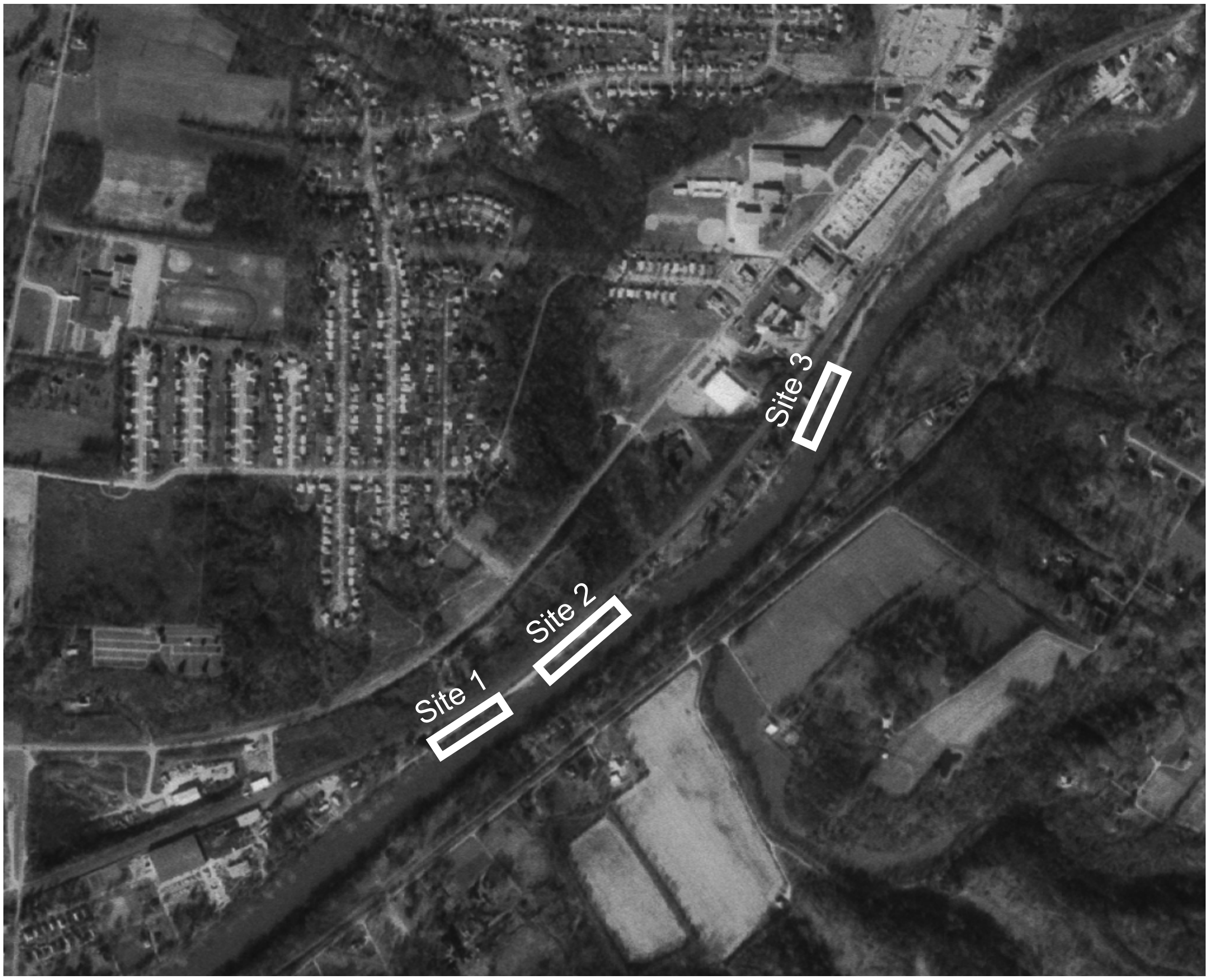


1952 (Source: USGS), approximate location of project sites.

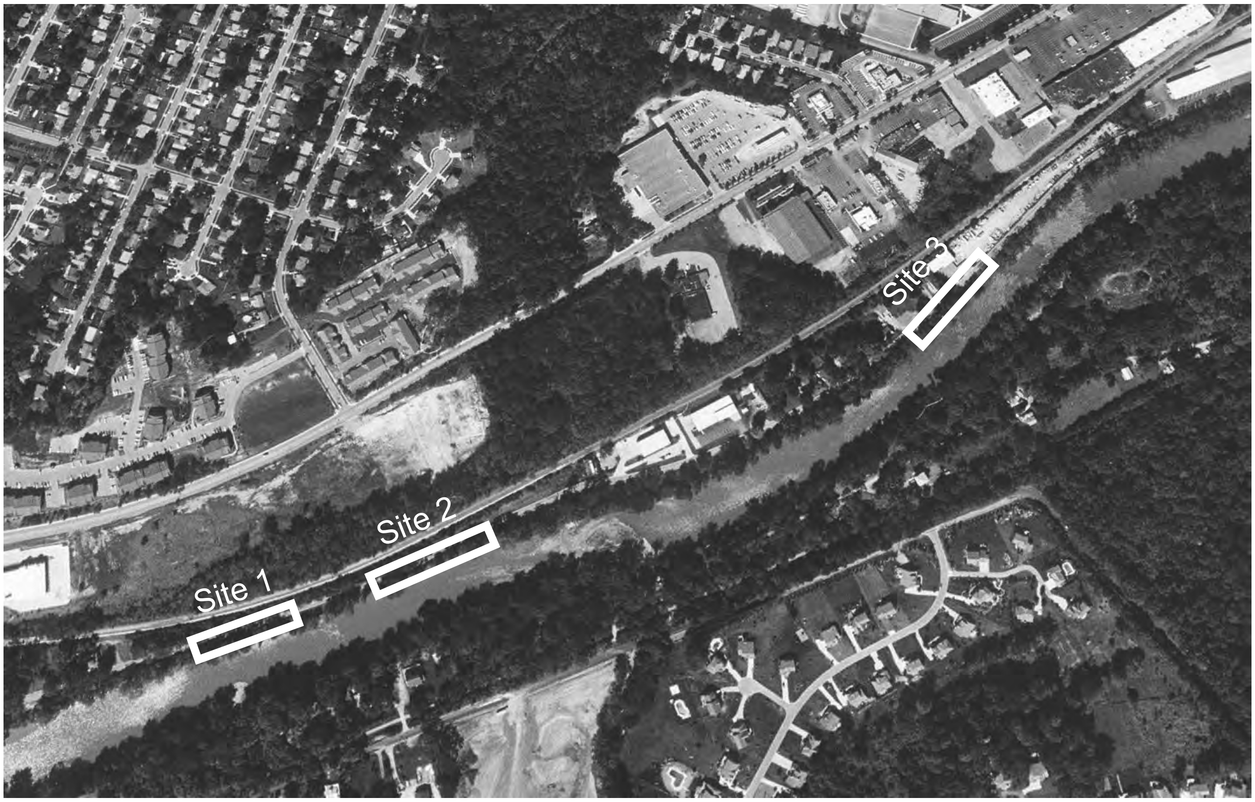


1960 (Source: USGS), approximate location of project sites.

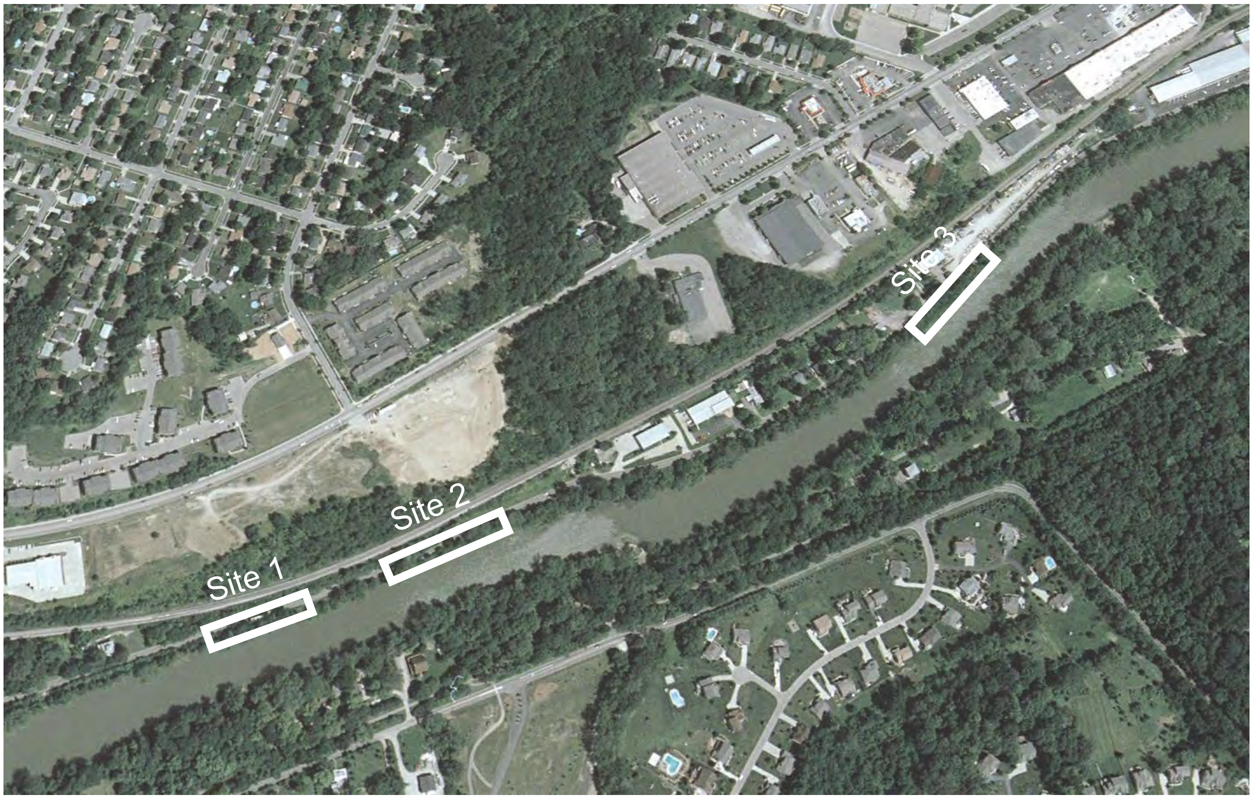
1964 (Source: USGS), approximate location of project sites.



1979 (Source: USGS), approximate location of project sites.



1994 (Source: Google Earth), approximate location of project sites.



2004 (Source: Google Earth), approximate location of project sites.

2010 (Source: Google Earth), approximate location of project sites.

2021 (Source: Google Earth), approximate location of project sites.

2.23. Attachment H: Geophysical Results

Attachment H:
Geophysical Results

HAGER-RICHTER
GEOSCIENCE, INC.

SURFACE GEOPHYSICAL SURVEY
E. KEMPER ROAD/S. RIVERSIDE AVENUE
LOVELAND, OHIO

Contract No. W912QR-20-D-0003

Prepared for:

American Engineers, Inc.
65 Aberdeen Drive
Glasgow, Kentucky 42141

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 22J14
June 7, 2022

June7, 2022
File 22J14

Dennis Mitchell, P.E.
Director of Geotechnical Services
American Engineers, Inc.
65 Aberdeen Drive
Glasgow, Kentucky 42141

Tel: 270-651-7220
Fax: 270-590-5390
Email: DMitchell@aei.cc

RE: Surface Geophysical Survey
E. Kemper Road/S. Riverside Ave
Loveland, Ohio
Contract No. W912QR-20-D-0003

Dear Mr. Mitchell:

In this report, we summarize the results of a geophysical survey conducted by Hager-Richter Geoscience, Inc. (HRGS) in support of a geotechnical evaluation of E. Kemper Road and S. Riverside Avenue along the Little Miami River in Loveland, Ohio for American Engineers, Inc. (AEI) and the Louisville District US Army Corps of Engineers (USACE-LRL). The scope of the survey and the area of interest were specified by AEI and USACE-LRL.

INTRODUCTION

The site is a roadway along the Little Miami River in Loveland, Ohio. Figure 1 shows the general location of the site. AEI and USACE-LRL specified two areas of interest for the geophysical survey in the vicinity of proposed borings. The Northern Area of interest is approximately 100 feet long and the width of the roadway. The Southern Area of interest is also the width of the roadway and is approximately 600 feet long. The purpose of the geophysical investigation was to determine the locations of subsurface anomalies such as those caused by changes in geologic conditions, old building foundations, and below-grade structures, as well as existing and abandoned utilities. The field work was performed in general accordance with Engineer Manual (EM) 385-1-1, *Safety and Health Requirements*.

OBJECTIVE

The objective of the geophysical survey was to detect, and if detected, to locate buried waste material (both metallic and non-metallic), uncontrolled fill, changes in shallow subsurface conditions, old building foundations, and abandoned or existing utilities in accessible exterior portions of the specified area of interest at the site.

THE SURVEY

Vanja Dezelic, Ph.D., and Timothy Williams of HRGS conducted the geophysical survey on May 5-6, 2022. The Project was coordinated with Mr. Dennis Mitchell, P.E. of AEI.

The geophysical survey was conducted using the methods specified by AEI and the USACE: time domain electromagnetic induction (EM61), frequency domain electromagnetic induction terrain conductivity (EM38), and ground penetrating radar (GPR).

EM61 data were acquired at approximately 8-inch intervals along lines spaced 5 feet apart across the accessible portions of the area of interest. The EM61 survey detects areas of buried metal to a depth of about 10 feet.

EM38 data were acquired at approximately 5-foot intervals along lines spaced 5 feet apart across the accessible portions the areas of interest. The EM38 data were acquired in the vertical dipole mode with the instrument's boom parallel to the survey lines. The EM38 survey detects areas of anomalous apparent terrain conductivity as well as areas of buried metal to a depth of about 5 feet.

GPR data were acquired along traverses spaced 5 feet apart parallel to the roadway, and 10 feet apart perpendicular to the roadway in the accessible exterior portions of the area of interest. The GPR survey was conducted in substantial accordance with ASTM D 6432.

HRGS established a local survey grid for the acquisition of the geophysical data. The survey grid and other site features were georeferenced using a Trimble Geo7X CM GPS system utilizing a Zephyr-2 external antenna. Site utilities were marked by others prior to HRGS mobilization to the Site. The locations of some utilities were marked by others were surveyed using GPS and are shown on the figures. The results of the survey are presented relative to UTM Zone 16N in US Survey Feet.

EQUIPMENT

EM61. The time domain electromagnetic induction survey was conducted using a Geonics EM61-MK2A time domain electromagnetic induction metal detector. The EM61-MK2A instrument was designed specifically for detecting buried metal objects such as USTs, drums, and utilities. An air-cored transmitter coil generates a pulsed primary magnetic field in the earth, thereby inducing eddy currents in nearby metal objects. The eddy current produces a secondary magnetic field that is sensed by two receiver coils, one coincident with the transmitter and one positioned 40 cm above the main coil. By measuring the secondary magnetic field after the current in the ground has dissipated but before the current in metal objects has dissipated, the instrument responds only to the secondary magnetic field produced by metal objects. Four channels of secondary response are measured in mV and are recorded on a digital data logger. The system is generally operated by pushing the coils configured as a wagon with an odometer mounted on the axle to trigger the data logger automatically at approximately 8-inch intervals. The EM61 survey was conducted in substantial accordance with ASTM D 6820.

EM38. The electromagnetic induction terrain conductivity survey was conducted using a Geonics Model EM38-MK2 terrain conductivity meter. This unit is an induction type instrument and provides measurement of both the quadrature-phase and in-phase components of terrain conductivity without ground electrodes or contact. The quadrature-phase data, also known as apparent conductivity data, are useful for detecting the presence of anomalously conductive ground, which might be caused by the presence of objects with properties unlike those of the natural materials on site, such as fill. The in-phase component data, on the other hand, are only used to interpret the presence of metal objects. The data for both components are recorded on a digital data logger. The EM38 is calibrated to read ground conductivity directly in millisiemens per meter with a resolution of 2% of full scale and an accuracy of 1 mmho/meter. The nominal depth of earth sampled by the EM38 in the vertical dipole mode is about 5 feet. The EM38 survey was conducted in substantial accordance with ASTM D 6639.

GPR. GPR survey was conducted using GSSI UtilityScan DF subsurface imaging radar system. The UtilityScan DF acquired data simultaneously from 800 MHz and 300 MHz antennas. Data was recorded digitally, and the GPR data can be reviewed in the field. The system included survey wheel that trigger the recording of the data at fixed intervals, thereby increasing the accuracy of the locations of features detected along the survey lines.

LIMITATIONS OF THE METHODS

> HAGER-RICHTER GEOSCIENCE, INC. MAKES NO GUARANTEE THAT ALL TARGETS OF INTEREST WERE DETECTED IN THIS SURVEY. HAGER-RICHTER GEOSCIENCE, INC. IS NOT RESPONSIBLE FOR DETECTING TARGETS THAT CANNOT BE DETECTED BY THE METHODS EMPLOYED OR BECAUSE OF SITE CONDITIONS.

EM61. The EM61 cannot detect non-metallic objects. The data from all EM surveys are adversely affected by surface metal, and subsurface information is eliminated at and near the surface metal. The EM61 has a depth sensitivity limited to about 10 feet.

Detection and identification should be clearly differentiated. Detection is the recognition of the presence of a metal object, and the electromagnetic method is excellent for such purposes. Identification, on the other hand, is determination of the nature of the causative body (i.e., what is the body -- a cache of drums, UST, automobile, white goods, etc.?). Although the EM data cannot be used to *identify* all buried metal objects, they provide excellent guides to the identification of some objects. For example, buried metal utilities produce anomalies with lengths many times their widths.

EM38. All electromagnetic geophysical methods are affected by the presence of power lines and surface metal objects (steel sided buildings, dumpsters, vehicles, railroad tracks, reinforced concrete, etc.). Where such are present, the effects of materials in the subsurface may be masked, and firm conclusions about subsurface conditions cannot be made.

The detection of any target, whether an object or change in geological conditions, is predicated in the assumption of a marked contrast in electrical conductivity. The EM38 instrument response varies with the orientation of the dipoles. In the horizontal dipole mode, the instrument is more sensitive to near-surface conductive layers than it is in the vertical dipole mode.

GPR. There are limitations of the GPR technique as used to detect and/or locate targets such as those of the objectives of this survey: (1) surface conditions, (2) electrical conductivity of the ground, (3) contrast of the electrical properties of the target and the surrounding soil, and (4) spacing of the traverses. Of these restrictions, only the last is controllable by us.

The condition of the ground surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. Sites covered with snow piles, high grass, bushes, landscape structures, debris, obstacles, soil mounds, etc. limit the survey access and the coupling of the GPR antenna with the ground. In many cases, the GPR signal will not penetrate below concrete pavement, especially inside buildings, and a target may not be detectable. The GPR method also commonly does not provide useful data under canopies found at some facilities.

The electrical conductivity of the ground determines the attenuation of the GPR signals, and thereby limits the maximum depth of exploration. For example, the GPR signal does not penetrate clay-rich soils, and targets buried in clay might not be detected.

A definite contrast in the electrical conductivities of the surrounding ground and the target material is required to obtain a reflection of the GPR signal. If the contrast is too small then the reflection may be too weak to recognize, possibly due to deeply corroded metal in the target, the target can be missed.
Spacing of the traverses is limited by access at many sites, but where flexibility of traverse spacing is possible, the spacing is adjusted to the size of the target.

RESULTS

The geophysical survey was conducted using time domain electromagnetic induction (EM61), frequency domain electromagnetic induction terrain conductivity (EM38), and ground penetrating radar (GPR). Figure 2 is a color contour plot of the EM38 data for Southern Area. Figure 3 is a color contour plot of EM61 data and integrated interpretation of the EM38, EM61 and GPR data for the Southern Area. Figure 4 is a color contour plot of the EM38 data for Northern Area. Figure 5 is a color contour plot of EM61 data and the integrated interpretation of the EM38, EM61 and GPR data for the Northern Area.

The EM38 data were acquired at approximately 5-foot intervals across the accessible portions of the areas of interest. The results of the EM38 survey are shown in color contour form for the apparent conductivity and in-phase components in Figures 2 and 4, respectively. As discussed above, the EM38 measures the quadrature-phase and in-phase components of terrain conductivity. The quadrature-phase data, also known as apparent conductivity data, are useful for detecting the presence of anomalously conductive ground, which might be caused by the presence of objects with properties unlike those of the natural materials on site, such as fill. The in-phase component data is only sensitive to the presence of buried metal.

The EM61 data were acquired at approximately 8-inch intervals along same survey lines as EM38 spaced 5 feet apart across the accessible portions of the areas of interest. The results of the EM61 survey are shown in color contour form in Figure 3 and 5, respectively. Interpretation of EM61 data is based upon the *relative* response of the instrument in millivolts to local conditions. The instrument is not calibrated to provide an absolute measure of a particular property, such as the conductivity of the soil or the strength of the earth's magnetic field. Subsurface metal objects produce sharply defined positive anomalies (red and yellow colors) when the EM61 is positioned directly over them. Acquiring data at short intervals along closely spaced lines, as was done at the subject site, provides high spatial resolution of the location and footprint of the targets. Thus, buried metal is recognized in contour plots of EM61 data by positive anomalies with spatial dimensions roughly corresponding to the dimensions of the buried metal.

As indicated above, the EM61 has a depth sensitivity limited to about 10 feet and the EM38 has a depth sensitivity of about 5 feet. A few of the high amplitude EM anomalies evident in the figures are associated with surface features such as manholes and a catch basins. Such areas are shown with blue hatching in Figure 3 and 5. We note that the presence or absence of subsurface metal objects in such areas cannot be determined based on the EM data alone due to the anomaly caused by the surface metal objects.

Several low- to high-amplitude linear EM anomalies not attributable to surface metal objects are present. We infer that such anomalies are caused by utilities and are shown in Figure 3 and 5 as dashed black lines and is some locations as known utilities such as water line and drain lines. We note that non-metallic utilities or metallic utilities at a depth of greater than 10 feet could be present at such locations and would not have been detected by the EM surveys.

Background apparent conductivity values vary from approximately 10-15 mS/m (blue) in areas unaffected by surface metal, buried utilities, or buried metal. No increased apparent conductivity anomalies indicative of filled areas are evident in the data for the site.

Apparent GPR signal penetration for the area of interest was good, with two-way travel time reflections received from approximately 20 ns of the 25 ns records acquired for the 800 MHz antenna and 40 to 45 ns of the 45 ns records acquired for the 300 MHz antenna. Based on velocity matching calibrations made for the site, the GPR signal penetration in the area of interest is estimated to have been about 4 feet for the 800 MHz antenna, and 6 to as much as 8 feet for the 300 MHz antenna, respectively.

Multiple unidentified possible utility segments were detected based on the office examination of the GPR data, and their locations are shown as black dashed lines in Figures 3 and 5. Note that such possible unidentified utilities were not marked on the ground at the time of the survey. Some of the unidentified utilities correlate with the EM anomalies, and we infer that those utilities are metallic in nature. Known utilities such as water line and drain lines were also identified and are marked as such in Figures 3 and 5.

CONCLUSIONS

Based on the results of a geophysical survey conducted by Hager-Richter Geoscience, Inc. (HRGS) in Loveland, Ohio for American Engineers, Inc. (AEI) and the Louisville District US Army Corps of Engineers (USACE-LRL) under Contract No. W912QR-20-D-0003 in May 2022, we conclude that:

- The subsurface at the Site contains several possible utilities
- No areas of concentrated fill were detected within the AOIs

LIMITATIONS ON USE OF THIS REPORT

This letter report was prepared for the exclusive use of AEI and the US Army Corps of Engineers (collectively Client). No other party shall be entitled to rely on this Report, or any information, documents, records, data, interpretations, advice, or opinions given to Client by Hager-Richter Geoscience, Inc. (HRGS) in the performance of its work. The Report relates solely to the specific project for which HRGS has been retained and shall not be used or relied upon by Client or any third party for any variation or extension of this project, any other project, or any other purpose without the express written permission of HRGS. Any unpermitted use by Client or any third party shall be at Client's or such third party's own risk and without any liability to HRGS.

HRGS has used reasonable care, skill, competence, and judgment in the performance of' its services for this project consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by HRGS should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, test pits, soil borings with collection of soil and water samples, and laboratory testing.

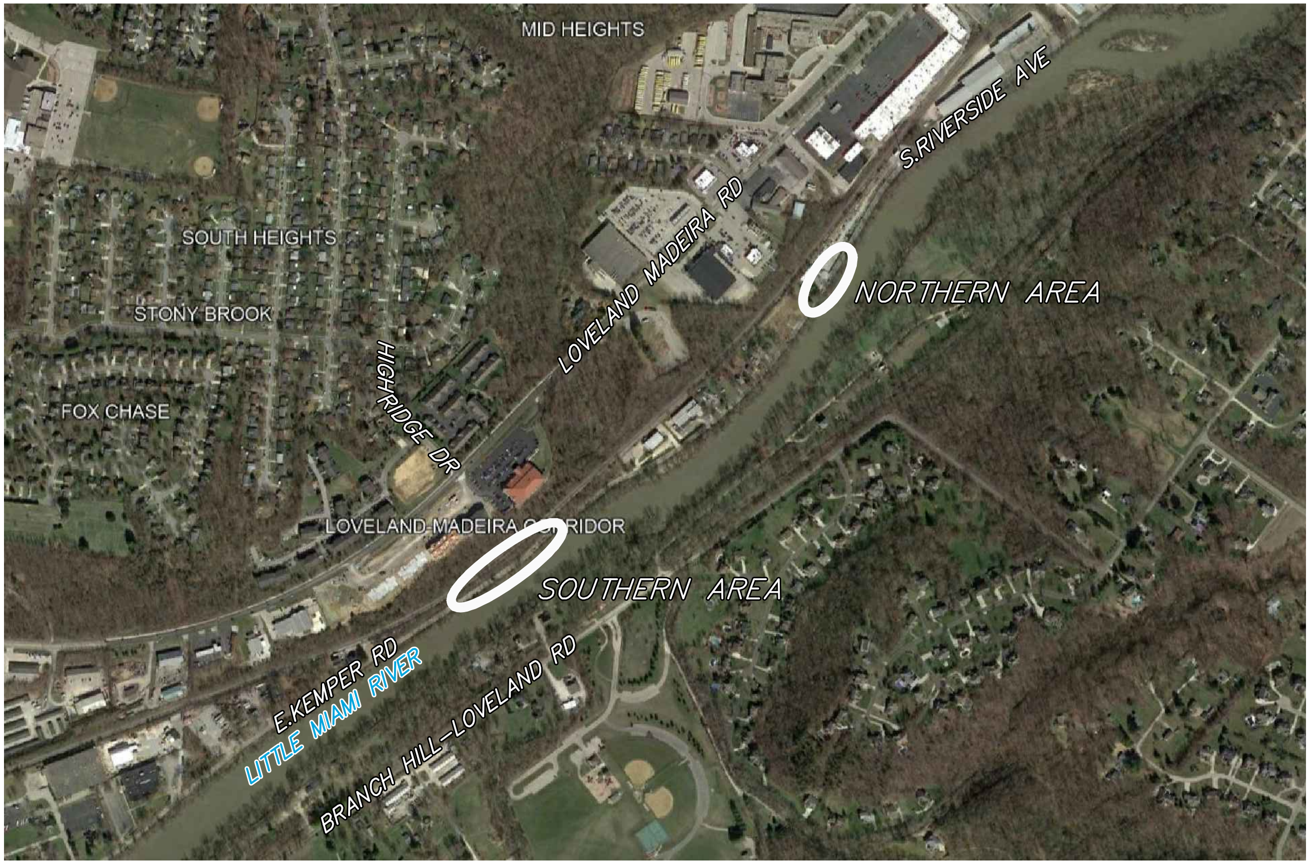
Except as expressly provided in this limitations section, HRGS makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.

If you have any questions or comments on this letter report, please contact us at your convenience. It has been a pleasure to work with AEI and the USACE on this project. We look forward to working with you again in the future.

Sincerely,
HAGER-RICHTER GEOSCIENCE, INC.

Jeffrey Reid, P.G.
Owner / Principal Geophysicist

Attachments: Figures 1 - 5



N

APPROXIMATE SCALE (feet)

0 1000 2000

LOCATION

NOTE:

Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
E. Kemper Road/S. Riverside Avenue
Loveland, Ohio
Contract No. W912QR-20-D-0003

File 22J14	May, 2022

HAGER-RICHTER
Salem, NH | Fords, NJ

APPARENT CONDUCTIVITY

IN–PHASE COMPONENT

NOTES:

1. Modified from Google Earth Pro aerial photograph.
2. Data were acquired with a Geonics EM38–MK2.

SCALE (feet)

0 20 40

LEGEND

DATA STATIONS

CATCH BASIN

N

Figure 2
EM38 Survey – Southern Area
E. Kemper Road/S. Riverside Avenue
Loveland, Ohio
Contract No. W912QR–20–D–003

File 22J14	May, 2022

HAGER–RICHTER
Salem, NH | Fords, NJ

EM61 SURVEY

GPR SURVEY & INTEGRATED INTERPRETATION

LEGEND

EM61 DATA STATIONS	POSIBLE DRAIN LINE
GPR TRAVERSE	POSSIBLE UTILITY
APPROXIMATE LIMITS OF EM SURVEY AREA	AREA OF POSSIBLE DISTURBED SOILS
POSSIBLE WATER LINE	

EM ANOMALY ATTRIBUTED TO EFFECTS OF SURFACE OBJECTS. THE PRESENCE OR ABSENCE OF BURIED METAL WITHIN THIS AREA CANNOT BE DETERMINED ON THE BASIS OF THE EM61 DATA ALONE.

CB CATCH BASIN

NOTES:

1. Modified from Google Earth Pro aerial photograph.
2. EM data were acquired with Geonics EM61–MK2. Differential response shown.
3. Differential response equals top coil response – bottom coil response.

SCALE (feet)

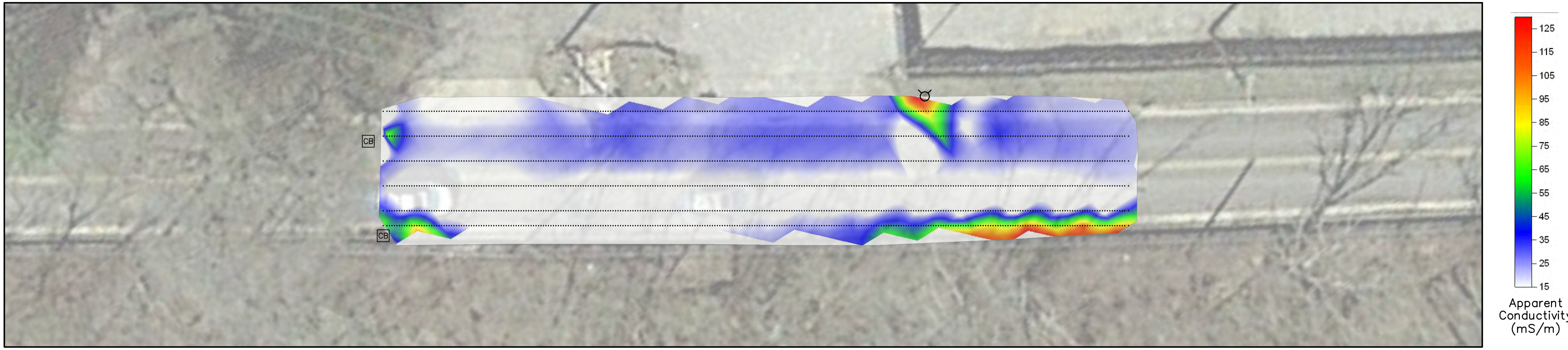
0 20 40

N

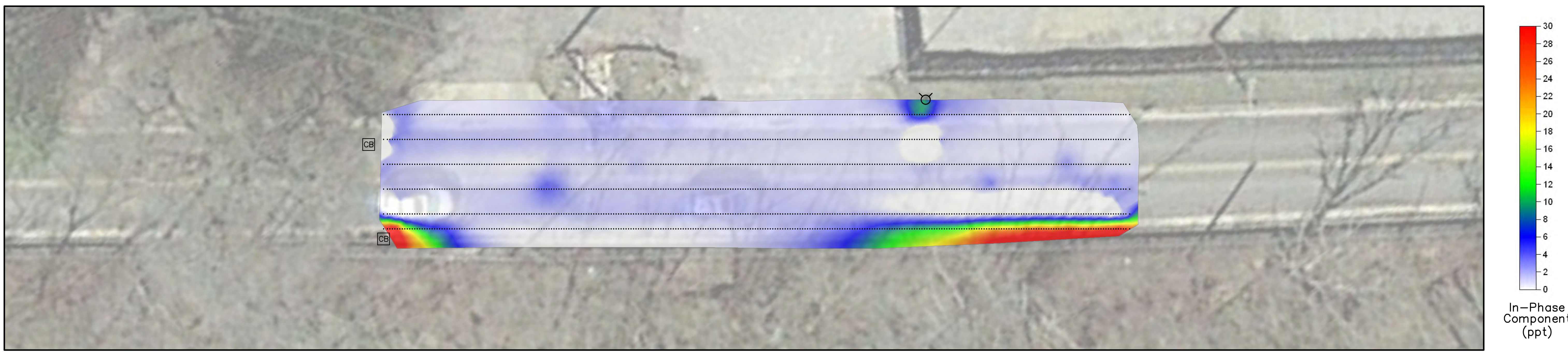
Figure 3
EM61, GPR Survey & Integrated Interpretation – Southern Area
E. Kemper Road/S. Riverside Avenue
Loveland, Ohio
Contract No. W912QR–20–D–003

File 22J14	May, 2022

HAGER–RICHTER
Salem, NH | Fords, NJ



APPARENT CONDUCTIVITY



IN–PHASE COMPONENT

SCALE (feet)

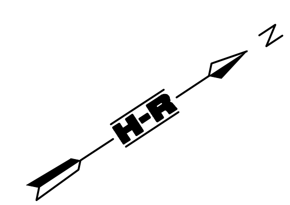
0 20 40

LEGEND

DATA STATIONS

HYDRANT

CB CATCH BASIN



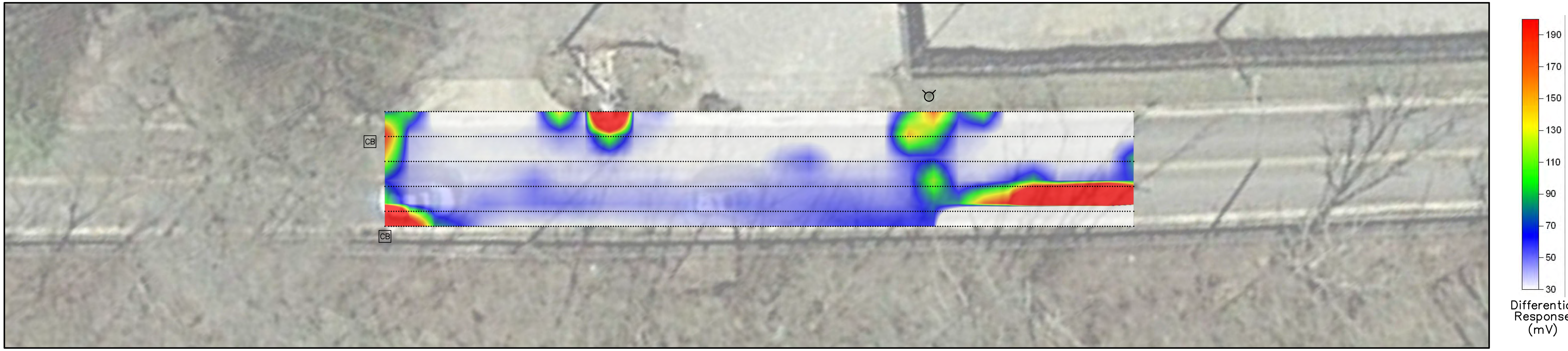
NOTES:

1. Modified from Google Earth Pro aerial photograph.
2. Data were acquired with a Geonics EM38–MK2.

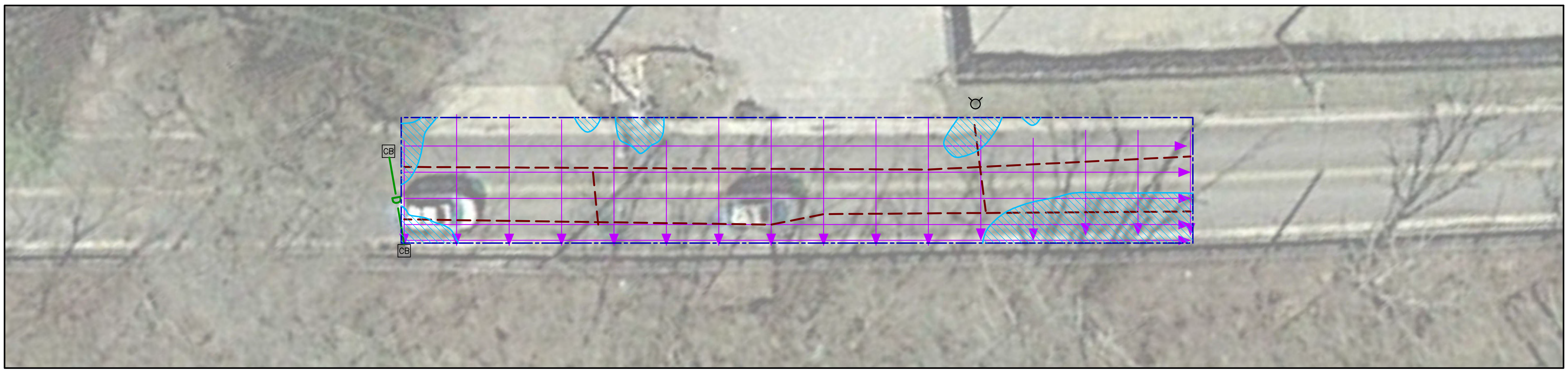
Figure 4
EM38 Survey – Northern Area
E. Kemper Road/S. Riverside Avenue
Loveland, Ohio
Contract No. W912QR–20–D–003

File 22J14	May, 2022

HAGER–RICHTER
Salem, NH | Fords, NJ



APPARENT CONDUCTIVITY



IN-PHASE COMPONENT

SCALE (feet)

0 20 40

LEGEND

EM61 DATA STATIONS

GPR TRAVERSE

APPROXIMATE LIMITS OF EM SURVEY AREA

POSIBLE DRAIN LINE

POSSIBLE UTILITY

EM ANOMALY ATTRIBUTED TO EFFECTS OF SURFACE OBJECTS. THE PRESENCE OR ABSENCE OF BURIED METAL WITHIN THIS AREA CANNOT BE DETERMINED ON THE BASIS OF THE EM61 DATA ALONE.

HYDRANT

CATCH BASIN

N

NOTES:

1. Modified from Google Earth Pro aerial photograph.
2. EM data were acquired with Geonics EM61-MK2. Differential response shown.
3. Differential response equals top coil response - bottom coil response.

Figure 5
EM61, GPR Survey & Integrated Interpretation – Northern Area
E. Kemper Road/S. Riverside Avenue
Loveland, Ohio
Contract No. W912QR-20-D-003

File 22J14	May, 2022

HAGER-RICHTER
Salem, NH | Fords, NJ

2.24. Attachment I: Boring Information

Attachment I:
Boring Information

Field Procedures
Soil and Rock Classification
Boring Logs
Soil and Rock Sample Photos
Soil Profiles

FIELD PROCEDURES

Field Operations: The general field procedures employed by the U.S. Army Corps of Engineers (USACE), Louisville District, are summarized in ASTM D420 which is entitled "Standard Guide for Site Characterization for Engineering Design and Construction Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in situ methods as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternative techniques depending upon the subsurface conditions. These techniques include, but are not necessarily limited to:

a. 2½ or 3¼ inch inside diameter (I.D.) hollow stem augers;
b. Wash borings using roller cone or drag bits (using drilling mud or water);
c. Continuous flight augers (ASTM D1452).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field boring log by a geologist or geotechnical engineer. The field boring logs contain information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these field boring logs contain both factual and interpretive information. The field boring logs are maintained in the district office.

The soil and rock samples plus the field boring logs are reviewed by a geologist or geotechnical engineer who classifies the soils in general accordance with the procedures outlined in ASTM D2488 and prepares the final boring logs which are the basis for all evaluations and recommendations.

The final boring logs represent the interpretation of the contents of the field boring logs based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and groundwater conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring logs are included with this report.

Soil Borings: Soil borings were made at the site at locations shown on the attached Boring Location Plan. Soil sampling and penetration testing were performed in accordance with ASTM D1586.

The borings were advanced into the soil. At regular intervals, the drilling tools were removed and soil samples obtained with a standard 1.4-inch inside diameter (I.D.), 2-inch outside diameter (O.D.), split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings or disturbed soils, then driven an additional foot with blows of a 140-pound hammer free falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance." The penetration resistance, when properly evaluated, is an index to the soil strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the contractor's laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. Boring logs are attached which graphically show the soil descriptions and penetration resistances.

Undisturbed Sampling: Split tube samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing. For quantitative testing, relatively undisturbed samples are obtained by pushing sections of 3-inch O.D., 16 gauge, steel tubing (Shelby tube) into the soil at the desired sampling levels. This procedure is described by ASTM D1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the boring logs.

Bulk Sampling: These samples consist of two five-gallon buckets of soil brought to the surface by the drilling augers. The samples were placed in the sealed buckets, with sealed jar samples of the material, and taken to the contractor's laboratory for testing. The locations of these samples are indicated on the appropriate boring logs.

Water Level Readings: Water level readings are normally taken in conjunction with borings and are recorded on the boring logs. These readings indicate the approximate location of the water level at the time of the field investigation. Where impervious (more clayey) soils are encountered, the amount of water seepage into the boring is small, and it generally is not possible to establish the location of the water through short term water level readings. The water level may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in water level should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The water level reported on the boring logs is determined by field crews as the drilling tools are advanced. The water level is detected by changes in the drilling rate, soil samples obtained, or by measurement after the drilling tools are withdrawn. Additional water level readings may be obtained after the borings are completed. A time lag of 24 hours may allow stabilization of the water level reading that may have been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface.

Occasionally, the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring logs.

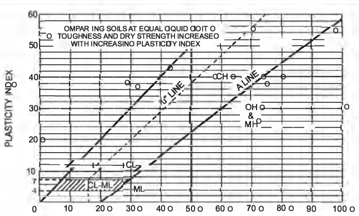
Pocket Penetrometer Test: The penetrometer testing device is inserted into the soil until the plunger penetrates the soil up to the calibration grade. The measured resistance provides an indication of the soil's consistency. The testing results are shown on the boring or test pit logs and are designated with PP.

UNIFIED OIL CLAS IFICATION
(INCLUDING IDENTIFICATION AND DESCRIPTION)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (EXCLUDINO PARTI LES LARGER THAN 3 INCHES AND BASINO FRACTIONS ON ESTI ATED WEI HTS)			LABORATORY CLASSIFICATION CRITERIA
1	2		3	4	5			6
COARSE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE.	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE.	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	WELL-GRADED GRAVELS, RAVEL-SAND IXTURES, ITTLE OR NO FINES.	WIDE RANGE IN GRA IN SIZES AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTI E SIZES.			$C_U = \frac{D_{60}}{D_{10}}$ REATER THAN 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3
			GP	POORLY-GRADED GRAVELS, RAVEL-SAND IXTURES, ITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES ISSING.			NOT MEET INO ALL GRADA TION REQOIREMENTS FOR GW
		GRAVELS WITH FINES (MORE THAN 12% FINES)	GM	SI TY GRAVELS, RAVEL-SAND-S ILT IXTURES.	NONPLASTI FINES OR FINES WITH LOW PLASTI ITY (FOR IDENTIFICATION PROCEDURES SEE BELOW)			ATTERBERG LI ITS BELOW "A" LINE WITH PI LESS THAN 4 — ABOVE "A" LINE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRINO USE OF DUAL SYMBOLS.
			GC	LAYEY GRAVELS, RAVEL-SAND-CLAY IXTURES.	PLASTI FINES (FOR IDENTIFICATION PROCEDURES SEE BELOW).			ATTERBERG LIMITS ON OR ABOVE "A" LINE WITH PI GREATER THAN 7
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE. (FOR VISUAL CLASSIFICATION, THE 1/4 IN. SIZE MAY BE USED AS EQUIVALENT TO THE NO. 4 SIEVE SIZE)	CLEAN SANDS (LESS THAN 5% FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	WIDE RANGE IN GRA IN SIZE AND SUBSTANTIAL AMOUNTS OF ALL NTERMEDIATE PARTICLE SIZES.			$C_U = \frac{D_{60}}{D_{10}}$ REATER THAN 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES ISSING.			NOT MEET INO ALL GRADATION REQOIREMENTS FOR SW
		SANDS WITH FINES (MORE THAN 12% FINES)	SM	SILTY SANDS, SAND-SILT IXTURES.	NONPLASTI FINES OR FINES WITH LOW PLASTI ITY (FOR IDENTIFI ATION PROCEDURES SEE BELOW).			ATTERBERG LI ITS BELOW "A" LINE WITH PI LESS THAN 4 — ABOVE "A" LINE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRINO USE OF DUAL SYMBOLS.
			SC	LAYEY SANDS, SAND-CLAY MIXTURES.	PLASTI FINES (FOR IDENTIFI AT ION PROCEDURES SEE BELOW).			ATTERBERG LI ITS ON OR ABOVE "A" LINE WITH PI GREATER THAN 7
					IDENTIFI AT ION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE.			
					DRY STRENGTH (CRUSHING HARACTER ISTI S)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PL)	
FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE. THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE.	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANI SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTI ITY.	NONE TO SLIGHT	QUICK TO SLOW	NONE	
			CL	INORGANI CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.	MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	
			OL	ORGANI SILTS AND ORGANI SILTY CLAYS OF LOW PLASTICITY.	SLIGHT TO MEDIUM	SLOW	SLIGHT	
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANI SILTS, MI ACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTI SILTS.	SLIGHT TO MEDIUM	SLOW TO NONE	SLIGHT TO MEDIUM	
			CH	INORGANI CLAYS OF HIGH PLASTI ITY, FAT CLAYS.	HIGH TO VERY HIGH	NONE	HIGH	
			OH	ORGANI CLAYS OF MEDIUM TO HIGH PLASITI ITY, ORGANIC SILTS.	MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	
HIGHLY ORGANI SOILS			PT	PEAT AND OTHER HIGHLY ORGANI SOILS.	READILY IDENTIFIED BY COLOR, ODOR, SPONGY FEEL AND FREQUENTLY BY FIBROUS TEXTURE.			

USE GRAIN-SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFI CATION.

DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN-SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN NO. 200 SIEVE SIZE) COARSE-GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:
LESS THAN 5% — GW, GP, SW, SP
MORE THAN 12% — GM, GC, SM, SC
5% to 12% — BORDERLINE CASES REQUIRING DUAL SYMBOLS



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

GENERAL NOTES

1.0 REFUSAL IS DEFINED AS THE POINT BEYOND WHICH FURTHER PENETRATION WAS I PRACT I AL W ITH THE EXPLORATION METHOD SED. SEE THE INDIVIDUAL BORING LOGS FOR THE EXPLORATION METHOD SED.

2.0 WATER ELEVATIONS INDI ATED ON THE BORINGS MAY HAVE BEEN INFLUENCED BY DRI INO OPERATIONS AND SHOULD NOT BE CONSTRUED AS INDI AT ING THE TRUE GROUNDWATER LEVEL.

3.0 ROUNDWATER LEVELS WILL VARY IN ACCORDANCE WITH RAINFALL AND STREAM STAGES, THEREFORE, ACTUAL LEVEL OF GROUNDWATER ON ANY DATE OTHER THAN THAT SHOWN ON THE LOGS MOST BE DETERMINED BY SEPARATE OBSERVATIONS. THE OMISSION OF GROUNDWATER ELEVATIONS SHALL NOT NECESSARILY BE ONSTRUED AS INDI AT INO THE ABSENCE OF GROUNDWATER AT A PARTI LAR BORINO LOCAT ION.

4.0 WHEREVER THE METHOD OF EXPLORATION PRECLUDED THE POSSIBILITY OF RECOVERING SAMPLES ABOVE ROOK, SOITABLE FOR EXAMINATION OR TESTS, THE ATER IAL IS DENOTED AS OVERBURDEN.

5.0 ASS IFI ATIONS AND PHYSI AL CHARACTER ISTI S OF SOI AND ROOK AS SHOWN ON THE LOGS WERE DETERMINED IN THE FIELD AND LATER SUPPLEMENTED BY ANALYSIS IN THE LABORATORY, AS APPROPRIATE.

6.0 FIELD BOOKS, FIELD LOOS, LABORATORY LOOS (PRESENTING THE RESULTS OF LABORATORY TESTS FOR SHEAR, ONSOLIDATION, PERMEABI ITY, ETO, WHEN PERFORMED) AND EDITED LOGS MAY BE VIEWED IN THE OFFI E OF THE DISTRI T ENGINEER. O.S. AROY ENOINEER DISTRI T, LOOISVILLE, OORPS OF ENGINEERS, FEDERAL OFFI E BOI D ING, LOOISVI E, KY. FAILURE OF THE CONTRACTOR TO AVAIL HI SELF OF THE INFORMATION REPRESENTED BY THE BORINO LOGS, INCLUDING LABORATORY TEST RESULTS, SHALL NOT BE GROUNDS FOR A LA I THAT THE GOVERNMENT W ITHHELD INFORMATION ON SUBSURFACE CONDIT IONS.

7.0 THE TERM "LOST WATER" IF SHOWN ON THE LOGS INDICATES A QUANTITY OF DRILLING WATER LOST IN THE DRILL HOLE.

8.0 DRIVE SAMPLES WERE TAKEN WITH A 1 3/8" I.D. -2" O.D. X 2'-8" SPLIT SPOON.

9.0 ORE HOLES WERE COMPLETED BY AN NXM OR NQ WIRE LINE SIZE CORE BARREL WITH DIAMOND BIT, UNLESS OTHERWISE INDI ATED.

10.0 O ISTURE CONTENT (MC) AS SHOWN ON GRAPH I LOG REPRESENTS THE MOISTURE ONTENT OF MATERIAL ON DATE COLLECTED.

11.0 ELEVATION SURFACE SHOWN ON THE BORINO LOGS IS THE ELEVATION AT THE TI E OF DRI L ING. THE ELEVATION MAY HAVE CHANGED SINCE THAT TI E. THE GROUND SURFACE ELEVATION REPORTED ON THE BORINO LOGS WAS INTERPOLATED TO +/-0.5 FOOT BASED ON THE TOPOGRAPHI MAP AND BORING LOCAT ION PLAN.

12.0 AXI DRY DENSITY AND OPTI O OISTURE WAS OBTAINED OSINO THE MODIFIED PROCTOR METHOD IN ACCORDANCE WITH ASTM D1557.

13.0 ENERAL NOTES 5 AND 6 MAY NOT BE APPLICABLE WHEN EXPLORATION AND TESTING IS PERFORMED BY OTHERS.

ABBREVIATIONS

HSA	HOLLOW STEM AUGER
LL	LIQUID LIMIT
MC	MOISTURE COOTEOT
PI	PLASTICITY INDEX
PL	PLASTIC LIMIT
PP	POCKET PENETROMETER
QU	UNCONFINED COMPRESSIVE STREOGTH PER ASTM D2166
RC	ROCK CORE
RQD	ROCK QUALITY DESIGNATION

TERMS FOR HARDNESS OF BEDROCK

VERY SOFT	AN BE INDENTED EASILY WITH THUMB.
SOFT	AN BE SCRATCHED WITH FINGERNAIL. OOLY EDGES CAN BE BROKEO WITH FINGERS.
ODERATELY HARD	AN BE SCRATCHED EASILY WITH KNIFE. ANNOT BE SCRATCHED WITH FI GERNA I.
HARD	DIFFI LT TO SCRATCH WITH KNIFE. HARD HAMMER BLOW TO BREAK SPECIMEN.
VERY HARD	CAN OT BE SCRATCHED WITH KNIFE. SEVERAL HARD HAMMER BLOWS TO BREAK SPECIMEN.

TERMS FOR THICKNESS OF ROCK BEDDING

PARTING	<0.02'
BAND	0.02'-0.2'
THIN BED	0.2'-0.5'
MEDIUM BED	0.5'-1.0'
THICK BED	1.0'-3.0'
MASSIVE	>3.0'

SOIL DESCRIPTIVE TERMS

SOIL DESCRIPTIVE TERMS	SIZE
BOULDER	>12 INCHES
OBBLE	3 INCHES TO 12 INCHES
OARSE GRAVEL	3/4 INCH TO 3 INCHES
FINE GRAVEL	1/4 INCH TO 3/4 INCH
OARSE SAND	2 TO 1/4 INCH
ED I SAND	0.425 TO 2
FINE SAND	0.075 TO 0.425
TRACE	ESS THAN 5%
FEW	5 TO 10%
ITTLE	15 TO 25%
SOME	30 TO 45%
OSTLY	50 TO 100%

WEATHERING

FRESH WEATHERED	NO VISIBLE SI N OF ROCK MATER IAL WEATHERINO; PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLI HTLY WEATHERED	DISCOLORATION INDI ATES WEATHERINO OF ROOK MATER IAL AND DISCONTINUITY SURFACES. STRENGTH PRESERVED.
MODERATELY WEATHERED	ESS THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED OR DISINTEGRATED. FRESH OR DISCOLORED ROOK IS PRESENT EITHER AS A CONT INUOUS FRAMEWORK OR AS CORE STONES. TEXTORE PRESERVED BUT STRENGTH LESS THAN OWEATHERED R OOK.
HIGHLY WEATHERED	ORE T HAO HALF OF THE ROCK MATER IAOIS DECOMPOSED OR DISINTEGRATED. FRESH OR DISCOLORED ROOK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS CORE STONES. TEXTURE INDISTINCT BUT FABRI PRESERVED. STRENGTH GREATLY REDUCED.
OMPLETELY WEATHERED	ALL ROOK MATER IAOIS DECOMPOSED AND/OR DISINTEGRATED TO SOI . MASS STRUCTURE IS STI LARGELY INTACT.
RESIDUAL SOI	ALL ROOK MATER IAOIS CONVERTED TO SOI . THE MASS STRUCTURE AND MATER IAOFABRI DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOI HAS NOT BEEN SI N IFI ANTLY TRANSPORTED.

CORRELATION OF PENETRATION RESISTANCE (ASTM D 1586) WITH RELATIVE DENSITY AND CONSISTENCY

	PENETRATION RESISTANCE, N60 BLOWS PER FOOT	RELATIVE DENSITY
SANDS AND GRAVELS	0-4	VERY LOOSE
	4-10	LOOSE
	10-30	MED DENSE
	30-50	DENSE
	OVER 50	VERY DENSE

	PENETRATION RESISTANCE, N60 BLOWS PER FOOT	CONSISTENCY
SILTS AND CLAYS	0-2	VERY SOFT
	2-4	SOFT
	4-8	MED STIFF
	8-15	STIFF
	15-30	VERY STIFF
	Over 30	HARD

PLAN NORTH

A1 SOIL AND CK CLASSIFICATION
SCALE: 0"=1" FULL SIZE

US Army Corps of Engineers®

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE
LOUISVILLE, KENTUCKY 40202

MARK	DESCRIPTION	DATE

SIZE: ANSI D

Loveland, OH PAS Study
Loveland, OH

SOIL AND ROCK CLASSIFICATION

SHEET ID

DS: LRL_Screen_FullSize.dscript ID: LRL_pdf.plt

DRILLING LOG

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study, Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 462381.40 E: 1465392.68	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-1	3. DRILLING AGENCY: DLZ	11. DATE BORING: STARTED May 18 2022	COMPLETED May 18 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL: / BEARING:	14. ELEVATION SURFACE	569.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	16.5'	16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK	13.0'	17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING	29.5'	Peyton Linder, Project Engineer	

ELEV	DEPTH	BLOWS/0.5ft	N	N60	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
567.8	1.25				ASPHALT (15")										
566.5	2.50	2 2 2	4	6	CRUSHED STONE; gray, moist, loose, coarse grained	47	SS-1						16		
		2 1 1	2	3	POTENTIAL FILL sampled as LEAN CLAY; brown, moist, medium stiff to soft	80	SS-2								
561.7	7.30	1 3 3	6	9		80	SS-3								Organics (roots) 6.6'-6.8'
		3 4 5	9	13	LEAN CLAY (CL); brown to light brown, moist, stiff	53	SS-4								
		8 5 5	10	14		60	SS-5								
		4 4 6	10	14		53	SS-6				42	22	16	CL	Gravel layer 14.3'-14.4'
552.5	16.50	33 33 33	66	94	SHALE, laminated, gray	93	SS-7								
549.5	19.50				SHALE INTERBEDDED WITH LIMESTONE, argillaceous, moderately weathered to slightly weathered, laminated to thin bedded, gray, soft	82	RC-1								Begin rock coring at 19.5' RQD = 32%
						100	RC-2								RQD = 60%
539.5	29.50				Borehole finished at 29.5										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 564, 559, 554, 549, 544, 539

DRILLING LOG

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1

Field	Value
1. PROJECT	Loveland, OH PAS Study Loveland, OH
10. COORDINATE SYSTEM	NAD 1983 StatePlane Ohio South FIPS 3402 Feet
VERTICAL	NAVD88
LOCATION COORDINATES	N: 462383.56 E: 1465394.14
LOCATION METHOD:	Handheld GPS
2. HOLE NUMBER	B-1A
3. DRILLING AGENCY	DLZ
11. DATE BORING	STARTED: May 19 2022; COMPLETED: May 19 2022
4. NAME OF DRILLER	Keith Conrad
12. HAMMER TYPE	Automatic, 30" drop, 140 lb
EFFICIENCY (%)	85.6
5. EQUIPMENT	CME 75
13. SIZE AND TYPE OF BIT	3.25" HSA
6. DIRECTION OF BORING	Vertical
DEG FROM VERTICAL	
BEARING	
14. ELEVATION SURFACE	569.0'
15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	13.9'
16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK	
17. SIGNATURE AND TITLE OF INSPECTOR	Peyton Linder, Project Engineer
9. TOTAL DEPTH OF BORING	13.9'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
567.8	1.25		ASPHALT (15")										
566.5	2.50		CRUSHED STONE; gray, moist, coarse grained										
			FILL sampled as SANDY LEAN CLAY; brown, moist	80	ST-1						27		
562.0	7.00			95	ST-2	3	34	63	32	11	26	CL	
560.0	9.00		LEAN CLAY CL); brown, moist	65	ST-3				37	15	24	CL	
			FAT CLAY (CH); brown, moist	70	ST-4	2	6	93	54	32	24	CH	
				100	ST-5						23		Sampler refused at 12.0'
555.1	13.90			100	ST-6								Sampler refused at 13.9'
			Borehole finished at 13.9										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 564, 559, 554, 549, 544, 539

DRILLING LOG

Field	Value
DIVISION	Great Lakes and Ohio River
INSTALLATION	
	Sheet 1 of 1
1. PROJECT	Loveland, OH PAS Study Loveland, OH
10. COORDINATE SYSTEM	NAD 1983 StatePlane Ohio South FIPS 3402 Feet
VERTICAL	NAVD88
LOCATION COORDINATES	N: 462402.92 E: 1465428.51
LOCATION METHOD:	Handheld GPS
2. HOLE NUMBER	B-2
3. DRILLING AGENCY	DLZ
11. DATE BORING	STARTED May 18 2022; COMPLETED May 18 2022
4. NAME OF DRILLER	Keith Conrad
12. HAMMER TYPE	Automatic, 30" drop, 140 lb
EFFICIENCY (%)	85.6
5. EQUIPMENT	CME 75
13. SIZE AND TYPE OF BIT	3.25" HSA
6. DIRECTION OF BORING	Vertical
DEG FROM VERTICAL	
BEARING	
14. ELEVATION SURFACE	569.0'
15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	16.7'
16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK	13.3'
17. SIGNATURE AND TITLE OF INSPECTOR	Peyton Linder, Project Engineer
9. TOTAL DEPTH OF BORING	30.0'

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
567.7	1.33					ASPHALT (16")										
566.6	2.40	19, 2, 2	4	6		CRUSHED STONE; gray, moist, loose, coarse grained FILL sampled as SANDY LEAN CLAY; brown, moist, medium stiff to soft	87	SS-1								Bulk sample obtained 2.5'-6.0' Gravel = 3% Sand = 42% Fines = 55% LL = 29% PI = 14% MC = 23% ASTM Class = CL
		2, 1, 1	2	3			33	SS-2								
562.5	6.50	1, 2, 2	4	6		FAT CLAY (CH); brown, moist, medium stiff to stiff	80	SS-3								Organics (roots) 6.8'-7.0'
		7, 5, 4	9	13			93	SS-4								Gravel layer 9.4'-9.5' Perched water within gravel layer
		4, 4, 6	10	14			13	SS-5								
554.6	14.40	5, 5, 31	36	51		FAT CLAY (CH); brown, moist, hard, some sand, trace gravel	100	SS-6						21		
552.3	16.70	10, 21, 18	39	56		SHALE, laminated, gray	73	SS-7								
549.5	19.50					SHALE INTERBEDDED WITH LIMESTONE, argillaceous, moderately weathered to slightly weathered, laminated to thin bedded, gray, soft	100	RC-1								Begin rock coring at 19.5' RQD = 55%
							60	RC-2								RQD = 23%
539.0	30.00					Borehole finished at 30.0										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 564, 559, 554, 549, 544, 539

DRILLING LOG	DIVISION Great Lakes and Ohio River	INSTALLATION	Sheet 1 of 1

1. PROJECT Loveland, OH PAS Study Loveland, OH		10. COORDINATE SYSTEM NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL NAVD88
		LOCATION COORDINATES N: 462399.05 E: 1465421.35	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER B-2A	3. DRILLING AGENCY DLZ	11. DATE BORING STARTED May 19 2022	COMPLETED May 19 2022
4. NAME OF DRILLER Keith Conrad		12. HAMMER TYPE Automatic, 30" drop, 140 lb	EFFICIENCY (%) 85.6
5. EQUIPMENT CME 75		13. SIZE AND TYPE OF BIT 3.25" HSA	
6. DIRECTION OF BORING Vertical	DEG FROM VERTICAL / BEARING	14. ELEVATION SURFACE	569.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	13.0'	16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK		17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING	13.0'	Peyton Linder, Project Engineer	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
567.7	1.33		ASPHALT (16")										
566.5	2.50		CRUSHED STONE; gray, moist, coarse grained										
			FILL sampled as SANDY LEAN CLAY; brown, moist	65	ST-1	0	36	64	29	12	20	CL	
564.0	5.00		LEAN CLAY CL); brown, moist	70	ST-2	0	10	90	31	14	26	CL	
				60	ST-3						24		
559.0	10.00			90	ST-4						26		Sampler refused at 10.0'
			LEAN CLAY WITH SAND (CL); brown, moist	70	ST-5	4	14	83	44	22	23	CL	
556.0	13.00		Borehole finished at 13.0										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 564, 559, 554, 549, 544, 539

DRILLING LOG

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study, Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 462705.61 E: 1465892.99	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-3	3. DRILLING AGENCY: DLZ	11. DATE BORING — STARTED: May 16 2022	COMPLETED: May 17 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL: / BEARING:	14. ELEVATION SURFACE: 566.0'	
		15. ELEVATION GROUND WATER: 557.0'	
7. THICKNESS OF OVERBURDEN: 14.3'		16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK: 11.4		17. SIGNATURE AND TITLE OF INSPECTOR: Peyton Linder, Project Engineer	
9. TOTAL DEPTH OF BORING: 25.7'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
						ASPHALT (12")										
565.0	1.00					CRUSHED STONE										
564.5	1.50	50	50/2"	143		FILL sampled as POORLY GRADED GRAVEL; gray to brown, moist, very dense, coarse grained	100	SS-1								
		50	50/2"	143			100	SS-2								
		50	50/2"	143			100	SS-3								
556.6	9.40	5, 3, 5	8	11		GRAVELLY LEAN CLAY (CL); brown to gray, wet, stiff	33	SS-4								
551.7	14.30	10, 20, 50	50/2"	143		SHALE, laminated, gray	100	SS-5								
		25, 50	50/2"	143			100	SS-6								
545.3	20.70					SHALE, argillaceous, moderately weathered, laminated, gray, very soft to soft	76	RC-1								Begin rock coring at 20.7' RQD = 76%
540.3	25.70					Borehole finished at 25.7										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 561, 556, 551, 546, 541, 536

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1

1. PROJECT: Loveland, OH PAS Study, Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 462671.17 E: 1465847.56	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-3 Offset	3. DRILLING AGENCY: DLZ	11. DATE BORING: STARTED May 26 2022	COMPLETED May 26 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL: / BEARING:	14. ELEVATION SURFACE	567.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	14.5'	16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK	0.8'	17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING	15.3'	Jacob Cowan, Project Engineer	

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
566.3	0.75					ASPHALT (9")										
565.8	1.25					CRUSHED STONE										
		6 4 4	8	11		FILL sampled as SANDY LEAN CLAY; dark brown, moist, stiff to medium stiff	7	SS-1								
		6 2 2	4	6			73	SS-2	3	46	51	24	11	14	CL	Glass debris 4.0'-4.2'
560.5	6.50	2 5 5	10	14		LEAN CLAY (CL); grayish brown, moist, stiff	80	SS-3				43	22	25	CL	
559.0	8.00	3 5 5	10	14		FAT CLAY (CH); grayish brown with gray mottle, moist, stiff	60	SS-4				56	35	23	CH	
555.5	11.50	5 6 8	14	20		FAT CLAY WITH GRAVEL (CH); grayish brown with gray mottle, moist, very stiff	67	SS-5	12	11	77	52	38	21	CH	
552.5	14.50	2 3 50	50/4"	143		SHALE, laminated, gray, soft	100	SS-6						5		
551.7	15.30					Borehole finished at 15.3										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 562, 557, 552, 547, 542, 537

DRILLING LOG

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 462731.18 E: 1465926.63	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-3A	3. DRILLING AGENCY: DLZ	11. DATE BORING: STARTED May 19 2022	COMPLETED May 19 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL: / BEARING:	14. ELEVATION SURFACE: 566.0'	
7. THICKNESS OF OVERBURDEN: 5.0'		15. ELEVATION GROUND WATER:	
8. DEPTH DRILLED INTO ROCK:		16. TOTAL NUMBER CORE BOXES:	
9. TOTAL DEPTH OF BORING: 5.0'		17. SIGNATURE AND TITLE OF INSPECTOR: Peyton Linder, Project Engineer	

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
565.0	1.00					ASPHALT (12")										
		3 4 5	9	13		FILL sampled as POORLY GRADED GRAVEL; gray, moist, medium dense, coarse grained	13	SS-1								
561.0	5.00					Borehole finished at 5.0										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 561, 556, 551, 546, 541, 536

DRILLING LOG

DRILLING LOG	DIVISION Great Lakes and Ohio River	INSTALLATION	Sheet 1 of 1
1. PROJECT Loveland, OH PAS Study Loveland, OH		10. COORDINATE SYSTEM NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL NAVD88
		LOCATION COORDINATES N: 462762.79 E: 1465968.03	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER B-3B	3. DRILLING AGENCY DLZ	11. DATE BORING STARTED May 19 2022	COMPLETED May 19 2022
4. NAME OF DRILLER Keith Conrad		12. HAMMER TYPE Automatic, 30" drop, 140 lb	EFFICIENCY (%) 85.6
5. EQUIPMENT CME 75		13. SIZE AND TYPE OF BIT 3.25" HSA	
6. DIRECTION OF BORING Vertical	DEG FROM VERTICAL / BEARING	14. ELEVATION SURFACE	566.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	5.0'	16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK		17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING	5.0'	Peyton Linder, Project Engineer	

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
565.0	1.00					ASPHALT (12")										
		16 35 50	50/2"	143		FILL sampled as POORLY GRADED GRAVEL; gray, moist, very dense, coarse grained	58	SS-1								
561.0	5.00					Borehole finished at 5.0										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 561, 556, 551, 546, 541, 536

DRILLING LOG

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION	Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study, Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 462742.56 E: 1465922.04	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-4	3. DRILLING AGENCY: DLZ	11. DATE BORING: STARTED May 16 2022	COMPLETED May 16 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL / BEARING	14. ELEVATION SURFACE	567.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN	14.0'	16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK	10.7'	17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING	24.7'	Peyton Linder, Project Engineer	

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
566.2	0.83					ASPHALT (10")										
565.5	1.50					CRUSHED STONE										
		7 / 14 / 17	31	44		FILL sampled as SILTY CLAY; brown, moist, hard	60	SS-1				21	7		CL-ML	Bulk sample obtained 1.5'-4.0'
563.0	4.00															
		1 / 1 / 3	4	6		FAT CLAY (CH); reddish brown to gray, moist, medium stiff to stiff	53	SS-2	0	3	97	59	33	29	CH	
		5 / 3 / 5	8	11			60	SS-3				52	35	23	CH	Gravel layer 6.5'-6.8'
558.0	9.00															
		4 / 6 / 5	11	16		LEAN CLAY (CL); brown to gray, moist, very stiff	47	SS-4	1	10	89	46	26	21	CL	
553.0	14.00															
		25 / 23 / 30	53	76		SHALE, laminated, gray	87	SS-5								
547.3	19.70	24 / 50	50/2"	143			100	SS-6								Begin rock coring at 19.7'
						SHALE, argillaceous, moderately weathered, laminated to thin bedded, gray, soft	100	RC-1								RQD = 60%
542.3	24.70					Borehole finished at 24.7										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 562, 557, 552, 547, 542, 537

DRILLING LOG

DIVISION	Great Lakes and Ohio River
INSTALLATION	
Sheet 1 of 1	
1. PROJECT	Loveland, OH PAS Study Loveland, OH
2. HOLE NUMBER	B-4 Offset
3. DRILLING AGENCY	DLZ
4. NAME OF DRILLER	Keith Conrad
5. EQUIPMENT	CME 75
6. DIRECTION OF BORING	Vertical
DEG FROM VERTICAL	
BEARING	
7. THICKNESS OF OVERBURDEN	14.0'
8. DEPTH DRILLED INTO ROCK	0.9'
9. TOTAL DEPTH OF BORING	14.9'
10. COORDINATE SYSTEM	NAD 1983 StatePlane Ohio South FIPS 3402 Feet
VERTICAL	NAVD88
LOCATION COORDINATES	N: 462690.06 E: 1465850.20
LOCATION METHOD:	Handheld GPS
11. DATE BORING STARTED	May 26 2022
COMPLETED	May 26 2022
12. HAMMER TYPE	Automatic, 30" drop, 140 lb
EFFICIENCY (%)	85.6
13. SIZE AND TYPE OF BIT	3.25" HSA
14. ELEVATION SURFACE	567.0'
15. ELEVATION GROUND WATER	
16. TOTAL NUMBER CORE BOXES	
17. SIGNATURE AND TITLE OF INSPECTOR	Jacob Cowan, Project Engineer

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
566.3	0.75					ASPHALT (9")										
						CRUSHED STONE										
564.2	2.83	18 8 3	11	16			60	SS-1						7		
563.0	4.00					LEAN CLAY (CL); brown, moist, very stiff, trace gravel										
		3 3 12	15	21		LEAN CLAY (CL); dark gray, moist, very stiff to stiff, trace gravel	67	SS-2						28		
		3 3 5	8	11			73	SS-3						25		
556.8	10.20	3 3 3	6	9			40	SS-4						29		
						FAT CLAY (CH); grayish brown with gray mottle, moist, stiff, trace gravel										
		4 3 4	7	10			67	SS-5						18		
553.0	14.00	18 50	50/2"	143		SHALE, argillaceous, laminated, gray, soft	100	SS-6						7		
552.1	14.90					Borehole finished at 14.9										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 562, 557, 552, 547, 542, 537

DRILLING LOG

DILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION	Sheet 1 of 1

1. PROJECT: Loveland, OH PAS Study, Loveland, OH
10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet — VERTICAL: NAVD88
LOCATION COORDINATES: N: 462776.02 E: 1465962.06 — LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-4A
3. DRILLING AGENCY: DLZ
11. DATE BORING: STARTED May 19 2022 — COMPLETED May 19 2022
4. NAME OF DRILLER: Keith Conrad
12. HAMMER TYPE: Automatic, 30" drop, 140 lb — EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75
13. SIZE AND TYPE OF BIT: 3.25" HSA
6. DIRECTION OF BORING: Vertical — DEG FROM VERTICAL: — BEARING:
14. ELEVATION SURFACE: 566.0'
15. ELEVATION GROUND WATER:
7. THICKNESS OF OVERBURDEN: 11.0
16. TOTAL NUMBER CORE BOXES:
8. DEPTH DRILLED INTO ROCK:
17. SIGNATURE AND TITLE OF INSPECTOR: Peyton Linder, Project Engineer
9. TOTAL DEPTH OF BORING: 11.0

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
565.0	1.00		ASPHALT (12")										
			FILL sampled as POORLY GRADED GRAVEL; gray, moist, coarse grained										
				0	ST-1								Immediate sampler refusal at 3.0'
561.0	5.00												
			LEAN CLAY WITH SAND (CL); brown, moist	50	ST-2	4	16	80	45	26	22	CL	
				45	ST-3						27		
557.0	9.00												
			LEAN CLAY CL); brown, moist	65	ST-4	0	8	92	48	21	20	CL	
555.5	10.50												
555.0	11.00		SHALE, gray										
			Borehole finished at 11.0										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

561
556
551
546
541
536

DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION:	Sheet 1 of 1

1. PROJECT: Loveland, OH PAS Study, Loveland, OH	10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet; VERTICAL: NAVD88
	LOCATION COORDINATES: N: 464079.48 E: 1467500.53; LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-5; 3. DRILLING AGENCY: DLZ	11. DATE BORING: STARTED May 17 2022; COMPLETED May 17 2022
4. NAME OF DRILLER: Keith Conrad	12. HAMMER TYPE: Automatic, 30" drop, 140 lb; EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75	13. SIZE AND TYPE OF BIT: 3.25" HSA
6. DIRECTION OF BORING: Vertical; DEG FROM VERTICAL: ; BEARING:	14. ELEVATION SURFACE: 575.0'
	15. ELEVATION GROUND WATER:
7. THICKNESS OF OVERBURDEN: 14.0'	16. TOTAL NUMBER CORE BOXES:
8. DEPTH DRILLED INTO ROCK: 12.8'	17. SIGNATURE AND TITLE OF INSPECTOR:
9. TOTAL DEPTH OF BORING: 26.8'	Peyton Linder, Project Engineer

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
574.3	0.75					ASPHALT (9")										
572.7	2.30	4 4 4	8	11		FILL sampled as CLAYEY SAND; gray, moist, medium dense, fine to medium grained	67	SS-1	4	48	48	23	11	14	SC	
568.5	6.50	2 2 2	4	6		FILL sampled as SANDY LEAN CLAY; brown, moist, stiff to medium stiff	53	SS-2	0	45	55	23	10	18	CL	
566.0	9.00	3 2 4	6	9		CLAYEY SAND (SC); brown to gray, moist, loose, fine to medium grained, poorly graded	93	SS-3	0	65	35	30	11	16	SC	
561.0	14.00	12 14 8	22	31		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM); brown to gray, wet, dense, fine to medium grained, poorly graded	73	SS-4	38	44	19	20	4		SC-SM	
559.5	15.50	9 27 40	67	96		SHALE, laminated, gray	87	SS-5								Begin rock coring at 15.5'
554.5	20.50					SHALE INTERBEDDED WITH LIMESTONE, argillaceous, weathered, laminated to thin bedded, gray to bluish gray, very soft	76	RC-1								RQD = 0%
548.2	26.80					SHALE, argillaceous, moderately weathered, laminated to thin bedded, gray, very soft to soft	100	RC-2								RQD = 57%
						Borehole finished at 26.8										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

Elevation scale: 570, 565, 560, 555, 550, 545

DRILLING LOG

DIVISION: Great Lakes and Ohio River	INSTALLATION:		Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study Loveland, OH	10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet		VERTICAL: NAVD88
	LOCATION COORDINATES: N: 464099.61 E: 1467514.23		LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-6 / 3. DRILLING AGENCY: DLZ	11. DATE BORING	STARTED: May 17 2022	COMPLETED: May 17 2022
4. NAME OF DRILLER: Keith Conrad	12. HAMMER TYPE: Automatic, 30" drop, 140 lb		EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75	13. SIZE AND TYPE OF BIT: 3.25" HSA		
6. DIRECTION OF BORING: Vertical / DEG FROM VERTICAL: / BEARING:	14. ELEVATION SURFACE: 575.0'		
	15. ELEVATION GROUND WATER:		
7. THICKNESS OF OVERBURDEN: 14.0'	16. TOTAL NUMBER CORE BOXES:		
8. DEPTH DRILLED INTO ROCK: 11.8	17. SIGNATURE AND TITLE OF INSPECTOR:		
9. TOTAL DEPTH OF BORING: 25.8'	Peyton Linder, Project Engineer		

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
574.3	0.75					ASPHALT (9")										
						CRUSHED STONE; gray, moist, medium dense, coarse grained										
572.7	2.30	10 3 4	7	10			80	SS-1						15		
						SILTY, CLAYEY SAND (SC-SM); brown, moist, medium dense, fine to medium grained										Bulk sample obtained 3.0'-6.0' Gravel = 7% Sand = 43% Fines = 50% LL = 20% PI = 6% MC = 16% ASTM CLASS = SC-SM
		3 3 4	7	10			47	SS-2						18		
568.5	6.50					LEAN CLAY WITH SAND (CL); brown, moist, stiff										
		2 2 5	7	10			73	SS-3						18		
566.0	9.00					SILTY SAND WITH GRAVEL (SM); brown to gray, moist, dense, fine to medium grained										
		5 16 14	30	43			67	SS-4								
561.0	14.00	12 38 49	87	124		SHALE, laminated, gray	80	SS-5								
559.5	15.50					SHALE, argillaceous, weathered, laminated, gray, soft										Begin rock coring at 15.5'
							100	RC-1								RQD = 55%
							72	RC-2								RQD = 36%
549.2	25.80					Borehole finished at 25.8										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

DRILLING LOG

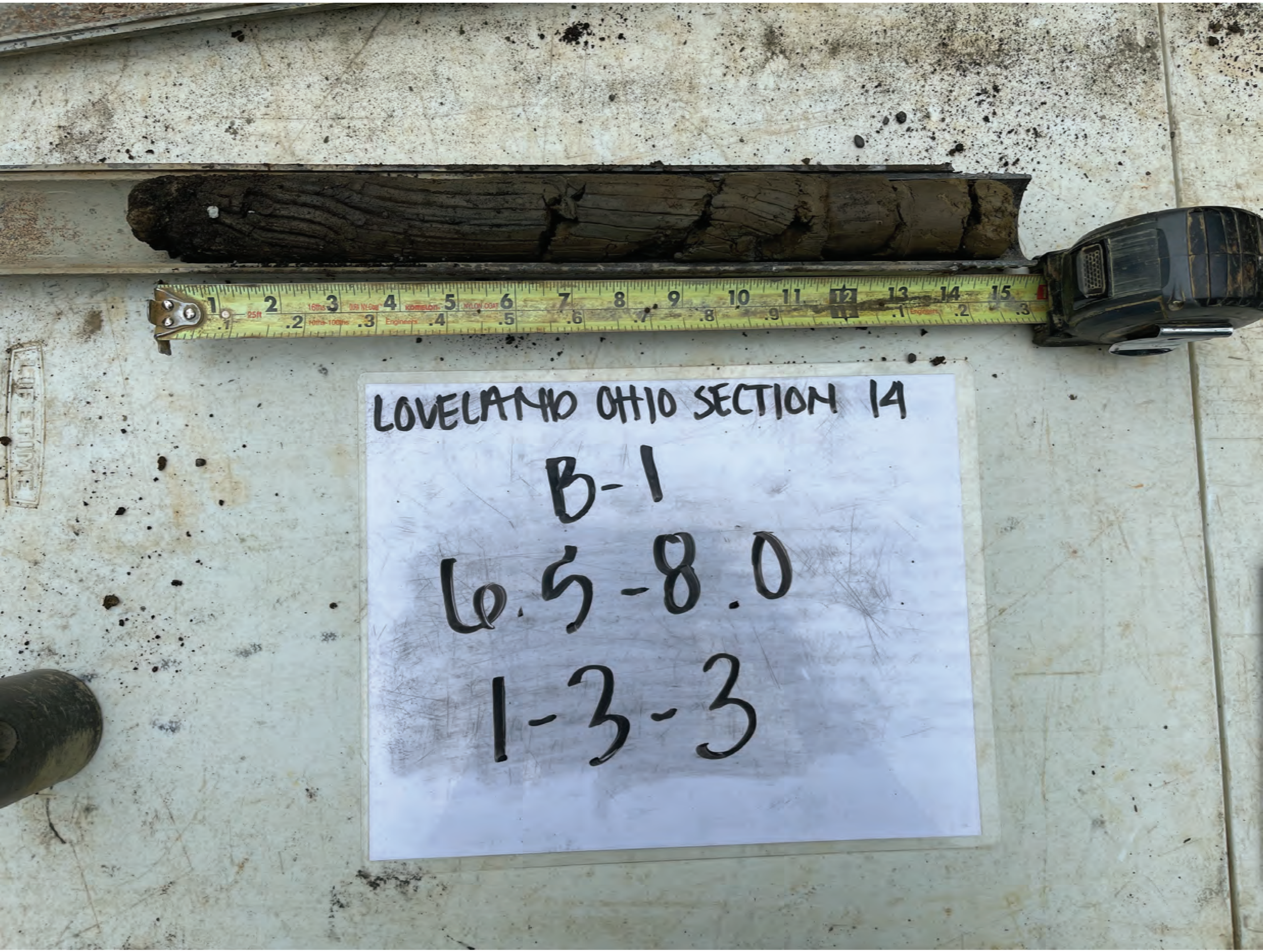
DRILLING LOG	DIVISION: Great Lakes and Ohio River	INSTALLATION	Sheet 1 of 1
1. PROJECT: Loveland, OH PAS Study, Loveland, OH		10. COORDINATE SYSTEM: NAD 1983 StatePlane Ohio South FIPS 3402 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 464137.38 E: 1467482.69	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: B-6 Offset	3. DRILLING AGENCY: DLZ	11. DATE BORING — STARTED: May 26 2022	COMPLETED: May 26 2022
4. NAME OF DRILLER: Keith Conrad		12. HAMMER TYPE: Automatic, 30" drop, 140 lb	EFFICIENCY (%): 85.6
5. EQUIPMENT: CME 75		13. SIZE AND TYPE OF BIT: 3.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING:	14. ELEVATION SURFACE: 577.0'
		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN: 14.0'		16. TOTAL NUMBER CORE BOXES	
8. DEPTH DRILLED INTO ROCK: 2.1'		17. SIGNATURE AND TITLE OF INSPECTOR	
9. TOTAL DEPTH OF BORING: 16.1'		Jacob Cowan, Project Engineer	

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS Description)	% REC	Samp No.	Gravel	Sand	Fines	LL	PI	MC	ASTM Class	REMARKS
576.3	0.67					CRUSHED STONE										
		6 6 4	10	14		GRAVELLY LEAN CLAY (CL); dark gray, moist, stiff	0	SS-1								
573.0	4.00	5 4 4	8	11		LEAN CLAY (CL); dark brown, moist, stiff	100	SS-2				23	12	11	CL	
572.0	5.00	3 10 10	20	29		POORLY GRADED GRAVEL WITH SAND (GP); grayish brown to gray, moist, medium dense, coarse grained	67	SS-3						4		
568.0	9.00	18 23 50	50/2"	143		CLAYEY SAND WITH GRAVEL (SC); grayish brown to gray, moist, very dense, fine to medium grained, poorly graded	100	SS-4	39	48	13			4		
		24 26 21	47	67			0	SS-5								
563.0	14.00	11 21 31	52	74		SHALE, argillaceous, laminated, gray, soft	87	SS-6						12		
560.9	16.10					Borehole finished at 16.1										Ground surface elevation estimated to +/- 2.0' based on information obtained from Google Earth Pro

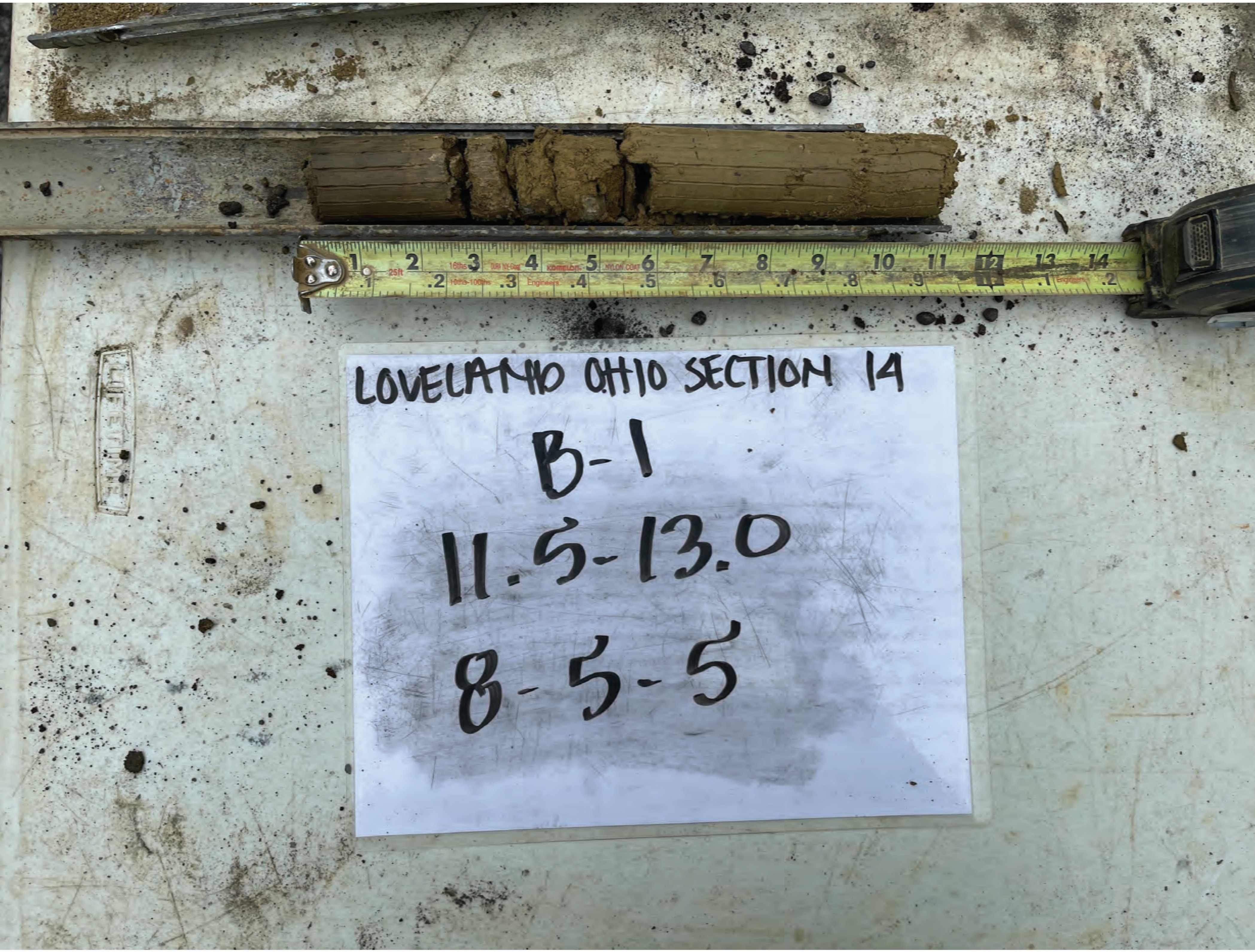
Elevation scale: 572, 567, 562, 557, 552, 547

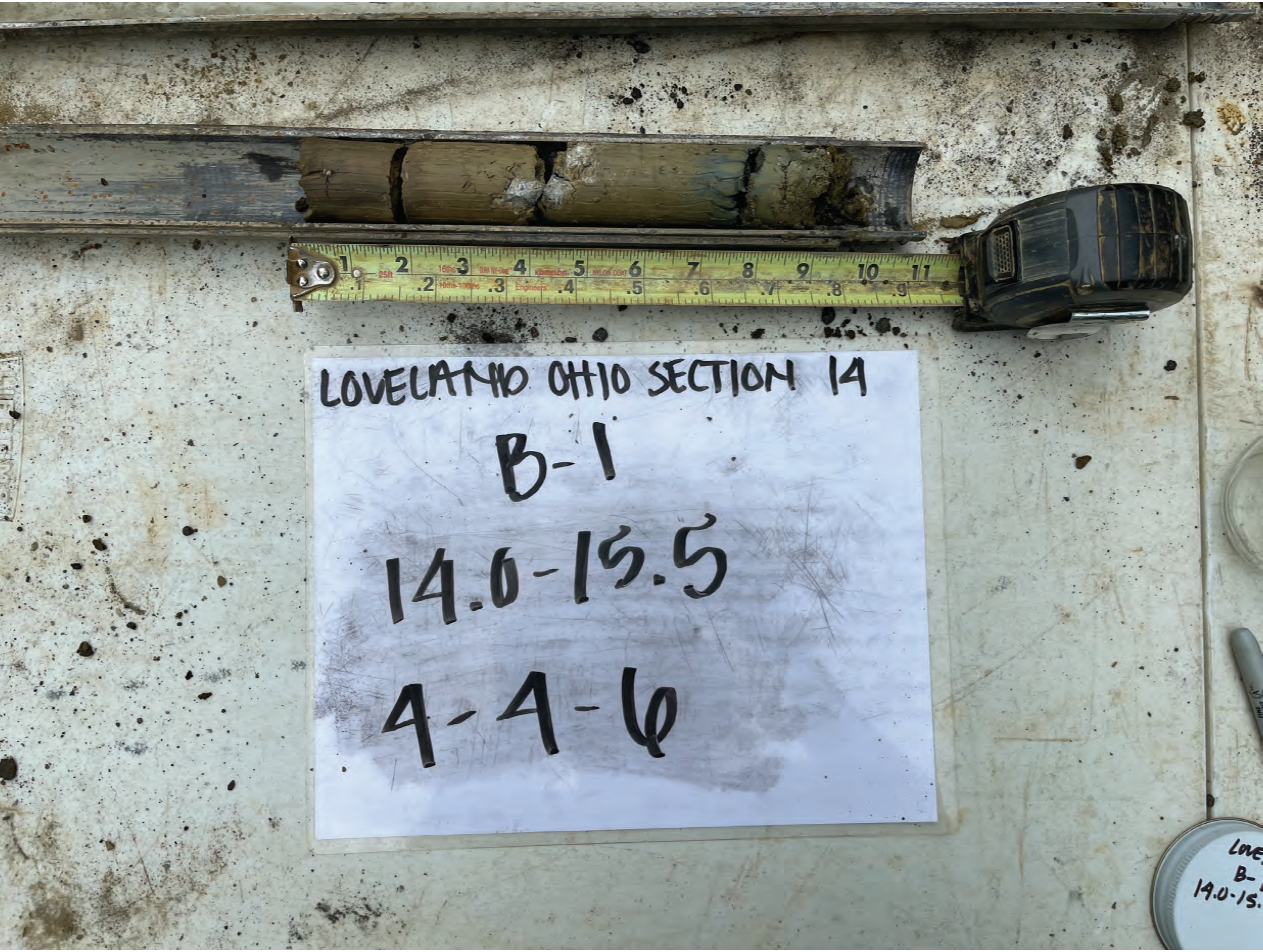

LOVELAND OHIO SECTION 14
B-1
1.5-3.0
2-2-2


LOVELAND OHIO SECTION 14
B-1
4.0-5.5
2-1-1


LOVELAND OHIO SECTION 14
B-1
6.5-8.0
1-3-3


LOVELAND OHIO SECTION 14
B-1
9.0-10.5
3-4-5

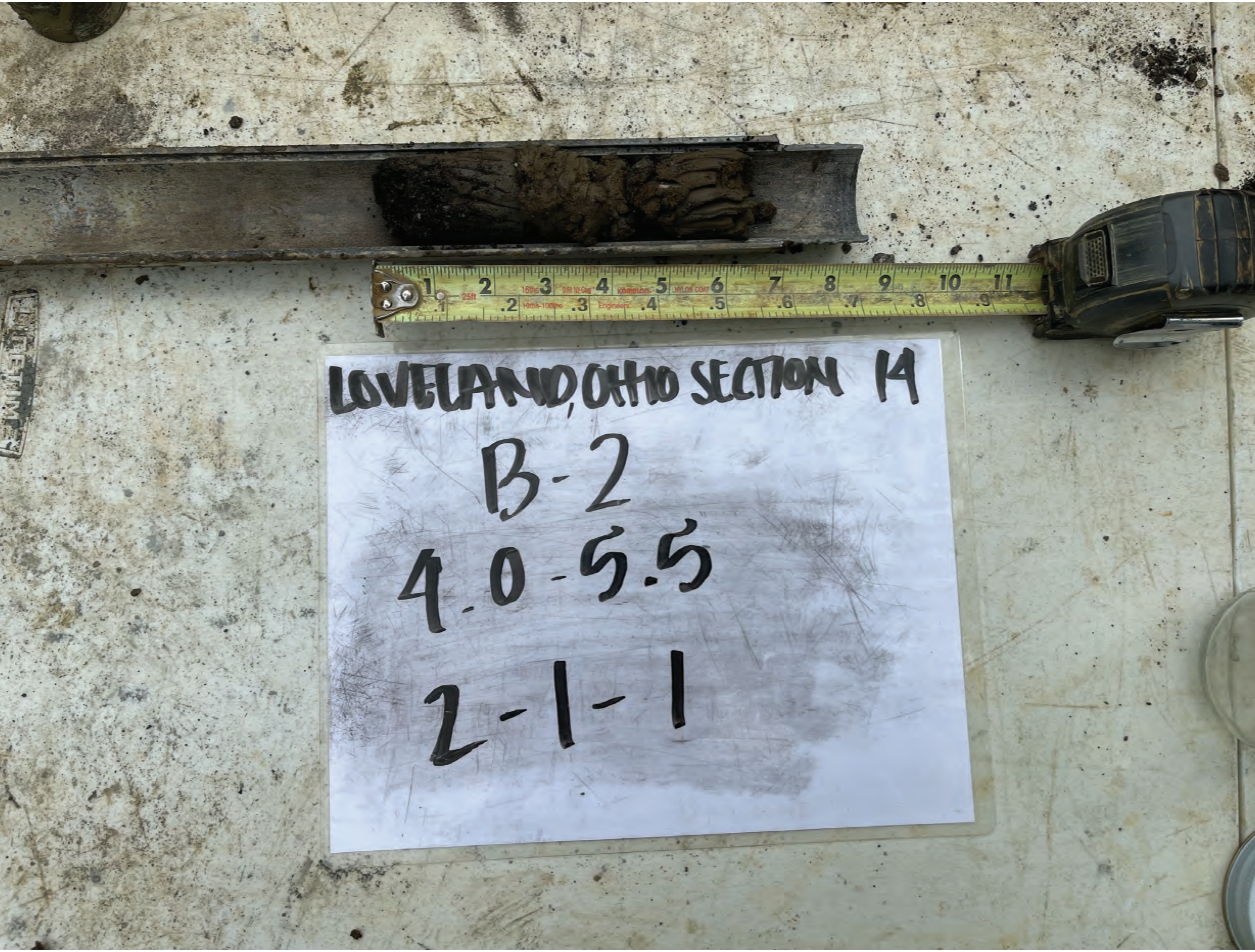

LOVELAND OHIO SECTION 14
B-1
11.5-13.0
8-5-5

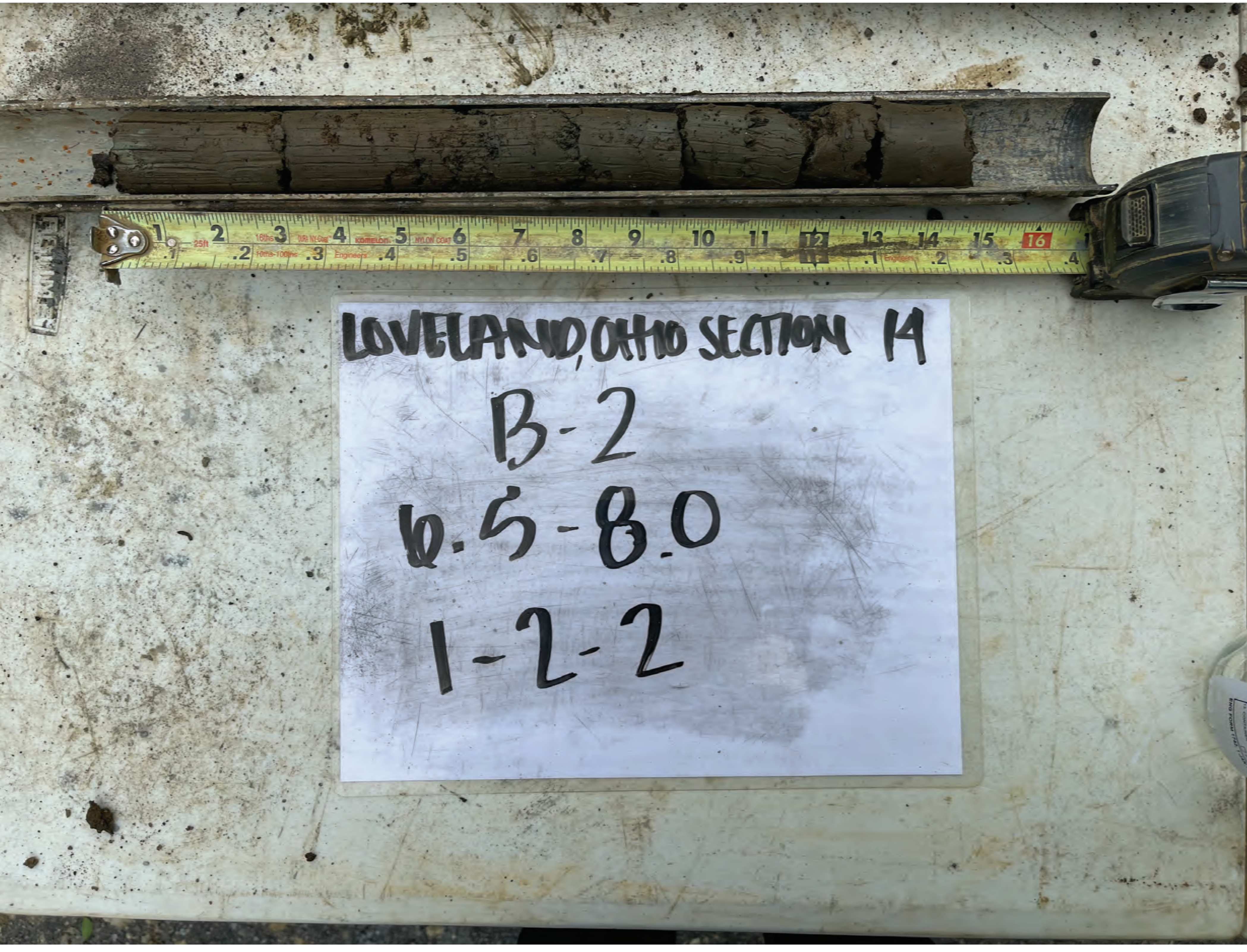

LOVELAND OHIO SECTION 14
B-1
14.0-15.5
4-4-6

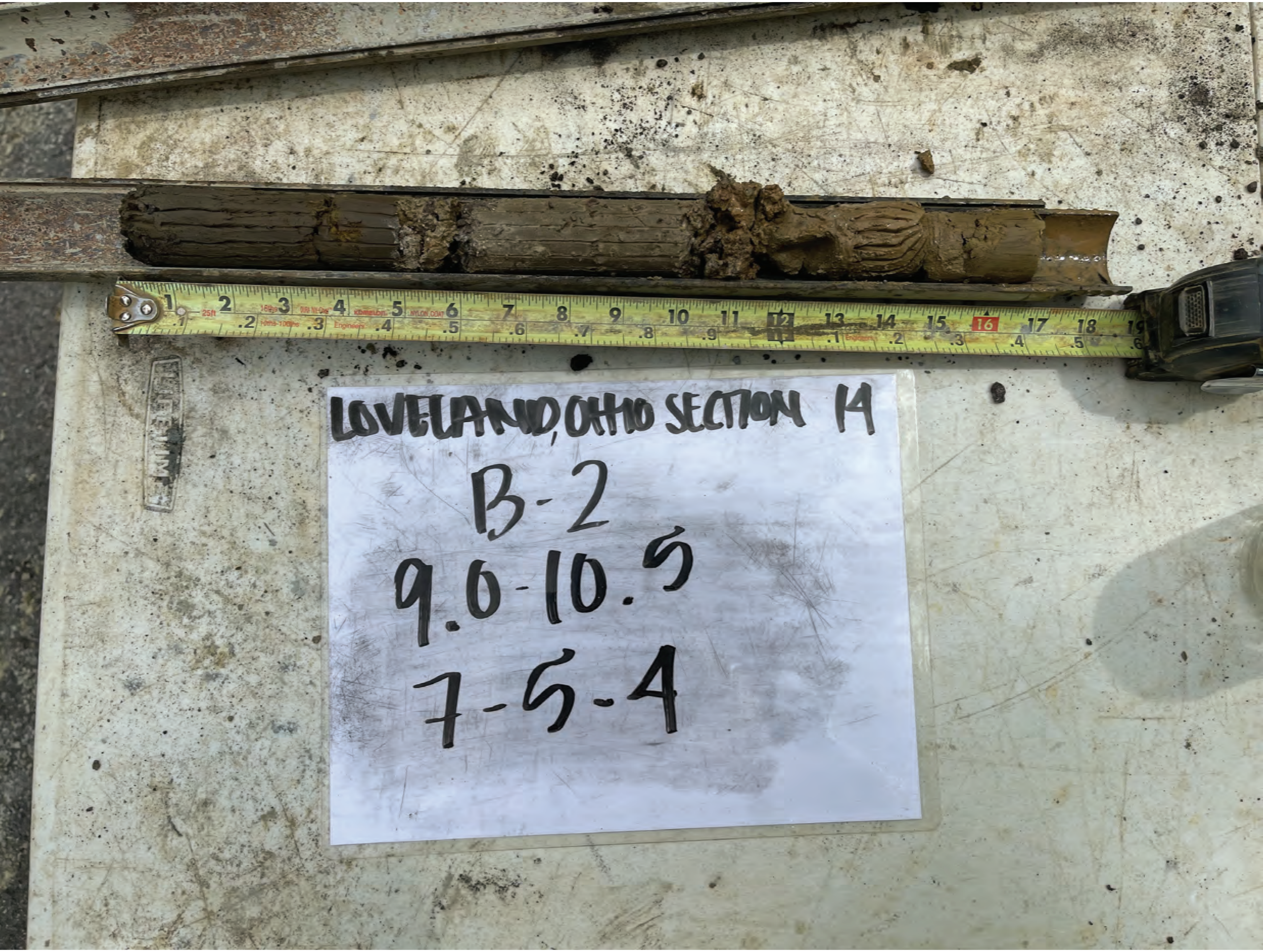

LOVELAND OHIO SECTION 14
B-1
16.5-18.0
33.33.33

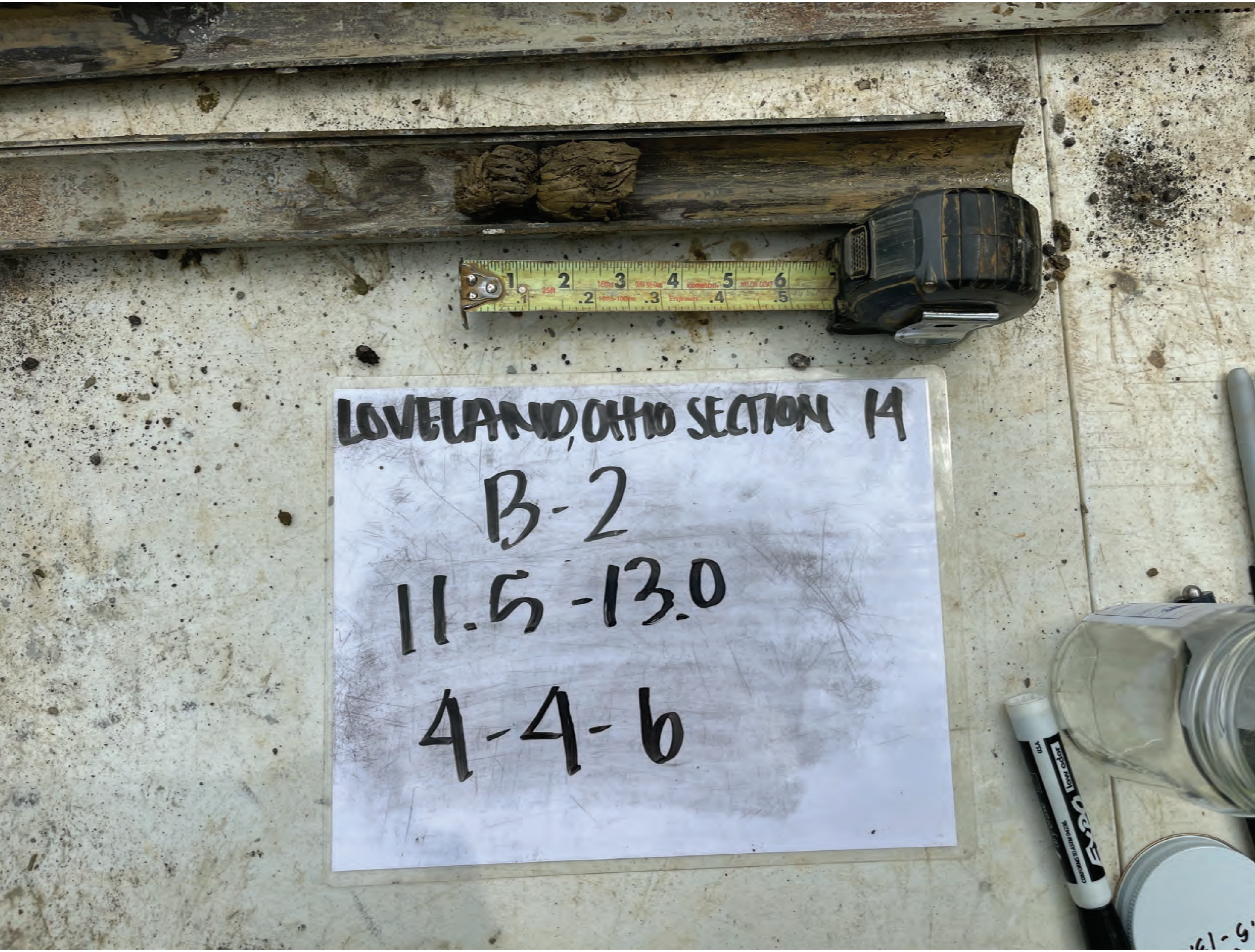
27.5
25.0
22.0'
19.5
LOVELAND OHIO SECTION 14
HOLE: B-1
BOX: 1 of 1
DEPTH: 19.5'-29.5'
24.5
29.5
27.5
25.0
22.0'

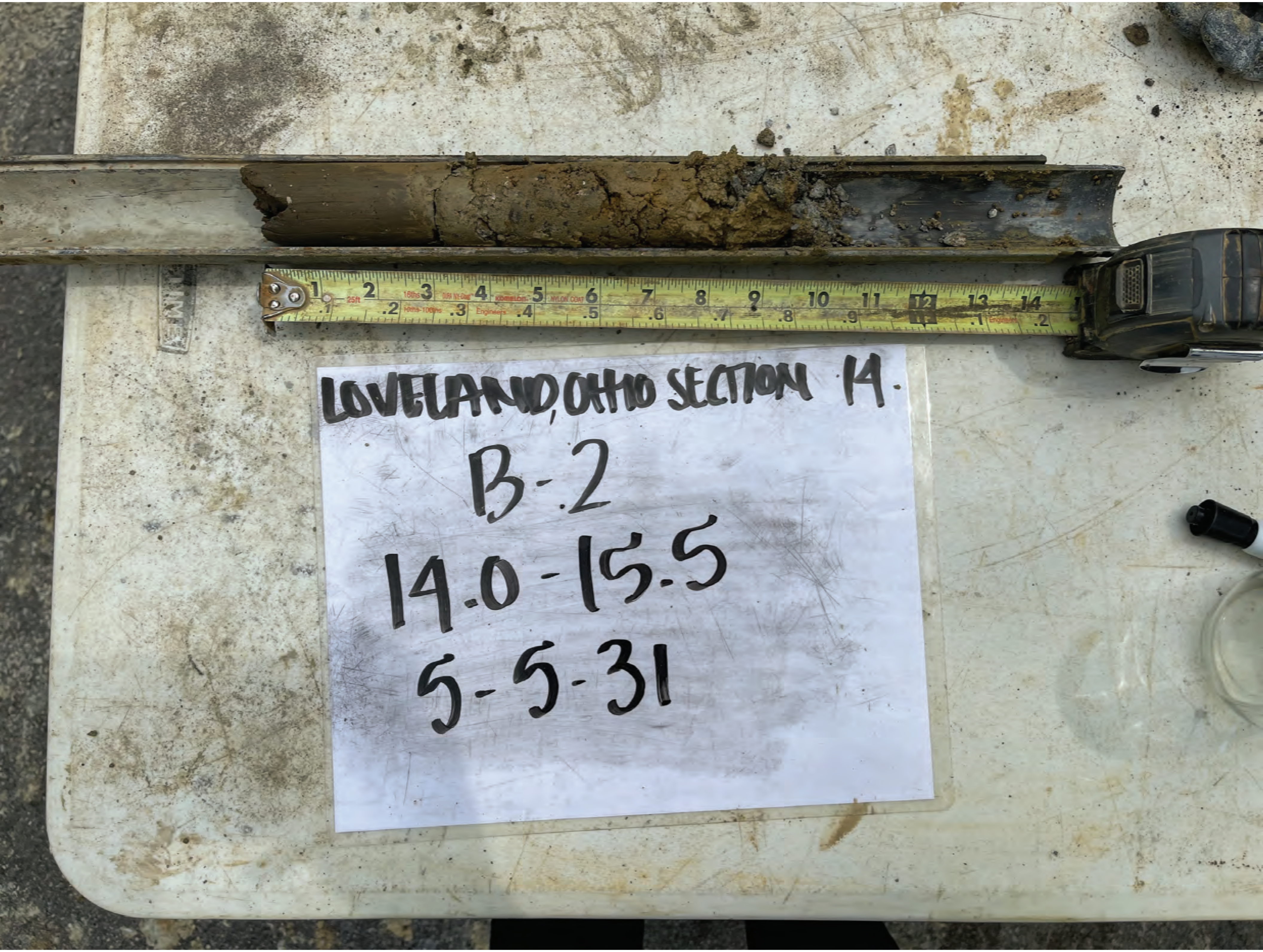
LOVELAND, OHIO SECTION 14
B-2
1.5-3.0
19-2-2
LOVELAND
B-2
1.5-3.0

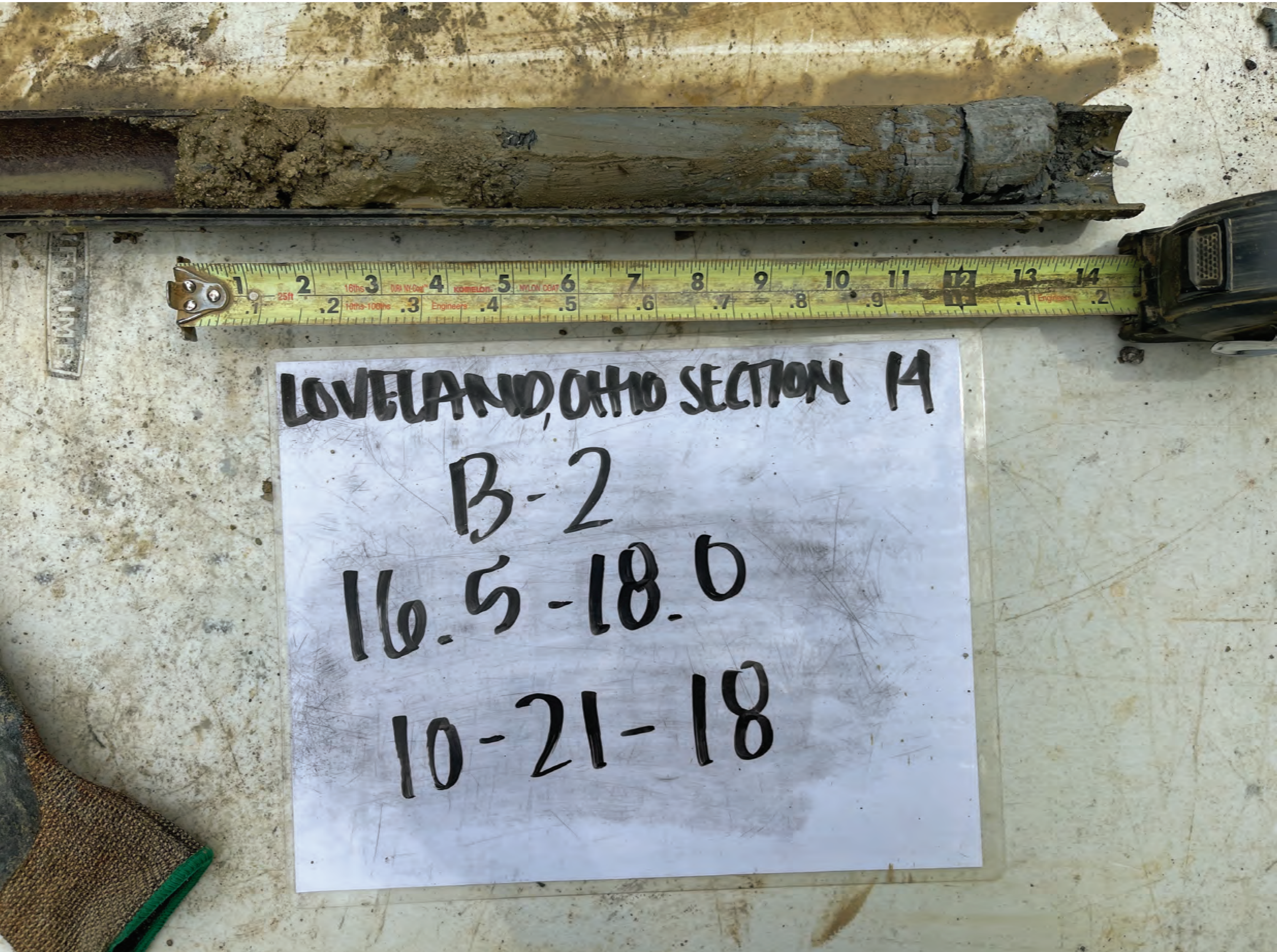

LOVELAND, OHIO SECTION 14
B-2
4.0-5.5
2-1-1


LOVELAND, OHIO SECTION 14
B-2
6.5-8.0
1-2-2


LOVELAND, OHIO SECTION 14
B-2
9.0-10.5
7-5-4

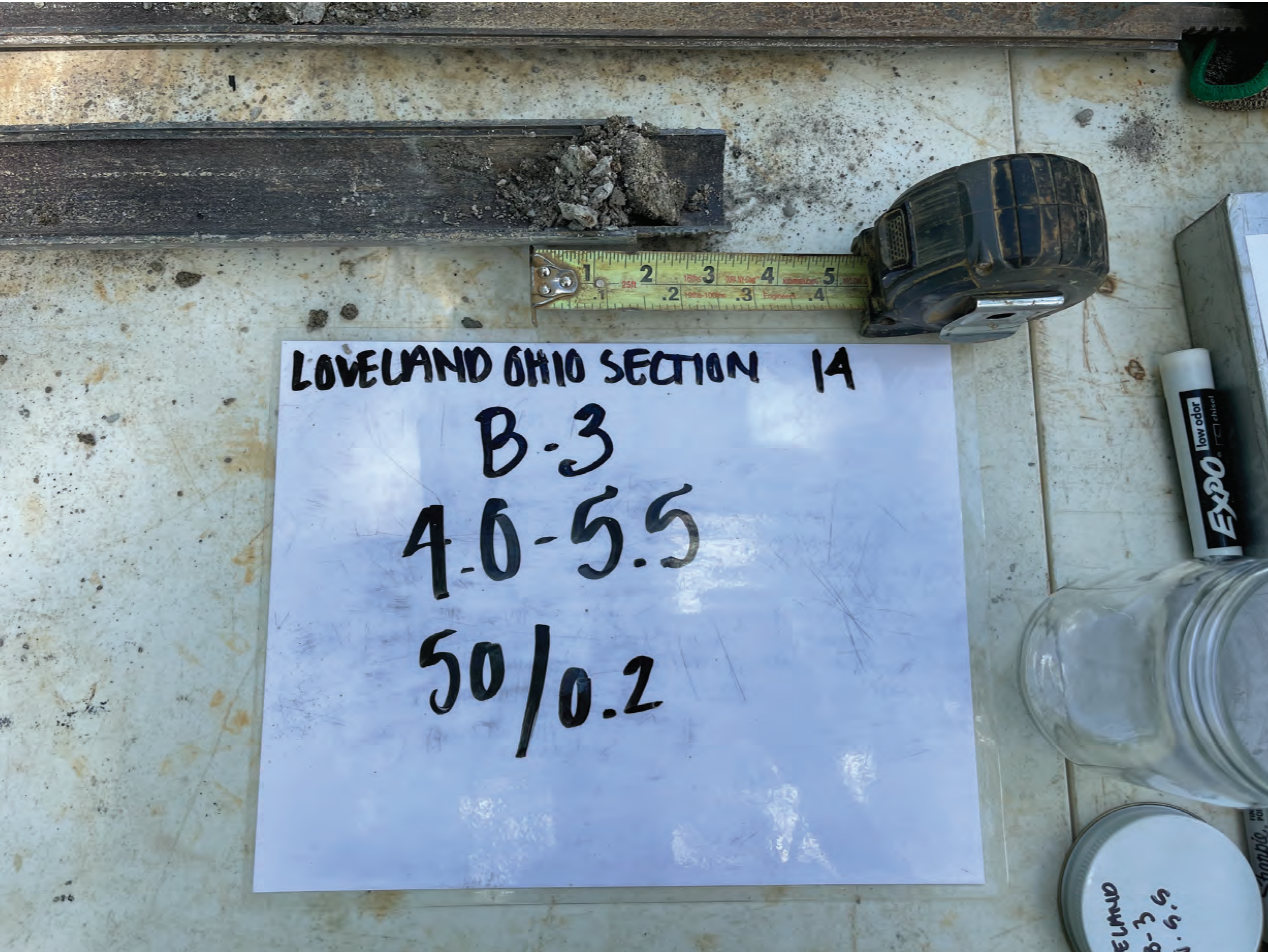

LOVELAND, OHIO SECTION 14
B-2
11.5-13.0
4-4-6


LOVELAND, OHIO SECTION 14.
B-2
14.0-15.5
5-5-31


LOVELAND, OHIO SECTION 14
B-2
16.5-18.0
10-21-18


LOVELAND OHIO SECTION 14
HOLE: B-2
BOX: 1 of 1
DEPTH: 19.5'-30.0'
28.0
24.5
22.0
19.5
25.0
30.0
28.0
24.5
22.0


LOVELAND OHIO SECTION 14
B-3
1.5-3.0
50/0.2'


LOVELAND OHIO SECTION 14
B-3
4.0-5.5
50/0.2


LOVELAND OHIO SECTION 14
B-3
6.5-8.0
50/0.2


LOVELAND OHIO SECTION 14
B-3
9.0-10.5
5-3-5
LOVELAND
B-3
9.0-10.5
EXPO low odor
Sharpie


LOVELAND OHIO SECTION 14
B-3
9.0-10.5
5-3-5


LOVELAND OHIO SECTION 14
B-3
14.0-15.2
10-20-50/0.2


LOVELAND OHIO SECTION 14
B-3
19.0-19.7
25-50/0.2


LOVELAND OHIO SECTION 14
HOLE: B-3
BOX: 1 of 1
DEPTH: 20.7'-25.7'
20.7'
25.7'


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
1. FROM
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
6. DEPTH: FROM
15
TO
7. ELEVATION
5. SAMPLE NUMBER
8. CLASSIFICATION
9. TYPE
a. DISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
13. CONTAINER
a. BAG
b. JAR
c. OTHER (Specify)
14. SAMPLE
OF
ENG FORM 1742, 1 JAN 1949
KOMELON
NYLON COAT
Engineers
25ft


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-3 offset
5. SAMPLE NUMBER
SPT-2
6. DEPTH: FROM 4 TO 5.5
7. ELEVATION
8. CLASSIFICATION
9. TYPE a. DISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR
c. OTHER (Specify)
1. FROM
14. SAMPLE
OF
ENG FORM 1742, 1 JAN 1949
NYLON COAT
KOMELON
Engineers


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-3 Offset
6. DEPTH FROM
6.5' TO 8
7. ELEVATION
5. SAMPLE NUMBER
SPT-3
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE.


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-3 offset
6. DEPTH FROM
4' TO 10.5
7. ELEVATION
5. SAMPLE NUMBER
SH-4
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-3
6. DEPTH, FROM
11.5'
TO
13'
7. ELEVATION
5. SAMPLE NUMBER
8. CLASSIFICATION
9. TYPE
a. DISTURBED
b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER
a. BAG
b. JAR
c. OTHER (Specify)
14. SAMPLE
OF
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG
1. FROM
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-3 offset
5. SAMPLE NUMBER
SH-6
6. DEPTH: FROM 14' TO 15.5
7. ELEVATION
8. CLASSIFICATION
9. TYPE a. DISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE


LOVELAND OHIO SECTION 14
B-3A
3.0-4.5
3-4-5


LOVELAND OHIO SECTION 1A
B-3A
3.0-5.0
AUGER CUTTINGS


LOVELAND OHIO SECTION 14
B-3B
3.0-4.2
16-35-50/0.2


LOVELAND OHIO SECTION 14
B-4
1.5-3.0
7-14-17


LOVELAND OHIO - SECTION 14
B-4
4.0-5.5
1-1-3


LOVELAND OHIO SECTION 14
B-4
6.5-8.0
5-3-5


LOVELAND OHIO SECTION 14
B-4
9.0-10.5
4-6-5


LOVELAND OHIO SECTION 14
B-4
14.0-15.5
25-23-30
LOVELAND
B-4
14.0-15.5

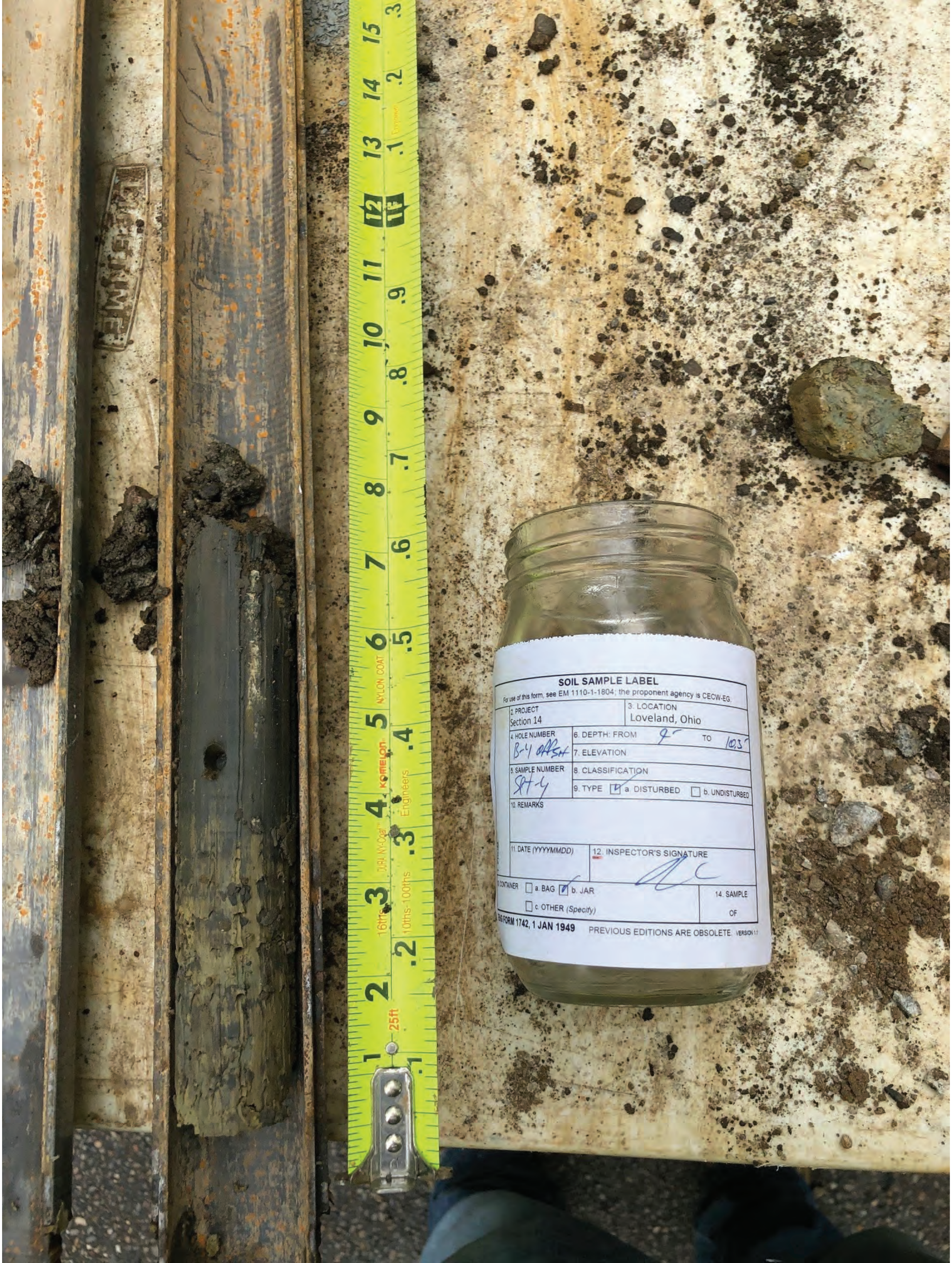

LOVELAND OHIO SECTION 14
B-4
19.0-19.7
24-50/0.2
LOVELAND
B-4
19.0-19.7
EXPO
dry erase


LOVELAND, OHIO SECTION 14
HOLE: B-4
BOX: 1 of 1
DEPTH: 19.7'-24.7'
23.5
19.7'
24.7
23.5


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
6. DEPTH: FROM
1.5'
TO
3'
7. ELEVATION
5. SAMPLE NUMBER
SH-1
8. CLASSIFICATION
9. TYPE
a. DISTURBED
b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
a. BAG
b. JAR
c. OTHER (Specify)
14. SAMPLE
OF
1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE

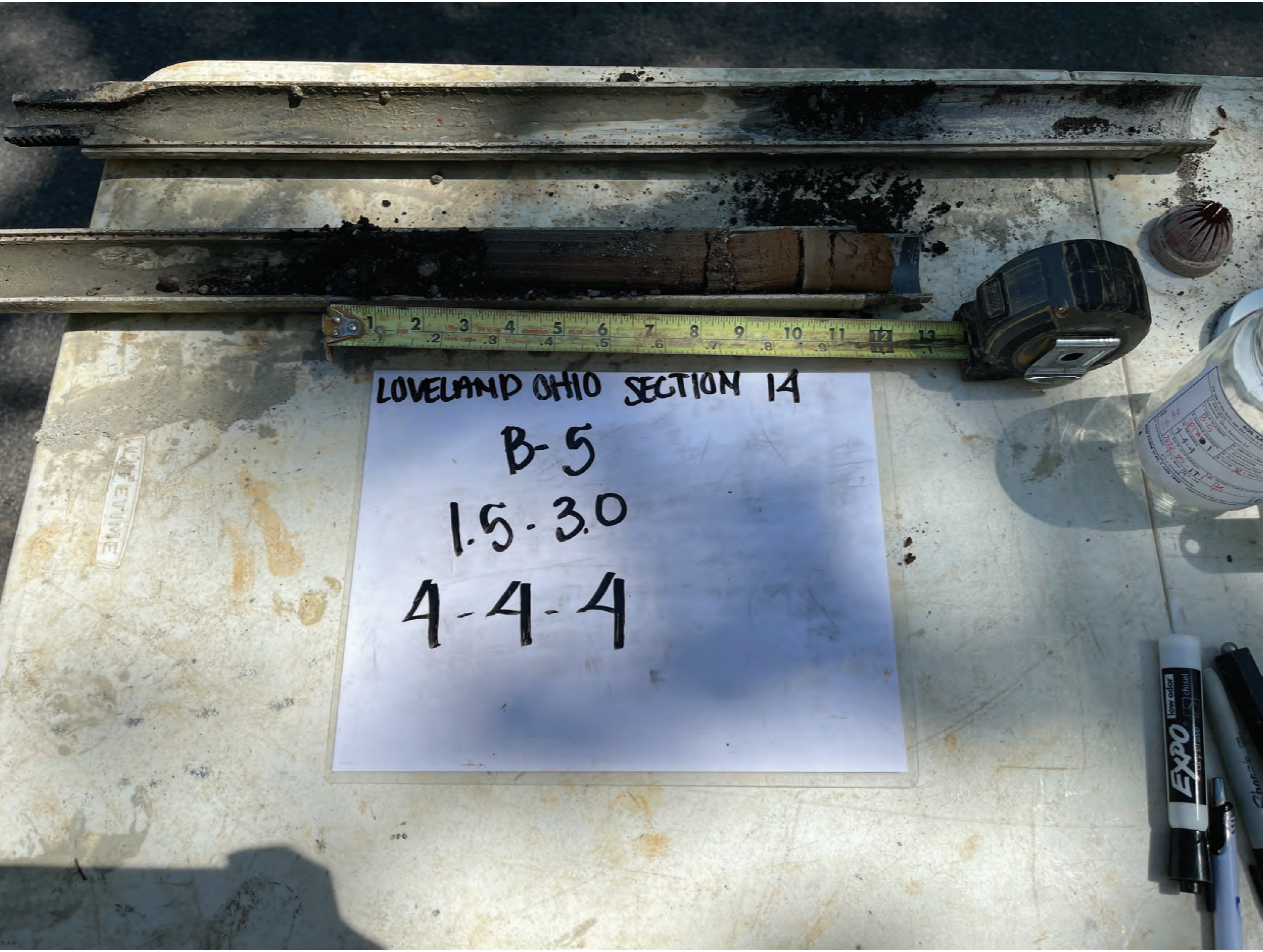

SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
6. DEPTH FROM
TO
7. ELEVATION
5. SAMPLE NUMBER
8. CLASSIFICATION
9. TYPE
a. DISTURBED
b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
13. CONTAINER
a. BAG
b. JAR
c. OTHER (Specify)
14. SAMPLE
OF
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE
KOMELON
NYLON COAT


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-4 Offset
5. SAMPLE NUMBER
SPT-3
6. DEPTH FROM 6.5' TO 8'
7. ELEVATION
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE.


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-4 Offset
6. DEPTH: FROM 9' TO 10.5'
7. ELEVATION
5. SAMPLE NUMBER
SPT-4
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE.
NYLON COAT
KOMELON
Engineers


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-4 offset
5. SAMPLE NUMBER
SPT 15
6. DEPTH FROM 11.5' TO 13'
7. ELEVATION
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE.
NYLON COAT
KOMELON
Engineers

SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
6. DEPTH: FROM
TO
7. ELEVATION
5. SAMPLE NUMBER
8. CLASSIFICATION
9. TYPE
a. DISTURBED
b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
12. INSPECTOR'S SIGNATURE
13. CONTAINER
a. BAG
b. JAR
c. OTHER (Specify)
14. SAMPLE
OF
ENG FORM 1742, 1 JAN 1949
PREVIOUS EDITIONS ARE OBSOLETE
KOMELON
NYLON COAT
Engineers


LOVELAND OHIO SECTION 14
B-5
1.5-3.0
4-4-4
EXPO


LOVELAND OHIO SECTION 14
B-5
4.0-5.5
2-2-2


LOVELAND OHIO SECTION 14
B-5
6.5-8.0
3-2-4
LOVELAND
B-5
6.5-8.0


LOVELAND OHIO SECTION 14
B-5
9.0-10.5
12-14-8


LOVELAND OHIO SECTION 14
B-5
14.0-15.5
9-27-40


LOVELAND OHIO SECTION 14
HOLE: B-5
BOX: 1 of 1
DEPTH: 15.5'-[redacted] 26.8'
20.5'
24.2'
26.8'
15.5'


LOVELAND OHIO SECTION 14
B-6
1.5-3.0
10-3-4
LOVELAND
B-6
1.5-3.0
LIFETIME


LOVELAND OHIO SECTION 14
B-6
4.0-5.5
3.3-A


LOVELAND OHIO SECTION 14
B-6
6.5-8.0
2-2-5


LOVELAND OHIO SECTION 14
B-6
9.0-10.5
5-16-14

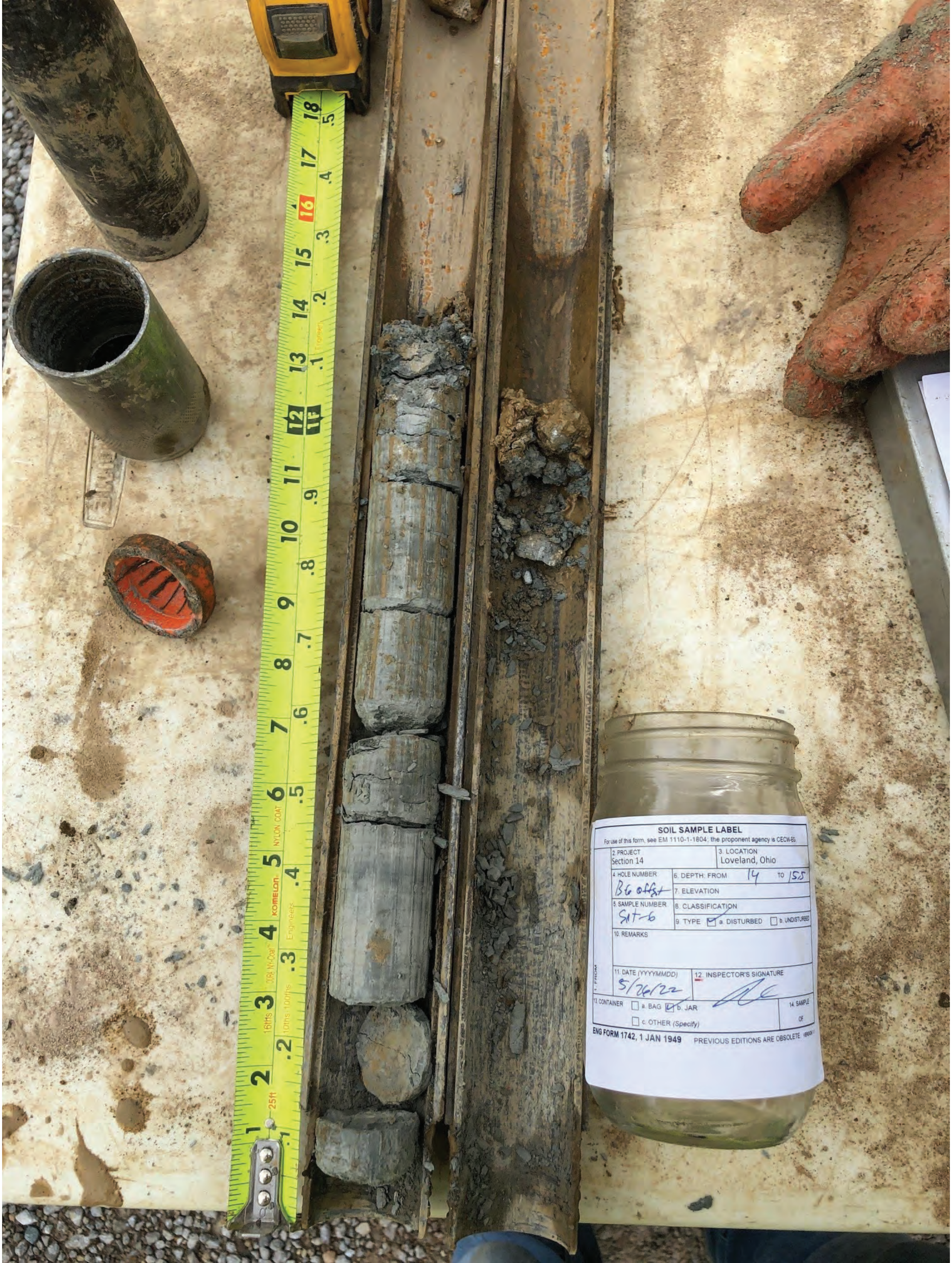

LOVELAND OHIO SECTION 14
B-6
14.0-15.5
12-38-49


LOVELAND OHIO SECTION 14
HOLE: B-6
BOX 1 of 1
DEPTH: 15.5'-25.8'
22.6'
19.2'-15.5'
20.8
25.8'
22.6'
19.2'

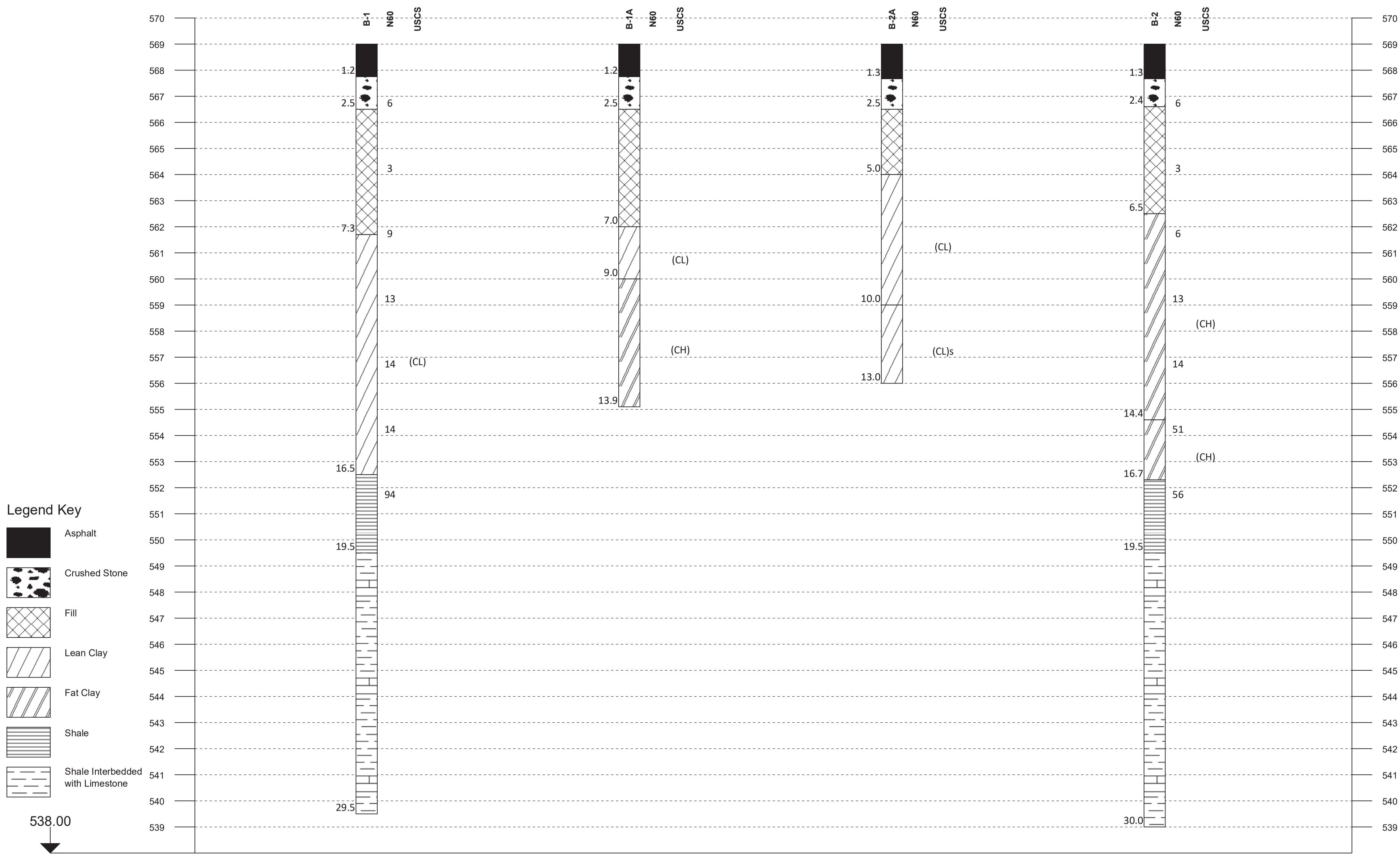

SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-6 offset
6. DEPTH: FROM 4 TO 5.5
7. ELEVATION
5. SAMPLE NUMBER
SPT-2
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE
LIFETIME


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-6
6. DEPTH: FROM 6.5' TO 8'
7. ELEVATION
5. SAMPLE NUMBER
SH-3
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE.

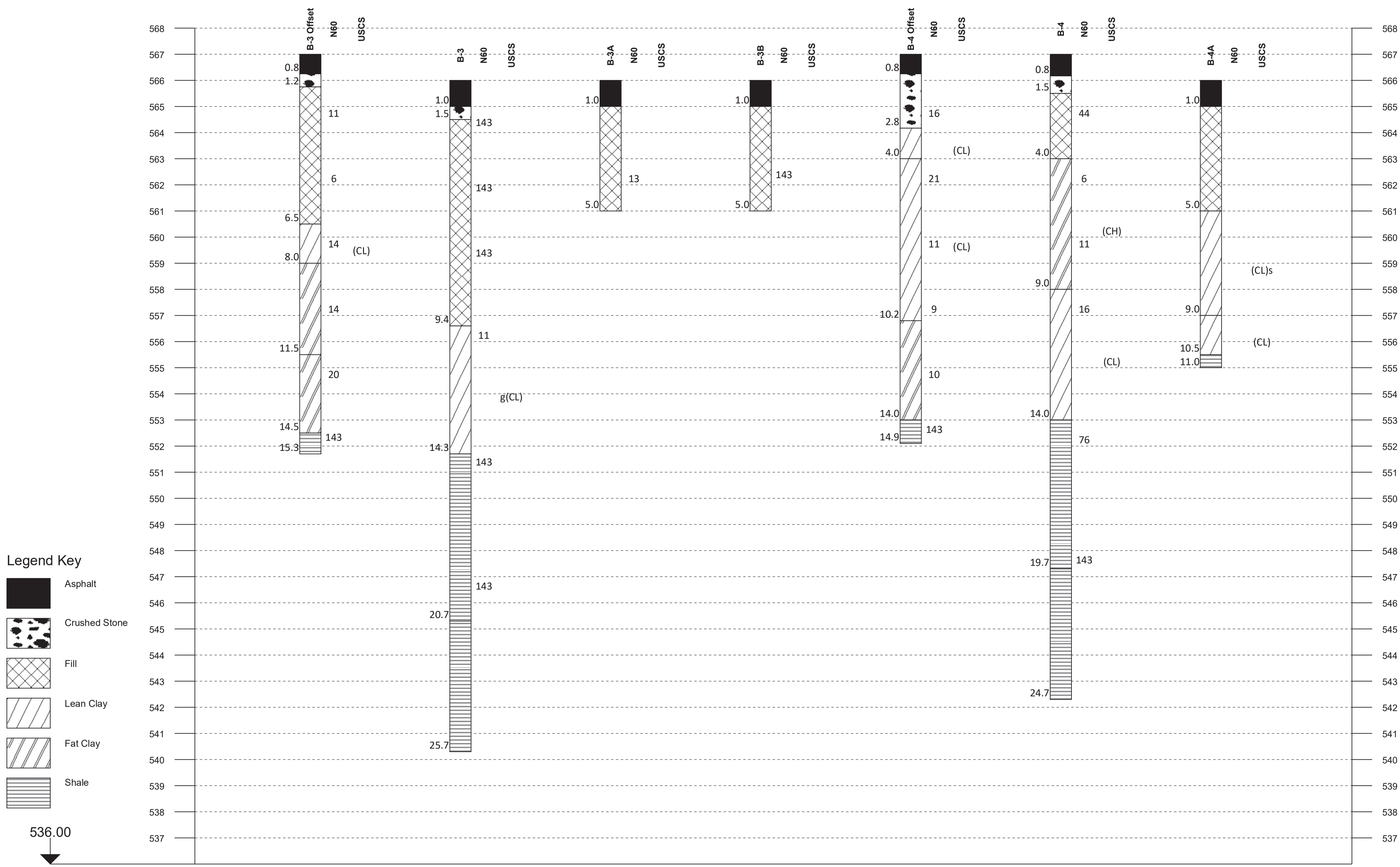

SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
B-C Offset
6. DEPTH: FROM 9 TO 10.5
7. ELEVATION
5. SAMPLE NUMBER
SPT-4
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE


SOIL SAMPLE LABEL
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.
2. PROJECT
Section 14
3. LOCATION
Loveland, Ohio
4. HOLE NUMBER
6. DEPTH: FROM 14 TO 15.5
7. ELEVATION
5. SAMPLE NUMBER
8. CLASSIFICATION
9. TYPE a. DISTURBED b. UNDISTURBED
10. REMARKS
1. FROM
11. DATE (YYYYMMDD)
5/26/22
12. INSPECTOR'S SIGNATURE
13. CONTAINER a. BAG b. JAR c. OTHER (Specify)
14. SAMPLE OF
ENG FORM 1742, 1 JAN 1949 PREVIOUS EDITIONS ARE OBSOLETE

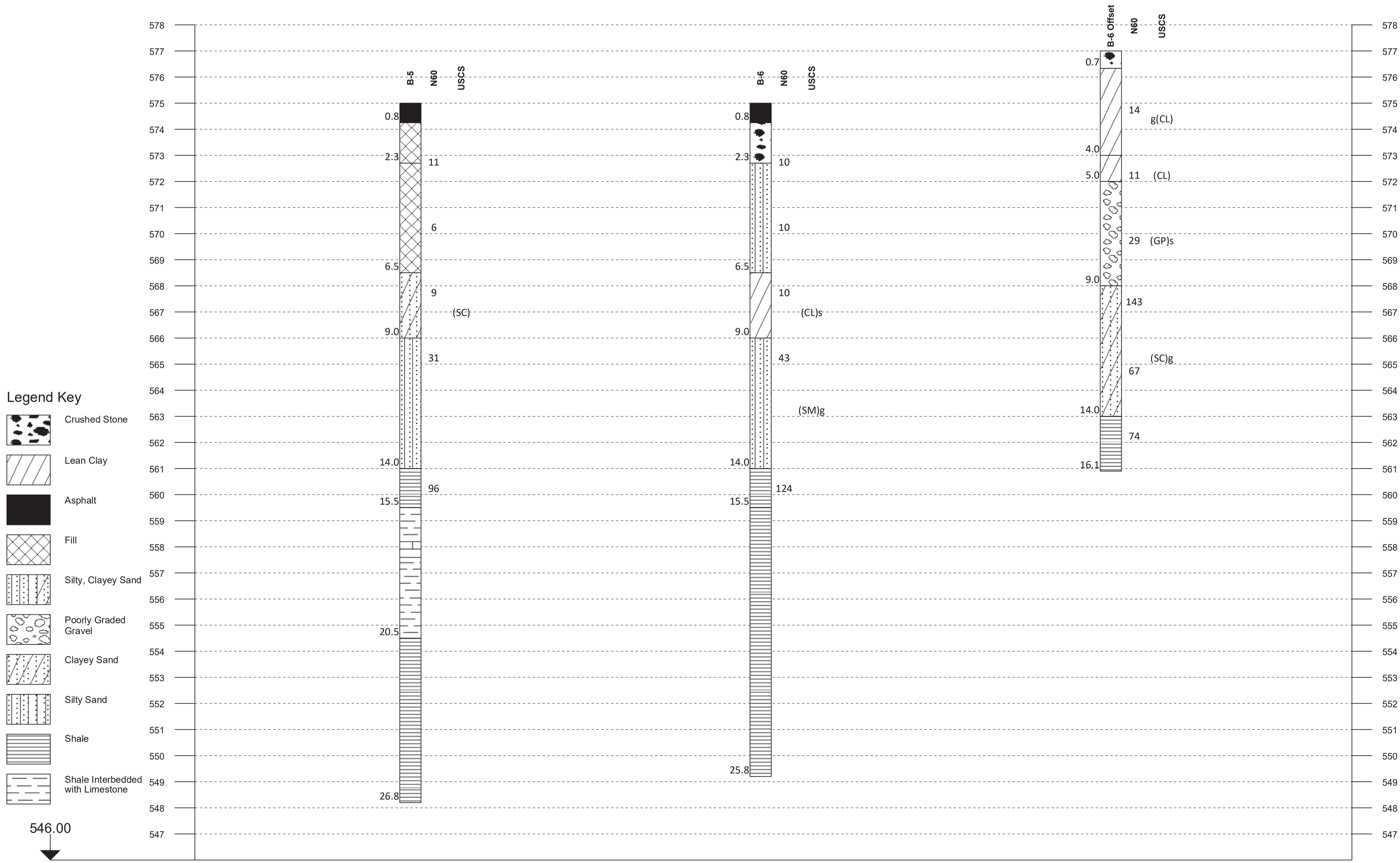
Project Id:	LRL-Loveland, OH PAS Study-498610	Title:	Section line 1
Project Title:	Loveland, OH PAS Study	Vertical Scale:	1:60
Location:	Loveland, OH	Horizontal Scale:	Not to scale
Client:	City of Loveland, OH	Engineer:	Jude Hutchins



Project Id:	LRL-Loveland, OH PAS Study-498610	Title:	Site 2
Project Title:	Loveland, OH PAS Study	Vertical Scale:	1:60
Location:	Loveland, OH	Horizontal Scale:	Not to scale
Client:	City of Loveland, OH	Engineer:	Jude Hutchins



Project Id:	LRL-Loveland, OH PAS Study-498610	Title:	Site 3
Project Title:	Loveland, OH PAS Study	Vertical Scale:	1:60
Location:	Loveland, OH	Horizontal Scale:	Not to scale
Client:	City of Loveland, OH	Engineer:	Jude Hutchins



2.25. Attachment J: Laboratory Testing

Attachment J:
Laboratory Testing

Laboratory Procedures
Summary of Laboratory Results
Atterberg Limits Results
Grain Size Distribution Results
Moisture-Density Relationship Results
Unconsolidated Undrained Results
Consolidated Undrained Results
Rock Moisture and Density Results
Rock Direct Shear Results

LABORATORY PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current situations. In the explorations, samples obtained during drilling operations are examined in the field and the contractor's laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on the boring records.

The classification system discussed above is primarily qualitative. A detailed soil classification requires two laboratory tests: grain size tests and plasticity tests. Using these test results, the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D2487). Each of these classification systems and the in-place physical soil properties provide an index for estimating the soil's behavior. The soil classification and physical properties determined are presented in this report.

Soil Classification Tests

Atterberg Limits: Portions of the samples are taken for Atterberg limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D4318.

Grain Size Tests: Grain size tests are performed to determine the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D421 (dry preparation) or ASTM D2217 (wet preparation). The grain size distribution of soils coarser than a No. 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. Materials passing the No. 200 sieve are suspended in water and the grain size distribution calculated from the measured settlement rate. These hydrometer tests are conducted in accordance with ASTM D422.

Percent Finer Than 200 Sieve: Selected samples of soils are washed through a No. 200 sieve to determine the percentage of material less than 0.075 mm in diameter.

Moisture Content: The moisture content is determined according to ASTM D2216. A test specimen is dried in an oven at a temperature of 110±5 degrees Celsius to a constant mass. The loss of mass due to drying is considered to be water. The water content is ratio of the mass of water divided by the mass of the dry specimen, expressed as a percentage.

Strength Tests

UU Triaxial "Q" Compression Test:
ASTM D 2850-15: This test method covers determination of the strength and stress-strain relationships of a cylindrical specimen of either intact, compacted, or remolded cohesive soil. Specimens are subjected to a confining fluid pressure in a triaxial chamber. No drainage of the specimen is permitted during the application of the confining fluid pressure or during the compression phase of the test. The specimen is axially loaded at a constant rate of axial deformation (strain controlled). This test method provides data for determining undrained strength properties and stress-strain relations for soils. This test method provides for the measurement of the total stresses applied to the specimen, that is, the stresses are not corrected for pore-water pressure.

CU Triaxial “R-Bar” Compression Test:
ASTM D 4767-11: This test method covers the determination of strength and stress-strain relationships of a cylindrical specimen of either an intact, reconstituted, or remolded saturated cohesive soil. Specimens are isotropically consolidated and sheared in compression without drainage at a constant rate of axial deformation (strain controlled). This test method provides for the calculation of total and effective stresses, and axial compression by measurement of axial load, axial deformation, and pore-water pressure.

Rock Direct Shear:
ASTM D 5607: While maintaining a constant force normal to the nominal shear plane of the specimen, an increasing external shear force is applied along the designated shear plane to cause shear displacement. The applied normal and shear forces and the corresponding normal and shear displacements are measured and recorded. These data are the basis for calculating the required parameters.

Compaction Tests

Modified Proctor Laboratory Compaction of Soil:
ASTM D1557-12: A soil at a selected molding water content is placed in five layers into a mold of given dimensions, with each layer compacted by 25 or 56 blows of a 10.00-lbf rammer dropped from a distance of 18.00 inches, subjecting the soil to a total compactive effort of about 56,000 ft-lbf/ft^3. The resulting dry unit weight is determined. The procedure is repeated for a sufficient number of molding water contents to establish a relationship between the dry unit weight and the molding water content for the soil. This data, when plotted, represent a curvilinear relationship known as the compaction curve. The values of optimum water content and modified maximum dry unit weight are determined from the compaction curve.

Rock Properties Tests

Rock Moisture:
The rock moisture content is determined with the same procedure as “Moisture Content” above according to ASTM D2216.

Rock Density:
Density is measured according to ASTM D 7263 by water displacement or direct measurement. Density is a key element in the phase relations, phase relationships, or mass-volume relationships of soil and rock.

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SUMMARY OF LABORATORY RESULTS

CLIENT USACE
PROJECT NAME Task Order No. 15 Loveland, OH Section 14
PROJECT NUMBER 219-206
PROJECT LOCATION Loveland, Ohio

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	1.5							15.6			
B-1	14.0	42	20	22				16.0			
B-1A	3.0							26.8			
B-1A	5.0	32	21	11	19	63	CL	26.4			
B-1A	7.0	37	22	15				23.5			
B-1A	9.0	54	22	32	19	93	CH	24.2			
B-1A	11.0							22.5			
B-2	2.5	29	15	14	19	54	CL	23.0			
B-2	14.0							20.8			
B-2A	3.0	29	17	12	4.75	64	CL	20.2			
B-2A	5.0	31	17	14	9.5	90	CL	25.7			
B-2A	7.0							24.1			
B-2A	9.0							26.2			
B-2A	11.0	44	22	22	19	83	CL	23.0			
B-3 Offset	1.5							7.2			
B-3 Offset	4.0	24	13	11	19	51	CL	14.1			
B-3 Offset	6.5	43	21	22				24.6			
B-3 Offset	9.0	56	21	35				23.1			
B-3 Offset	11.5	52	14	38	19	77	CH	21.1			
B-3 Offset	14.0							4.9			
B-4	1.5	21	14	7				4.5			
B-4	4.0	59	26	33	9.5	97	CH	28.5			
B-4	6.5	52	17	35				22.5			
B-4	9.0	46	20	26	9.5	89	CL	20.6			
B-4 Offset	1.5							7.4			
B-4 Offset	4.0							28.3			
B-4 Offset	6.5							25.2			
B-4 Offset	9.0							29.3			
B-4 Offset	11.5							17.9			
B-4 Offset	14.0							6.9			
B-4A	5.0	45	19	26	19	80	CL	21.9			
B-4A	7.0							27.1			
B-4A	9.0	48	27	21	4.75	92	CL	19.8			
B-5	1.5	23	12	11	9.5	48	SC	13.7			
B-5	4.0	23	13	10	9.5	55	CL	17.7			
B-5	6.5	30	19	11	9.5	35	SC	16.0			
B-5	9.0	20	16	4	19	19	SC-SM	4.0			
B-6	1.5							14.9			
B-6	3.0	20	14	6	19	50	SC-SM	15.9			
B-6	4.0							18.1			
B-6	6.5							17.9			
B-6	9.0							3.3			
B-6 Offset	4.0	23	11	12				10.8			

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Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-6 Offset	6.5							3.6			
B-6 Offset	9.0				19	13		3.8			
B-6 Offset	14.0							11.9			

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ATTERBERG LIMITS' RESULTS

CLIENT USACE
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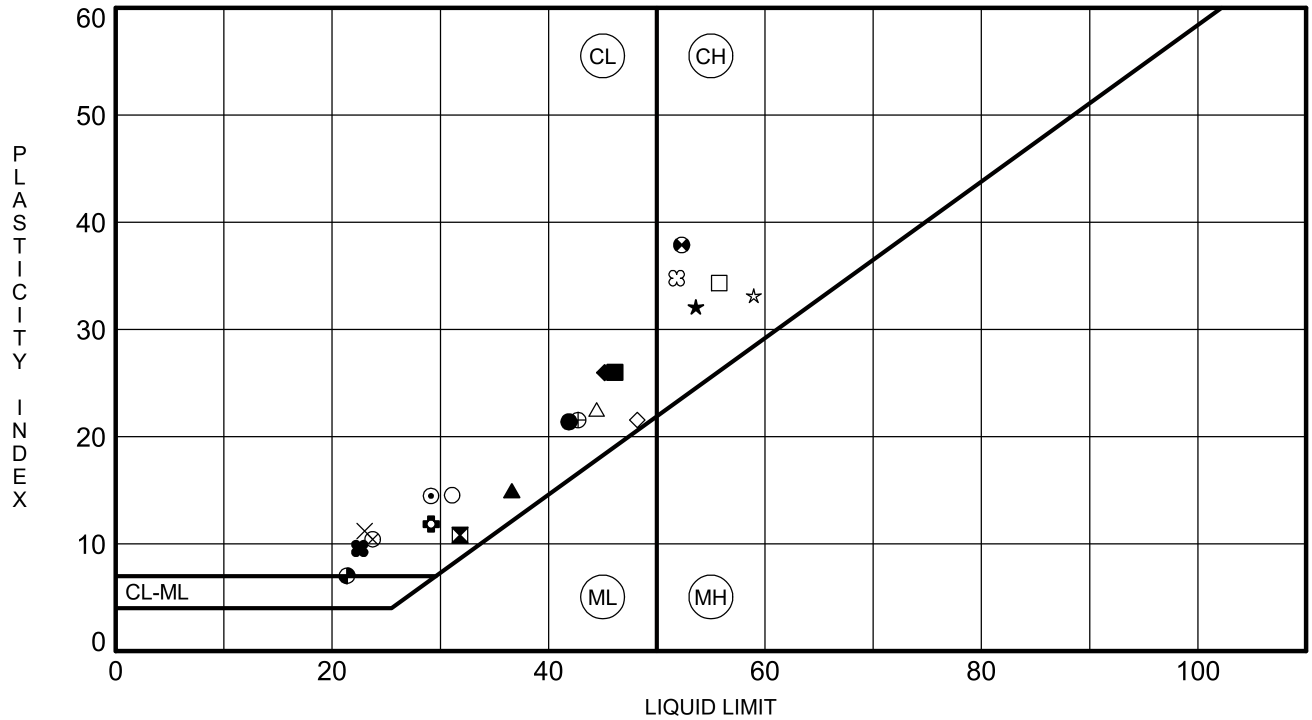
PROJECT NUMBER 219-206
PROJECT LOCATION Loveland, Ohio



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-1**	**14.0**	**42**	**20**	**22**		**LEAN CLAY(CL)**
⧗	**B-1A**	**5.0**	**32**	**21**	**11**	**63**	**SANDY LEAN CLAY(CL)**
▲	**B-1A**	**7.0**	**37**	**22**	**15**		**LEAN CLAY(CL)**
★	**B-1A**	**9.0**	**54**	**22**	**32**	**93**	**FAT CLAY(CH)**
⊙	**B-2**	**2.5**	**29**	**15**	**14**	**54**	**SANDY LEAN CLAY(CL)**
✿	**B-2A**	**3.0**	**29**	**17**	**12**	**64**	**SANDY LEAN CLAY(CL)**
○	**B-2A**	**5.0**	**31**	**17**	**14**	**90**	**LEAN CLAY(CL)**
△	**B-2A**	**11.0**	**44**	**22**	**22**	**83**	**LEAN CLAY with SAND(CL)**
⊗	**B-3 Offset**	**4.0**	**24**	**13**	**11**	**51**	**SANDY LEAN CLAY(CL)**
⊕	**B-3 Offset**	**6.5**	**43**	**21**	**22**		**LEAN CLAY(CL)**
□	**B-3 Offset**	**9.0**	**56**	**21**	**35**		**FAT CLAY(CH)**
❂	**B-3 Offset**	**11.5**	**52**	**14**	**38**	**77**	**FAT CLAY with GRAVEL(CH)**
◕	**B-4**	**1.5**	**21**	**14**	**7**		**LEAN CLAY(CL)**
☆	**B-4**	**4.0**	**59**	**26**	**33**	**97**	**FAT CLAY(CH)**
✥	**B-4**	**6.5**	**52**	**17**	**35**		**FAT CLAY(CH)**
■	**B-4**	**9.0**	**46**	**20**	**26**	**89**	**LEAN CLAY(CL)**
◆	**B-4A**	**5.0**	**45**	**19**	**26**	**80**	**LEAN CLAY with SAND(CL)**
◇	**B-4A**	**9.0**	**48**	**27**	**21**	**92**	**LEAN CLAY(CL)**
✕	**B-5**	**1.5**	**23**	**12**	**11**	**48**	**CLAYEY SAND(SC)**
✖	**B-5**	**4.0**	**23**	**13**	**10**	**55**	**SANDY LEAN CLAY(CL)**

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ATTERBERG LIMITS' RESULTS

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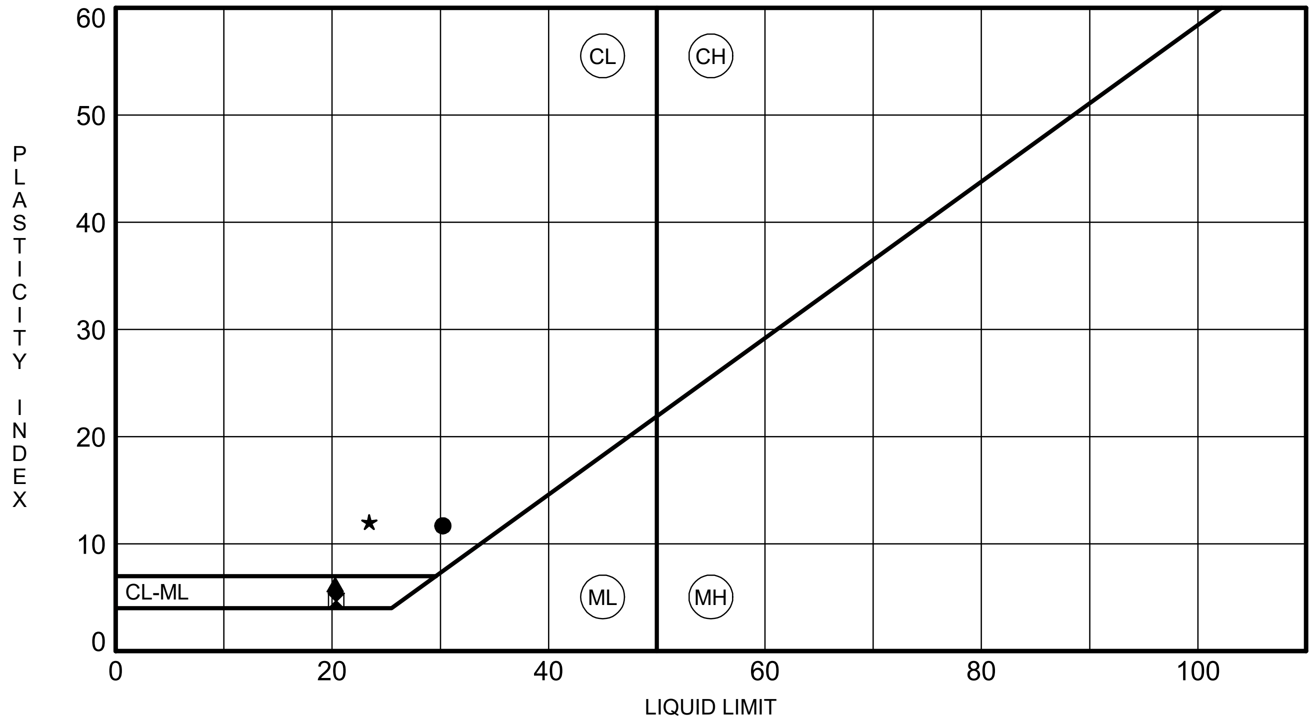
PROJECT NUMBER 219-206
PROJECT LOCATION Loveland, Ohio



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-5**	**6.5**	**30**	**19**	**11**	**35**	**CLAYEY SAND(SC)**
⧗	**B-5**	**9.0**	**20**	**16**	**4**	**19**	**SILTY, CLAYEY SAND with GRAVEL(SC-SM)**
▲	**B-6**	**3.0**	**20**	**14**	**6**	**50**	**SILTY, CLAYEY SAND(SC-SM)**
★	**B-6 Offset**	**4.0**	**23**	**11**	**12**		**LEAN CLAY(CL)**

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GRAIN SIZE DISTRIBUTION

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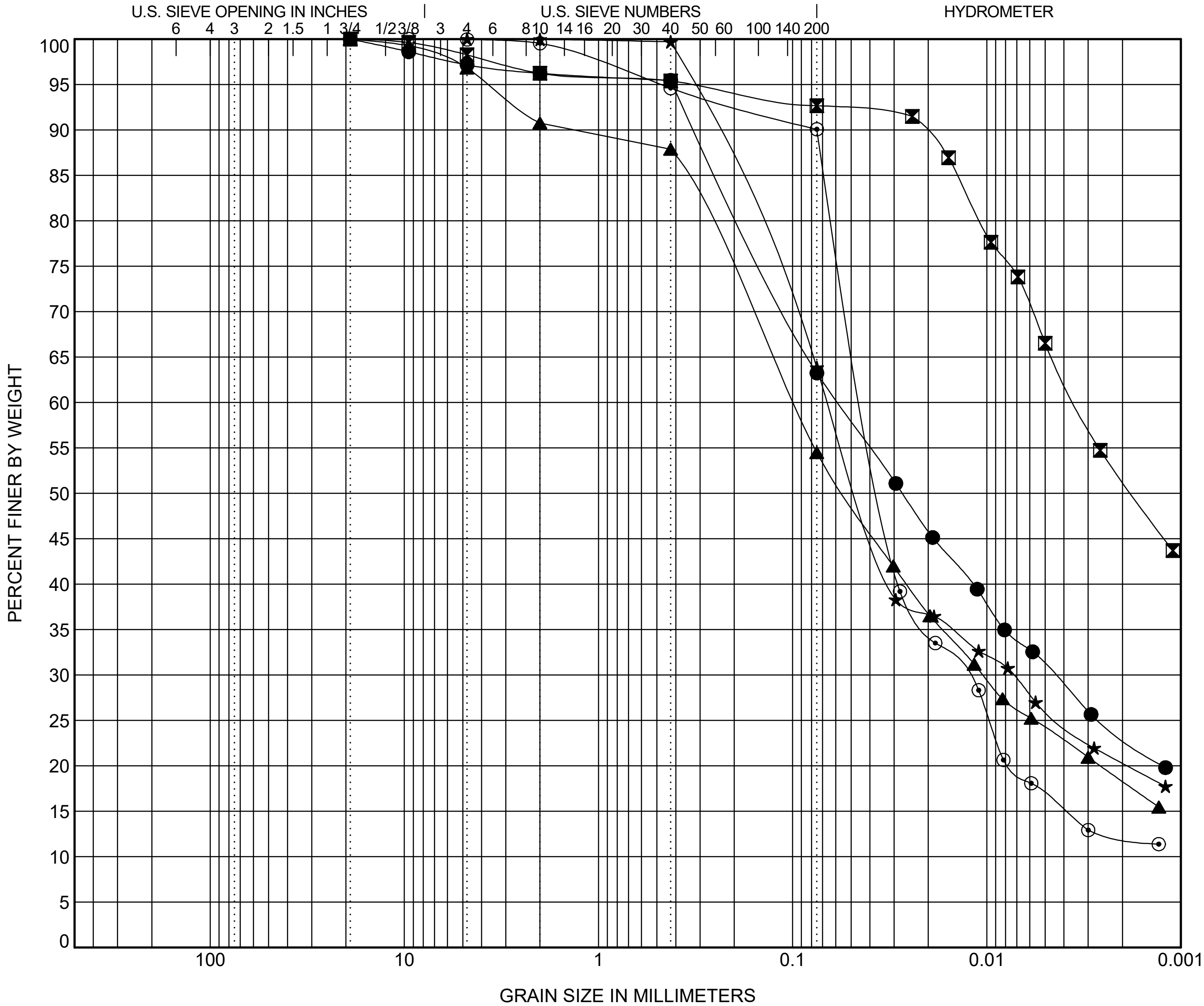
PROJECT NUMBER 219-206
PROJECT LOCATION Loveland, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-1A**	**5.0**	**SANDY LEAN CLAY(CL)**	**32**	**21**	**11**		
⊠	**B-1A**	**9.0**	**FAT CLAY(CH)**	**54**	**22**	**32**		
▲	**B-2**	**2.5**	**SANDY LEAN CLAY(CL)**	**29**	**15**	**14**		
★	**B-2A**	**3.0**	**SANDY LEAN CLAY(CL)**	**29**	**17**	**12**		
⊙	**B-2A**	**5.0**	**LEAN CLAY(CL)**	**31**	**17**	**14**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1A**	**5.0**	**19**	**0.058**	**0.004**		**2.8**	**33.9**	**32.2**	**31.1**
⊠	**B-1A**	**9.0**	**19**	**0.003**			**1.7**	**5.6**	**26.2**	**66.5**
▲	**B-2**	**2.5**	**19**	**0.1**	**0.01**		**3.2**	**42.3**	**30.3**	**24.2**
★	**B-2A**	**3.0**	**4.75**	**0.065**	**0.007**		**0.0**	**36.1**	**37.7**	**26.2**
⊙	**B-2A**	**5.0**	**9.5**	**0.042**	**0.013**		**0.0**	**9.9**	**73.3**	**16.8**

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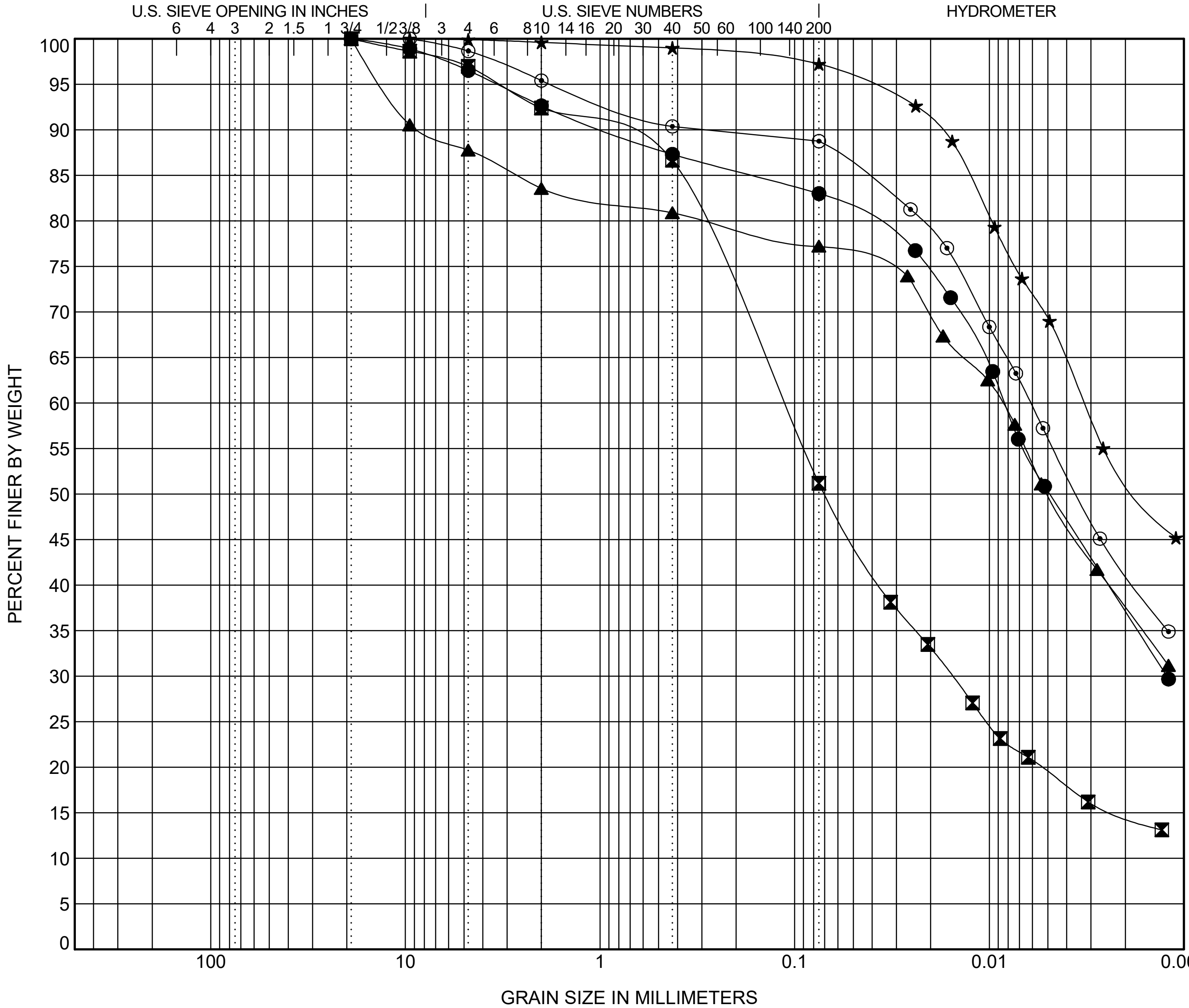
PROJECT NUMBER 219-206 **PROJECT LOCATION** Loveland, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-2A**	**11.0**	**LEAN CLAY with SAND(CL)**	**44**	**22**	**22**		
⧗	**B-3 Offset**	**4.0**	**SANDY LEAN CLAY(CL)**	**24**	**13**	**11**		
▲	**B-3 Offset**	**11.5**	**FAT CLAY with GRAVEL(CH)**	**52**	**14**	**38**		
★	**B-4**	**4.0**	**FAT CLAY(CH)**	**59**	**26**	**33**		
⊙	**B-4**	**9.0**	**LEAN CLAY(CL)**	**46**	**20**	**26**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2A**	**11.0**	**19**	**0.008**	**0.001**		**3.5**	**13.5**	**32.7**	**50.3**
⧗	**B-3 Offset**	**4.0**	**19**	**0.115**	**0.016**		**3.0**	**45.8**	**31.7**	**19.5**
▲	**B-3 Offset**	**11.5**	**19**	**0.009**			**12.2**	**10.6**	**27.2**	**50.0**
★	**B-4**	**4.0**	**9.5**	**0.003**			**0.1**	**2.7**	**27.9**	**69.3**
⊙	**B-4**	**9.0**	**9.5**	**0.006**			**1.3**	**9.9**	**32.6**	**56.2**

GRAIN SIZE - GINT STD US LAB.GDT - 9/7/22 11:44 - T:\GEOTECH SUPPORT\USACE\USACE GEOTECH IDIQ LOUISVILLE (SECOND)\TASK ORDER NO. 15 LOVELAND, OH SECTION 14\LAB\TASK ORDER NO. 15 LOVELAND, OH SECTION 14 SOILS.GPJ

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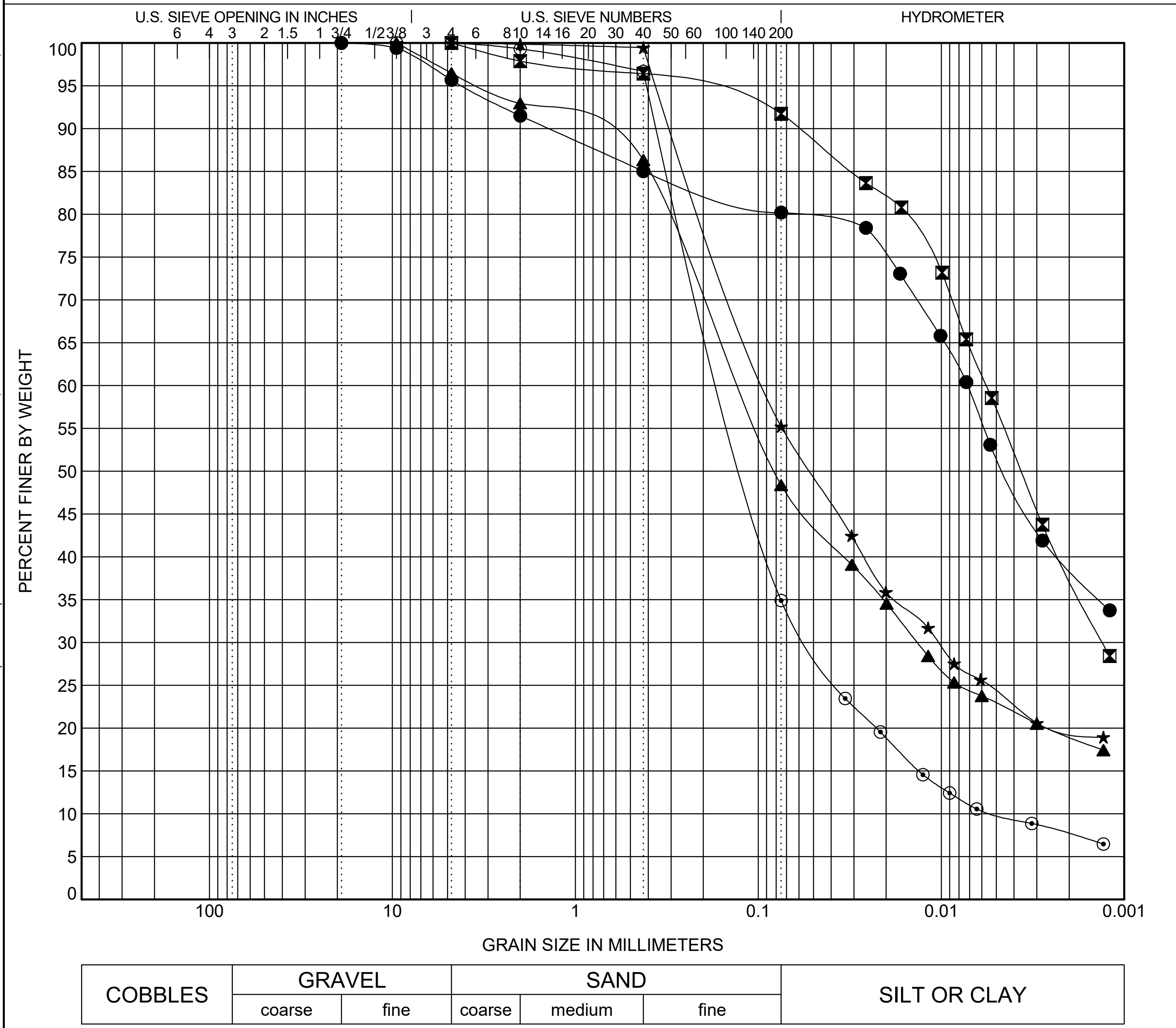
PROJECT LOCATION Loveland, Ohio



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-4A**	**5.0**	**LEAN CLAY with SAND(CL)**	**45**	**19**	**26**		
⧗	**B-4A**	**9.0**	**LEAN CLAY(CL)**	**48**	**27**	**21**		
▲	**B-5**	**1.5**	**CLAYEY SAND(SC)**	**23**	**12**	**11**		
★	**B-5**	**4.0**	**SANDY LEAN CLAY(CL)**	**23**	**13**	**10**		
⊙	**B-5**	**6.5**	**CLAYEY SAND(SC)**	**30**	**19**	**11**	**3.65**	**29.78**

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-4A**	**5.0**	**19**	**0.007**			**4.3**	**15.5**	**28.4**	**51.8**
⧗	**B-4A**	**9.0**	**4.75**	**0.006**	**0.001**		**0.0**	**8.3**	**34.5**	**57.2**
▲	**B-5**	**1.5**	**9.5**	**0.128**	**0.014**		**3.5**	**48.1**	**25.5**	**22.9**
★	**B-5**	**4.0**	**9.5**	**0.09**	**0.01**		**0.0**	**44.8**	**31.0**	**24.2**
⊙	**B-5**	**6.5**	**9.5**	**0.152**	**0.053**	**0.005**	**0.0**	**65.1**	**24.9**	**10.0**

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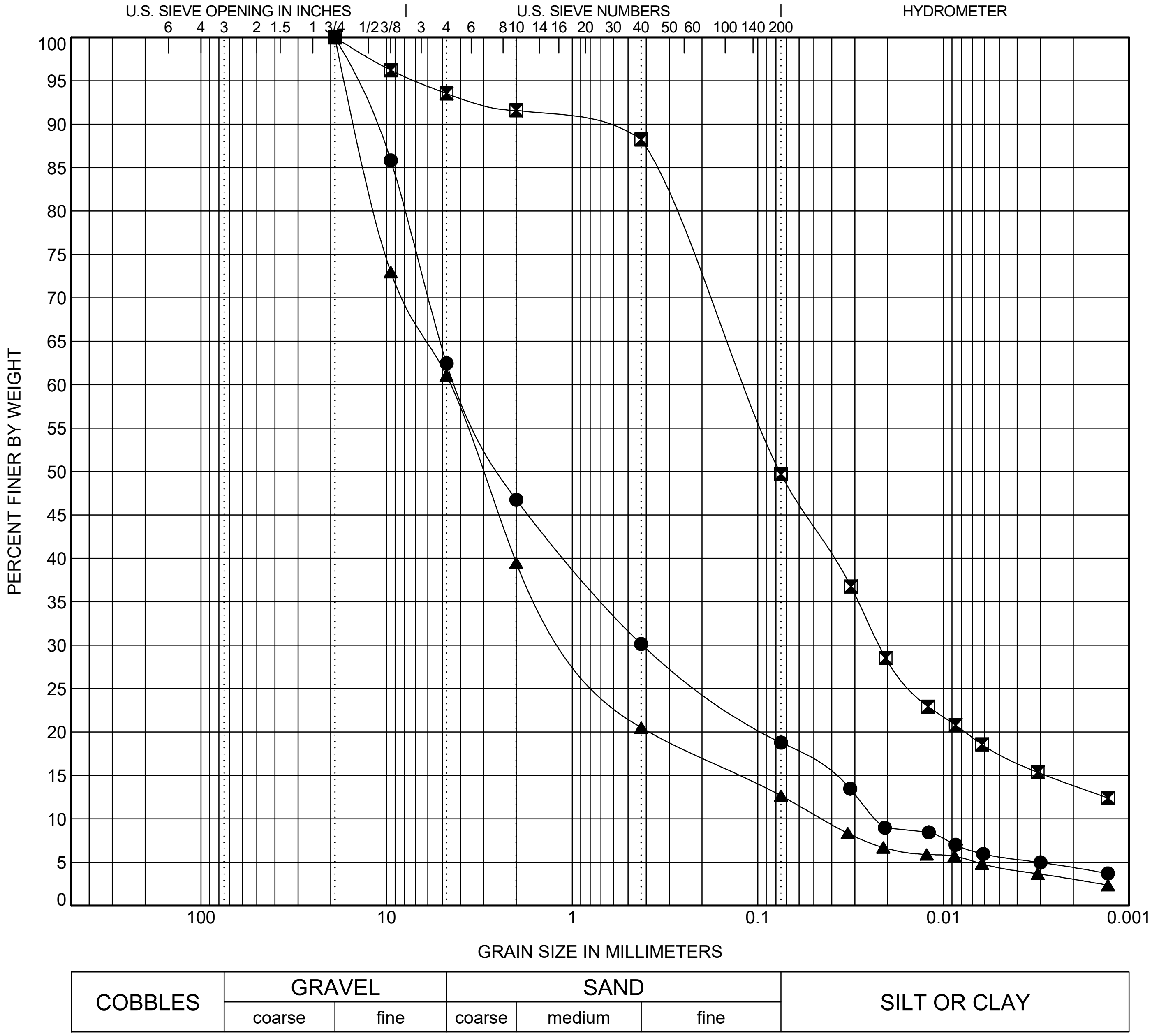

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-5**	**9.0**	**SILTY, CLAYEY SAND with GRAVEL(SC-SM)**	**20**	**16**	**4**	**1.83**	**181.69**
⊠	**B-6**	**3.0**	**SILTY, CLAYEY SAND(SC-SM)**	**20**	**14**	**6**		
▲	**B-6 Offset**	**9.0**	**CLAYEY SAND with GRAVEL(SC)**				**4.15**	**101.09**

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5**	**9.0**	**19**	**4.149**	**0.417**	**0.023**	**37.5**	**43.7**	**13.1**	**5.7**
⊠	**B-6**	**3.0**	**19**	**0.119**	**0.022**		**6.5**	**43.8**	**32.1**	**17.6**
▲	**B-6 Offset**	**9.0**	**19**	**4.554**	**0.923**	**0.045**	**38.9**	**48.4**	**8.2**	**4.5**

MOISTURE-DENSITY RELATIONSHIP

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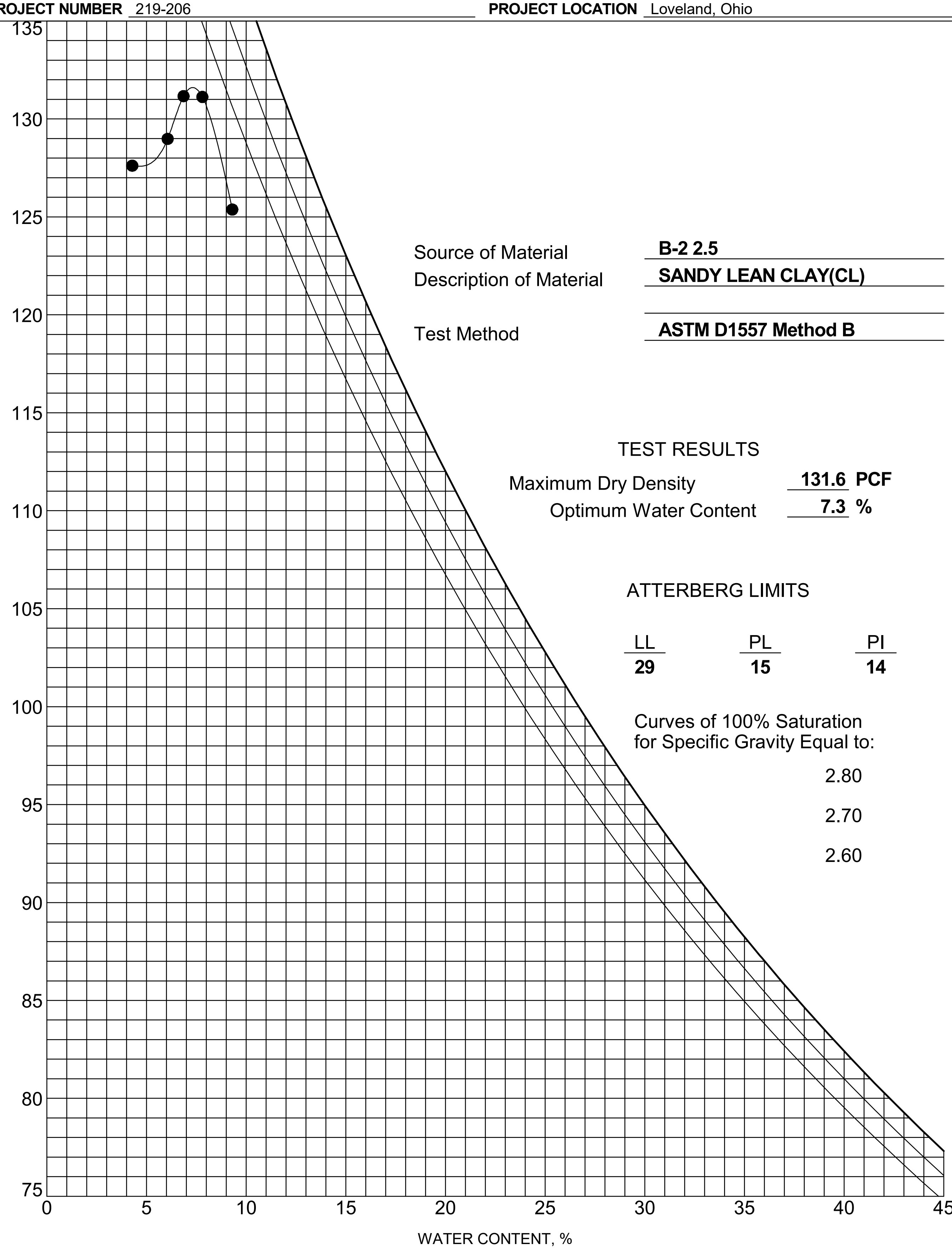

Source of Material **B-2 2.5**
Description of Material **SANDY LEAN CLAY(CL)**

Test Method **ASTM D1557 Method B**

TEST RESULTS

Maximum Dry Density **131.6 PCF**
Optimum Water Content **7.3 %**

ATTERBERG LIMITS

LL	PL	PI
29	**15**	**14**

Curves of 100% Saturation
for Specific Gravity Equal to:
2.80
2.70
2.60

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MOISTURE-DENSITY RELATIONSHIP

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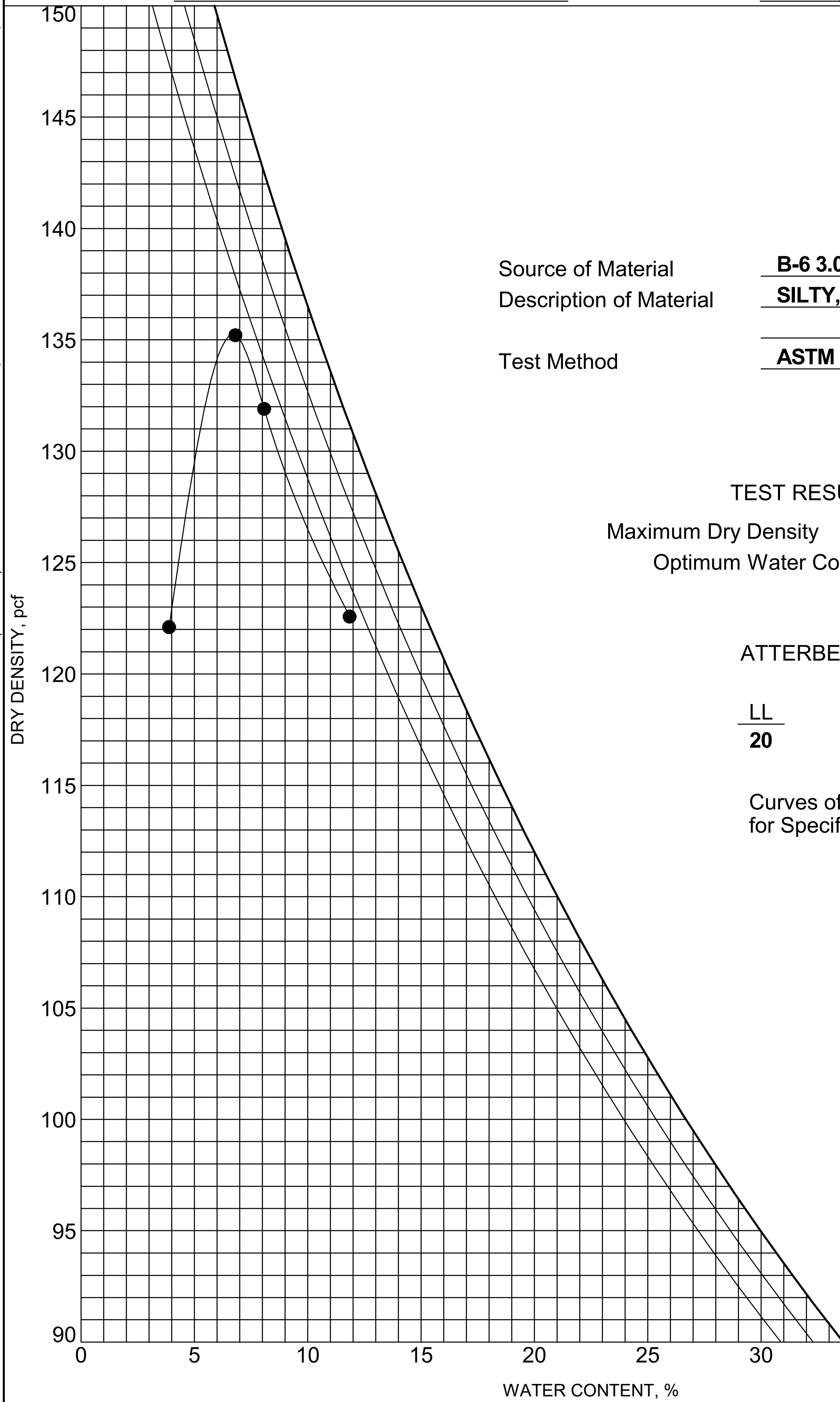
PROJECT LOCATION Loveland, Ohio



Source of Material **B-6 3.0**

Description of Material **SILTY, CLAYEY SAND(SC-SM)**

Test Method **ASTM D1557 Method B**

TEST RESULTS

Maximum Dry Density **135.2** **PCF**

Optimum Water Content **6.7** **%**

ATTERBERG LIMITS

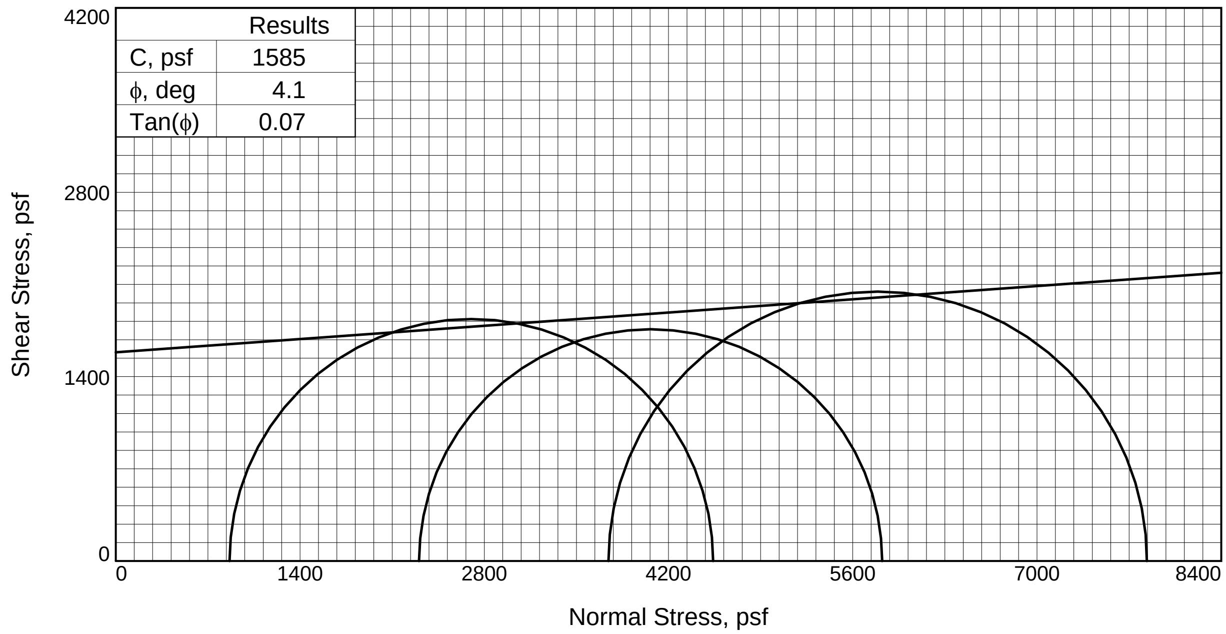
LL	PL	PI
20	**14**	**6**

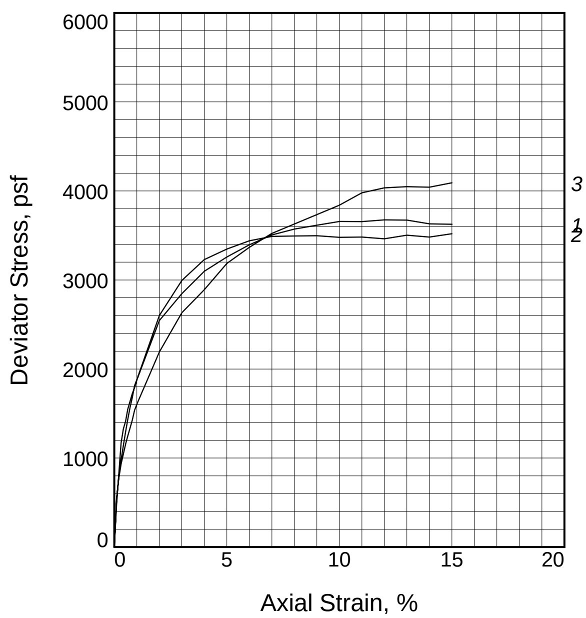
Curves of 100% Saturation
for Specific Gravity Equal to:

2.80

2.70

2.60





Sample No.		1	2	3
Initial	Water Content, %	25.5	24.1	20.0
	Dry Density, pcf	99.9	102.9	111.0
	Saturation, %	95.3	96.6	98.7
	Void Ratio	0.7499	0.6991	0.5632
	Diameter, in.	2.85	2.83	2.83
	Height, in.	5.77	5.75	5.74
At Test	Water Content, %	26.0	25.3	20.7
	Dry Density, pcf	99.9	102.9	111.0
	Saturation, %	97.1	101.4	102.0
	Void Ratio	0.7499	0.6991	0.5632
	Diameter, in.	2.85	2.83	2.83
	Height, in.	5.77	5.75	5.74
Strain rate, in./min.		0.058	0.058	0.057
Back Pressure, psi		5.00	3.00	3.00
Cell Pressure, psi		11.00	19.00	29.00
Fail. Stress, psf		3674	3520	4091
Ult. Stress, psf				
σ_1 Failure, psf		4538	5824	7835
σ_3 Failure, psf		864	2304	3744

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed

Description:

Assumed Specific Gravity= 2.8

Remarks:

Specimen 1: B-1A 7.0'-9.0'

Specimen 2: B-2A 7.0'-9.0'

Specimen 3: B-1A 13.0'-13.9'

Figure ________

Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

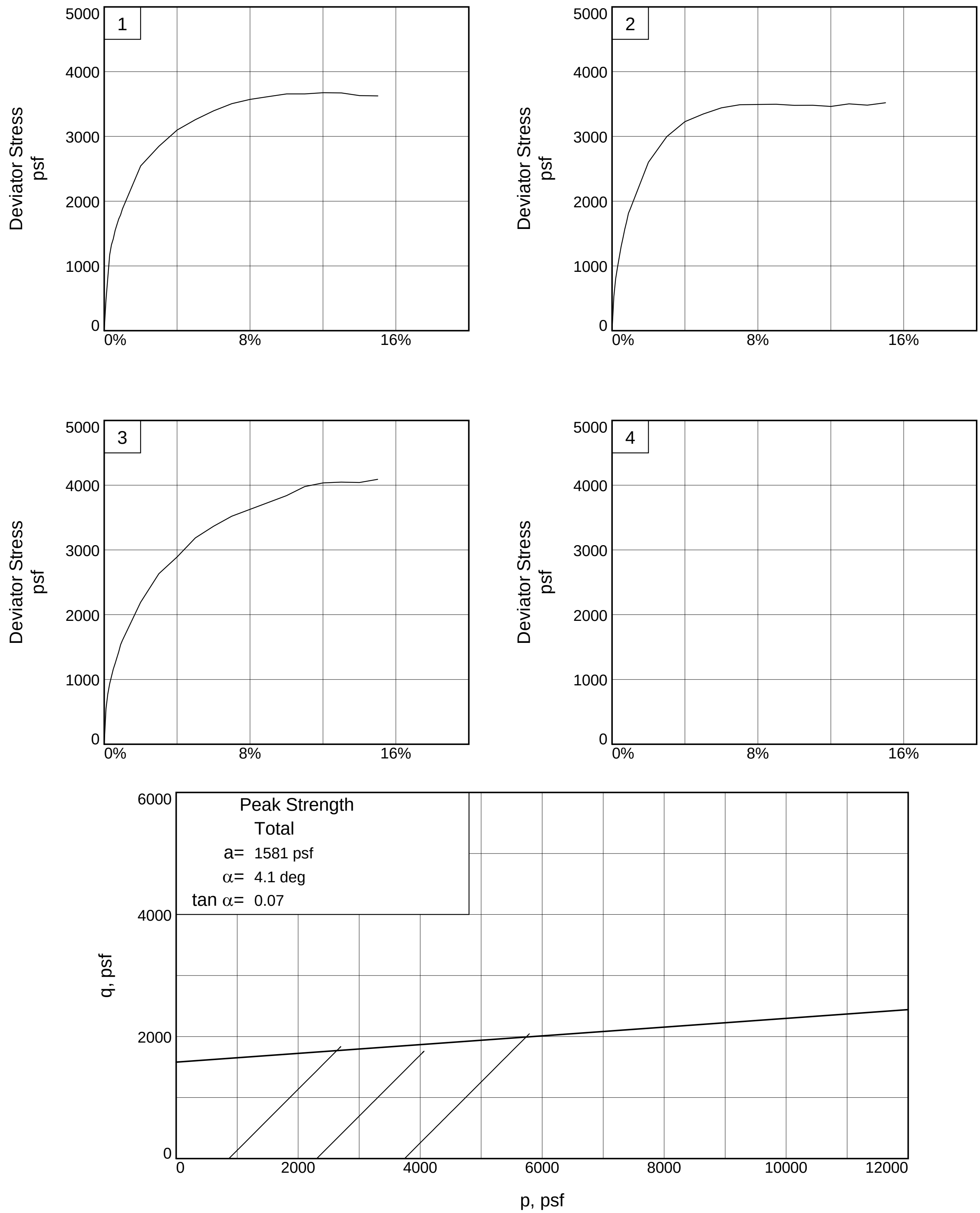
Source of Sample: B-1A, B-2A **Depth:** 7.0' - 9.0' (B-1A, B-2A), 13.0'-13.9' (B-1A)

Sample Number: Set A

Proj. No.: 219-206 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

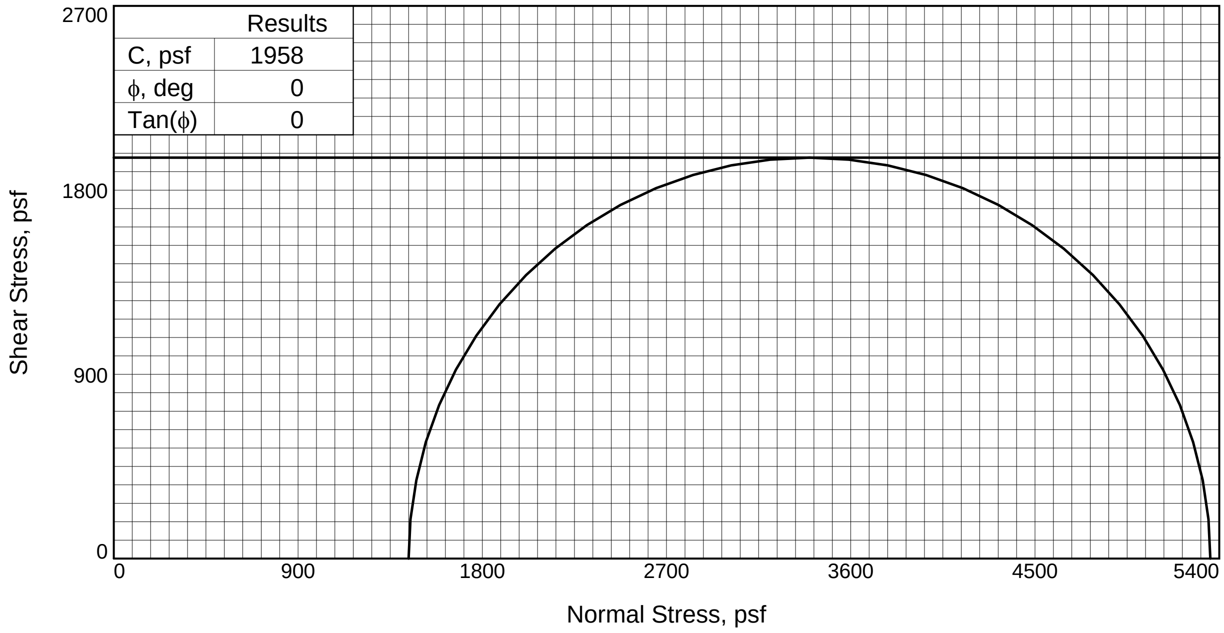
Tested By: KB **Checked By:** DM

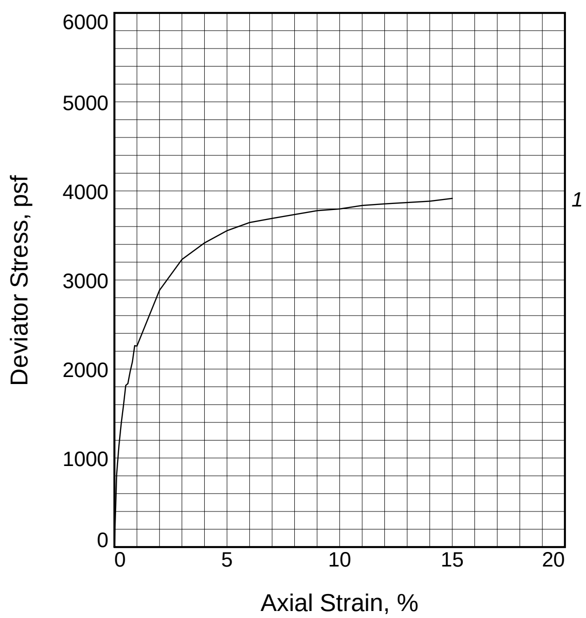


Client: USACE
Project: Task Order No. 15 Loveland, OH Section 14
Source of Sample: UU **Depth:** 7.0' - 9.0' **Sample Number:** Set A
Project No.: 219-206 **Figure** ________ **American Engineers, Inc.**

Tested By: KB **Checked By:** DM

	Results
C, psf	1958
ϕ, deg	0
Tan(ϕ)	0





Sample No.		1
Initial	Water Content, %	23.2
	Dry Density, pcf	104.3
	Saturation, %	97.2
	Void Ratio	0.6644
	Diameter, in.	2.83
	Height, in.	5.75
At Test	Water Content, %	23.4
	Dry Density, pcf	104.3
	Saturation, %	98.0
	Void Ratio	0.6644
	Diameter, in.	2.83
	Height, in.	5.75
Strain rate, in./min.		0.058
Back Pressure, psi		3.00
Cell Pressure, psi		13.00
Fail. Stress, psf		3917
Ult. Stress, psf		
σ_1 Failure, psf		5357
σ_3 Failure, psf		1440

Type of Test:
Unconsolidated Undrained

Sample Type: Undrained

Description:

Assumed Specific Gravity= 2.78

Remarks:
Specimen 1: B-2A (9.0'-11.0')

Figure ________

Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

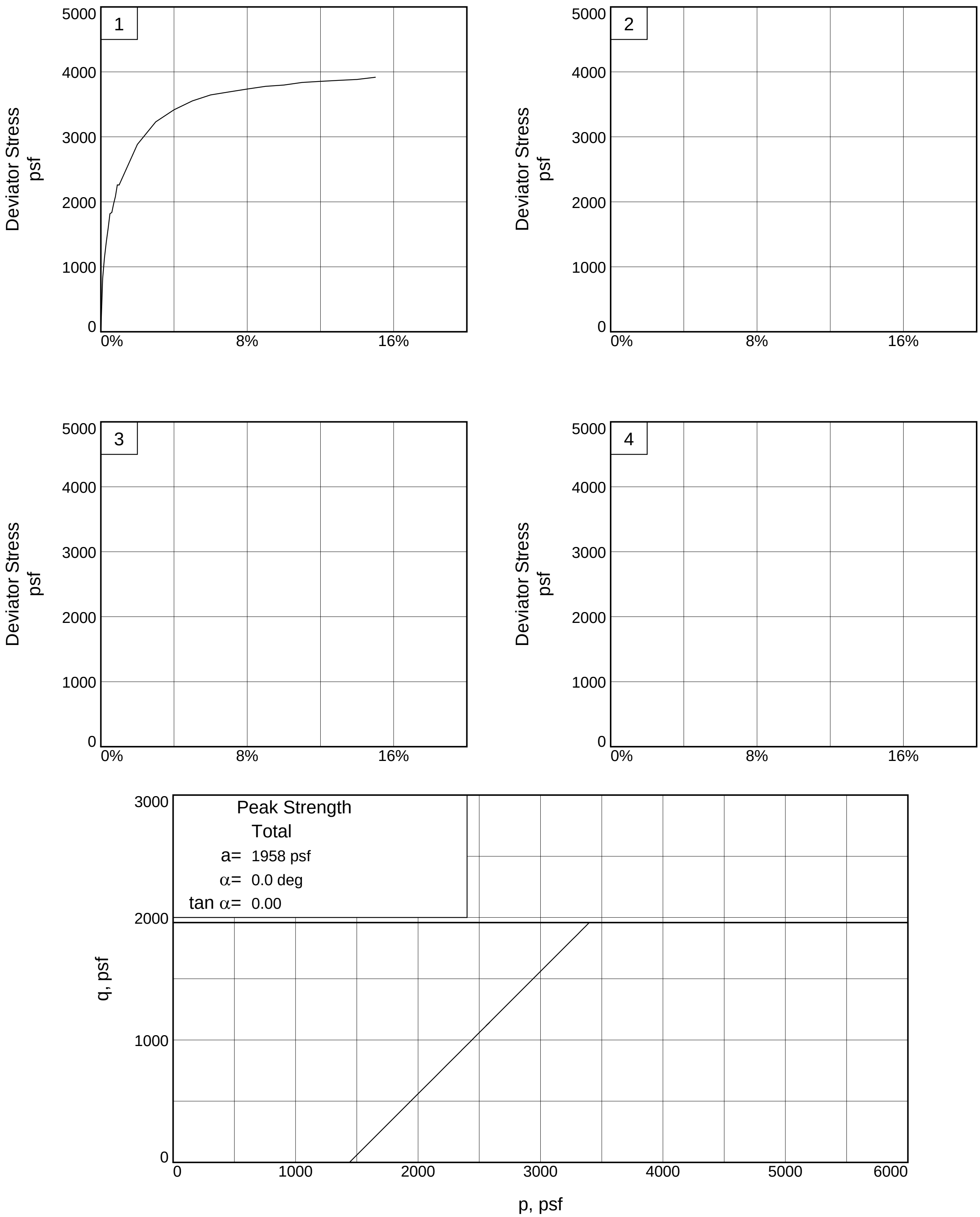
Source of Sample: UU **Depth:** B-2A (9.0'-11.0')

Sample Number: Set B

Proj. No.: 219-206 **Date Sampled:**

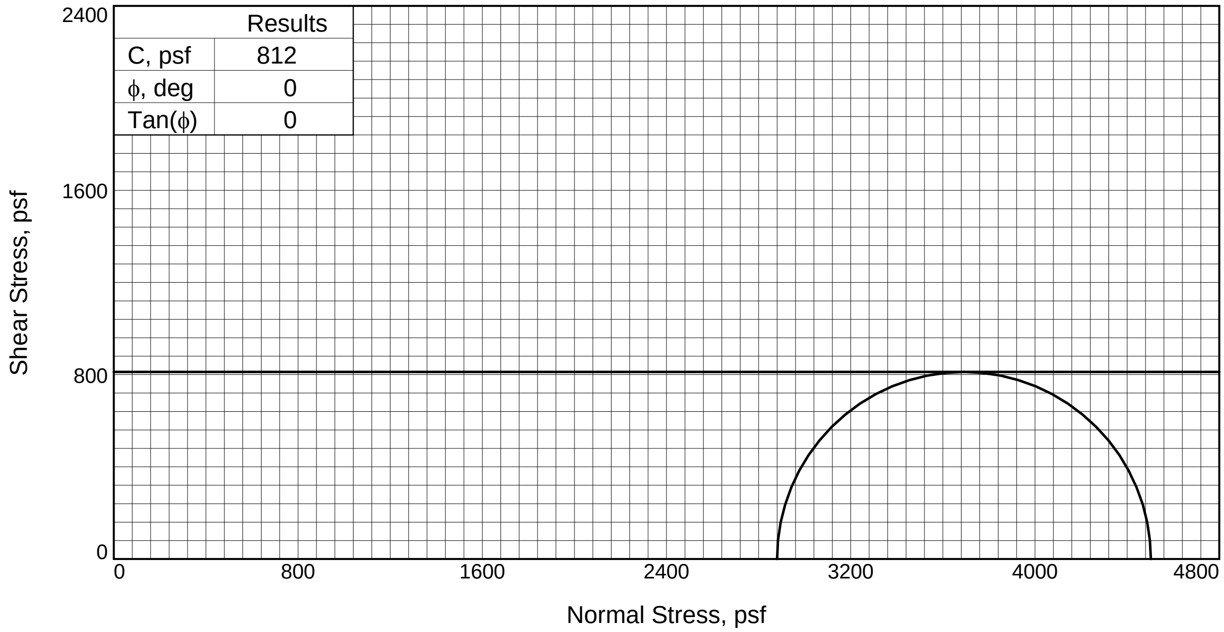
TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

Tested By: KB **Checked By:** DM

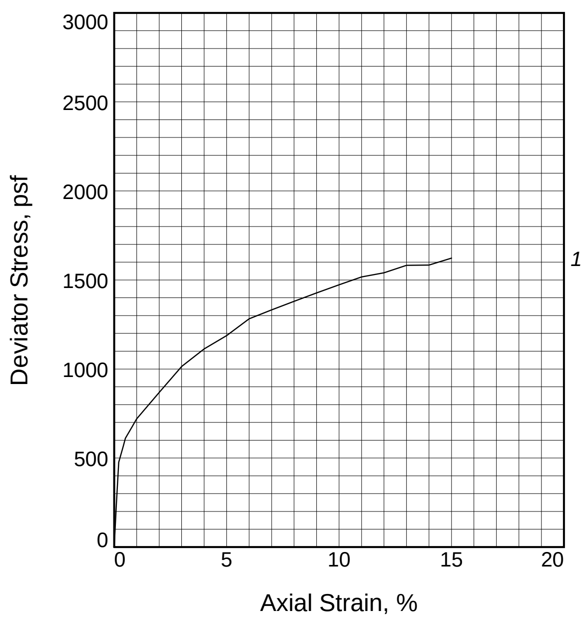


Client: USACE
Project: Task Order No. 15 Loveland, OH Section 14
Source of Sample: UU **Depth:** B-2A (9.0'-11.0') **Sample Number:** Set B
Project No.: 219-206 **Figure** ________ **American Engineers, Inc.**

Tested By: KB **Checked By:** DM



	Results
C, psf	812
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content, %	24.7
	Dry Density, pcf	104.1
	Saturation, %	99.4
	Void Ratio	0.7091
	Diameter, in.	2.84
	Height, in.	5.71
At Test	Water Content, %	24.8
	Dry Density, pcf	104.1
	Saturation, %	99.8
	Void Ratio	0.7091
	Diameter, in.	2.84
	Height, in.	5.71
Strain rate, in./min.		0.057
Back Pressure, psi		3.00
Cell Pressure, psi		23.00
Fail. Stress, psf		1623
Ult. Stress, psf		
σ_1 Failure, psf		4503
σ_3 Failure, psf		2880

Type of Test:
Unconsolidated Undrained
Sample Type: Undrained
Description: lean CLAY

LL= 48 **PL=** 27 **PI=** 21
Assumed Specific Gravity= 2.85
Remarks:
Specimen 2: B-4A (9.0'-11.0')

Figure ________

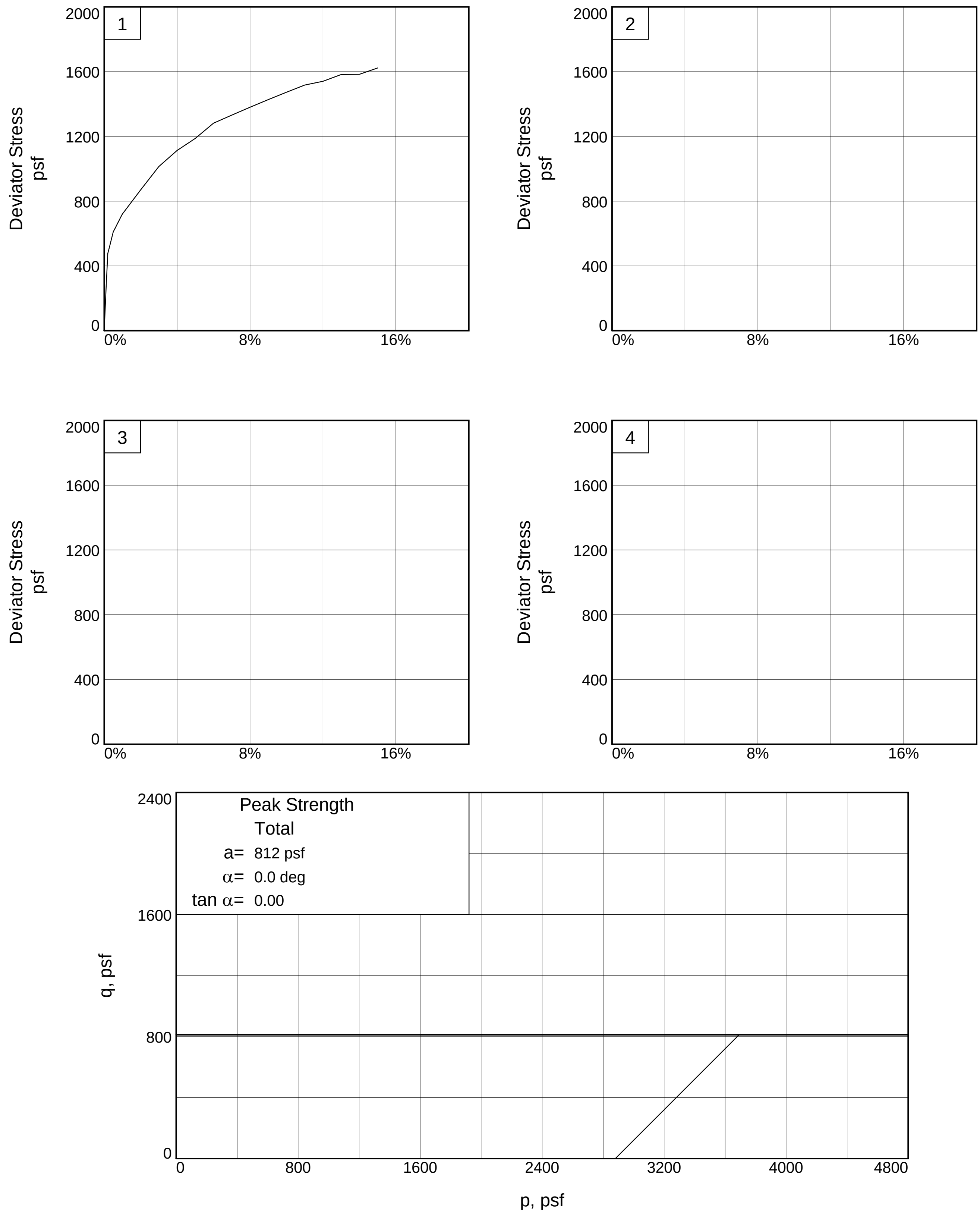
Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

Source of Sample: UU **Depth:** B-4A (9.0'-11.0')
Sample Number: Set B
Proj. No.: 219-206 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

Tested By: KB **Checked By:** DM



Client: USACE

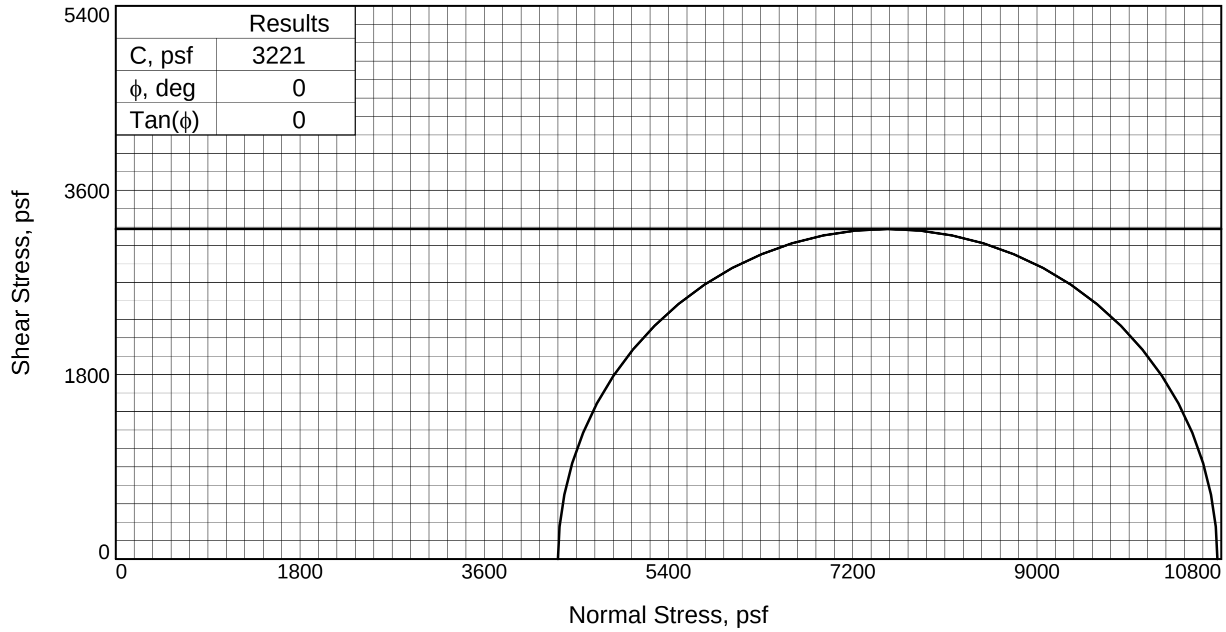
Project: Task Order No. 15 Loveland, OH Section 14

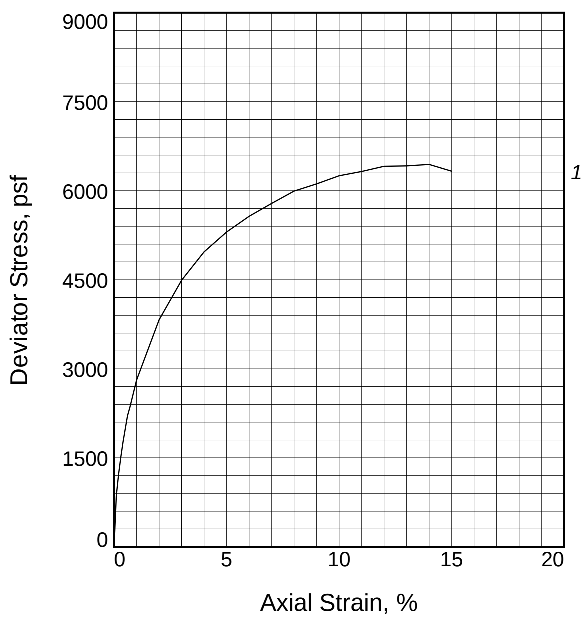
Source of Sample: UU **Depth:** B-4A (9.0'-11.0') **Sample Number:** Set B

Project No.: 219-206 **Figure** ________

American Engineers, Inc.

Tested By: KB **Checked By:** DM





Sample No.		1
Initial	Water Content, %	17.6
	Dry Density, pcf	114.3
	Saturation, %	94.5
	Void Ratio	0.5189
	Diameter, in.	2.84
	Height, in.	5.76
At Test	Water Content, %	18.6
	Dry Density, pcf	114.3
	Saturation, %	99.6
	Void Ratio	0.5189
	Diameter, in.	2.84
	Height, in.	5.76
Strain rate, in./min.		0.058
Back Pressure, psi		3.00
Cell Pressure, psi		33.00
Fail. Stress, psf		6442
Ult. Stress, psf		
σ_1 Failure, psf		10762
σ_3 Failure, psf		4320

Type of Test:
Unconsolidated Undrained
Sample Type: Undrained
Description: lean CLAY

LL= 44 **PL=** 22 **PI=** 22
Assumed Specific Gravity= 2.78
Remarks:
Specimen 3: B-2A (11.0'-13.0')

Figure ________

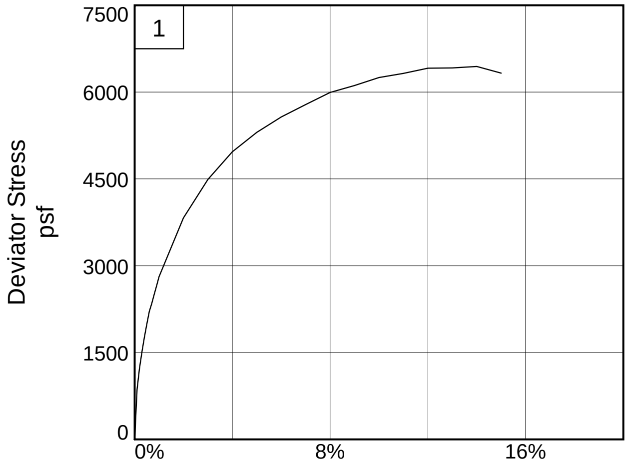
Client: USACE

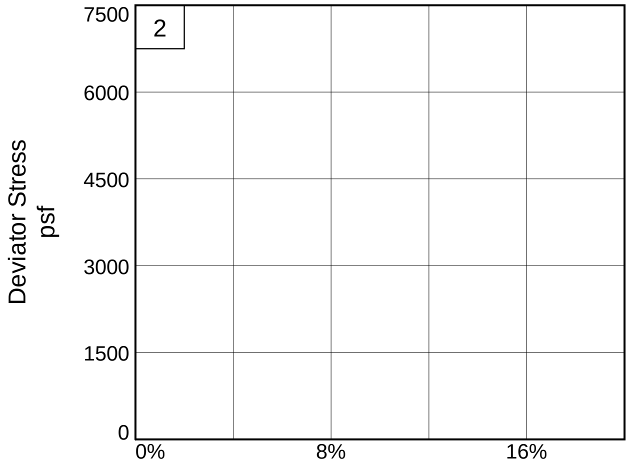
Project: Task Order No. 15 Loveland, OH Section 14

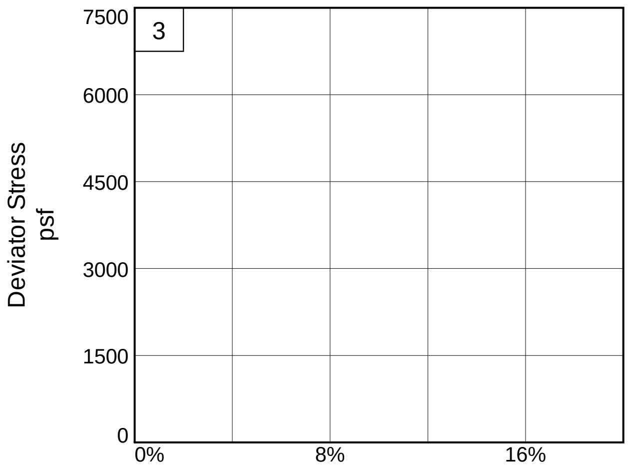
Source of Sample: UU **Depth:** B-2A (11.0'-13.0')
Sample Number: Set B
Proj. No.: 219-206 **Date Sampled:**

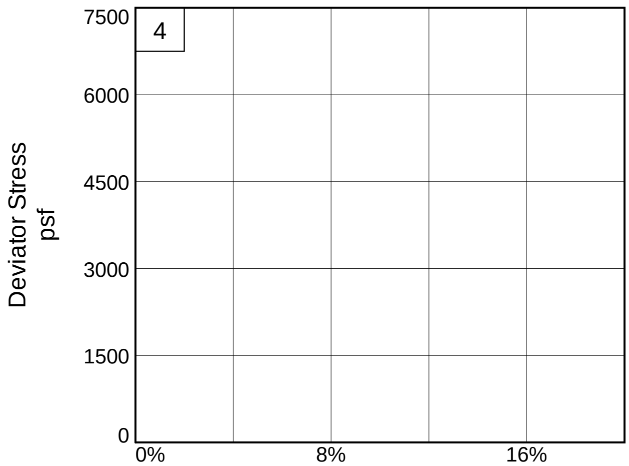
TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

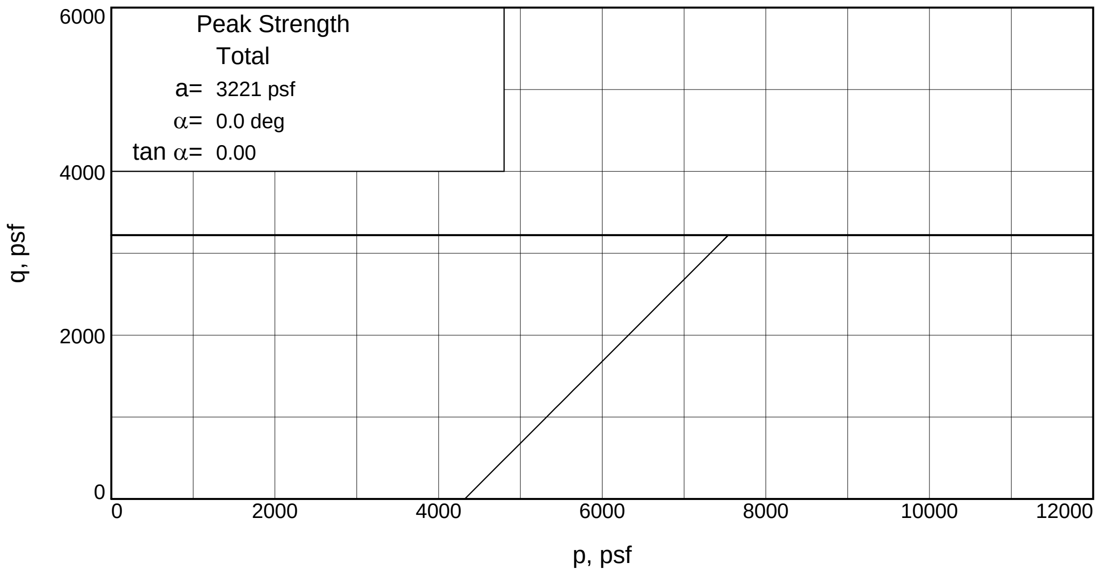
Tested By: KB **Checked By:** DM





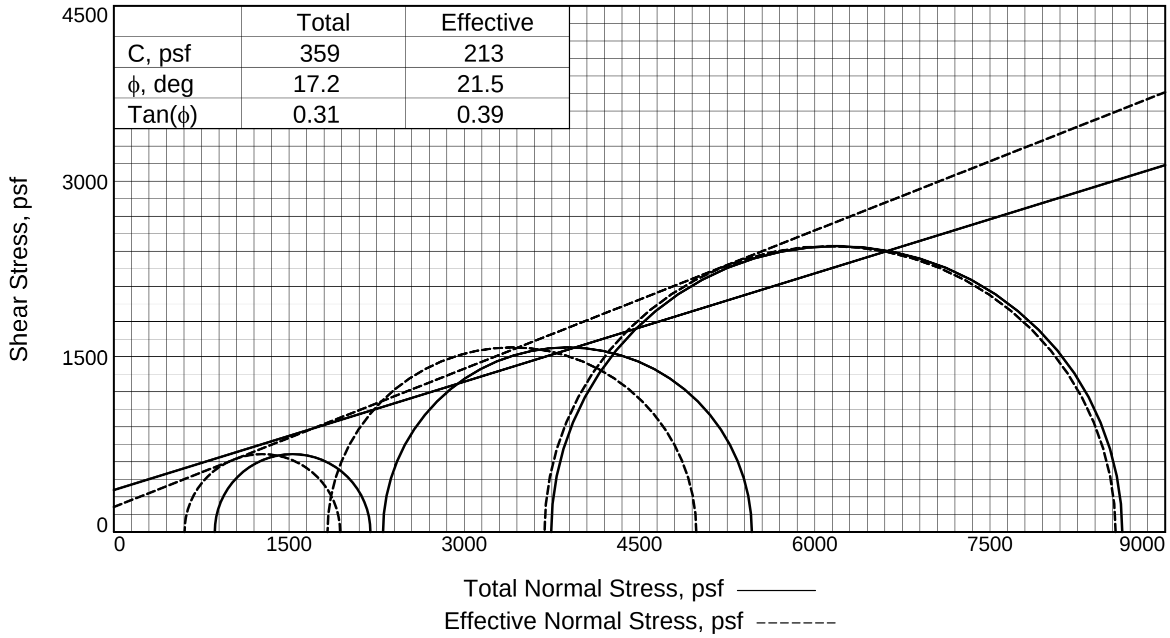




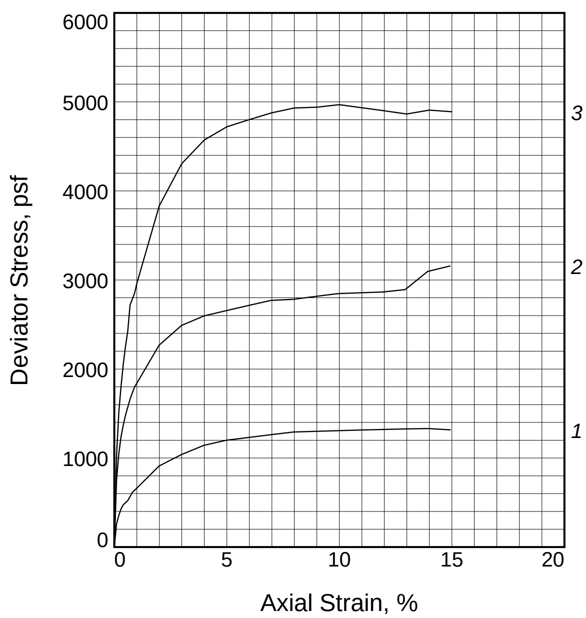


Client: USACE
Project: Task Order No. 15 Loveland, OH Section 14
Source of Sample: UU **Depth:** B-2A (11.0'-13.0') **Sample Number:** Set B
Project No.: 219-206 **Figure** ________ **American Engineers, Inc.**

Tested By: KB **Checked By:** DM



	Total	Effective
C, psf	359	213
ϕ, deg	17.2	21.5
Tan(ϕ)	0.31	0.39



	Sample No.	1	2	3
Initial	Water Content, %	26.2	24.7	23.8
	Dry Density, pcf	99.2	99.6	101.5
	Saturation, %	96.3	91.8	97.5
	Void Ratio	0.7616	0.7547	0.6601
	Diameter, in.	2.78	2.85	2.85
	Height, in.	5.75	5.75	5.74
At Test	Water Content, %	26.7	25.6	22.4
	Dry Density, pcf	100.1	101.8	105.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7470	0.7165	0.6050
	Diameter, in.	2.78	2.83	2.82
	Height, in.	5.74	5.71	5.67
	Strain rate, in./min.	0.002	0.002	0.002
	Back Pressure, psi	30.00	30.00	30.00
	Cell Pressure, psi	36.00	46.00	56.00
	Fail. Stress, psf	1332	3157	4889
	Total Pore Pr., psf	4579	4795	4378
	Ult. Stress, psf	1332	3157	2719
	Total Pore Pr., psf	4579	4795	1670
	$\bar{\sigma}_1$ Failure, psf	1936	4986	8576
	$\bar{\sigma}_3$ Failure, psf	605	1829	3686

Type of Test:
CU with Pore Pressures

Sample Type: UD

Description: lean CLAY

LL= 37 **PL=** 22 **PI=** 15

Specific Gravity= 2.8

Remarks:

Sample 1: B-1A (3.0'-5.0')

Sample 2: B-1A (5.0'-7.0')

Sample 3: B-1A (7.0'-9.0')

Figure ________

Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

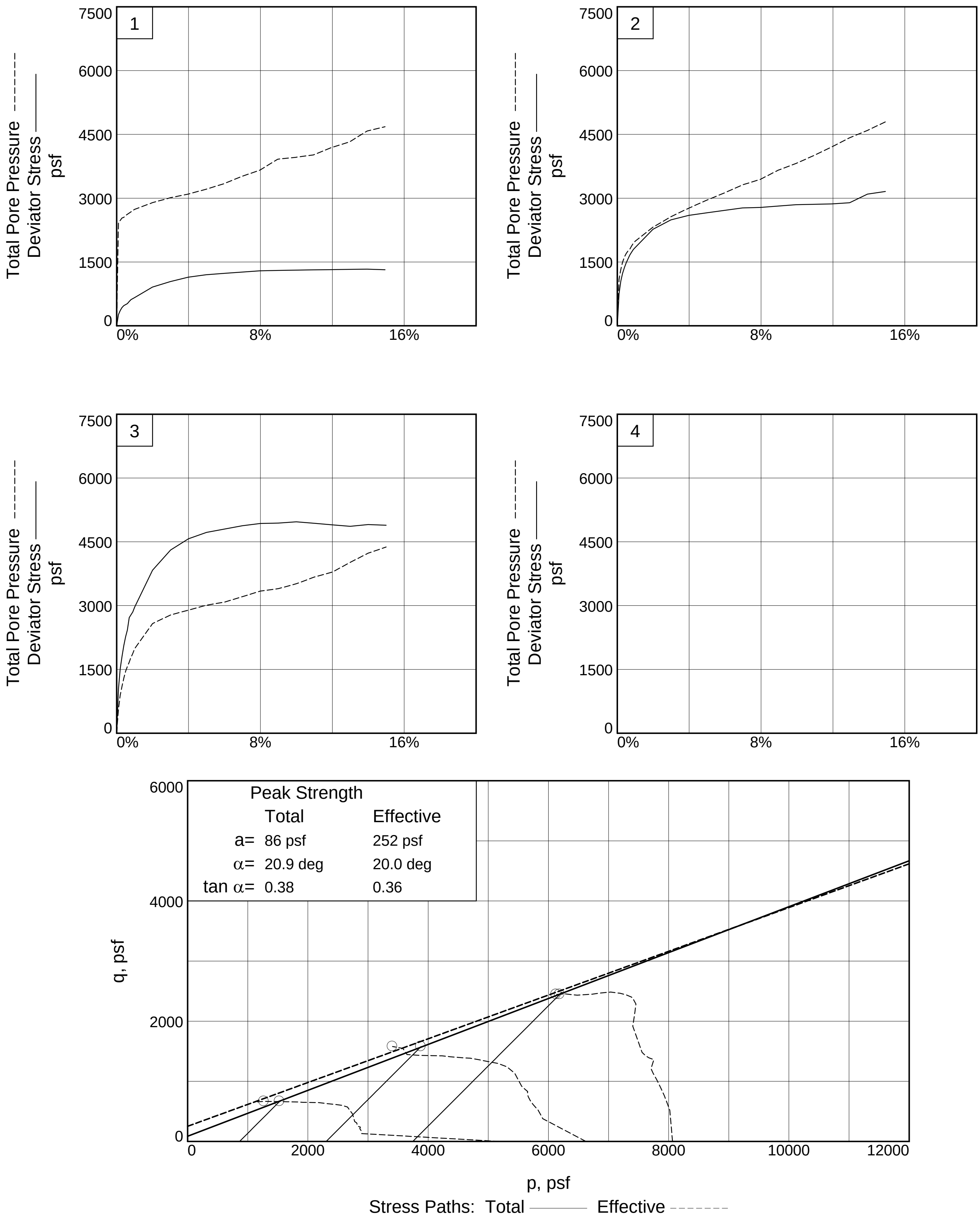
Source of Sample: B-1A **Depth:** 3.0'-9.0'

Sample Number: Set A

Proj. No.: 219-206 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

Tested By: TR **Checked By:** KB



Client: USACE

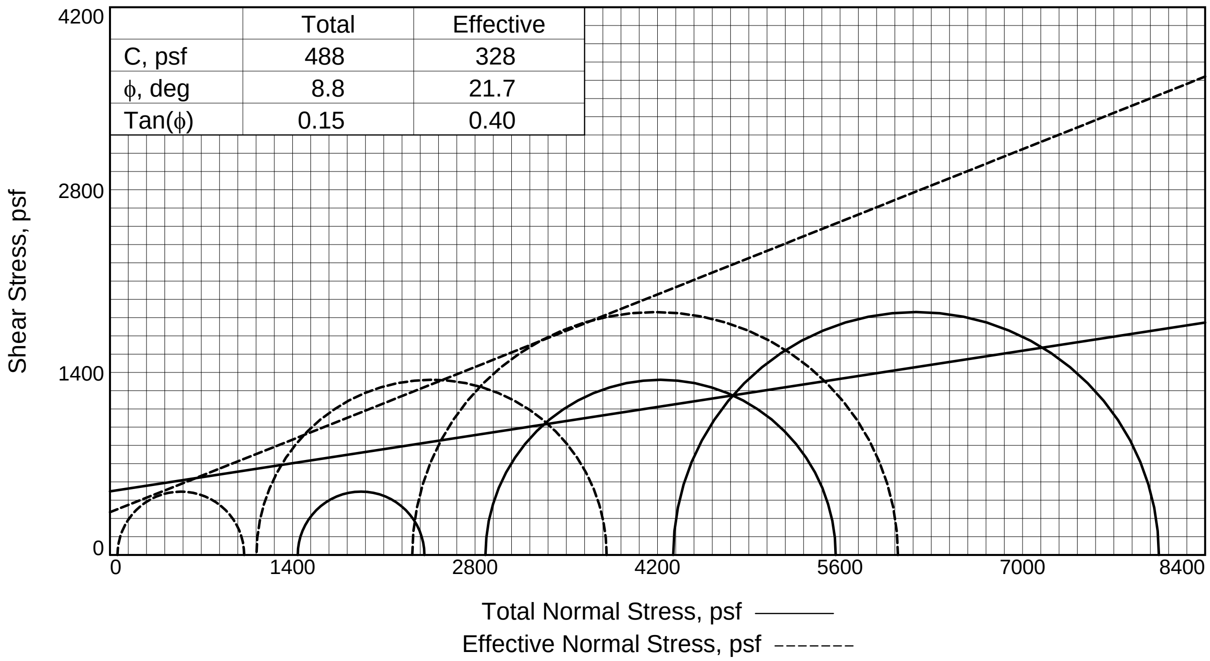
Project: Task Order No. 15 Loveland, OH Section 14

Source of Sample: B-1A **Depth:** 3.0'-9.0' **Sample Number:** Set A

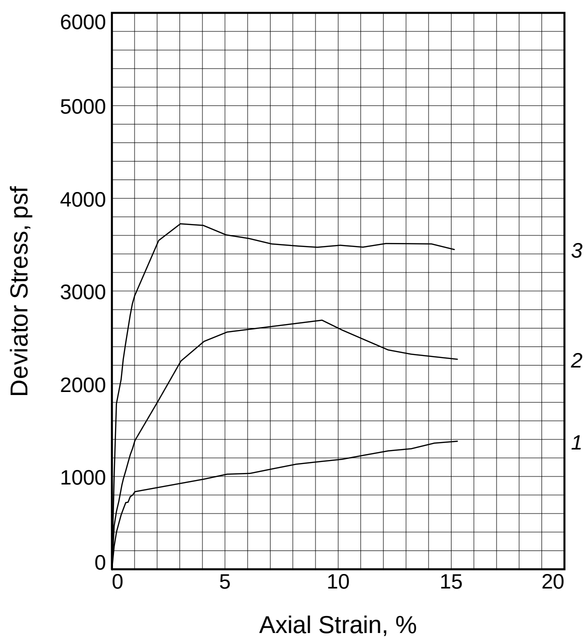
Project No.: 219-206 **Figure** ________

American Engineers, Inc.

Tested By: TR **Checked By:** KB



	Total	Effective
C, psf	488	328
ϕ, deg	8.8	21.7
Tan(ϕ)	0.15	0.40



	Sample No.	1	2	3
Initial	Water Content, %	24.3	22.7	21.7
	Dry Density, pcf	102.5	104.5	106.2
	Saturation, %	96.4	97.1	96.0
	Void Ratio	0.7052	0.6434	0.6276
	Diameter, in.	2.85	2.85	2.86
	Height, in.	5.33	5.64	5.36
At Test	Water Content, %	24.3	22.7	21.7
	Dry Density, pcf	104.1	105.7	107.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6799	0.6248	0.6023
	Diameter, in.	2.85	2.87	2.88
	Height, in.	5.25	5.52	5.20
	Strain rate, in./min.	0.002	0.002	0.002
	Eff. Cell Pressure, psi	10.00	20.00	30.00
	Fail. Stress, psf	971	2686	3726
	Total Pore Pr., psf	7142	6077	6322
	Strain, %	4.1	9.3	3.0
	Ult. Stress, psf	405	2557	3546
	Total Pore Pr., psf	6120	5818	5918
	Strain, %	0.2	5.1	2.1
	$\bar{\sigma}_1$ Failure, psf	1029	3810	6044
	$\bar{\sigma}_3$ Failure, psf	58	1123	2318

Type of Test:
CU with Pore Pressures

Sample Type: lean CLAY

Description:

Assumed Specific Gravity= 2.8

Remarks:

B-1A (9.0'-11.0')

B-1A (9.0'-11.0')

B-4A (9.0'-11.0')

Figure ________

Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

Source of Sample: B-1A, B-4A **Depth:** 9.0'-11.0'

Sample Number: Set B

Proj. No.: 219-206 **Date Sampled:**

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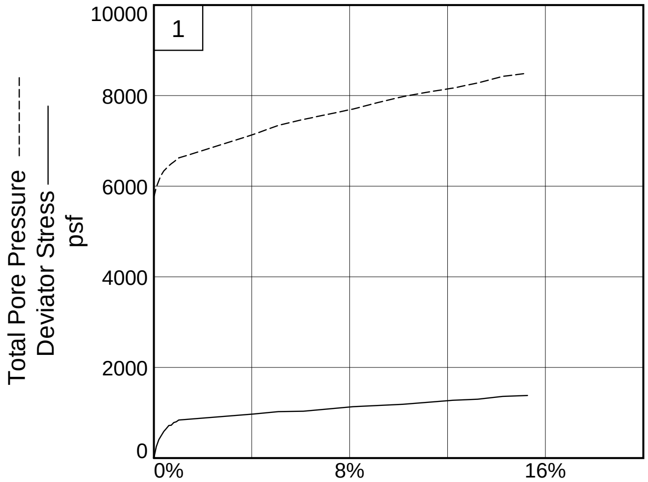
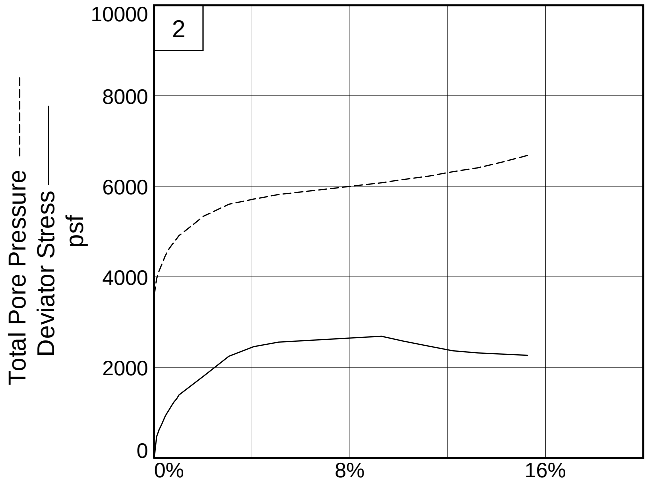
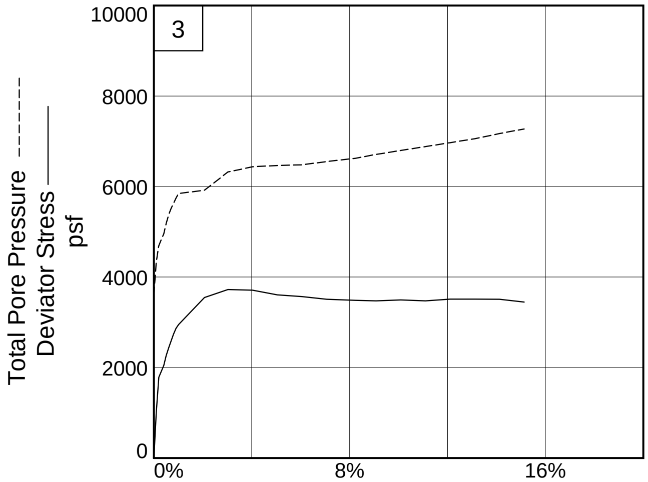
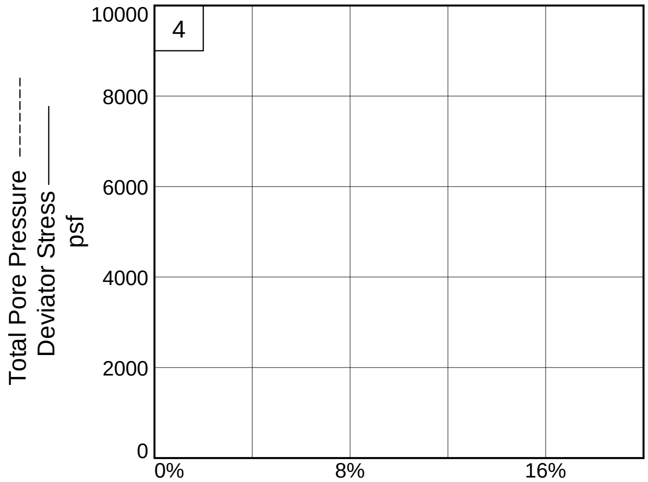
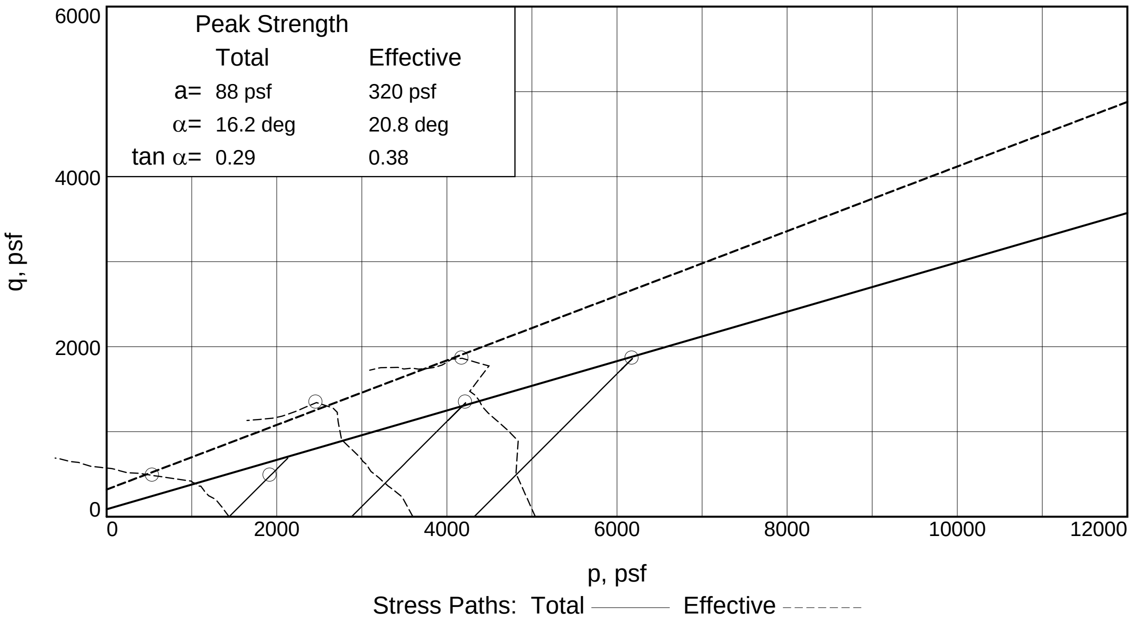
Field Services Center











Client: USACE

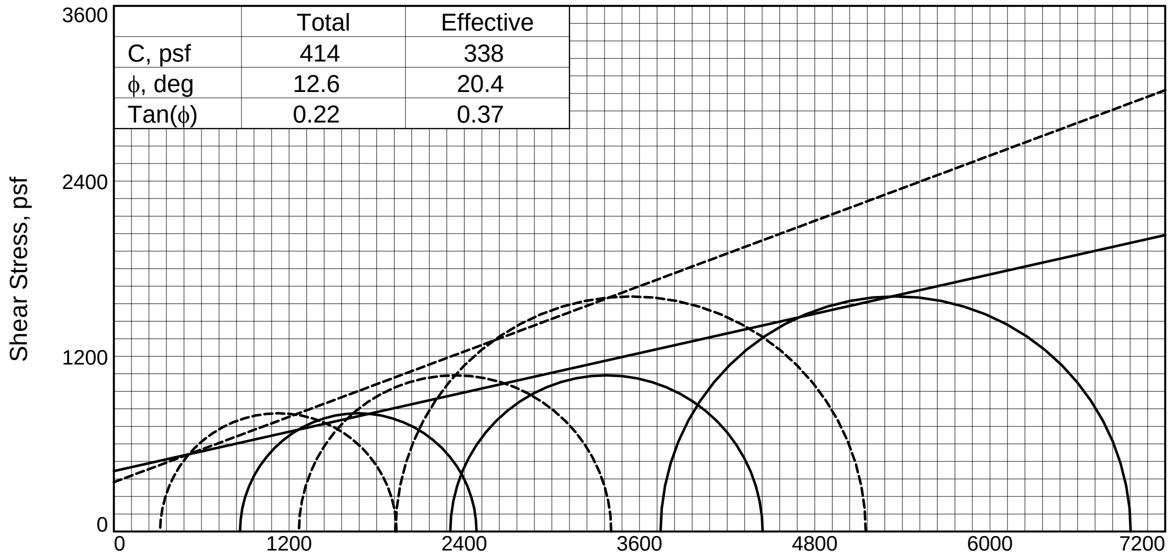
Project: Task Order No. 15 Loveland, OH Section 14

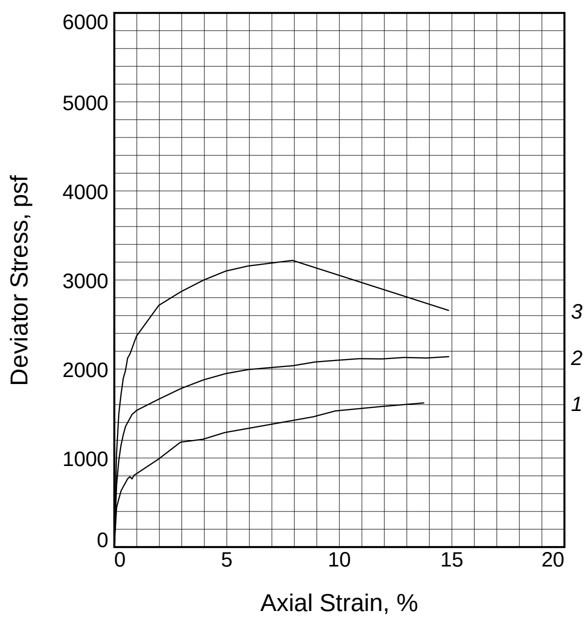
Source of Sample: B-1A **Depth:** 9.0'-11.0' **Sample Number:** Set A

Project No.: 219-206 **Figure** ________

American Engineers, Inc.

	Total	Effective
C, psf	414	338
φ, deg	12.6	20.4
Tan(φ)	0.22	0.37





	Sample No.	1	2	3
Initial	Water Content, %	25.1	27.1	26.4
	Dry Density, pcf	101.1	97.1	99.4
	Saturation, %	96.3	97.1	97.5
	Void Ratio	0.7290	0.7672	0.7582
	Diameter, in.	2.81	2.80	2.83
	Height, in.	5.80	5.77	5.78
At Test	Water Content, %	25.7	25.9	24.5
	Dry Density, pcf	101.6	100.3	103.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7210	0.7116	0.6868
	Diameter, in.	2.80	2.77	2.80
	Height, in.	5.79	5.71	5.70
	Strain rate, in./min.	0.002	0.002	0.002
	Back Pressure, psi	35.00	28.00	14.00
	Cell Pressure, psi	41.00	44.00	40.00
	Fail. Stress, psf	1619	2139	3220
	Total Pore Pr., psf	5587	5069	3830
	Ult. Stress, psf	766	1353	1708
	Total Pore Pr., psf	3341	2074	1109
	$\bar{\sigma}_1$ Failure, psf	1936	3406	5150
	$\bar{\sigma}_3$ Failure, psf	317	1267	1930

Type of Test:
CU with Pore Pressures

Sample Type: UD

Description: lean CLAY

Assumed Specific Gravity= 2.8

Remarks:

Sample 1 - B-2A (3.0'-5.0') ST-1 Bottom

Sample 2 - B-2A (5.0'-7.0') ST-2 Top

Sample 3 - B-2A (5.0'-7.0') ST-2 Bottom

Figure ________

Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

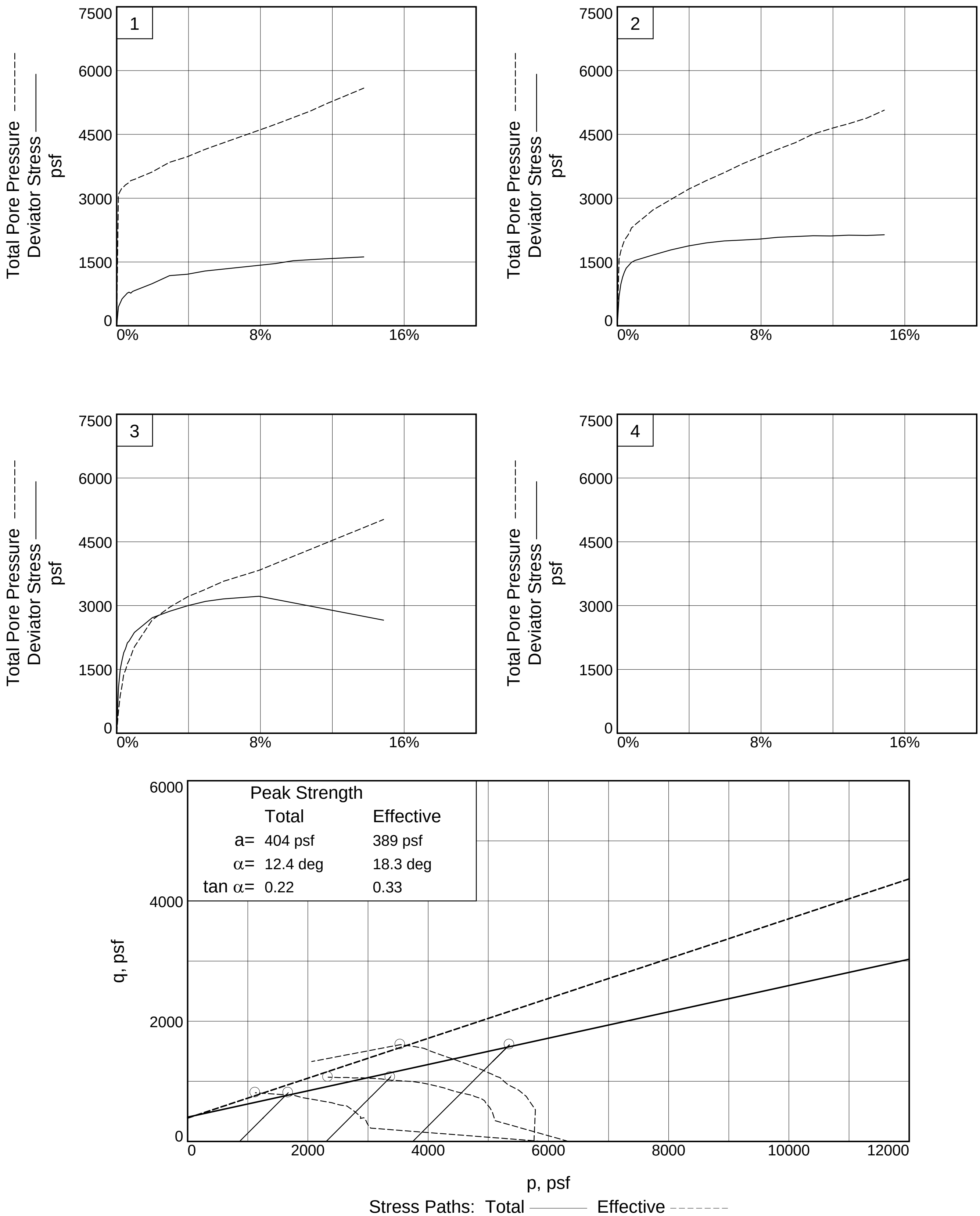
Source of Sample: B-2A **Depth:** 3.0'-7.0'

Sample Number: Set C

Proj. No.: 219-206 **Date Sampled:** 2022/08/06

TRIAXIAL SHEAR TEST REPORT
American Engineers, Inc.
Field Services Center

Tested By: KB **Checked By:** DM



Client: USACE

Project: Task Order No. 15 Loveland, OH Section 14

Source of Sample: B-2A **Depth:** 3.0'-7.0' **Sample Number:** Set C

Project No.: 219-206 **Figure** ________

American Engineers, Inc.

Tested By: KB **Checked By:** DM

ADVANCED TERRA TESTING

Rock Moisture and Density
ASTM D 2216 and ASTM D 7263

CLIENT	American Engineers, Inc.	JOB NO.	3157-001
PROJECT	Loveland, Ohio Section 14	LOCATION	--
PROJECT NO.	219-206		

BORING NO.	B-2	B-3	B-4	
DEPTH	20.5-20.9	20.7-21.4	22.0-22.4	
SAMPLE NO.				
DATE SAMPLED				
DATE TESTED	07/18/22	07/29/22	07/29/22	
TECHNICIAN	HN	HN	HN	
ROCK TYPE				
Mass of Wet Rock and Pan (g):	108.90	230.40	298.50	
Mass of Dry Rock and Pan (g):	98.70	213.18	276.71	
Mass of Pan (g):	6.70	7.30	7.20	
Moisture (%):	**11.09**	**8.36**	**8.09**	
Diameter (in):	1.966	1.875	1.975	
Height (in):	5.503	2.815	3.599	
Mass of Wet Rock (g):	590.10	285.40	412.30	
Wet Density (lbs/ft³):	**134.6**	**139.9**	**142.5**	
Dry Density (lbs/ft³):	**121.1**	**129.1**	**131.8**	
Wet Density (g/cm³):	**2.156**	**2.241**	**2.282**	
Dry Density (g/cm³):	**1.940**	**2.068**	**2.111**	

BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	
Mass of Wet Rock and Pan (g):	
Mass of Dry Rock and Pan (g):	
Mass of Pan (g):	
Moisture (%):	
Diameter (in):	
Height (in):	
Mass of Wet Rock (g):	
Wet Density (lbs/ft³):	
Dry Density (lbs/ft³):	
Wet Density (g/cm³):	
Dry Density (g/cm³):	
NOTES	

Data entry by:	DL	Date:	08/01/22
Checked by:	HN	Date:	08/01/22
File name:	3157001__M and D ASTM D7263_0.xlsm		

ADVANCED TERRA TESTING

Rock Direct Shear

ASTM D 5607

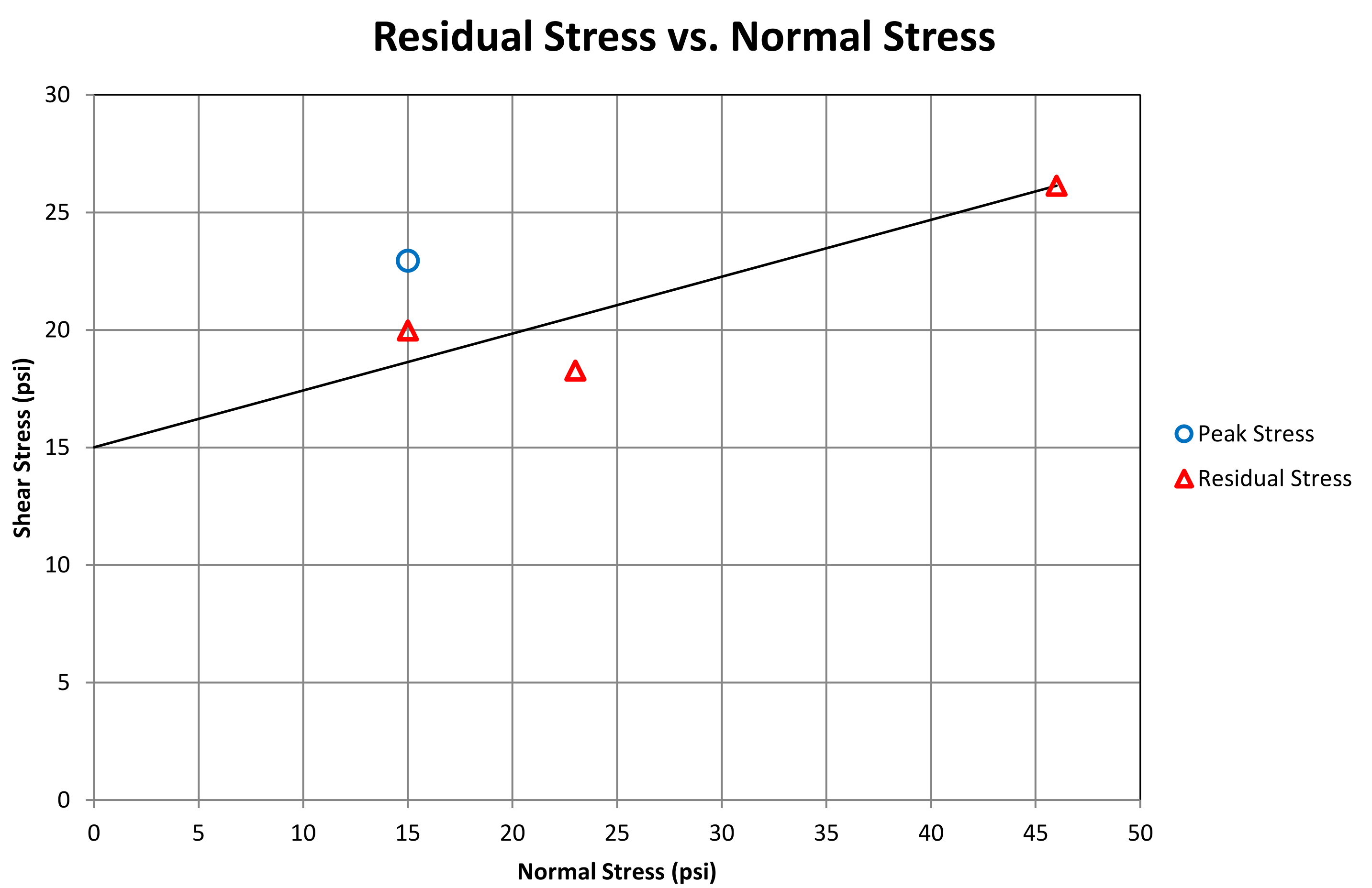
CLIENT	American Engineers, Inc.	BORING NO.	B-2
JOB NO.	3157-001	DEPTH	20.5-20.9
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	07/19/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Direct Shear Results

Point:	A	B	C
Normal Stress (psi):	15.0	23.0	46.0
Normal Stress (kPa):	103	159	317
Residual Shear Stress (psi):	20.0	18.3	26.1
Residual Shear Stress (kPa):	138	126	180
Peak Strength (psi):	22.9		
Peak Strength (kPa):	158		

Residual Stress

Friction Angle (°):	13.0
Cohesion (psi):	15.0
Cohesion (kPa):	103



Data entry by:	HN	Date:	07/19/22
Checked by:	DL	Date:	07/20/22
File name:	3157001__Rock Direct Shear ASTM D5607_0.xlsm	Page 1 of 2	

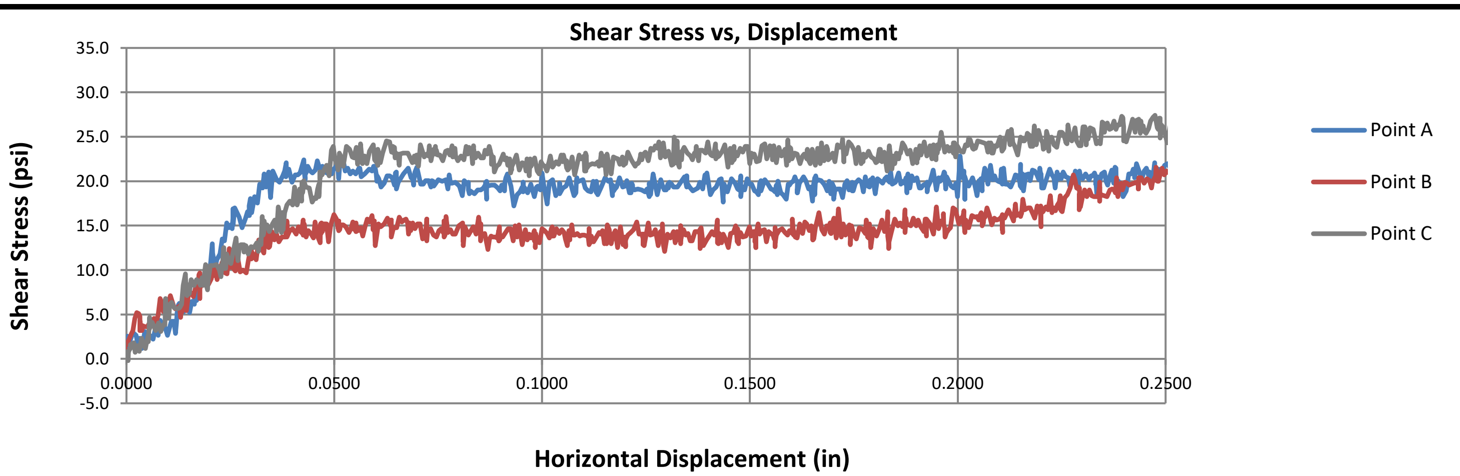
Rock Direct Shear

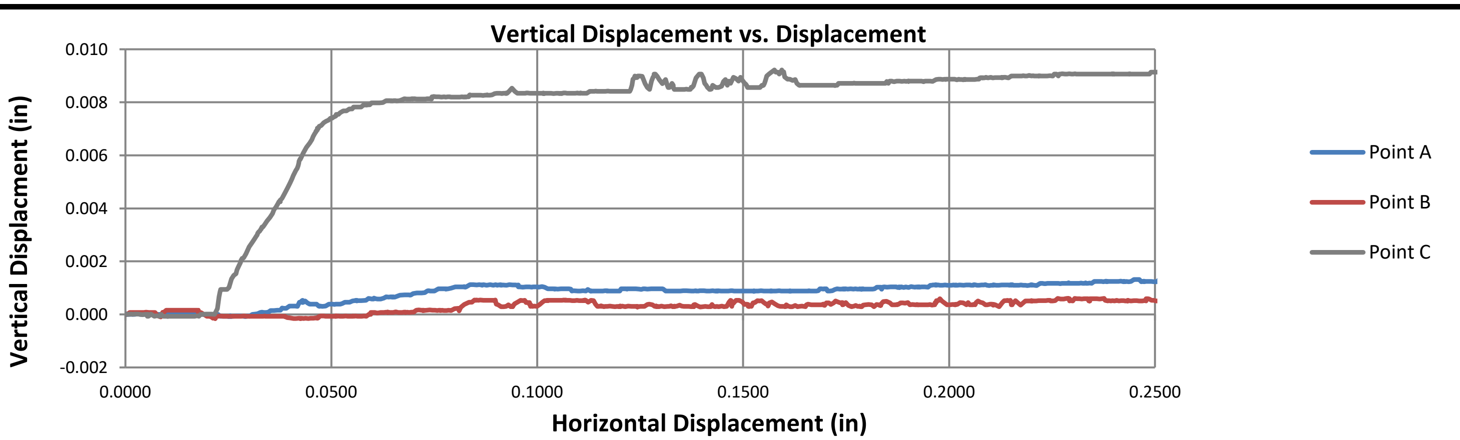
ASTM D 5607

CLIENT	American Engineers, Inc.	BORING NO.	B-2
JOB NO.	3157-001	DEPTH	20.5-20.9
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	07/19/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Test Parameters

Raw Data Files:	20run1.txt, 20run2.txt, 20run3.txt, FALSE
Diameter (in):	1.966
Height (in):	--
Mass (g):	484.1
Density (pcf):	--
Density (g/cm³):	--
Angle of Shear Plane (°):	--
Shear Plane Area (in²):	3.036





NOTES:	Uneven and partially broken shear area.

File name: 3157001__Rock Direct Shear ASTM D5607_0.xlsm

Rock Direct Shear
ASTM D5607

CLIENT	American Engineers, Inc.	BORING NO.	B-2
JOB NO.	3157-001	DEPTH	20.5-20.9
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	07/19/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture

NOTES	Uneven and partially broken shear area.

Picture File: 1.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_0.xlsm

Rock Direct Shear
ASTM D6507

CLIENT	American Engineers, Inc.	BORING NO.	B-2
JOB NO.	3157-001	DEPTH	20.5-20.9
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	07/19/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

NOTES	Uneven and partially broken shear area.

Picture File: 1a.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_0.xlsm

Rock Direct Shear

ASTM D 5607

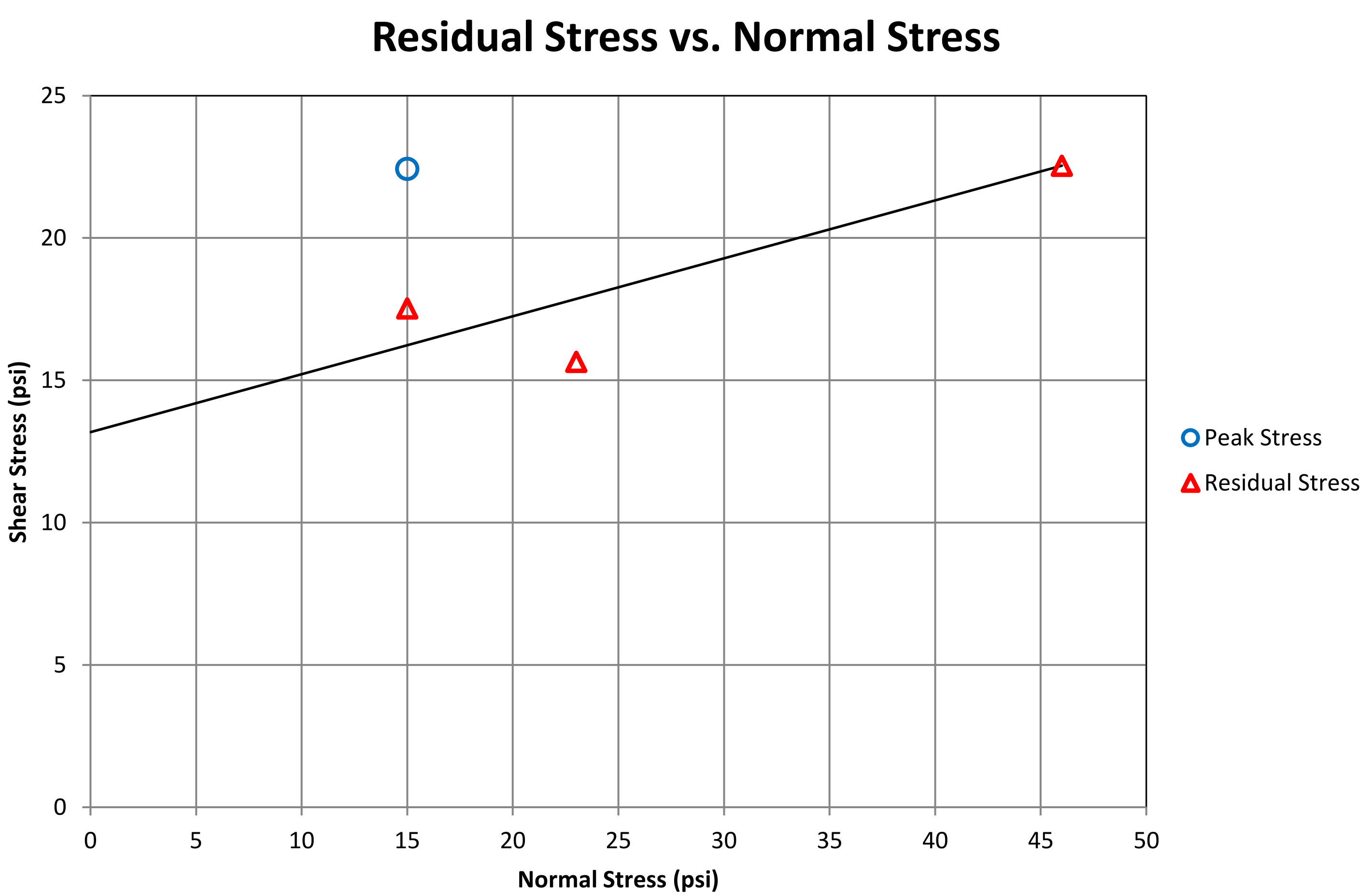
CLIENT	American Engineers, Inc.	BORING NO.	B-3
JOB NO.	3157-001	DEPTH	22.0-22.4
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	08/02/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Direct Shear Results

Point:	A	B	C
Normal Stress (psi):	15.0	23.0	46.0
Normal Stress (kPa):	103	159	317
Residual Shear Stress (psi):	17.5	15.7	22.5
Residual Shear Stress (kPa):	121	108	155
Peak Strength (psi):	22.4		
Peak Strength (kPa):	155		

Residual Stress

Friction Angle (°):	10.9
Cohesion (psi):	13.2
Cohesion (kPa):	91



Data entry by:	HN	Date:	08/02/22
Checked by:	DL	Date:	08/02/22
File name:	3157001__Rock Direct Shear ASTM D5607_2.xlsm	Page 1 of 2	

Rock Direct Shear

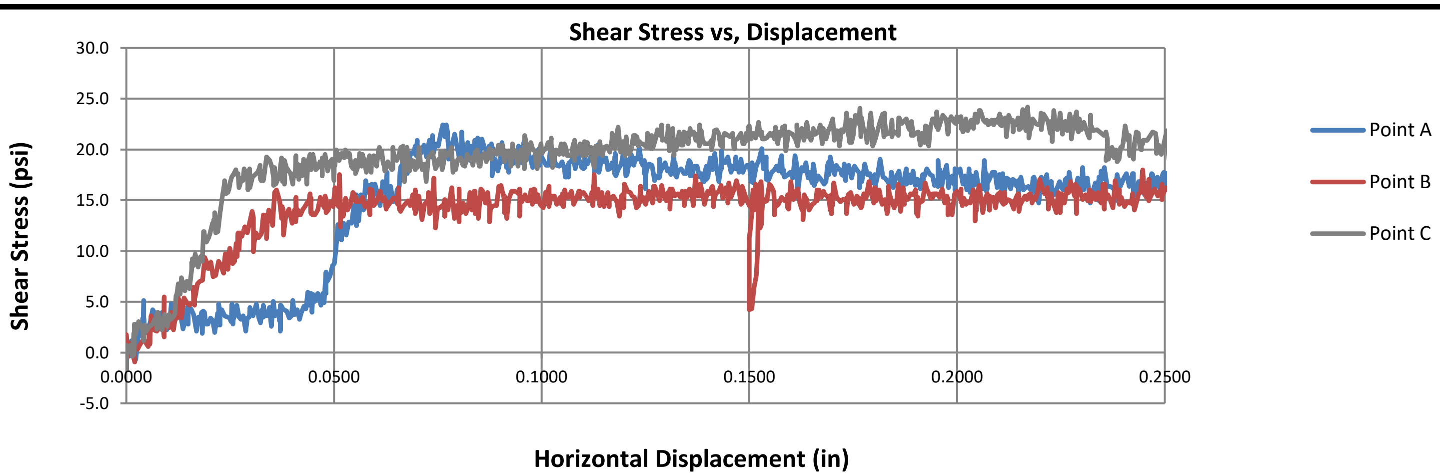
ASTM D 5607

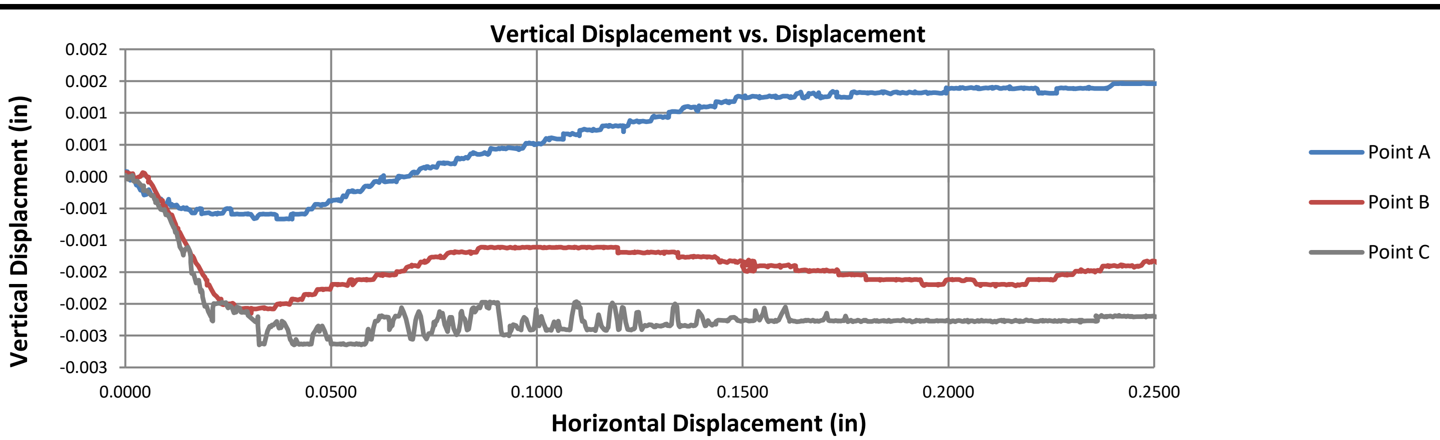
ADVANCED TERRA TESTING

CLIENT	American Engineers, Inc.	BORING NO.	B-3
JOB NO.	3157-001	DEPTH	22.0-22.4
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	08/02/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Test Parameters

Raw Data Files:	22run1.txt, 22run2.txt, 22run3.txt, FALSE
Diameter (in):	1.875
Height (in):	2.815
Mass (g):	285.4
Density (pcf):	139.9
Density (g/cm³):	2.241
Angle of Shear Plane (°):	--
Shear Plane Area (in²):	2.761





NOTES:	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

File name: 3157001__Rock Direct Shear ASTM D5607_2.xlsm

ADVANCED TERRA TESTING

Rock Direct Shear
ASTM D5607

CLIENT	American Engineers, Inc.	BORING NO.	B-3
JOB NO.	3157-001	DEPTH	22.0-22.4
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	08/02/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture

NOTES	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

Picture File: 3.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_2.xlsm

ADVANCED TERRA TESTING

Rock Direct Shear
ASTM D6507

CLIENT	American Engineers, Inc.	BORING NO.	B-3
JOB NO.	3157-001	DEPTH	22.0-22.4
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	08/02/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

NOTES	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

Picture File: 3a.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_2.xlsm

Rock Direct Shear

ASTM D 5607

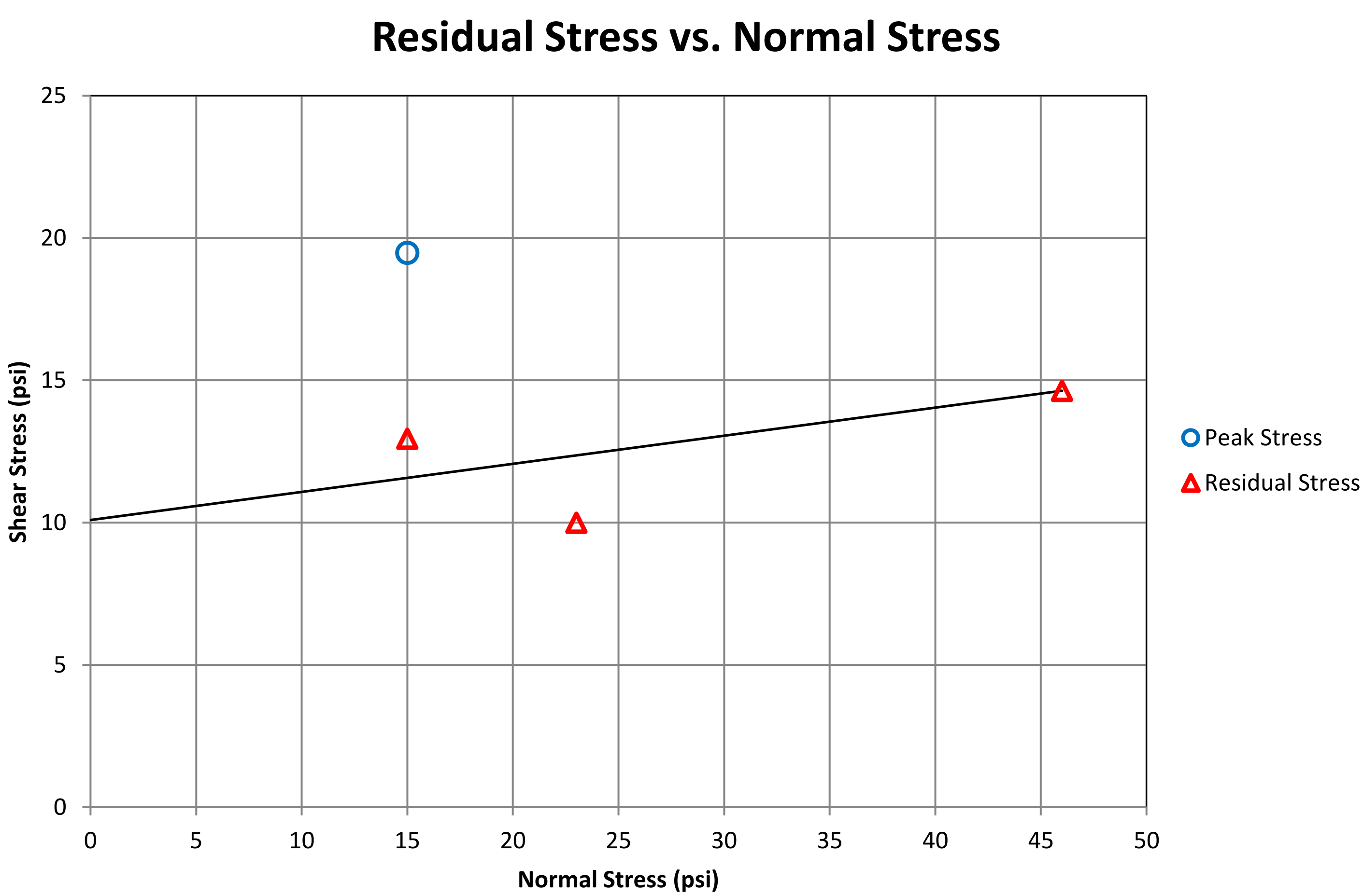
CLIENT	American Engineers, Inc.	BORING NO.	B-4
JOB NO.	3157-001	DEPTH	20.7-21.3
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	07/25/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Direct Shear Results

Point:	A	B	C
Normal Stress (psi):	15.0	23.0	46.0
Normal Stress (kPa):	103	159	317
Residual Shear Stress (psi):	12.9	10.0	14.6
Residual Shear Stress (kPa):	89	69	101
Peak Strength (psi):	19.5		
Peak Strength (kPa):	134		

Residual Stress

Friction Angle (°):	5.0
Cohesion (psi):	10.1
Cohesion (kPa):	70



Data entry by:	HN	Date:	07/25/22
Checked by:	DL	Date:	07/26/22
File name:	3157001__Rock Direct Shear ASTM D5607_1.xlsm	Page 1 of 2	

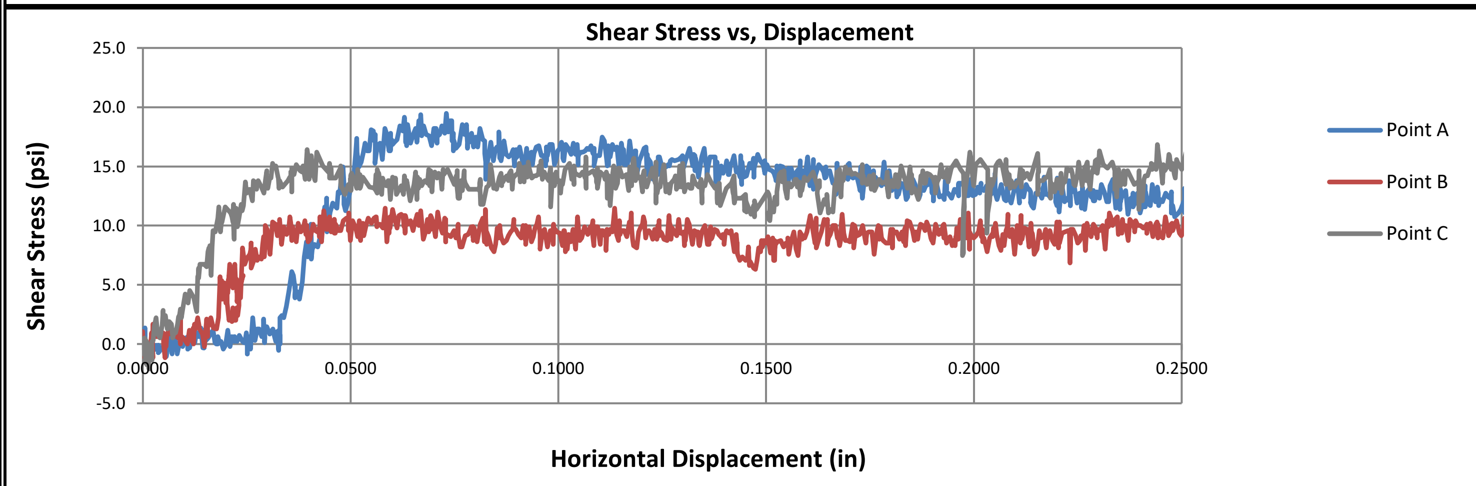
Rock Direct Shear

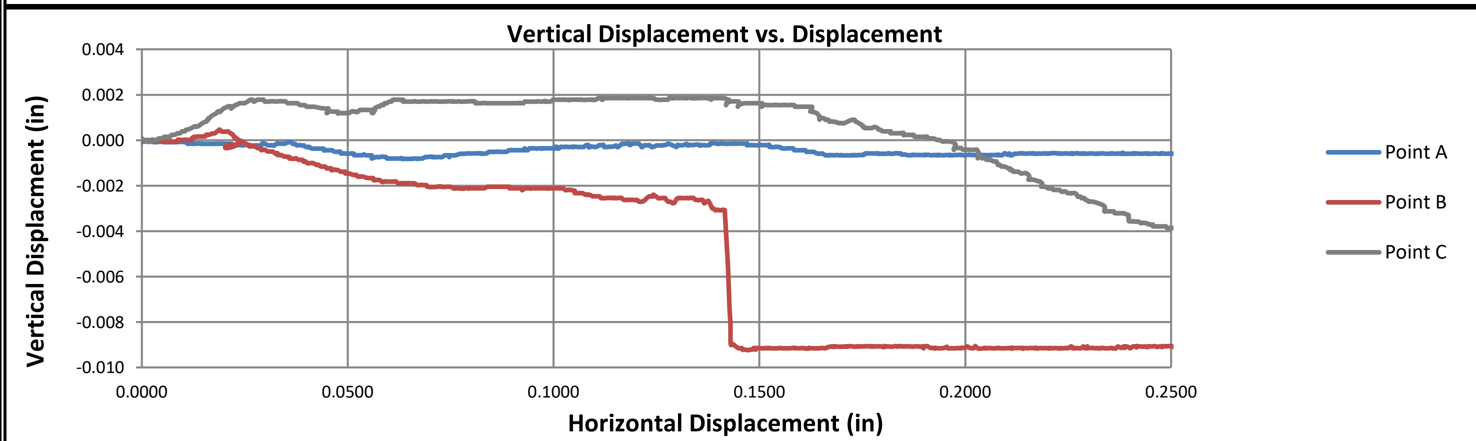
ASTM D 5607

CLIENT	American Engineers, Inc.	BORING NO.	B-4
JOB NO.	3157-001	DEPTH	20.7-21.3
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	ROCK TYPE	--
DATE TESTED	07/25/22		
TECHNICIAN	HN	JOINT TYPE	Intact

Test Parameters

Raw Data Files:	207run1.txt, 207run2.txt, 207run3.txt, FALSE
Diameter (in):	1.975
Height (in):	3.599
Mass (g):	412.3
Density (pcf):	142.5
Density (g/cm³):	2.282
Angle of Shear Plane (°):	--
Shear Plane Area (in²):	3.06





NOTES:	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

File name: 3157001__Rock Direct Shear ASTM D5607_1.xlsm

Rock Direct Shear
ASTM D5607

CLIENT	American Engineers, Inc.	BORING NO.	B-4
JOB NO.	3157-001	DEPTH	20.7-21.3
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	07/25/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture

NOTES	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

Picture File: 2.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_1.xlsm

Rock Direct Shear
ASTM D6507

CLIENT	American Engineers, Inc.	BORING NO.	B-4
JOB NO.	3157-001	DEPTH	20.7-21.3
PROJECT	Loveland, Ohio Section 14	SAMPLE NO.	--
PROJECT NO.	219-206	DATE SAMPLED	--
LOCATION	--	DATE TESTED	07/25/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

NOTES	Due to client's request specimen has been wet during the tests. Uneven broken, wet shear area.

Picture File: 2a.JPG
File name: 3157001__Rock Direct Shear ASTM D5607_1.xlsm

2.26. Attachment K- Calculations

Attachment K: Calculations

Seismic Design Coefficients
CU-UU Lab Testing Analyses
Slope Stability Analyses

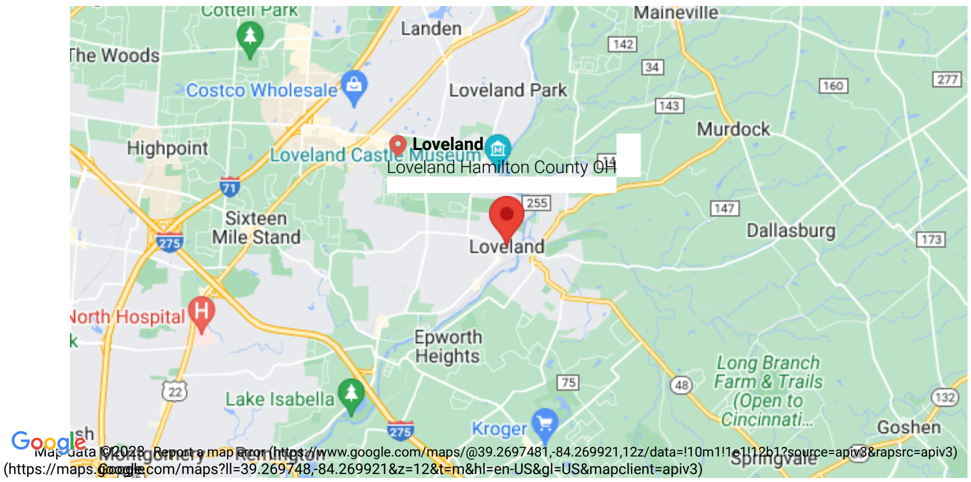
Structural Load Data Tool For UFC 3-301-01

U.S. Address Loveland, OH, USA

SEISMIC DATA ATTRIBUTES

Latitude, Longitude	(39.2689476, -84.26382600000001)
Reference	2016 ASCE 7 Standard
Risk Category	Risk Category II
Site Soil Class	Site Class D – 'Stiff Soil'

Submit Reset



(https://maps.google.com/maps?ll=39.269748,-84.269921&z=12&t=m&hl=en-US&gl=US&mapclient=apiv3)

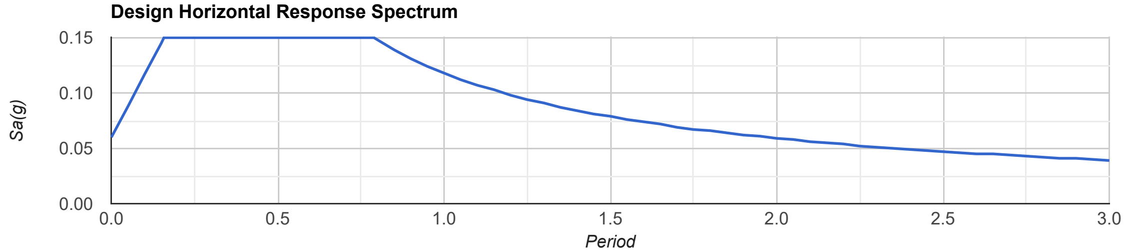
Loveland, OH, USA

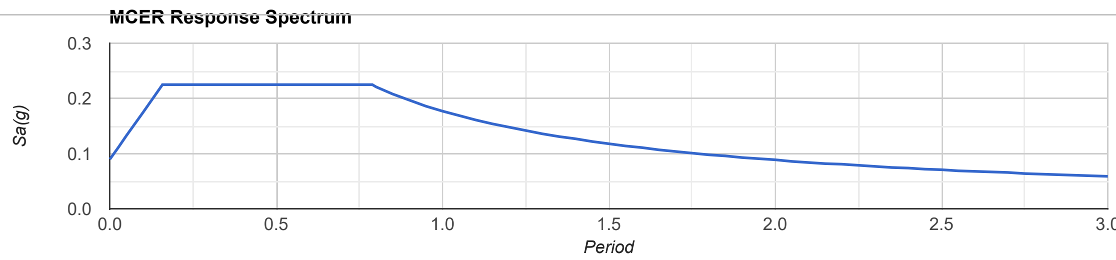
Latitude / Longitude 39.2689476, -84.26382600000001

SEISMIC DATA (SITE CLASS D)

PGA (%G)	**S_S (%G)**	**S_1 (%G)**	**S_{MS} (%G)**	**S_{M1} (%G)**
7	14	7.4	22.5	17.7

Design Horizontal Response Spectrum




MCER Response Spectrum
Sa(g)
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Period

Consolidated Undrained Triaxial Test Results for Low Plasticity Clay (CL) Soil

Effective Stress

B-1A 3.0-5.0		**CU SET A**		
Specimen	**1**	**2**	**3**	
p'	1270.5			
q	665.5			
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
--	--	--	--	FILL (Sandy Lean Clay)
B-1A 5.0-7.0		**CU SET A**		
Specimen	**1**	**2**	**3**	
p'	3407.5			
q	1578.5			
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CL	32	21	11	FILL (Sandy Lean Clay)
B-1A 7.0-9.0		**CU SET A**		
Specimen	**1**	**2**	**3**	
p'	7035			
q	2485			
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CL	37	22	15	CL
B-2A 3.0-5.0		**CU SET C**		
Specimen	**1**	**2**	**3**	
p'	1126.5			
q	809.5			
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CL	29	17	12	FILL (Sandy Lean Clay)
B-2A 5.0-7.0		**CU SET C**		
Specimen	**1**	**2**	**3**	
p'	2336.5	3540		
q	1069.5	1610		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CL	31	17	14	CL
B-4A 9.0-11.0		**CU SET B**		
Specimen	**1**	**2**	**3**	
p'	4181			
q	1863			
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CL	48	27	21	CL
B-1A 9.0-11.0		**CU SET B**		
Specimen	**1**	**2**	**3**	
p'	-606	2466.5		
q	690	1343.5		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**Field Classification**
CH	54	22	32	CH

Best Fit Line

q = 0.3107p' + 423.9

q = 0.3107p' + 423.9 (adjust for a minimum of 2/3 of points above the line)

p'	q	
0	200	d = 200
8000	3400	ψ = 21.8

Strength Paramenters

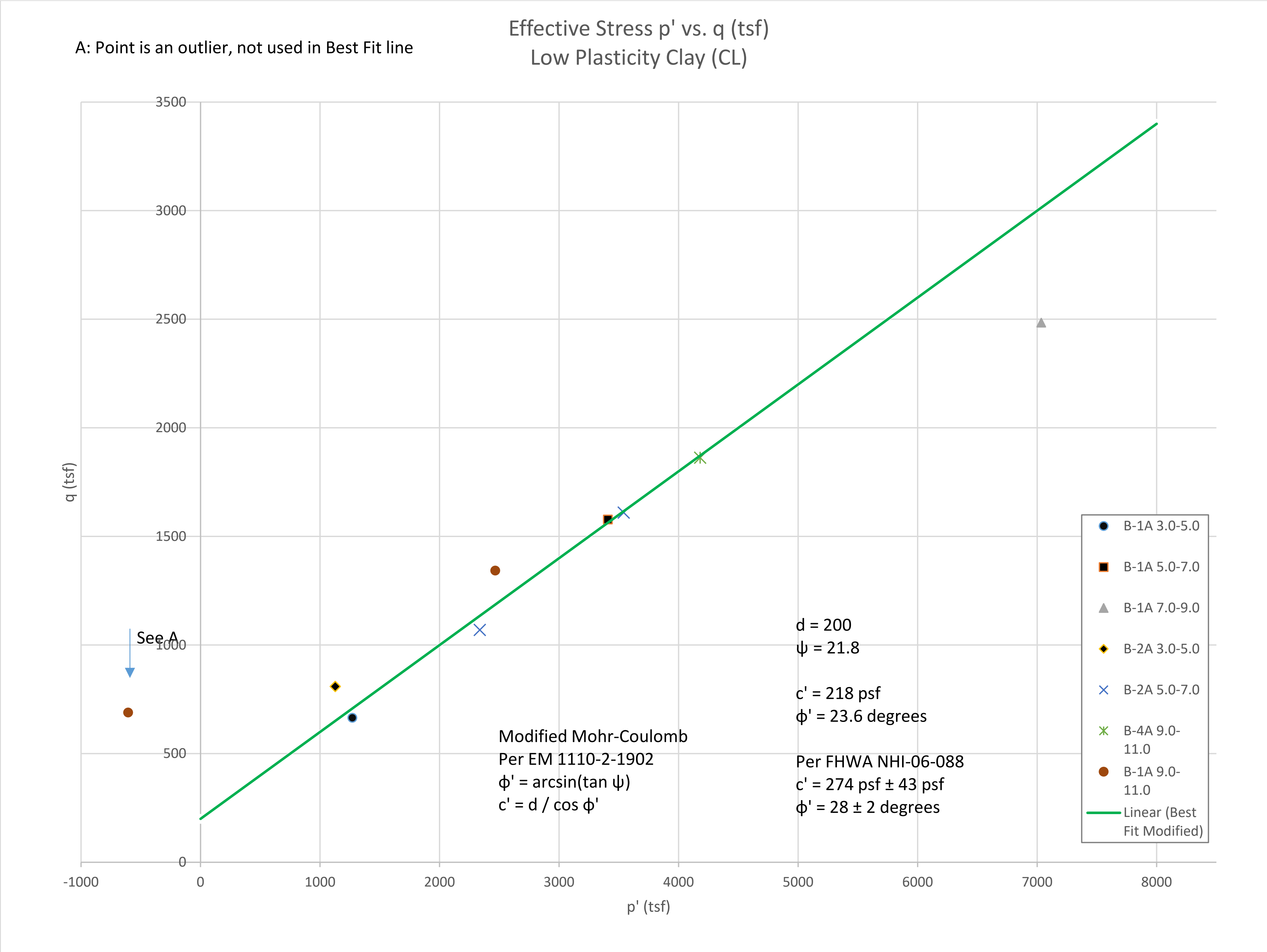
ϕ' = arcsin(tan ψ)

ϕ' = 23.6 degrees

c' = d / cos ϕ'

c' = 218 psf

Based on modified Mohr-Columb diagram (EM 1110-2-1902 Appendix D)



A: Point is an outlier, not used in Best Fit line
Effective Stress p' vs. q (tsf)
Low Plasticity Clay (CL)
3500
3000
2500
2000
1500
1000
500
0
q (tsf)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
p' (tsf)
See A
Modified Mohr-Coulomb
Per EM 1110-2-1902
ϕ' = arcsin(tan ψ)
c' = d / cos ϕ'
d = 200
ψ = 21.8
c' = 218 psf
ϕ' = 23.6 degrees
Per FHWA NHI-06-088
c' = 274 psf ± 43 psf
ϕ' = 28 ± 2 degrees
B-1A 3.0-5.0
B-1A 5.0-7.0
B-1A 7.0-9.0
B-2A 3.0-5.0
B-2A 5.0-7.0
B-4A 9.0-11.0
B-1A 9.0-11.0
Linear (Best Fit Modified)

Unconsolidated Undrained Triaxial Test Results

Consolidated Undrained Strength

B-4A 9.0-11.0

Specimen	**A**	**B**	**C**
p	3691.5		
q	811.5		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
CL	46	20	26

B-2A 9.0-13.0

Specimen	**A**	**B**	**C**
p	7541	3398.5	
q	3221	1958.5	
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
CL	44	22	22

B-1A 7.0-9.0

Specimen	**A**	**B**	**C**
p	2701		
q	1837		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
CL	37	22	15

B-2A 7.0-9.0

Specimen	**A**	**B**	**C**
p	4064		
q	1760		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
CL	31	17	14

B-1A 13.0-13.9

Specimen	**A**	**B**	**C**
p	5789.5		
q	2045.5		
USCS	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**

Best Fit Line

q = 0.2p + 950

q = 0.2p + 950 (adjust for a minimum of 2/3 of points above the line)

p	q		
0	950	d =	950
8000	2550	ψ =	11.3

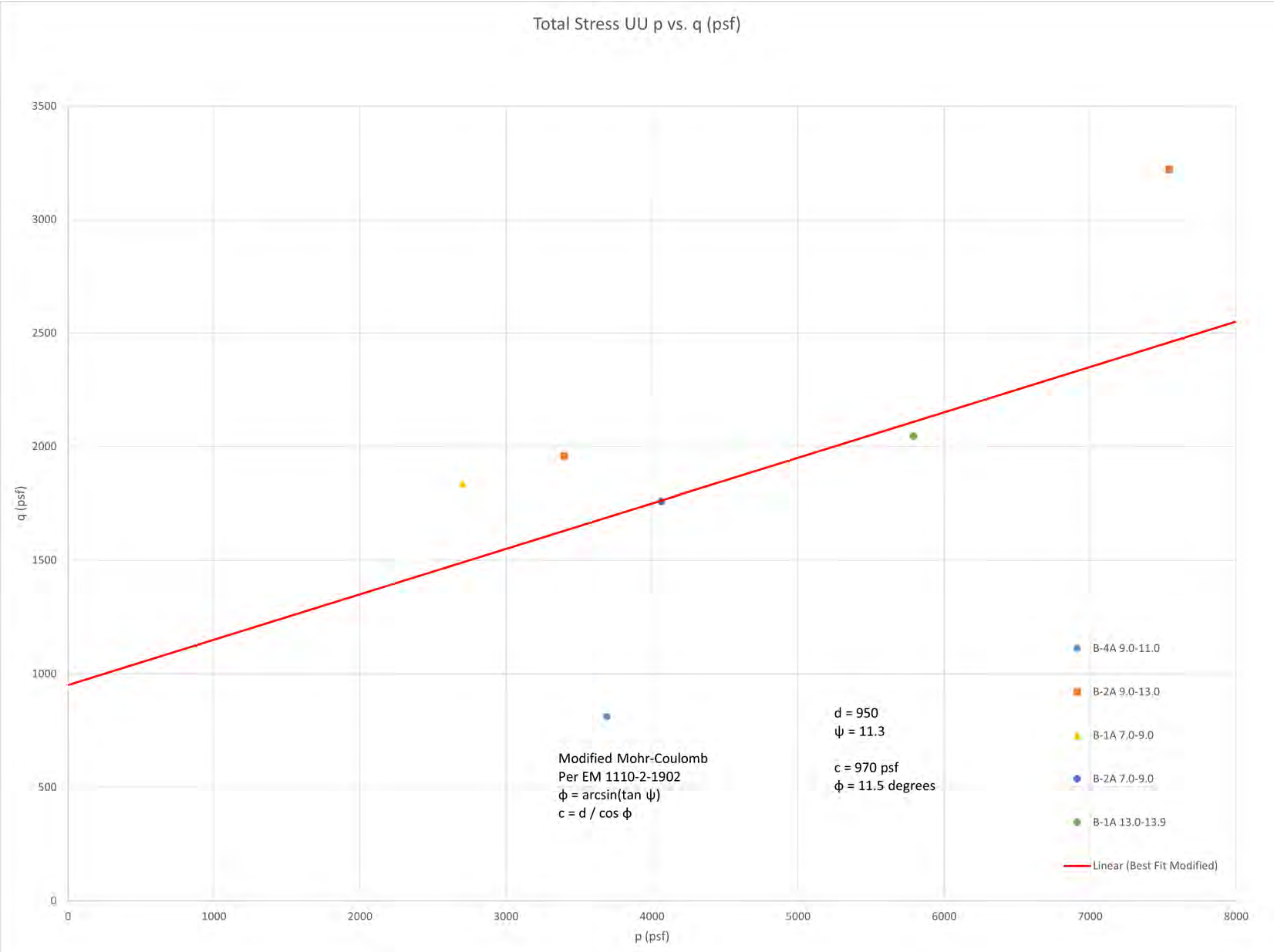
Strength Paramenters

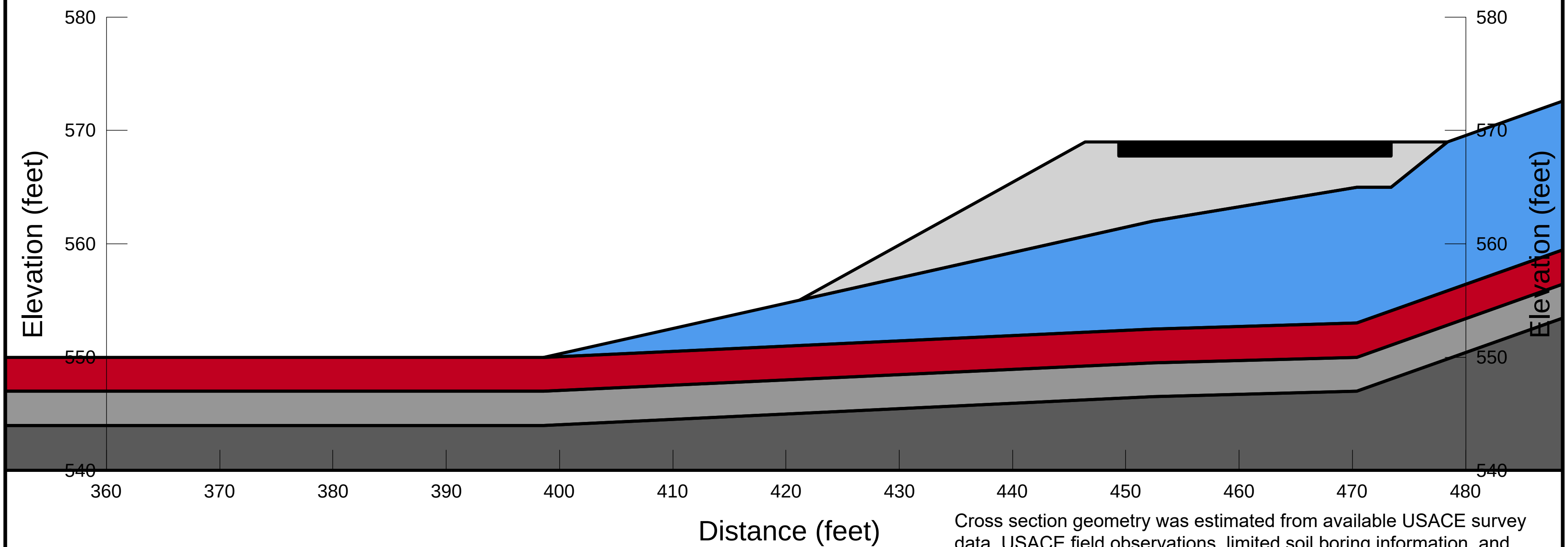
ϕ' = arcsin(tan ψ)

ϕ = 11.5 degrees

c = d / cos ϕ

c = 970 psf


Total Stress UU p vs. q (psf)
q (psf)
p (psf)
B-4A 9.0-11.0
B-2A 9.0-13.0
B-1A 7.0-9.0
B-2A 7.0-9.0
B-1A 13.0-13.9
Linear (Best Fit Modified)
Modified Mohr-Coulomb
Per EM 1110-2-1902
ϕ = arcsin(tan ψ)
c = d / cos ϕ
d = 950
ψ = 11.3
c = 970 psf
ϕ = 11.5 degrees



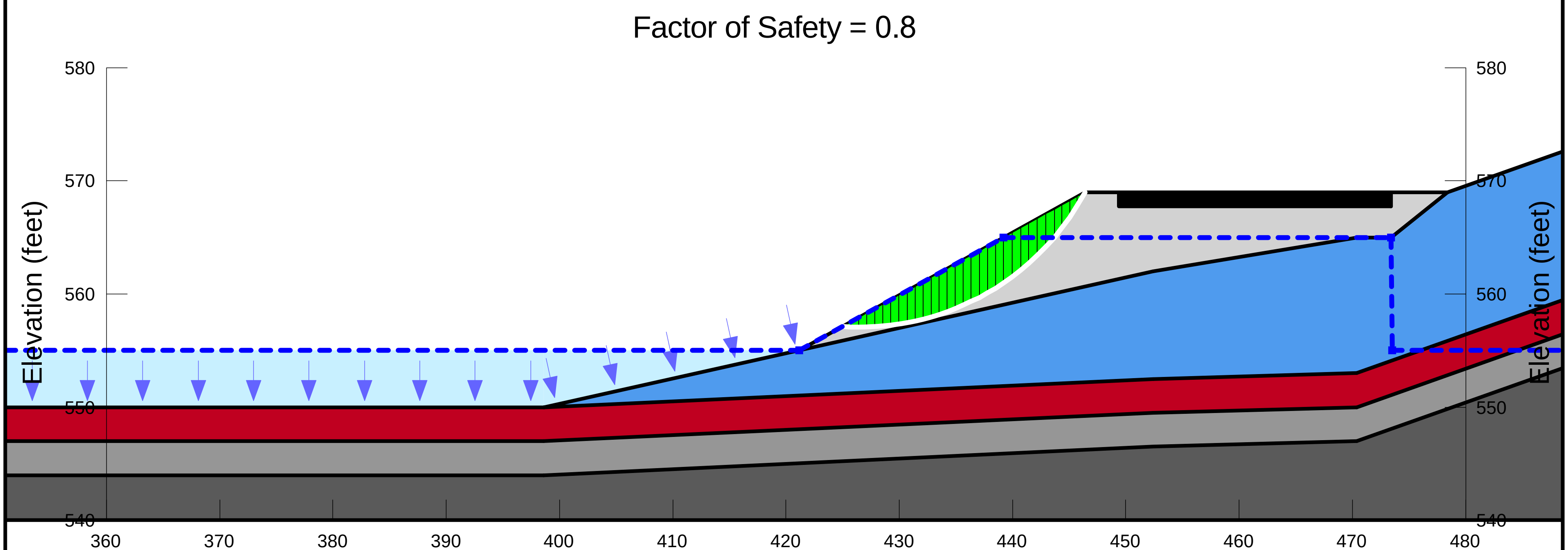
Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name
	1: Asphalt
	2: Existing Fill
	3: Clay
	4: Upper Kope Zone
	5: Weathered Shale
	6: Bedrock

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Existing Conditions: Cross-Section Geometry

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			

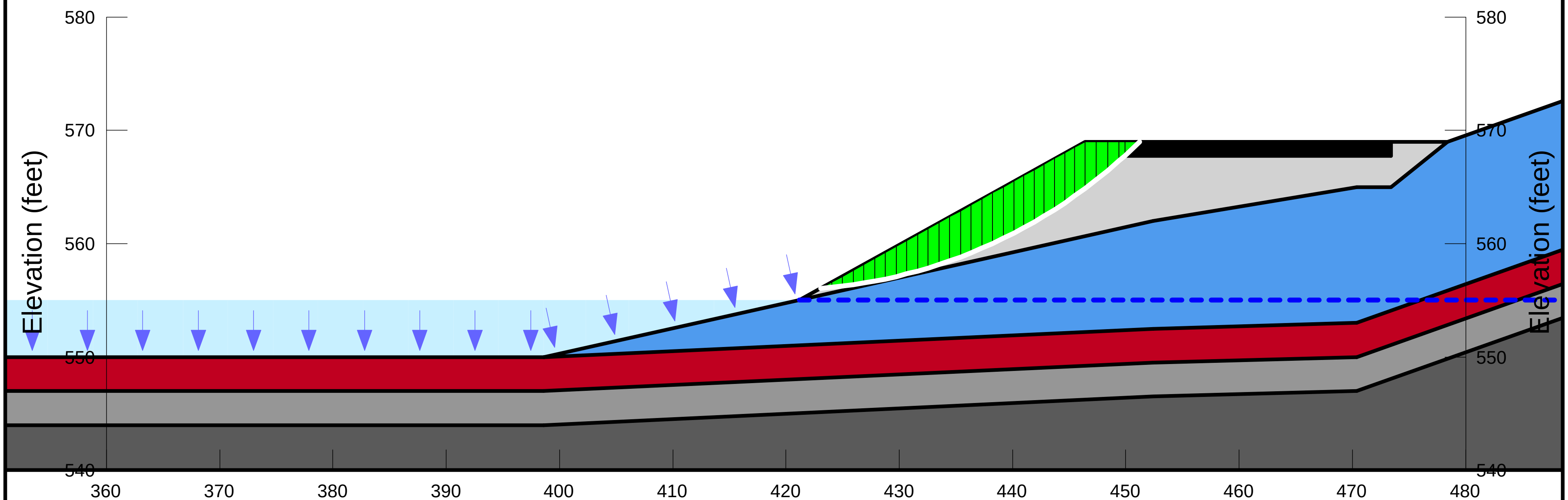
Legend	
Water Surface Elevation	
Ponding Arrows	
Lowest Factor of Safety Failure Slip Surface	

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Existing Conditions: Rapid Drawdown Slope Stability

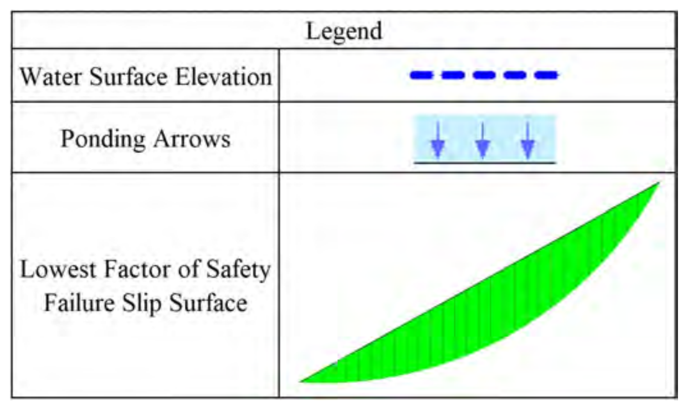
Date: 02/01/2023 Scale: 1:165

Factor of Safety = 1.2



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light grey	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Grey	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark grey	6: Bedrock	Bedrock (Impenetrable)			

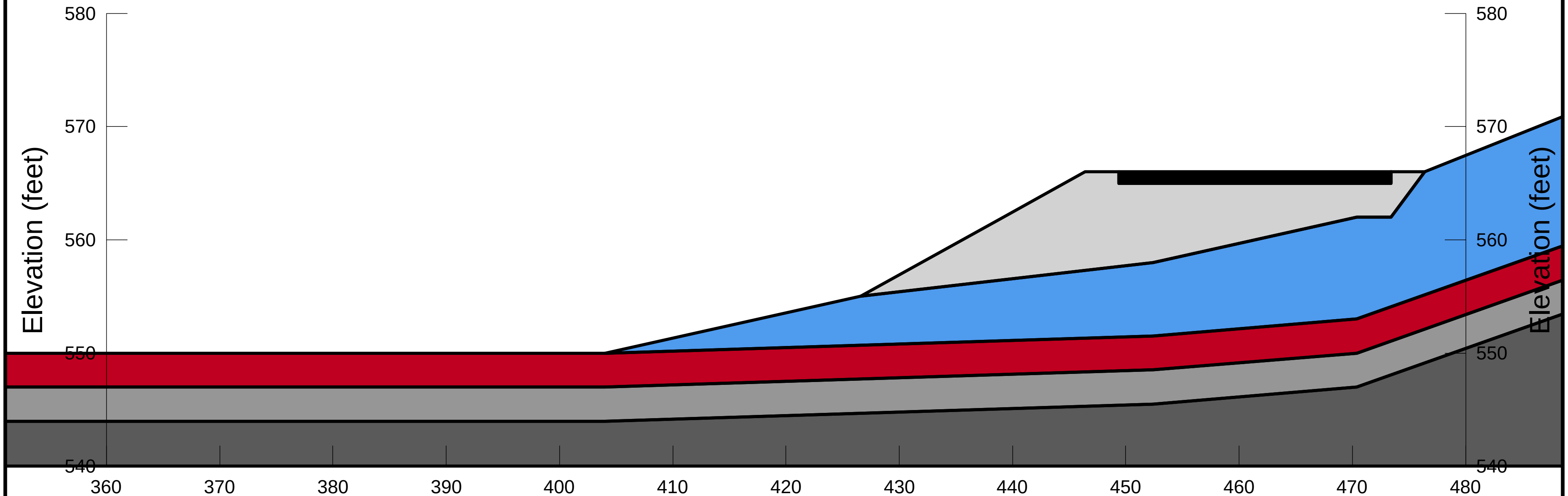


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Existing Conditions: Steady State Slope Stability

Date: 02/01/2023

Scale: 1:165



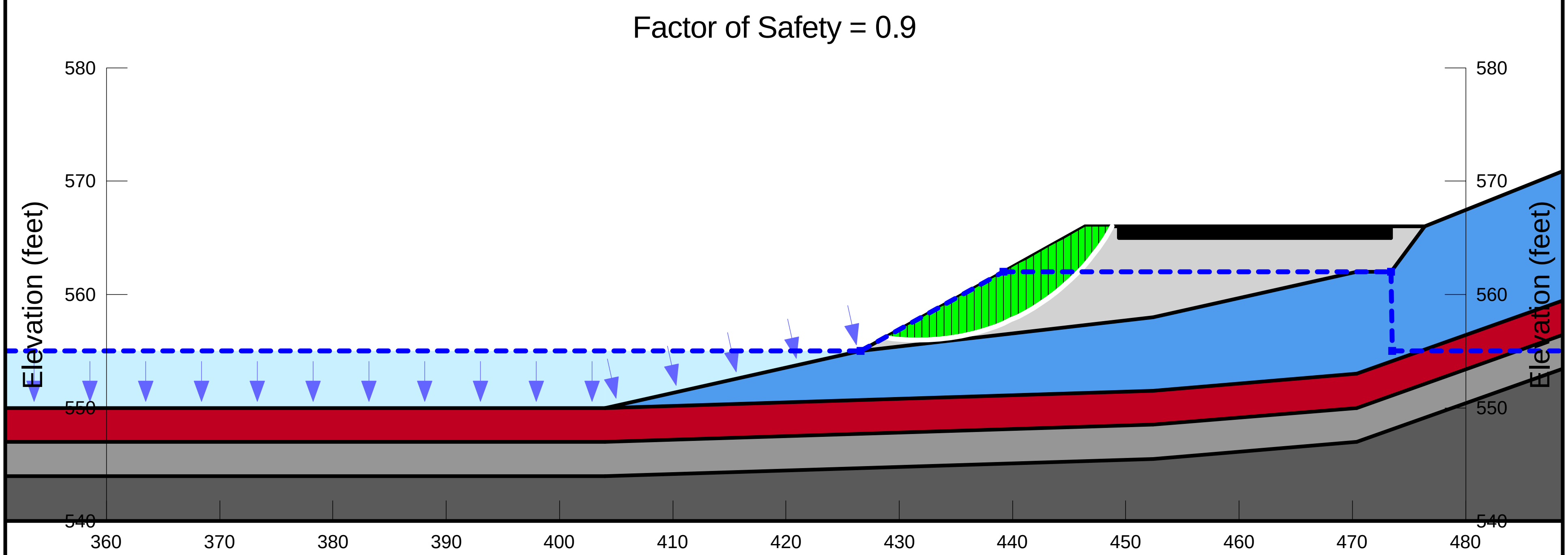
Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name
	1: Asphalt
	2: Existing Fill
	3: Clay
	4: Upper Kope Zone
	5: Weathered Shale
	6: Bedrock

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

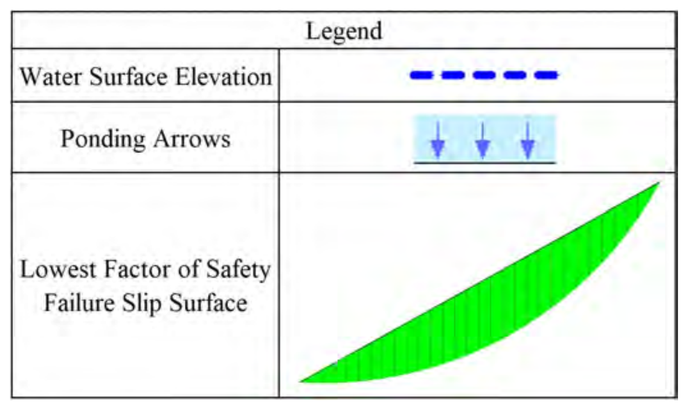
Site 2 Existing Conditions: Cross-Section Geometry

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

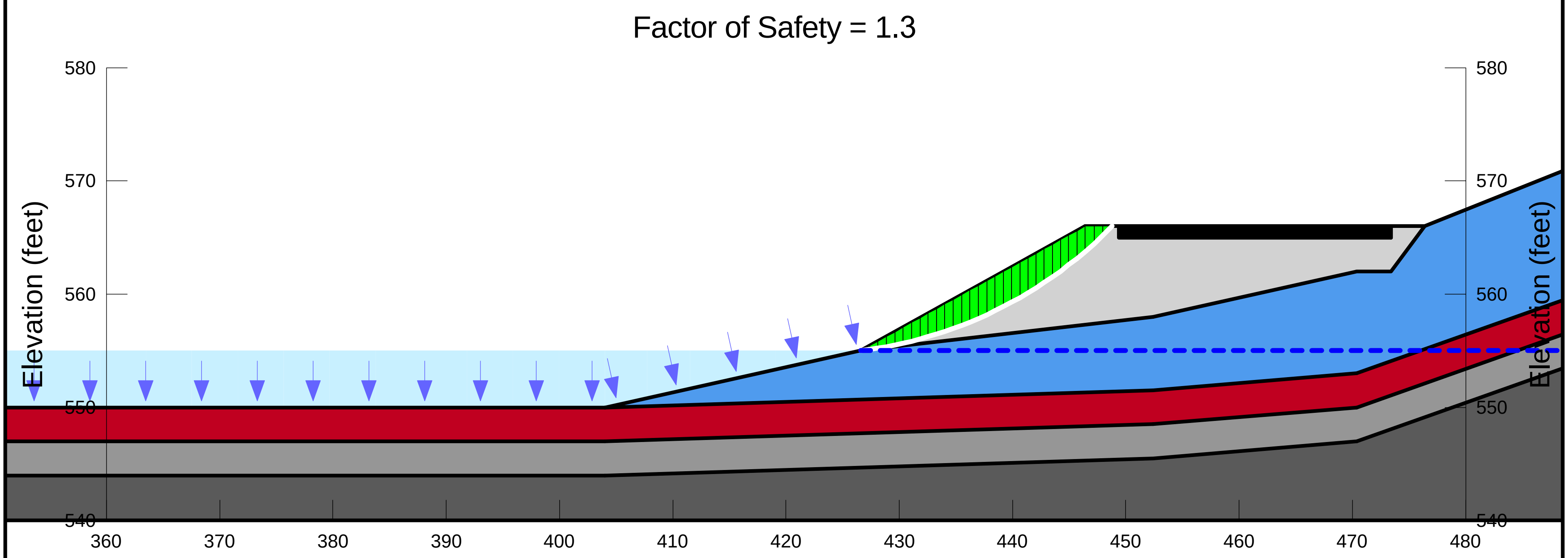
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light gray	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Gray	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark gray	6: Bedrock	Bedrock (Impenetrable)			



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

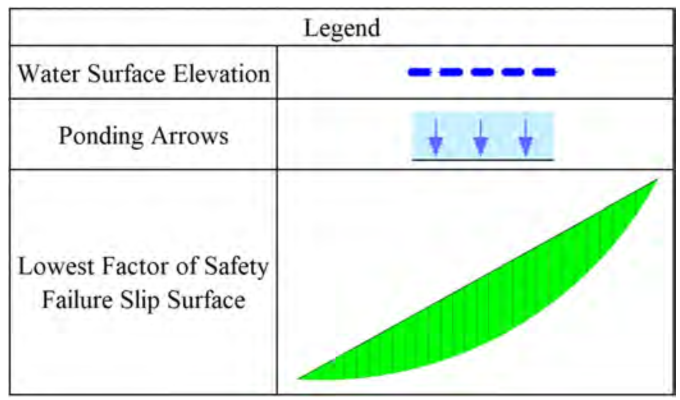
Site 2 Existing Conditions: Rapid Drawdown Slope Stability

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

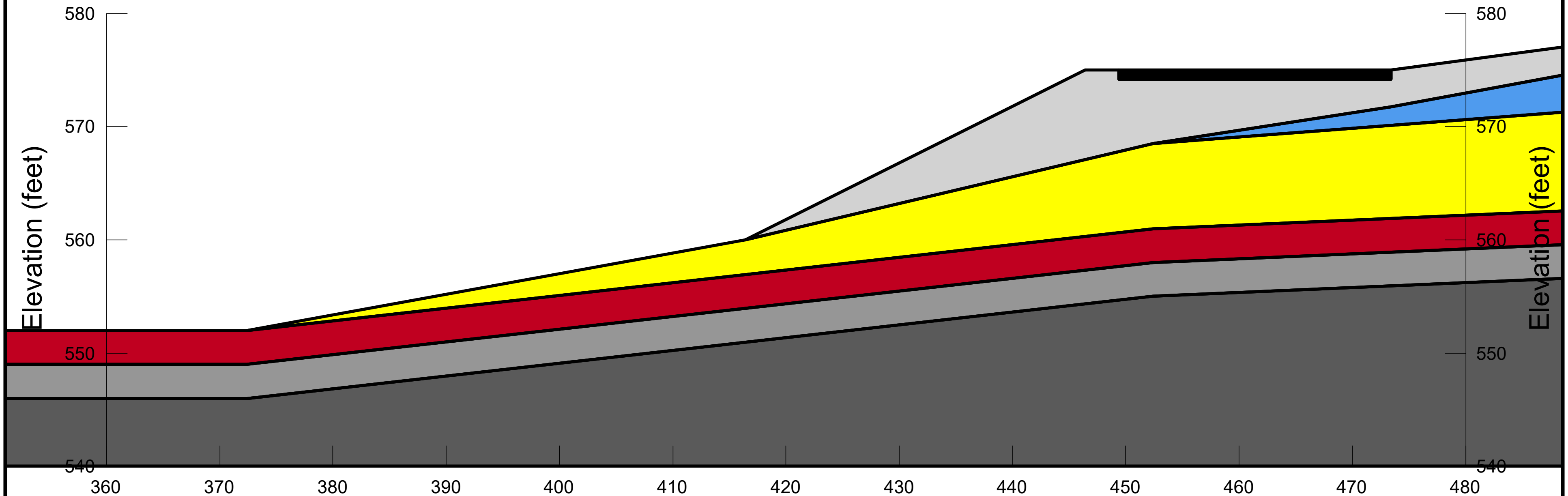
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light gray	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Gray	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark gray	6: Bedrock	Bedrock (Impenetrable)			



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Existing Conditions: Steady State Slope Stability

Date: 02/01/2023 Scale: 1:165



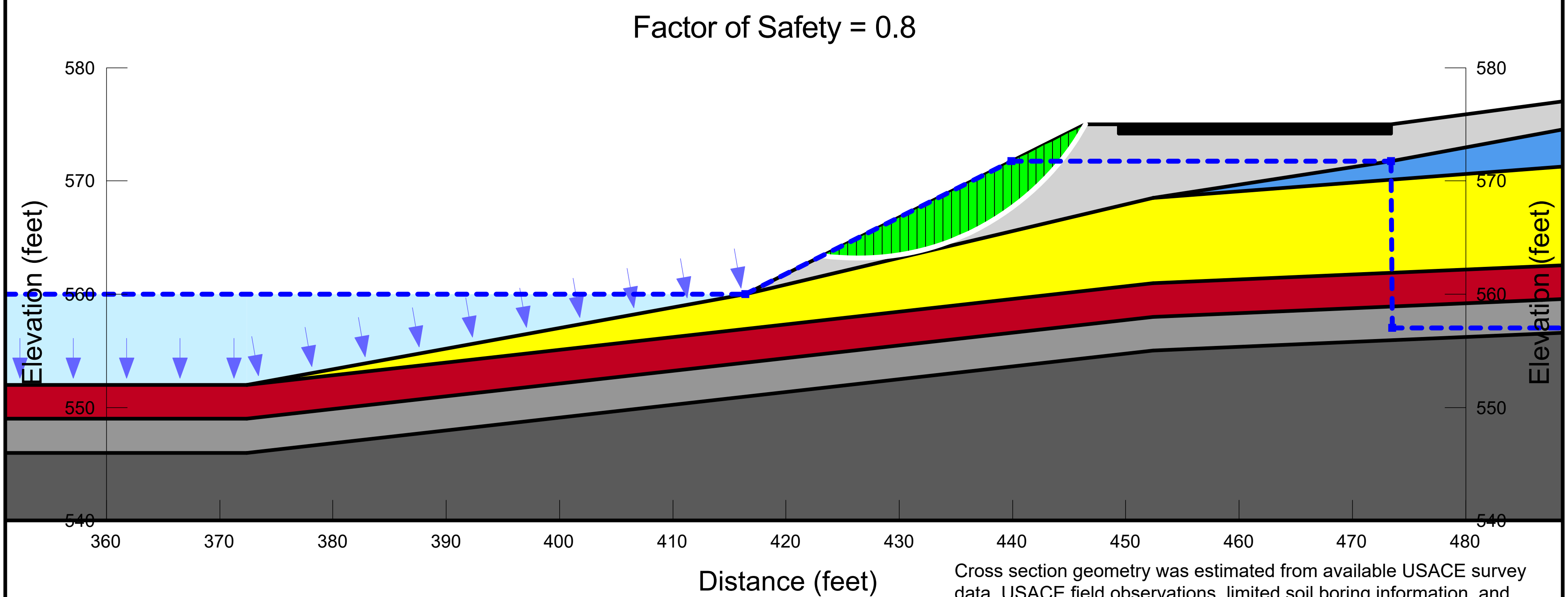
Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name
(black)	1: Asphalt
(light gray)	2: Existing Fill
(blue)	3: Clay
(yellow)	4: Clayey Sand
(red)	5: Upper Kope Zone
(gray)	6: Weathered Shale
(dark gray)	7: Bedrock

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Existing Conditions: Cross-Section Geometry

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Clayey Sand	Mohr-Coulomb	120	100	27
	5: Upper Kope Zone	Mohr-Coulomb	140	140	13
	6: Weathered Shale	Mohr-Coulomb	140	200	15
	7: Bedrock	Bedrock (Impenetrable)			

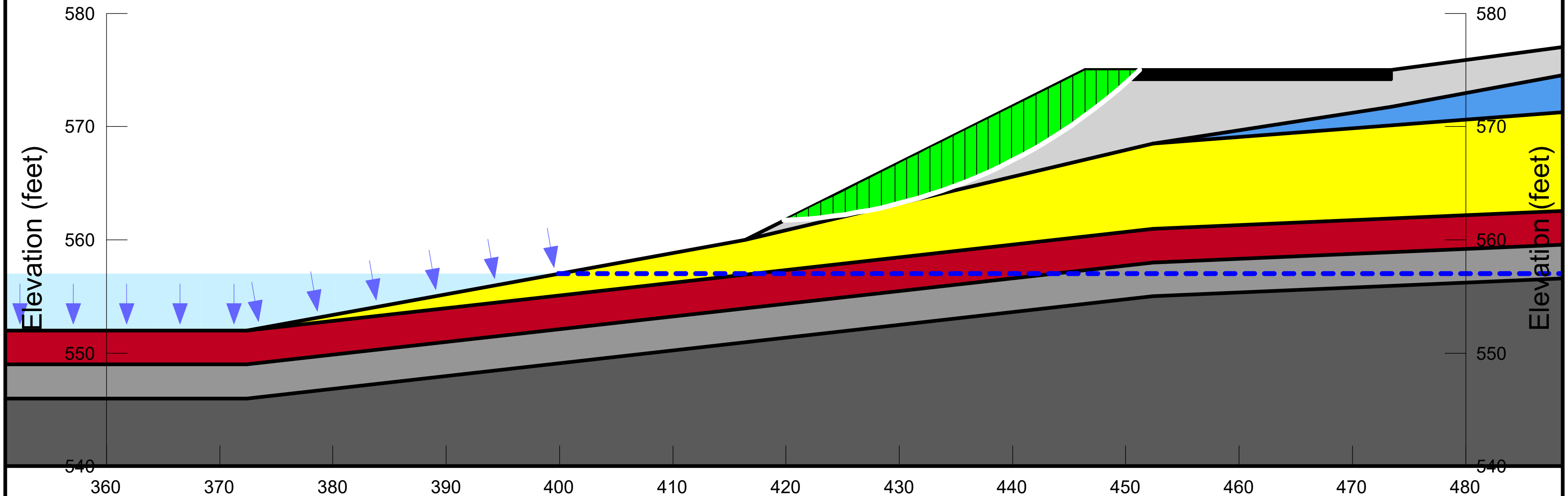
Legend	
Water Surface Elevation	
Ponding Arrows	
Lowest Factor of Safety Failure Slip Surface	

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Existing Conditions: Rapid Drawdown Slope Stability

Date: 02/01/2023 Scale: 1:165

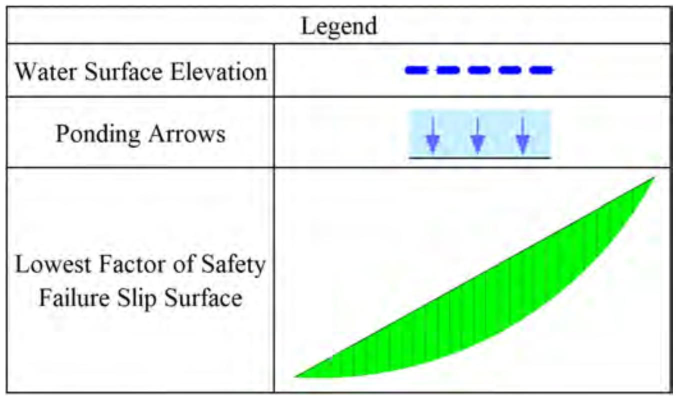
Factor of Safety = 1.3



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
(black)	1: Asphalt	Mohr-Coulomb	145	0	40
(light gray)	2: Existing Fill	Mohr-Coulomb	125	50	22
(blue)	3: Clay	Mohr-Coulomb	130	200	23
(yellow)	4: Clayey Sand	Mohr-Coulomb	120	100	27
(red)	5: Upper Kope Zone	Mohr-Coulomb	140	140	13
(gray)	6: Weathered Shale	Mohr-Coulomb	140	200	15
(dark gray)	7: Bedrock	Bedrock (Impenetrable)			

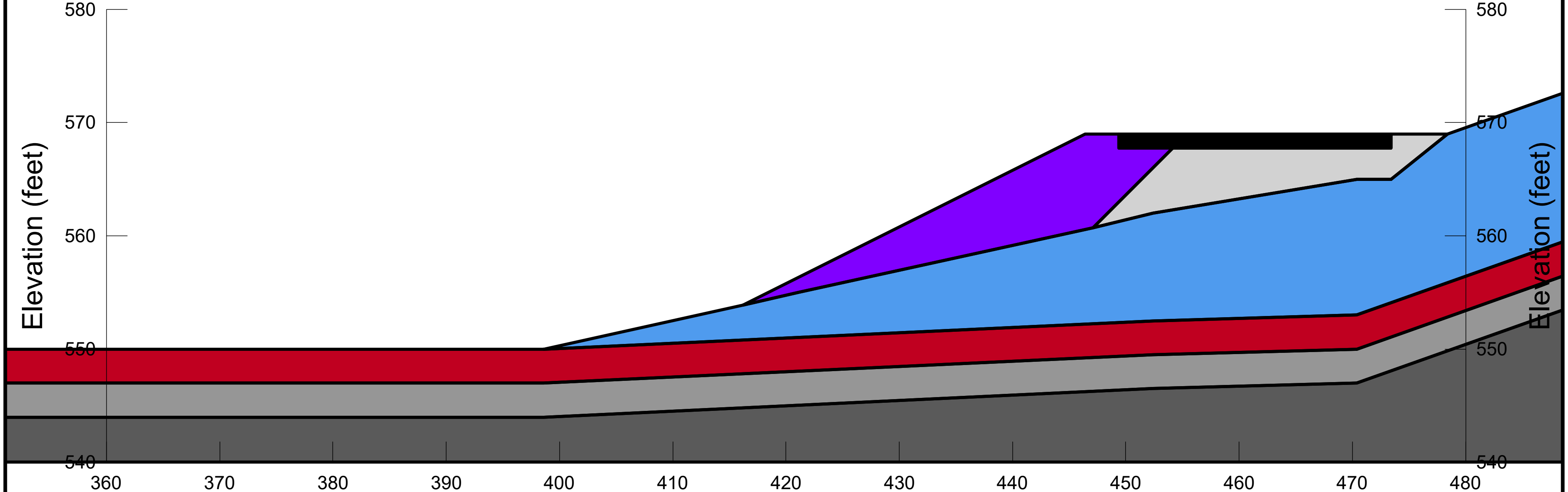
Legend



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Existing Conditions: Steady State Slope Stability

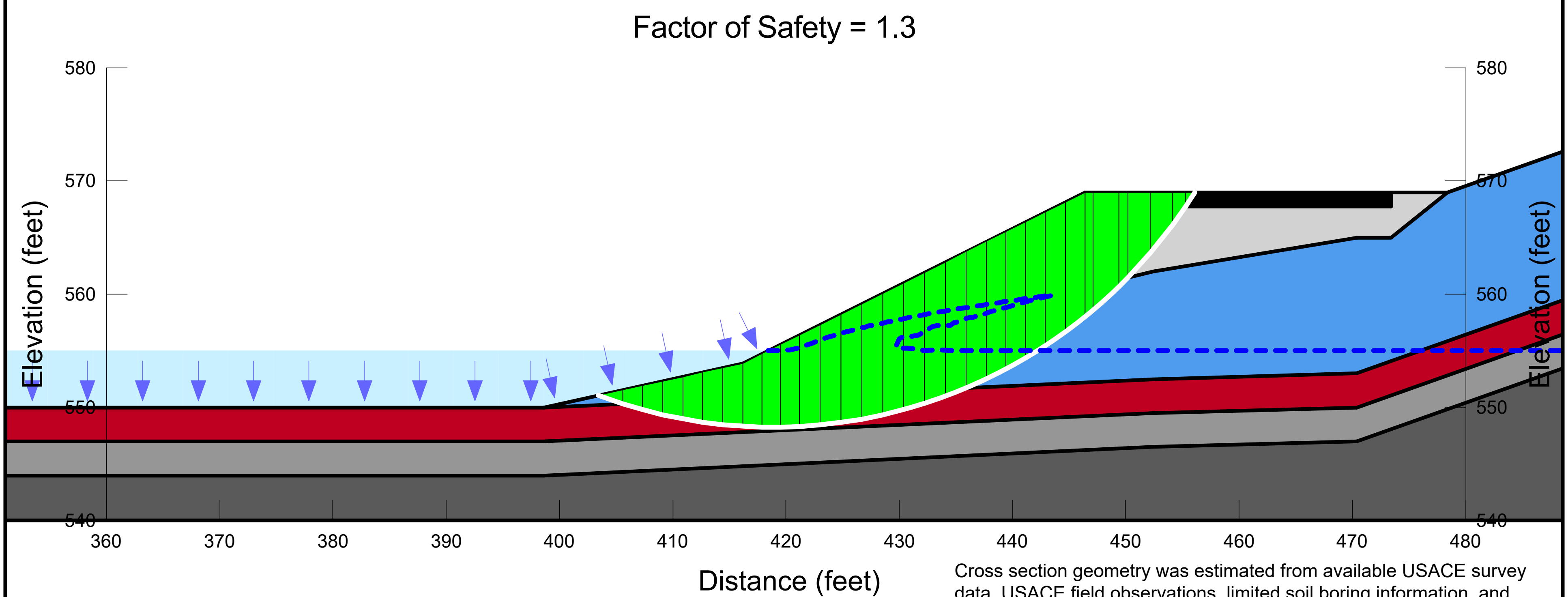
Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

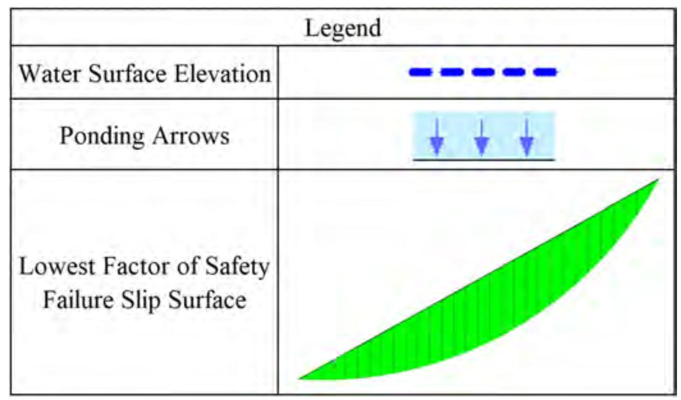
Color	Name
Black	1: Asphalt
Light gray	2: Existing Fill
Blue	3: Clay
Red	4: Upper Kope Zone
Gray	5: Weathered Shale
Dark gray	6: Bedrock
Purple	7: Riprap

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility	
Site 1 Best Value Alternative: Cross-Section Geometry	
Date: 02/01/2023	Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40

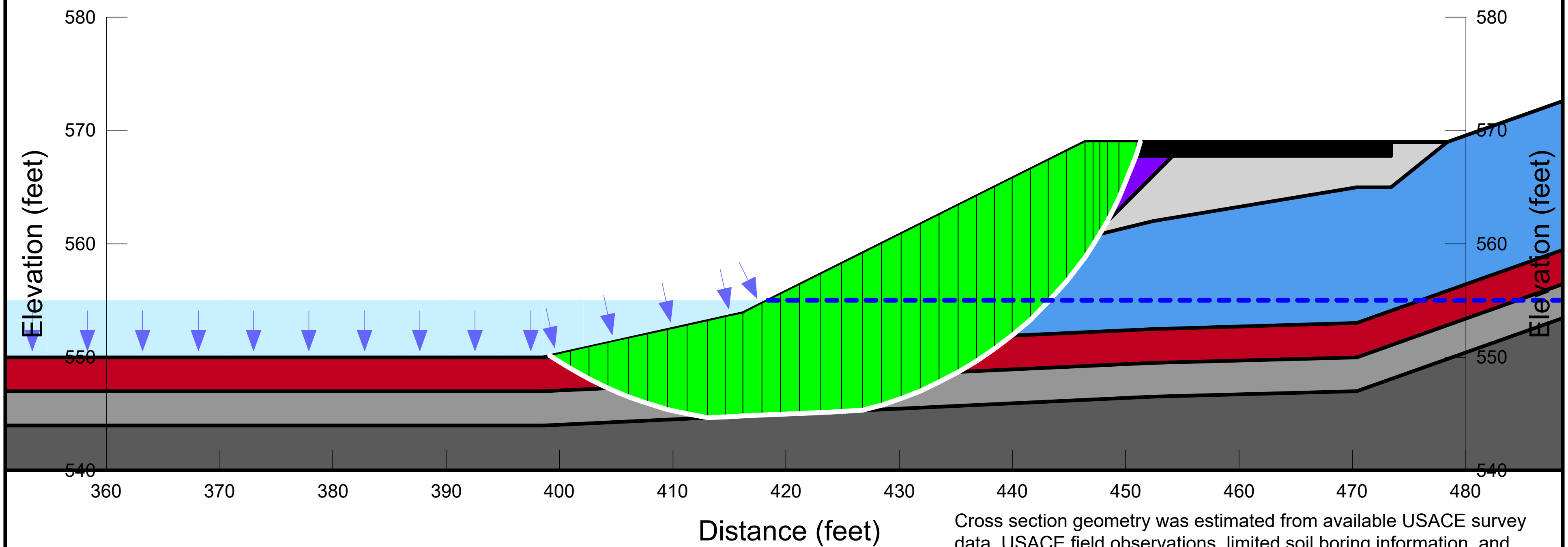


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Best Value Alternative: Rapid Drawdown Slope Stability

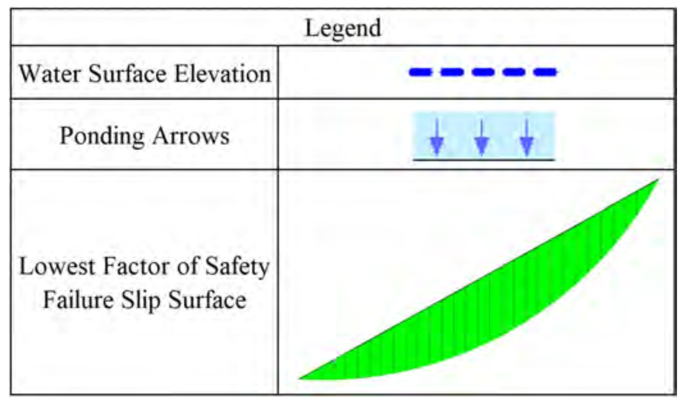
Date: 02/01/2023 Scale: 1:165

Factor of Safety = 1.7



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■ (black)	1: Asphalt	Mohr-Coulomb	145	0	40
■ (light gray)	2: Existing Fill (Undrained)	Mohr-Coulomb	125	800	0
■ (blue)	3: Clay (Undrained)	Mohr-Coulomb	130	1,000	0
■ (red)	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
■ (gray)	5: Weathered Shale	Mohr-Coulomb	140	200	15
■ (dark gray)	6: Bedrock	Bedrock (Impenetrable)			
■ (purple)	7: Riprap	Mohr-Coulomb	135	10	40

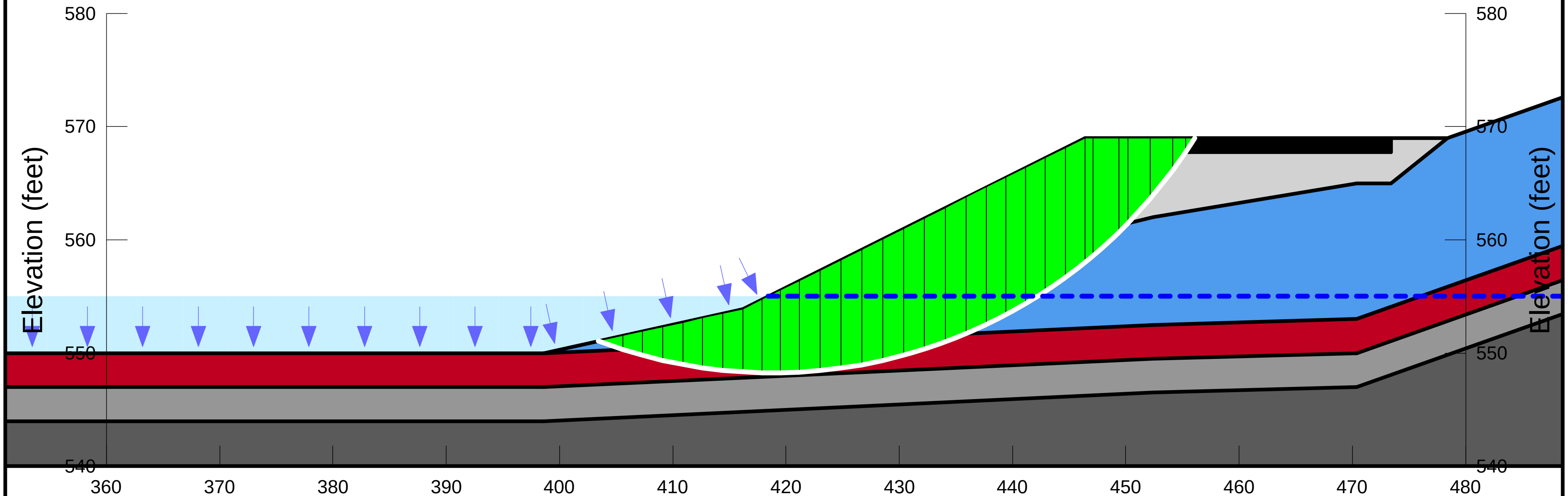


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Best Value Alternative: Post Construction Slope Stability

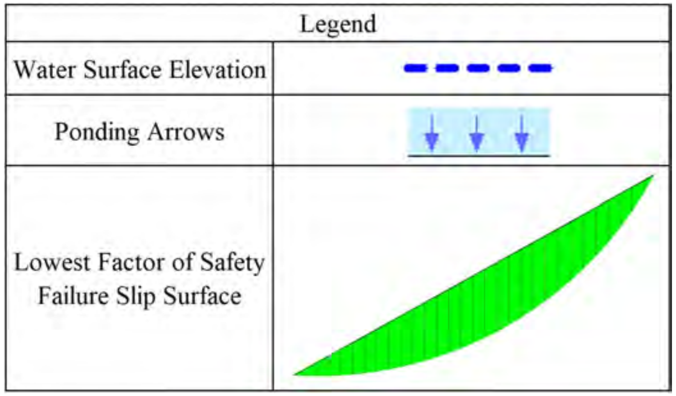
Date: 02/01/2023 Scale: 1:165

Factor of Safety = 1.1



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

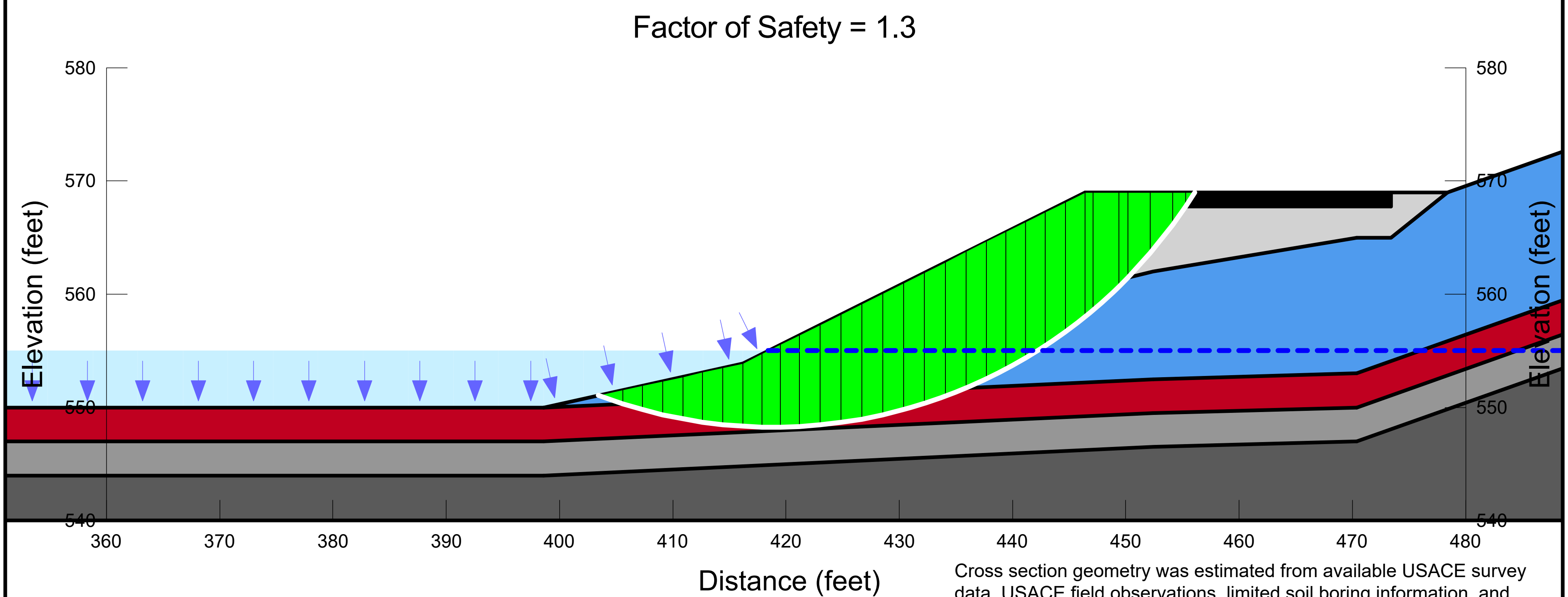
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light gray	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Gray	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark gray	6: Bedrock	Bedrock (Impenetrable)			
Purple	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

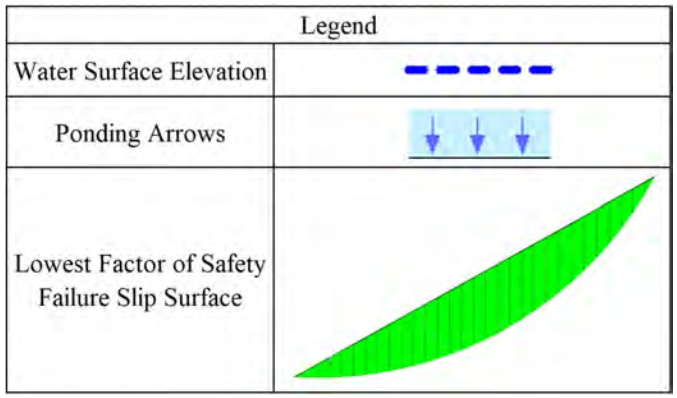
Site 1 Best Value Alternative: Seismic Slope Stability

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

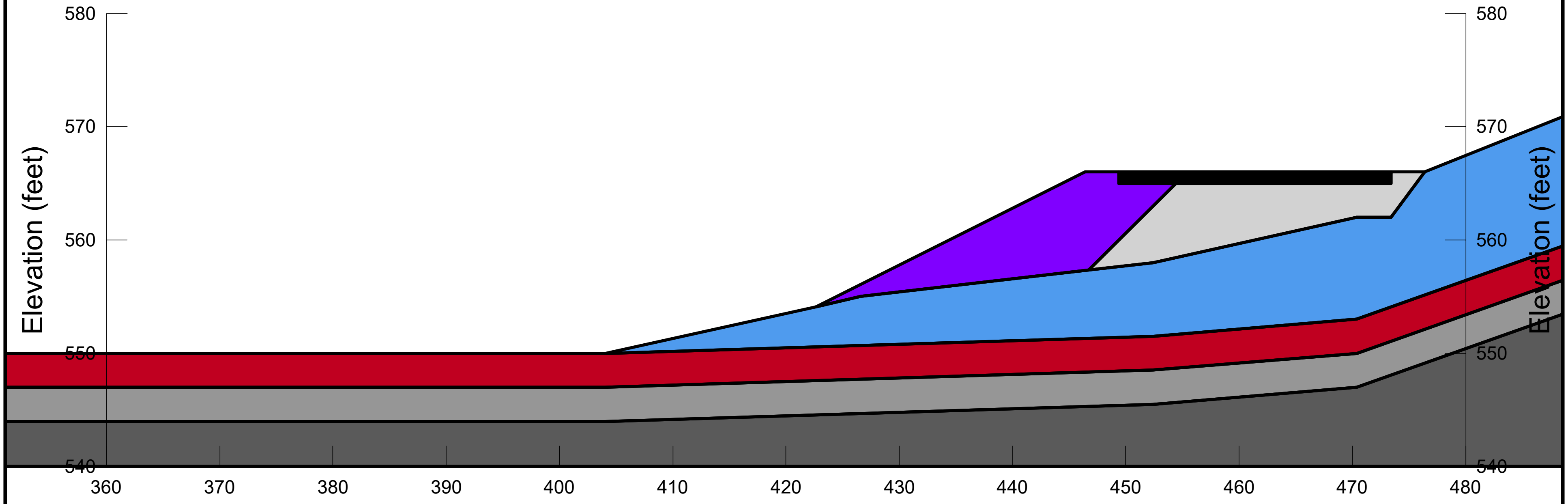
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 1 Best Value Alternative: Steady State Slope Stability

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

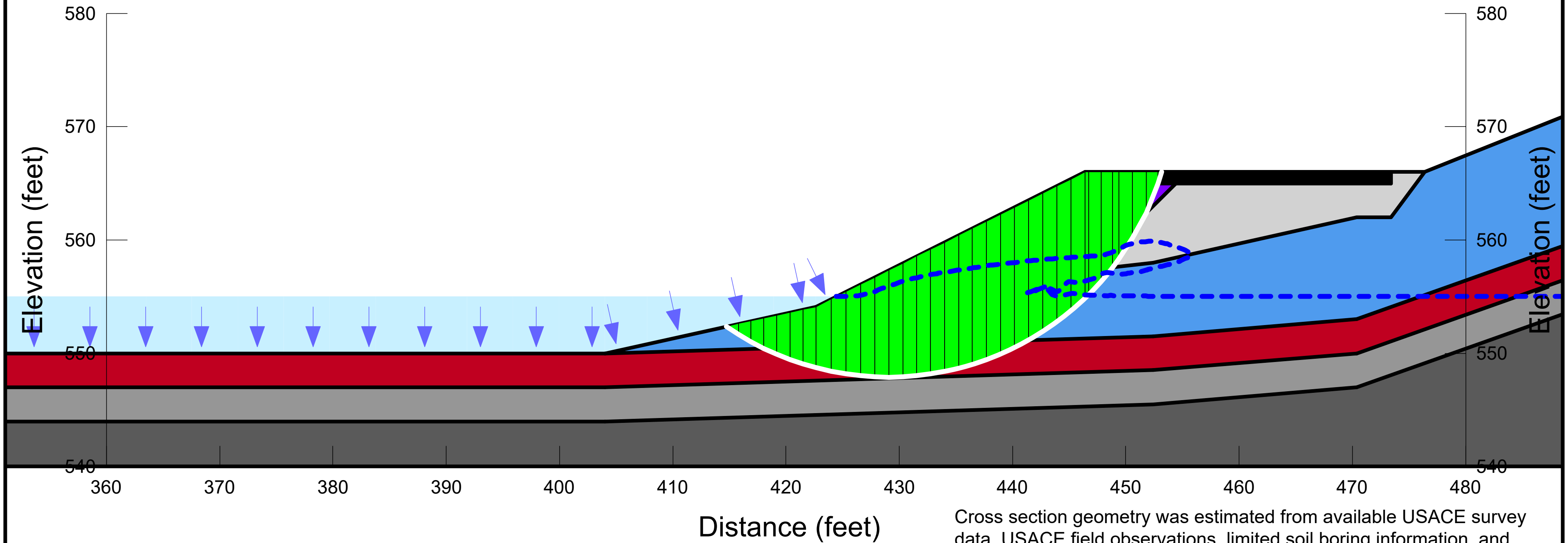
Color	Name
	1: Asphalt
	2: Existing Fill
	3: Clay
	4: Upper Kope Zone
	5: Weathered Shale
	6: Bedrock
	7: Riprap

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative: Cross-Section Geometry

Date: 02/01/2023 Scale: 1:165

Factor of Safety = 1.4

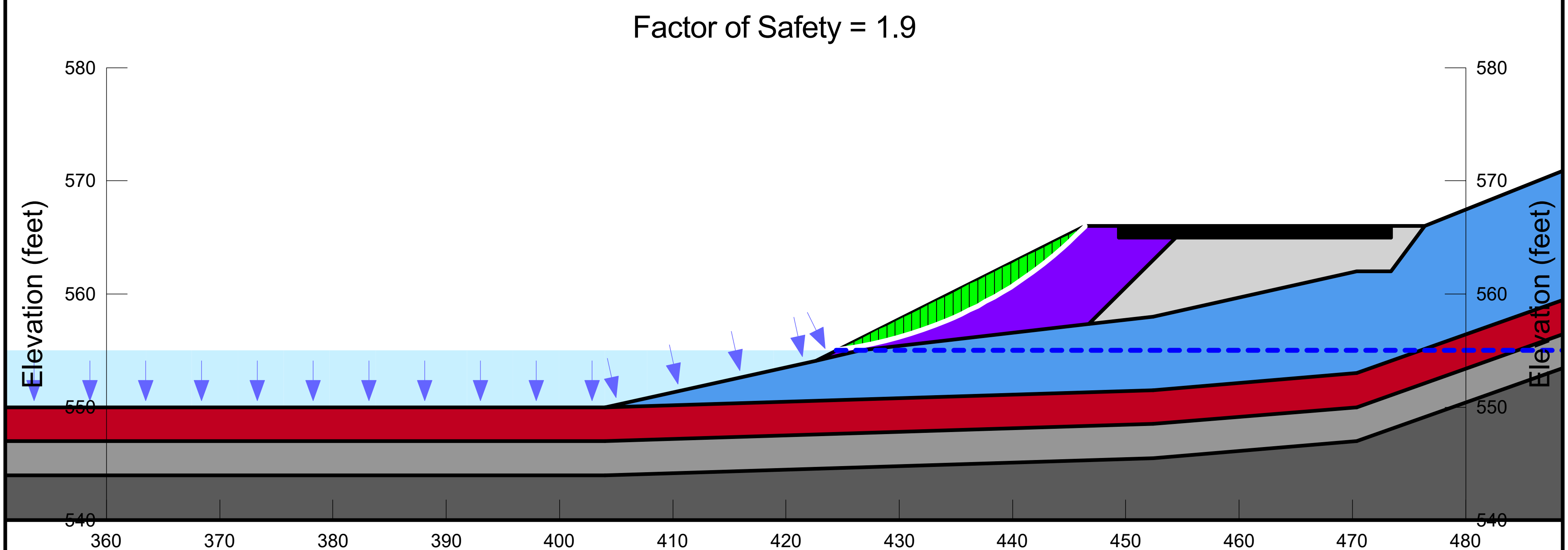


Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light grey	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Grey	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark grey	6: Bedrock	Bedrock (Impenetrable)			
Purple	7: Riprap	Mohr-Coulomb	135	10	40

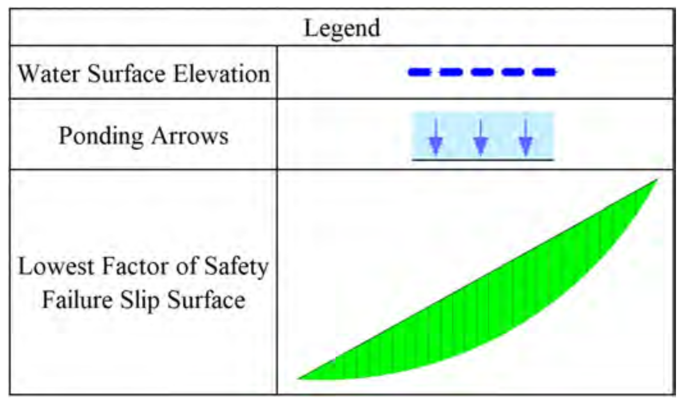
Legend	
Water Surface Elevation	- - - - -
Ponding Arrows	↓ ↓ ↓
Lowest Factor of Safety Failure Slip Surface	

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility	
Site 2 Best Value Alternative: Rapid Drawdown Slope Stability	
Date: 02/01/2023	Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

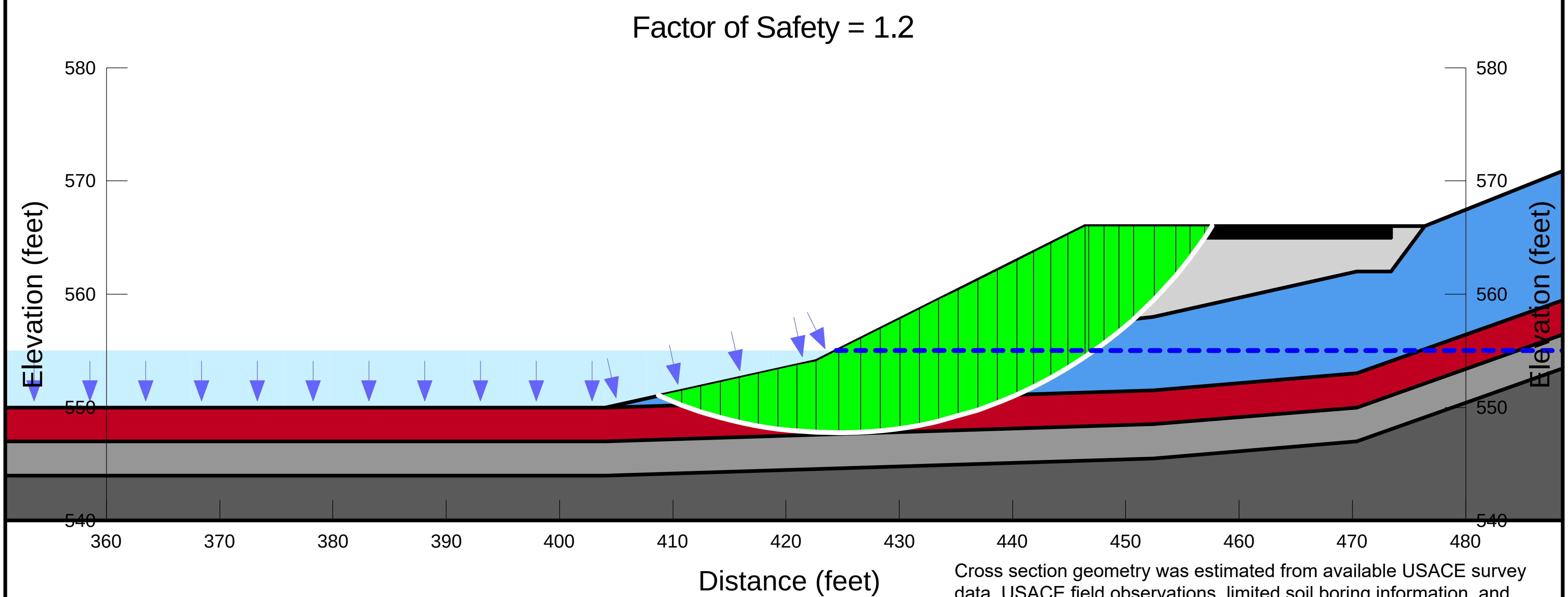
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill (Undrained)	Mohr-Coulomb	125	800	0
	3: Clay (Undrained)	Mohr-Coulomb	130	1,000	0
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

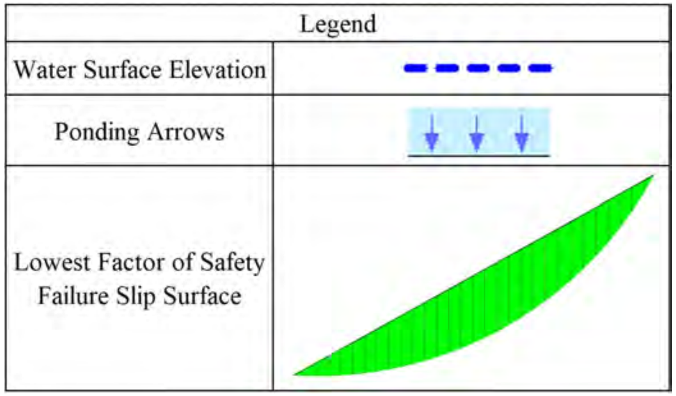
Site 2 Best Value Alternative: Post Construction Slope Stability

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40

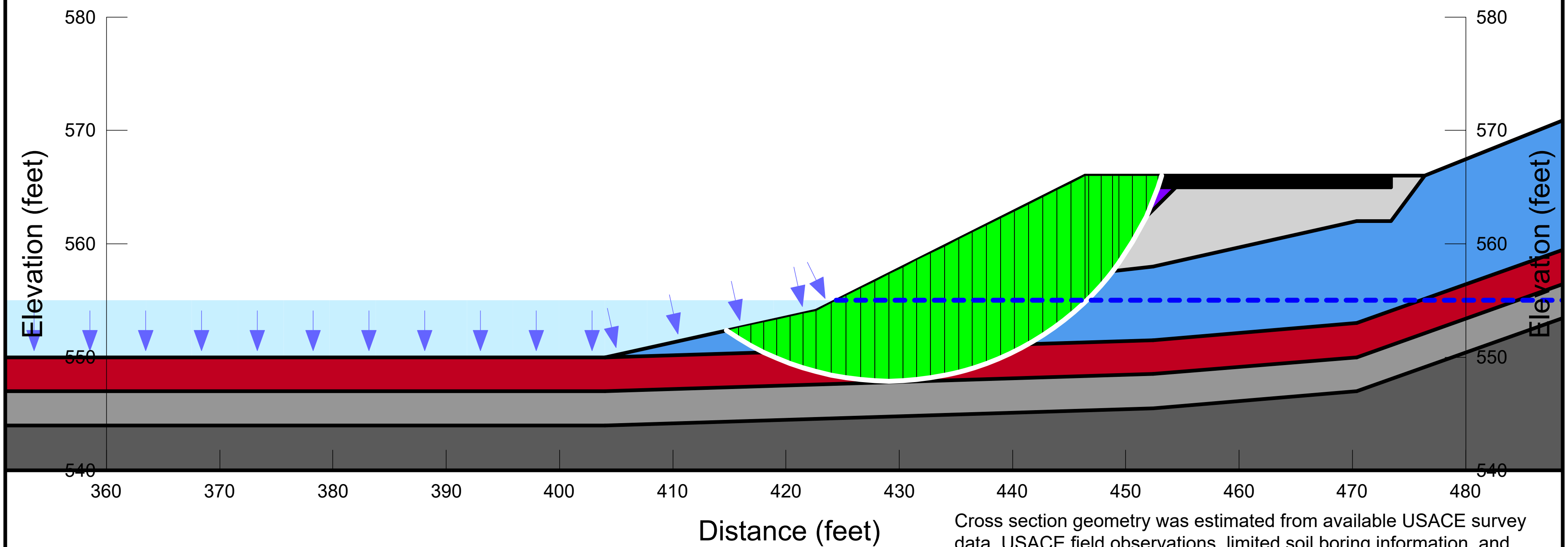


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative: Seismic Slope Stability

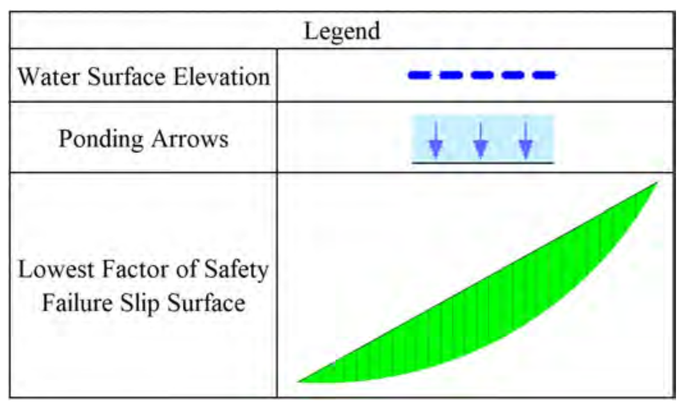
Date: 02/01/2023 Scale: 1:165

Factor of Safety = 1.4



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

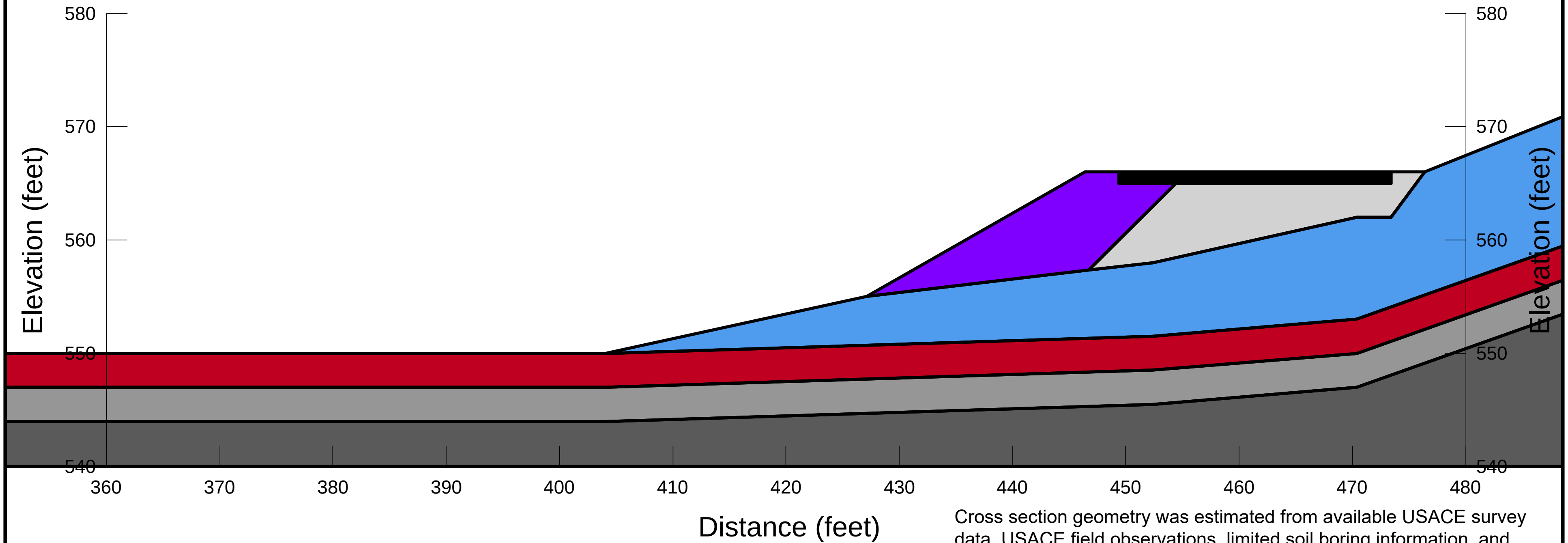
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Black	1: Asphalt	Mohr-Coulomb	145	0	40
Light gray	2: Existing Fill	Mohr-Coulomb	125	50	22
Blue	3: Clay	Mohr-Coulomb	130	200	23
Red	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
Gray	5: Weathered Shale	Mohr-Coulomb	140	200	15
Dark gray	6: Bedrock	Bedrock (Impenetrable)			
Purple	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative: Steady State Slope Stability

Date: 02/01/2023 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

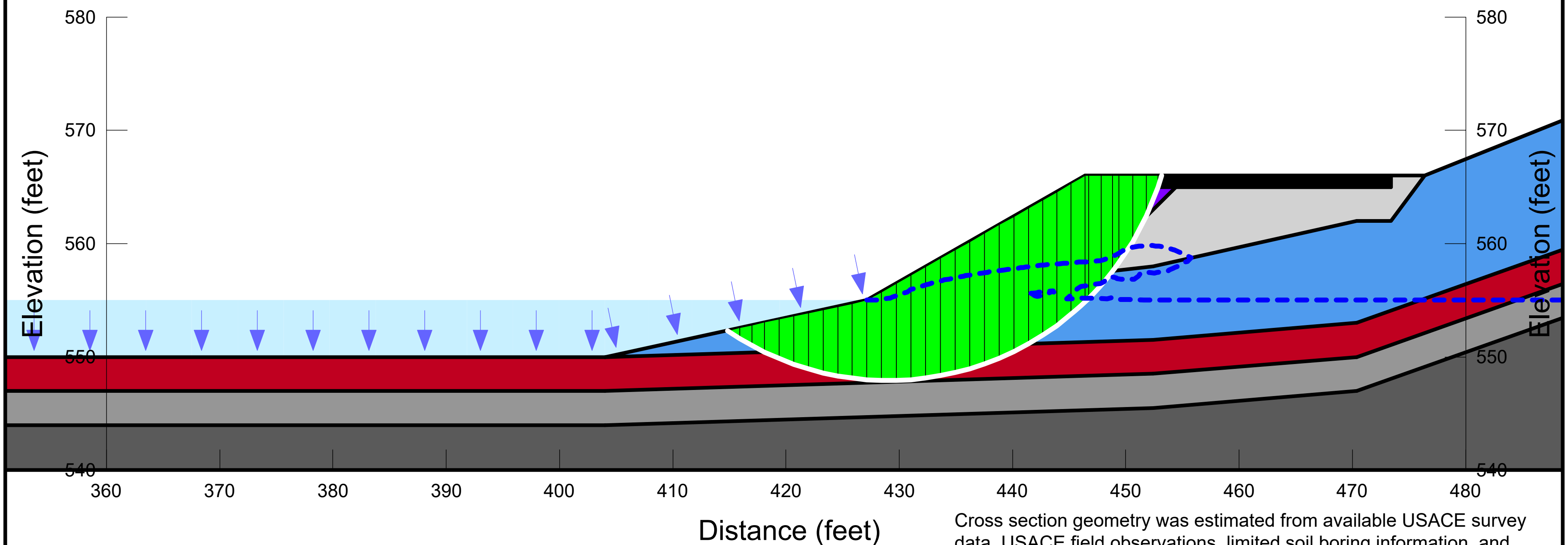
Color	Name
	1: Asphalt
	2: Existing Fill
	3: Clay
	4: Upper Kope Zone
	5: Weathered Shale
	6: Bedrock
	7: Riprap

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative (1.75H:1V): Cross-Section Geometry

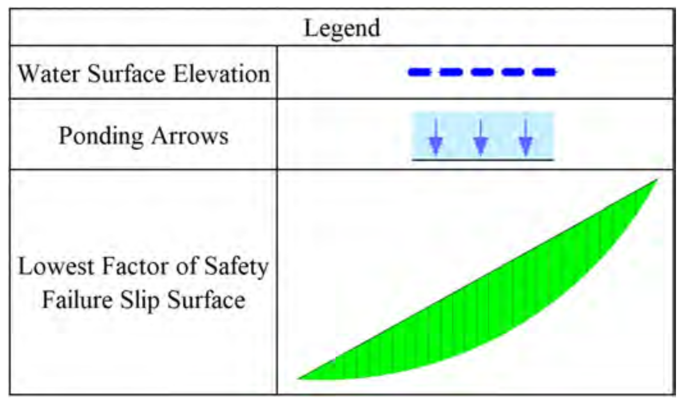
Date: 01/25/2024 Scale: 1:165

Factor of Safety = 1.4



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	1: Asphalt	Mohr-Coulomb	145	0	40
■	2: Existing Fill	Mohr-Coulomb	125	50	22
■	3: Clay	Mohr-Coulomb	130	200	23
■	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
■	5: Weathered Shale	Mohr-Coulomb	140	200	15
■	6: Bedrock	Bedrock (Impenetrable)			
■	7: Riprap	Mohr-Coulomb	135	10	40

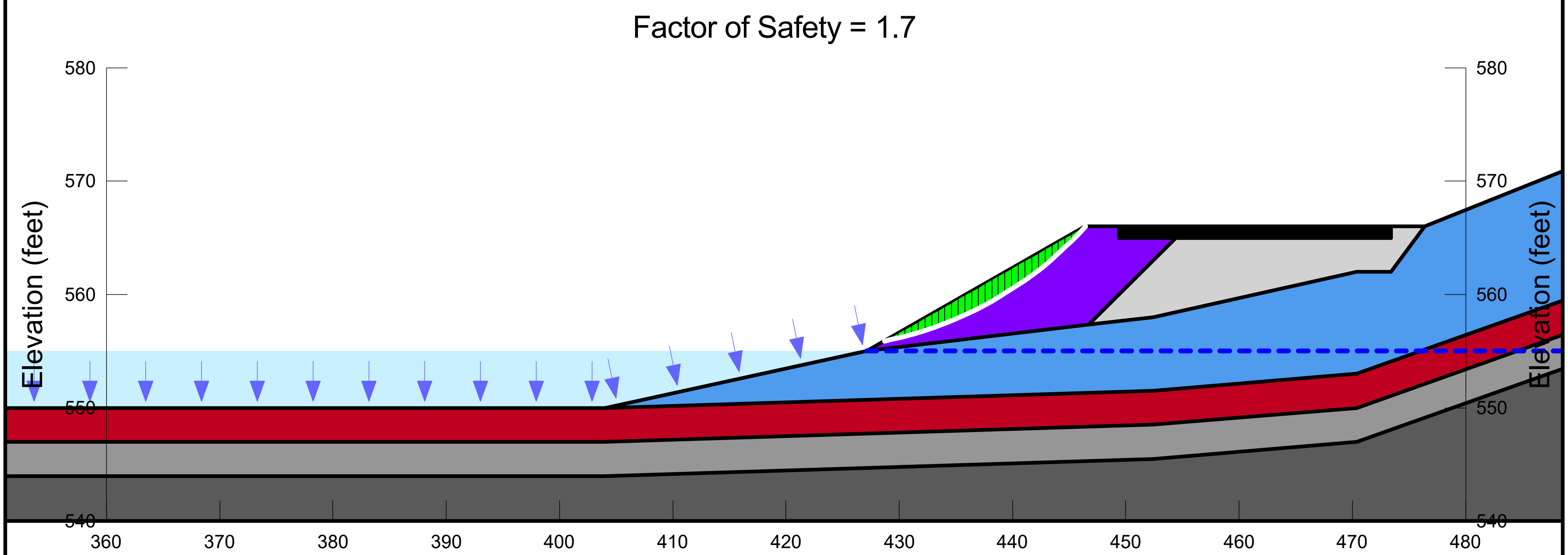
Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

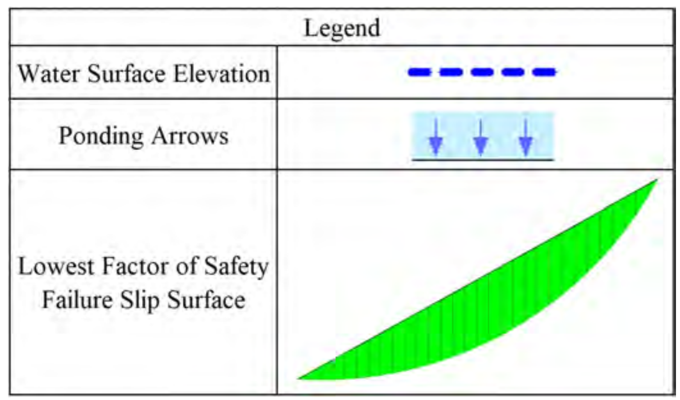
Site 2 Best Value Alternative (1.75H:1V): Rapid Drawdown Slope Stability

Date: 01/25/2024 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill (Undrained)	Mohr-Coulomb	125	800	0
	3: Clay (Undrained)	Mohr-Coulomb	130	1,000	0
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40

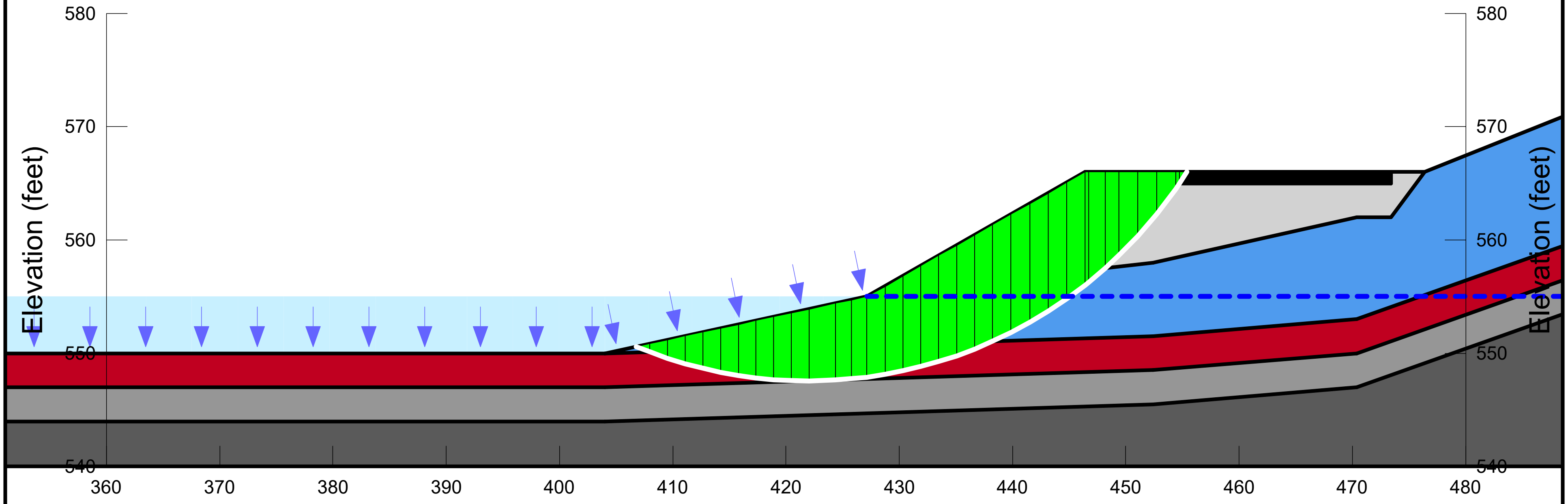


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative (1.75H:1V): Post Construction Slope Stability

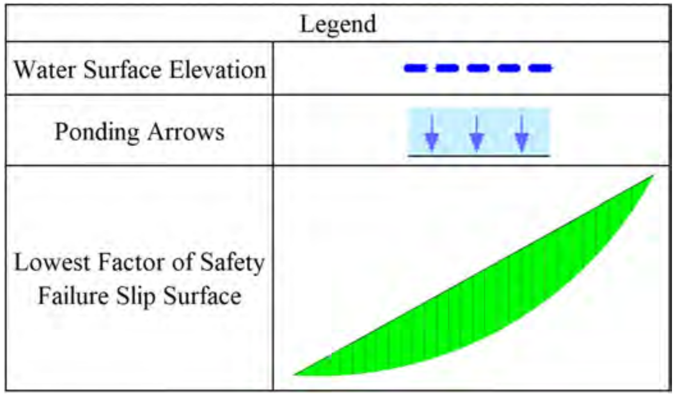
Date: 01/25/2024 Scale: 1:165

Factor of Safety = 1.2



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

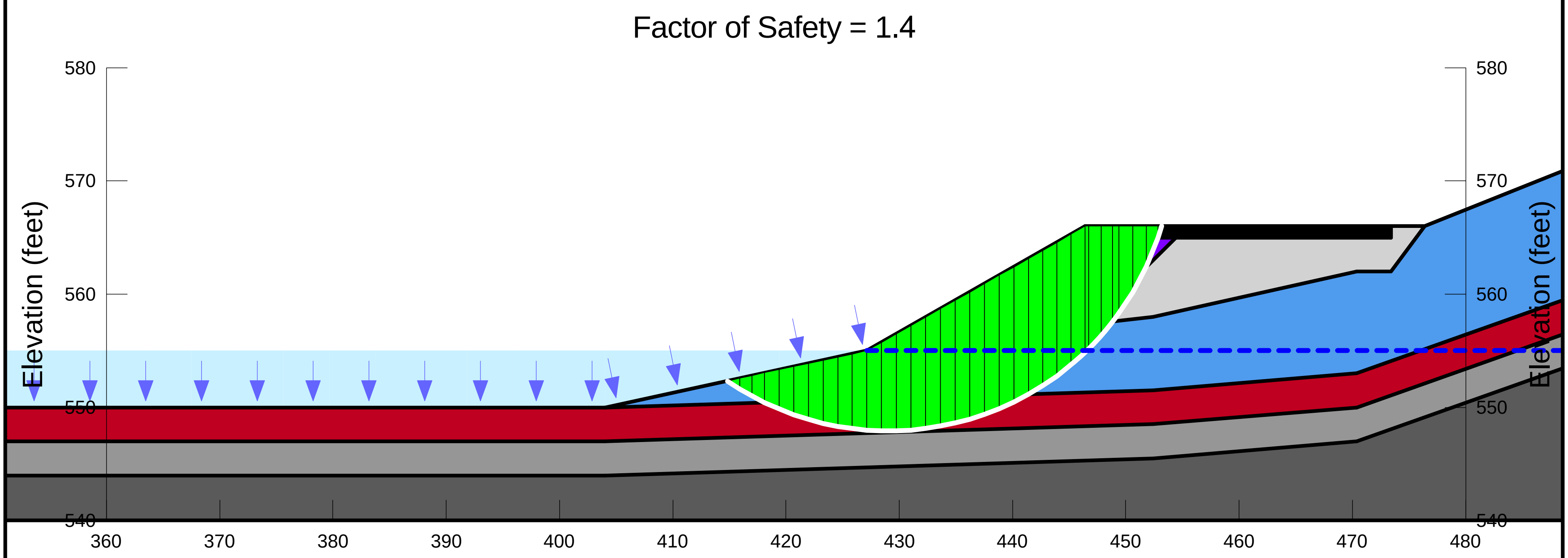
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative (1.75H:1V): Seismic Slope Stability

Date: 01/25/2024 Scale: 1:165



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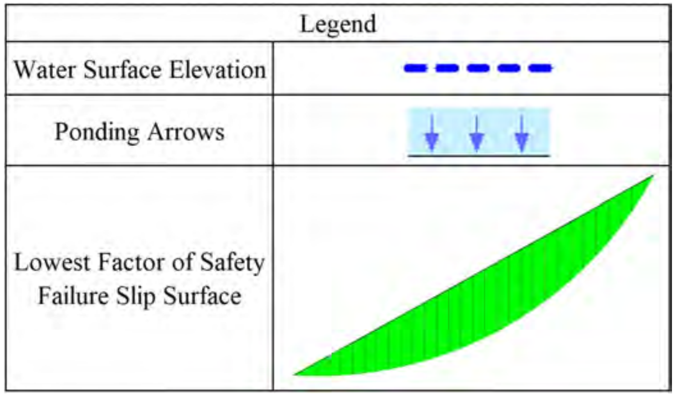
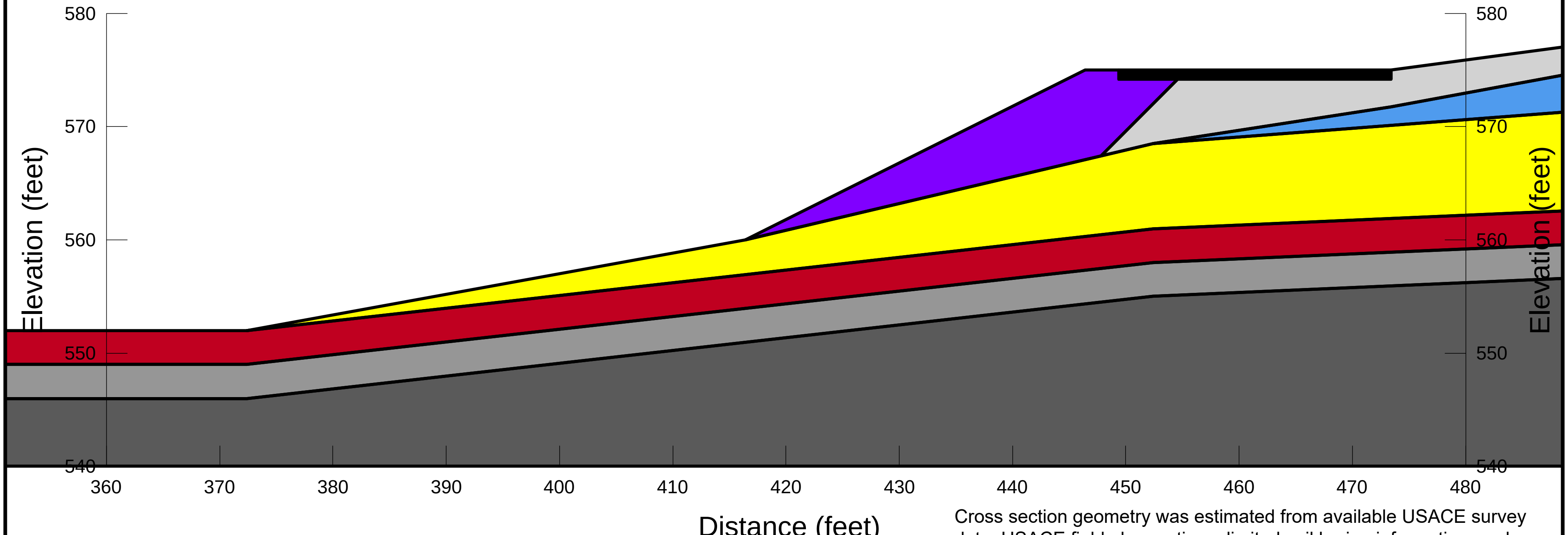
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Upper Kope Zone	Mohr-Coulomb	140	140	13
	5: Weathered Shale	Mohr-Coulomb	140	200	15
	6: Bedrock	Bedrock (Impenetrable)			
	7: Riprap	Mohr-Coulomb	135	10	40



E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 2 Best Value Alternative (1.75H:1V): Steady State Slope Stability

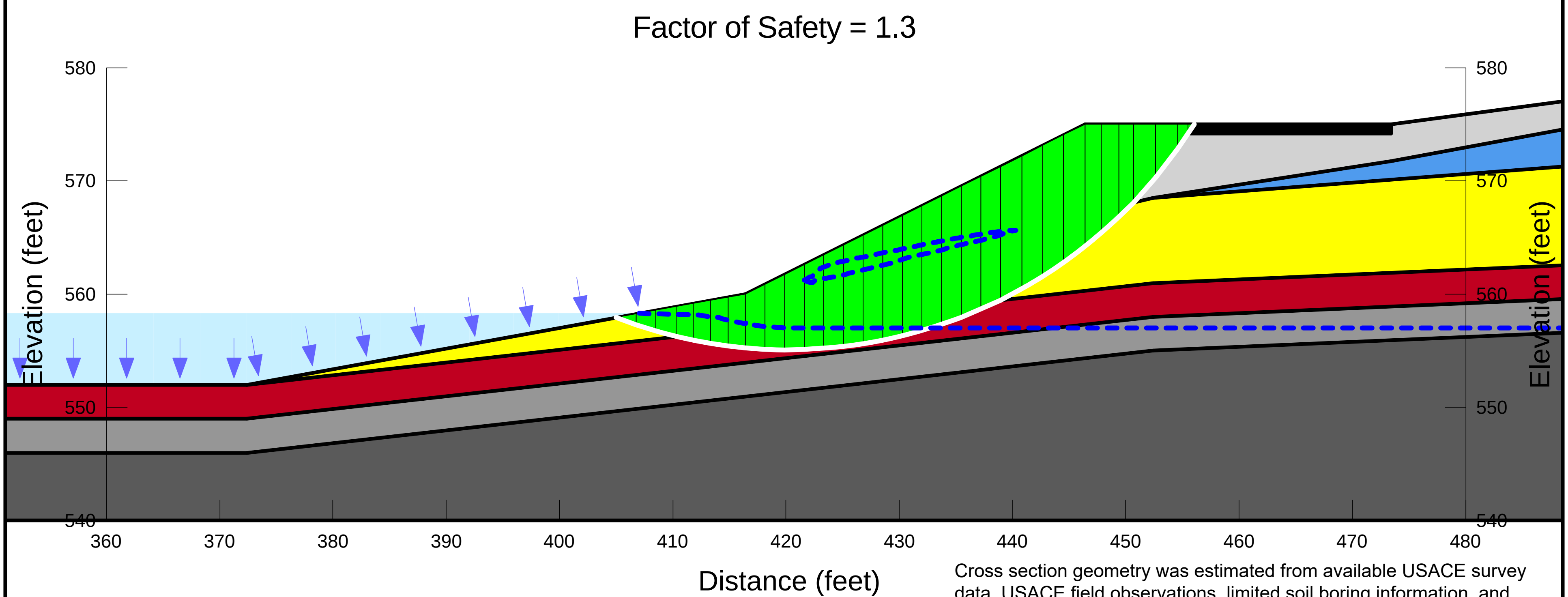
Date: 01/25/2024 Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

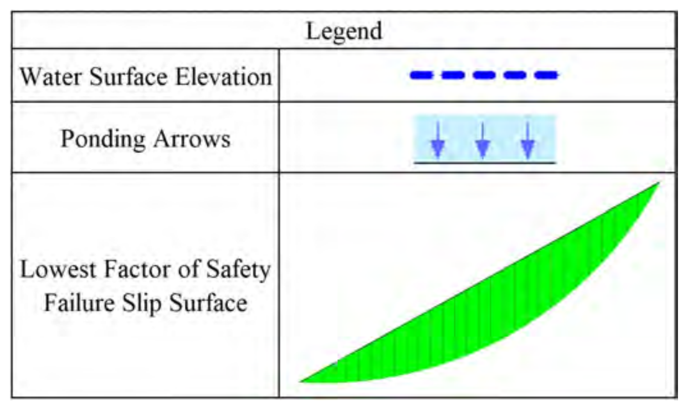
■	1: Asphalt
■	2: Existing Fill
■	3: Clay
■	4: Clayey Sand
■	5: Upper Kope Zone
■	6: Weathered Shale
■	7: Bedrock
■	8: Riprap

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility	
Site 3 Best Value Alternative: Cross-Section Geometry	
Date: 02/01/2023	Scale: 1:165



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill	Mohr-Coulomb	125	50	22
	3: Clay	Mohr-Coulomb	130	200	23
	4: Clayey Sand	Mohr-Coulomb	120	100	27
	5: Upper Kope Zone	Mohr-Coulomb	140	140	13
	6: Weathered Shale	Mohr-Coulomb	140	200	15
	7: Bedrock	Bedrock (Impenetrable)			
	8: Riprap	Mohr-Coulomb	135	10	40

Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

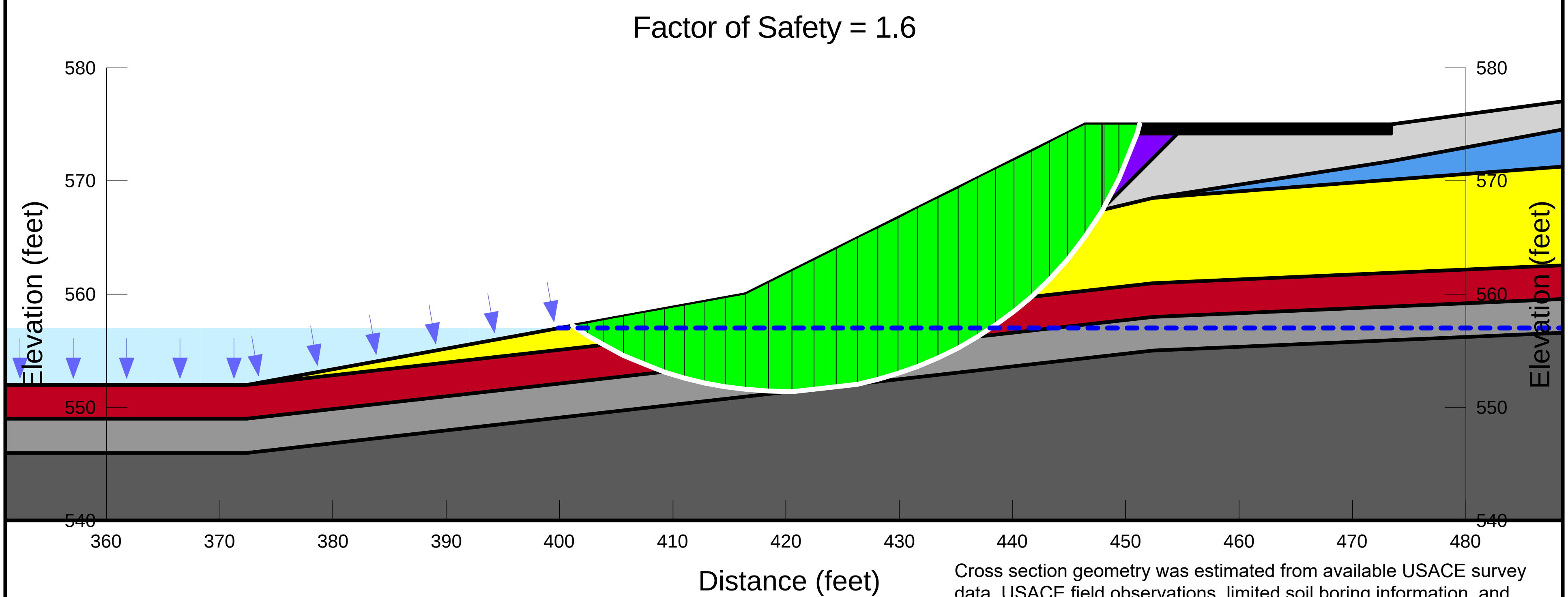


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Best Value Alternative: Rapid Drawdown Slope Stability

Date: 02/01/2023

Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

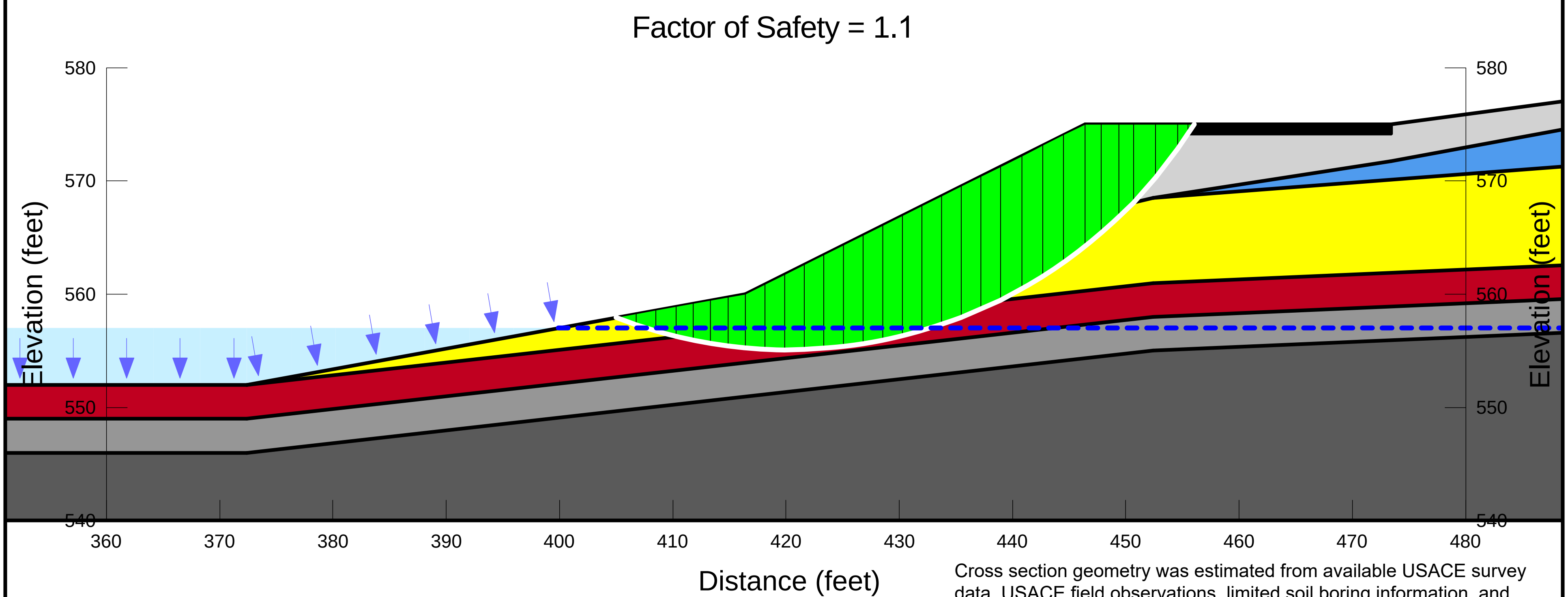
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1: Asphalt	Mohr-Coulomb	145	0	40
	2: Existing Fill (Undrained)	Mohr-Coulomb	125	800	0
	3: Clay (Undrained)	Mohr-Coulomb	130	1,000	0
	4: Clayey Sand (Undrained)	Mohr-Coulomb	120	500	15
	5: Upper Kope Zone	Mohr-Coulomb	140	140	13
	6: Weathered Shale	Mohr-Coulomb	140	200	15
	7: Bedrock	Bedrock (Impenetrable)			
	8: Riprap	Mohr-Coulomb	135	10	40

Legend	
Water Surface Elevation	
Ponding Arrows	
Lowest Factor of Safety Failure Slip Surface	

E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Best Value Alternative: Post Construction Slope Stability

Date: 02/01/2023 Scale: 1:165



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	3: Clay	Mohr-Coulomb	130	200	23
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	5: Upper Kope Zone	Mohr-Coulomb	140	140	13
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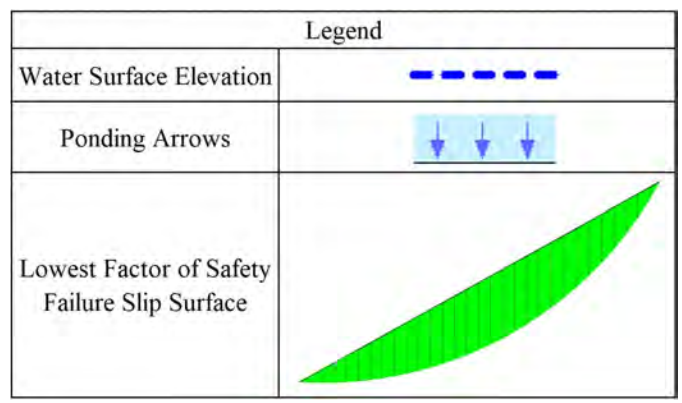
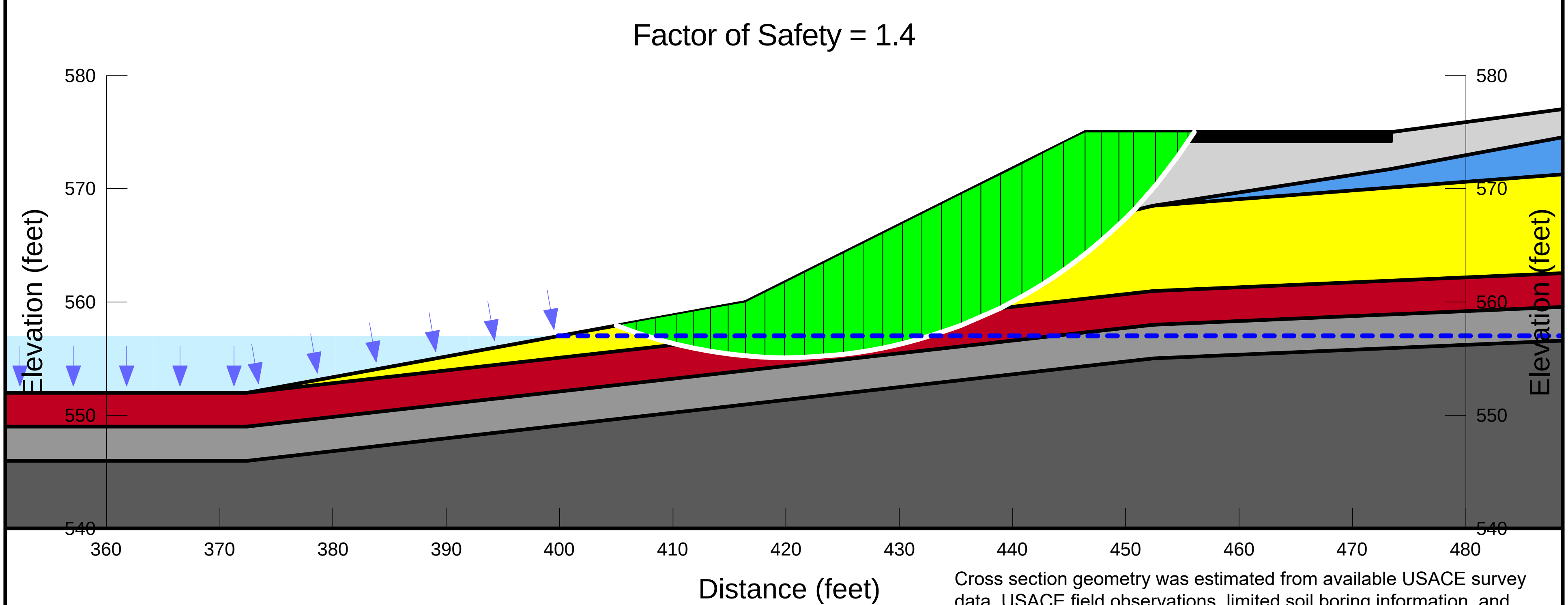


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Best Value Alternative: Seismic Slope Stability

Date: 02/01/2023

Scale: 1:165



Cross section geometry was estimated from available USACE survey data, USACE field observations, limited soil boring information, and Google Earth aerial photography. Actual conditions may vary from those assumed in this analysis.

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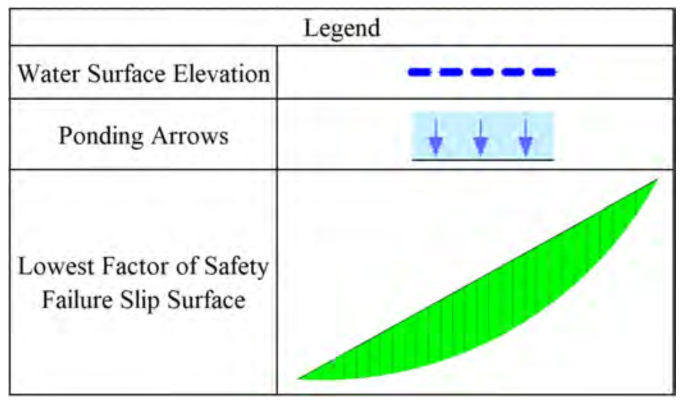


E Kemper Rd Slope Failure - Loveland, OH CAP Section 14 Feasibility

Site 3 Best Value Alternative: Steady State Slope Stability

Date: 02/01/2023 Scale: 1:165

City of Loveland, Ohio
Continuing Authorities Program Section 14
Feasibility Study

Appendix B

Environmental Resources

June 2024

US Army Corps
of Engineers
Louisville District

Clean Water Act Section 404(b)(1) Evaluation Section 14 Emergency Streambank ProtectionLittle Miami River Loveland, Hamilton County, Ohio

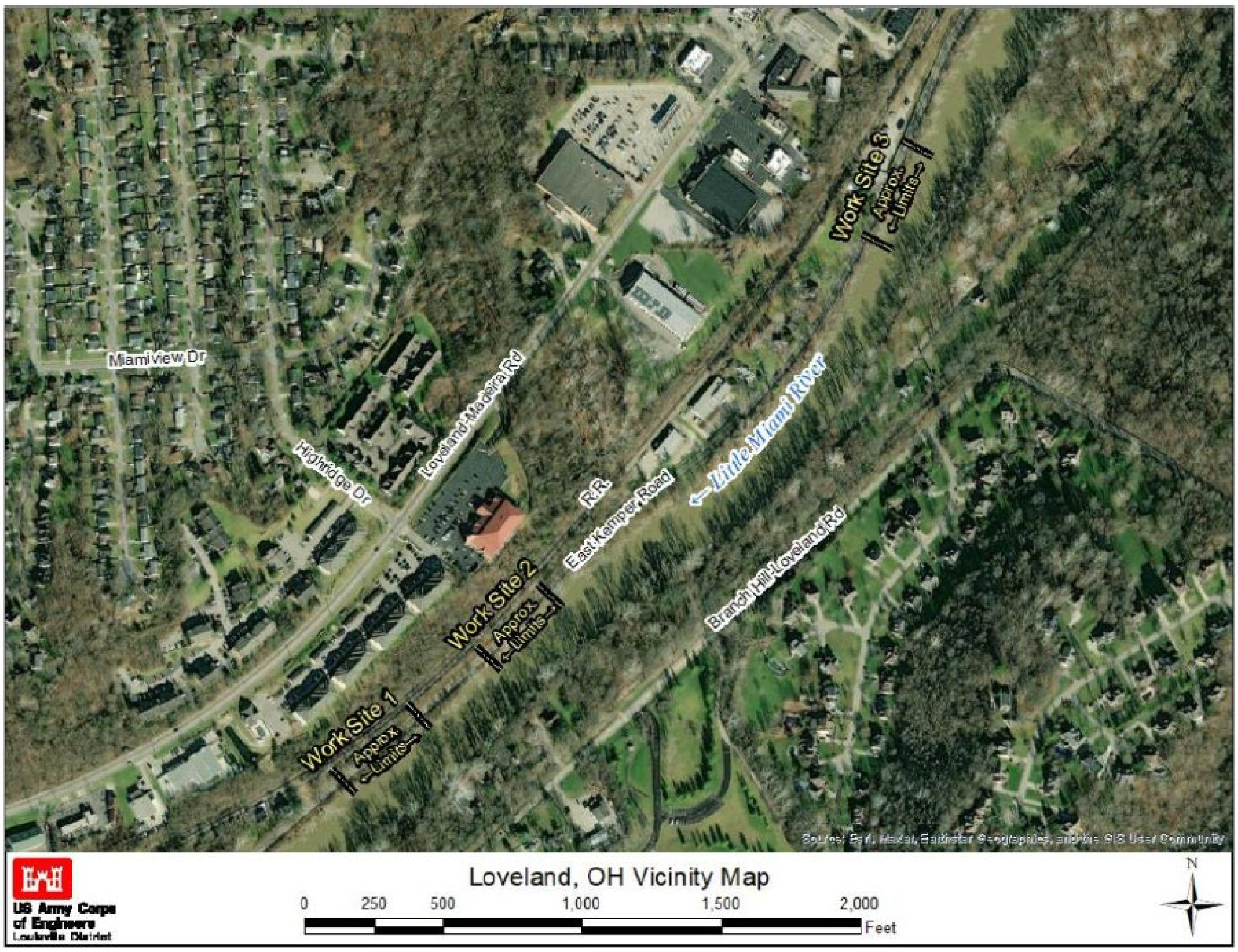
Prepared by:
U.S. Army Corps of Engineers, Louisville District
June 2024

I. Project Description

a. Location

The project is located in the City of Loveland, in southwest Ohio, 17 miles northeast of downtown Cincinnati. The city has a population of 13,307 according to the 2020 Census (USCB 2024). Loveland is unique in that the city is in three different counties: Clermont, Hamilton, and Warren. The Project Area is entirely within Hamilton County on East Kemper Road along the right (northwestern) bank of the Little Miami River at approximate river mile 23.7 to 22.9 (Figure 1). The Little Miami River watershed drains a total of 1,758 square miles and flows through all or part of 11 counties (EPA 2023).

Figure 1. Project site location map.



b. General Description

This Clean Water Act Section 404(b)(1) evaluation addresses the proposed discharge of dredged or fill material into the waters of the U.S. As part of a feasibility study for the proposed Section 14 Emergency Streambank Protection Project, the U.S. Army Corps of Engineers (USACE) prepared an Environmental Assessment for, which included the proposed placement of riprap toe and along the bank of an estimated 1,140 linear feet (LF) of the Little Miami River in Loveland, Ohio.

This alternative would protect 1,140 LF of streambank within the project footprint. The bank would be cleared, removing all the trees with exposed roots and any trees that are dead, dying or otherwise unstable. Once the bank has been cleared, the impacted areas would be regraded and excavated down to underlying clay to form a stable slope upon which the riprap/shot rock toe can be installed.

Once the slope was formed, riprap and/or shot rock would be placed at the foot of the slope. The riprap will be placed on the outer surface of the slope in two, approximately two-foot-thick layers (to be confirmed during the design phase). This alternative is estimated to require clearing a total of approximately 0.6 acres, placing an estimated 12,616 cubic yards of riprap shot rock, and soil below the ordinary high-water mark (OHWM). USACE engineers have estimated a 65% riprap/shot rock to 35% soil ratio for the fill material.

After placement of each riprap layer, the surface voids of the riprap will be filled with topsoil. Once placed, the topsoil shall be watered to work the topsoil into the lower void space of the riprap to promote enhanced continuity and contact between the soil and riprap. Complete saturation of the topsoil with water is typically required to achieve this contact. For all riprap layers, except the final riprap lift, it is critical that these surface voids not be overfilled, such that the next riprap layer does not interlock with the underlying layer. After placement of the final riprap layer, the surface voids of the riprap should be filled with topsoil to create a smooth surface, slightly over filling the void space of the riprap. The topsoil layer should be watered to promote infiltration of the topsoil into the riprap. After the first watering, topsoil will be placed again to create a smooth surface that will support vegetative growth. The topsoil should be hydroseeded with native grasses and plants from the Natural Resources Conservation Service (NRCS) seed mix list, or equivalent. which provides candidate species suitable for the application and site conditions. The topsoil should be protected with an erosion mat prior to any high-water events.

Impact Type	Worksite 1 (ft^2)	Worksite 2 (ft^2)	Worksite 3 (ft^2)
Instream Impact (via rip rap coverage of steam bottom)	4,792	4,792	6,124
Forested Habitat Removed	5,150	1,846	4,356
Total Area	9,942	6,638	10,480

c. Authority and Purpose

This project is being conducted under Section 14 of the Flood Control Act of 1946, as amended, which authorizes the USACE to study, design and construct emergency streambank and shoreline works to protect public services including (but not limited to) streets, bridges, schools, water and sewer lines, National Register Historic sites, and churches from damage or loss by natural erosion. It is a Continuing Authorities Program (CAP) which focuses on water resource related projects of relatively smaller scope, cost and complexity.

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material

Fill material will consist of a combination of riprap, shot rock, and soil, sourced from an approved distributer. Preliminary estimates call for the use of 86-pound maximum graded limestone riprap that would be placed at the toe of the slope.

(2) Quantity of Material

Bank stabilization would require placing an estimated 501 cubic yards of soil, 3,609 cubic yards of riprap, and 8,506 cubic yards of shot rock.

(3) Source of Material

The rock would be obtained from commercial sources.

e. <u>Description of the Proposed Discharge Sites</u>

(1) Location

The project site is located on the right (northwestern) bank of the Little Miami River at approximate river mile 23.7 to 22.9 along E. Kemper Road in Loveland, Ohio.

(2) Size

The penitential discharge sites related to the proposed project include the entire length of the streamside imprint. As designed, this involves an estimated 1,159.4 feet of the Little Miami River shoreline. Best management practices will be used to limit instream inputs to the greatest extent possible.

(3) Type(s) of Sites and Habitats

No formal benthic habitat evaluation of the site has been conducted in support of the proposed project. Based on a site visit conducted 10 August 2023, instream substrates are primarily a mixture of cobble, silt, and sand. Sections of site have also been heavily impacted by urbanization with the placement of fill comprised of construction debris into nearshore areas over the preceding decades.

(4) Time and Duration of Discharge

The estimated total construction time of the Tentatively Selected Plan would be 180 days.

f. <u>Description of Disposal Method</u>

Placement of the fill will be accomplished from land (via the existing roadbed) by crane and/or excavator. Excavated material will be hauled off site to a commercial landfill.

II. Factual Determinations

a. <u>Physical Substrate Determinations</u>

(1) Substrate

No formal assessment of benthic substrates within the project footprint have been conducted. Based on a site visit conducted 10 August 2023, instream substrates are primarily a mixture of cobble, silt, and sand. Moderate silt accumulation near stream margins haveoccurred from eroded banks.

(2) Sediment Type

Sediments at the project sites are mostly fine sediments, sands, and deposited material from the river. Sediments resulting from erosion along the riverbank transported by water flow are composed of sorted gravel, sand, silt, and other fine materials.

(3) Dredged/Fill Material Movement

No dredging will be conducted at the site. The movement of fill material will be limited by the size of the riprap and shot rock materials.

(4) Physical Effects on Benthos

Temporary and localized impacts to benthic organisms and their habitats would occur in the immediate areas of construction. Benthic flora and fauna would be crushed or smothered via the placement of riprap/shot rock materials in nearshore areas. However, benthic organisms are expected to quickly rebound from the short-term impacts of material placement.

(5) Other Effects

No other effects are known.

(6) Actions Taken to Minimize Impacts

Impacts to surface water and physical substrates from excavation of riverbed material would be minimized by using appropriate construction best management practices and limiting excavation quantities and ground disturbance to the absolute minimum required.

b. Water Circulation, Fluctuation, and Salinity Determinations

(1) Water

Temporary increases in turbidity would occur at the construction areas and downstream of the areas during construction. These changes in turbidity have not been modeled; however, due to the limited scope of the project, they are not expected to significantly impact water quality.

No significant negative impacts would be expected to water quality or sensitive organisms where material would be placed.

(a) Salinity

There are no impacts expected to salinity.

(b) Water Chemistry

There are no impacts expected to water chemistry.

(c) Clarity

There may be a local and temporary increase in turbidity during construction activities. Because of reduced sediment load, water clarity near the project site is expected to improve from preconstruction conditions shortly after operations are completed.

(d) Color

Water immediately surrounding the construction area may become discolored temporarily due to disturbance of the sediment during placement of the riprap.

(e) Odor

Negligible amounts of hydrogen sulfide may be expected when disturbing possible anoxic sediments at the construction sites. Otherwise, there are no long-term impacts to odor.

(f) Taste

There are no impacts expected to taste.

(g) Dissolved Gas Levels

No impacts to dissolved gas levels would be expected.

(h) Nutrients

The proposed action could cause temporary nutrient increases during periods of resuspension of sediment and organic debris. Once construction is complete, nutrients entering the water column from erosion of the streambank would be significantly decreased at the project site.

(i) Eutrophication

Construction activities would not lead to eutrophication of surrounding waters.

(j) Others as Appropriate

None known.

(2) Current Patterns and Circulation

(a) Current Patterns and Flow

Construction activities would not have a significant effect on inflows to the system or water surface elevations.

(b) Velocity

Placement of material within the channel would not significantly impact velocities.

(c) Stratification

No changes in water stratification are anticipated.

(d) Hydrologic Regime

Hydrologic regimes would not be altered with placement of material.

(3) Normal Water Level Fluctuations

The average water surface elevation throughout the study area would be unaffected by construction activities.

(4) Salinity Gradients

There would be no change in salinity gradients.

(5) Actions That Would Be Taken to Minimize Impacts

Impacts to surface water and physical substrates from excavation of riverbed material would be minimized by using appropriate construction best management practices and limiting excavation quantities to the absolute minimum required.

c. <u>Suspended Particulate/Turbidity Determination</u>

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

A temporary and localized increase in suspended particulates and turbidity levels is expected during excavation and placement of material at the project site. Upon completion of construction activities, suspended particulates and turbidity levels are expected to quickly return to preconstruction levels.

(2) Effects on Chemical and Physical Properties of the Water Column

(a) Light Penetration

Turbidity levels would be temporarily increased during placement operations material. Upon completion of construction activities light penetration is expected to improve from preconstruction levels due to reduced sedimentation from erosion at the project sites.

(b) Dissolved Oxygen

No adverse impacts to dissolved oxygen (DO) are expected; a reduction in DO may occur at localized and temporary events during construction activities.

(c) Toxic metals and organics

Suspended particles resulting from placement would not result in detrimental effects to chemical and physical properties of the water column.

(d) Pathogens

None expected or found.

(e) Aesthetics

No impacts to aesthetics would be anticipated.

(f) Others as Appropriate

None known.

(3) Effects on Biota

No impacts are expected on photosynthesis, suspension/filter feeders, and sight feeders, except for temporary and localized impacts from placement operations (e.g., burial of benthos or temporary increase of local turbidity levels).

(4) Actions Taken to Minimize Impacts

Impacts to surface water and physical substrates from excavation of riverbed material would be minimized by using appropriate construction best management practices and limiting excavation quantities and ground disturbance to the absolute minimum required.

d. <u>Contaminant Determinations</u>

The riprap would be acquired from a state-approved commercial source. No contaminated materials would be released during construction of this project. Should contaminationbe found, necessary steps to avoid the materials or cleanup of the area would take place.

e. <u>Aquatic Ecosystem and Organism Determinations</u>

(1) Effects on Plankton

The proposed action could cause some negligible mortality because of increases in total suspended solids and turbidity and decreases in dissolved oxygen levels during construction periods. Impacts would be temporary and short-term in nature, and recolonization of the area by plankton should occur quickly after construction is complete.

(2) Effects on Benthos

Temporary effects on benthic macroinvertebrates could occur during construction, but once the project is complete, recolonization of the project areas by the native benthos is expected.

(3) Effects on Nekton

No significant impacts to the nekton of the area from the proposed construction and placement operations are expected.

(4) Effects on Aquatic Food Web

Reductions in primary productivity from turbidity would be temporary and localized around the immediate area of the construction and would be limited to the duration of the plume at a given site.

(5) Effects on Special Aquatic Sites

Construction activities would not have detrimental effects on special aquatic sites in the study area (i.e., sanctuaries and refuges, wetlands, mudflats).

(6) Threatened and Endangered Species

Coordination is ongoing with the U.S. Fish and Wildlife Service (USFWS) and the Ohio Department of Natural Resources (ODNR). Based on data obtained from the USFWS Information for Planning and Consultation (IPaC) online planning tool (USFWS 2023), four Federally listed species have been or are known to occur within range of the proposed Project. This list includes the Federally endangered Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*), the proposed endangered tri-colored bat (*Perimyotis subflavus*), and the candidate monarch butterfly (*Danaus plexippus*). No Federally listed aquatic species are known in the project footprint. Final determination of the presence of mussels will be provided via an agency-approved mussel survey to be conducted prior to the onset of construction activities. Should mussels be encountered during the survey, all mussels will be relocated out of the zone of impact and agency coordination will be completed, as necessary.

(7) Other Wildlife

Because existing conditions within the proposed project area provide poor quality wildlife habitat, there would be no significant loss of wildlife habitat. However,placed stone could provide wildlife habitat over the long-term.

(8) Actions to Minimize Impacts

Construction and riprap placement operations would be limited to low flow conditions, where possible, to minimize the overall impacts of disturbance. Construction best management practices would be implemented to minimize impacts. In addition, USACE is coordinating with the USFWS and IDNR regarding potential impacts to threatened and endangered species in the action area, and a Clean Water Act - Section 401 Water Quality Certification will be obtainedfrom the Ohio Environmental Protection Agency (OHEPA) before construction begins. To minimize impacts to roosting Federally listed bats, no trees over three inches diameter at breast height will be removed from April 1st to September 30th.

f. <u>Proposed Disposal Site Determinations</u>

(1) Mixing Zone Determination

N/A

(2) Determination of Compliance with Applicable Water Quality Standards

In the No Action Alternative condition, water and sediment quality are not expected to substantially change in the Little Miami River or its surrounding waters.

For the proposed project alternative, no violation of water quality standards is anticipated. A Clean Water Act - Section 401 Water Quality Certification will be obtained from the OHEPA before construction begins.

(3) Potential Effects on Human Use Characteristics

(a) Municipal and Private Water Supply

Construction activities would not impact any municipal or private water supplies.

(b) Recreational and Commercial Fisheries

No significant impacts to recreational and commercial fishing are anticipated from implementation of the proposed project. Completion of the bank stabilization project may have positive effects on the aquatic food chain by providing additional habitat below OHW for aquatic plant and animal species. This in turn, could potentially improve the local fishery.

(c) Water-related Recreation

No impacts to water-related recreation would occur as a result of the proposed construction activities.

(d) Aesthetics

No significant impacts to aesthetics are expected. Some trees will be removed from the project site; however, without the implement of an erosion protection, these trees will be undercut and fall in a relatively short timeframe. Construction of the project will protect the bank and allow new vegetation to establish.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

No special sites would be negatively impacted by the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

From a watershed perspective, the stabilized 1,140 LF of riverbank would not be highly visible in the overall reduction of aquatic resource impairments due to sedimentation; however, it would provide some minor progress in reducing riverbank erosion.

The construction activities of the proposed project are expected to have negligible adverse impacts to the environment when considered directly, indirectly, and/or cumulatively. The placement of bank protection is expected to improve water quality from preconstruction conditions by reducing erosion in the area. Riprap protection currently exists in the footprint of the project but will be improved and extended to protect more riverbank from erosion. Cumulative effects are discussed in further detail in Section 4.12 of the integrated DPR/Environmental Assessment document.

h. Determination of Secondary Effects on the Aquatic Ecosystem

Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill material but do not result from the actual placement of the material. No adverse significant secondary effects on the aquatic ecosystem should occur as a result of the proposed project.

III. Findings of Compliance with Restrictions on Discharge with Section 404(b)(1) Guidelines for the White Lick Creek Streambank Protection Study

a. **Adaptation of the Section 404(b)(1) Guidelines to this Evaluation**: No significant adaptations of the Guidelines were made relative to the evaluation for this project.

b. **Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem**: The proposed project is the result of thorough evaluation of six proposed alternatives (including the No-Action Alternative). Refer to the associated Environmental Assessment and Feasibility Report for a complete comparative analysis of available alternatives. The proposed alternative of streambank protection in the form of vegetated riprap system is the practicablealternative that would have the least adverse impact on the aquatic ecosystem.

c. **Compliance with Applicable State Water Quality Standards**: The discharges associated with the proposed project alternative are not anticipated to cause or contribute to violation of any water quality standards. A Clean Water Act Section 401 Water Quality Certification will be obtained from the State of Ohio before commencing any work in waters of the U.S. Floodplain permit and Section 402 (National Pollution Discharge Elimination System) permit will also be obtained prior to construction, as needed. Additionally, the proposed project alternative would not violate any toxic effluent standards of Section 307 of the Clean Water Act.

d. **Compliance with Applicable Toxic Effluent Standard of Prohibition Under Section 307 of the Clean Water Act**: Bank stabilization operations would not violate Section 307 of the Clean Water Act.

e. **Compliance with the Endangered Species Act**: Based on the design, scope, and timing of the proposed project, the USACE has made a preliminary determination that the proposed project will have no effect on Federally listed species or critical habitats (see associated Integrated DPR and EA document for details). Should the mussel survey conducted in the project footprint document Federally listed species, coordination with U.S. Fish and Wildlife Service will and Ohio Department of Natural Resources will be initiated, as required by Section 7 of the Endangered Species Act, and a final effects determination will be made, as needed.

f. **Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972**: Not applicable.

g. **Evaluation of Extent of Degradation of the Waters of the United States**: The proposed project would not result in adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, wildlife, and special aquatic sites. There are no significant adverse impacts expected to the aquatic ecosystem diversity, productivity and stability, or recreational, aesthetic, and economic values.

h. **Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the discharge on the Aquatic Ecosystem**: Appropriate steps to minimize potential adverse impacts on the aquatic system include close coordination with the State and Federal resource agencies during the final design prior to construction to incorporate all valid suggestions. Construction best management practices would be implemented to minimize impacts to the riparian zone and riverbed and to control erosion and resuspension of soil and sediments. Additionally, construction activities would be limited to low flow conditions to minimize the overall effects of sediment disturbance and alterations of the riverbank, riparian vegetation, and the river substrate would be limited to the greatest extent possible.

i. **EPA 404 (b) (1) Guidelines:** The proposed disposal site for the discharge of dredged or fill material is in compliance with requirements of these guidelines, with the inclusion of the appropriate conditions and construction best management practices to minimize impacts to the aquatic ecosystem.

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United States Department of Agriculture

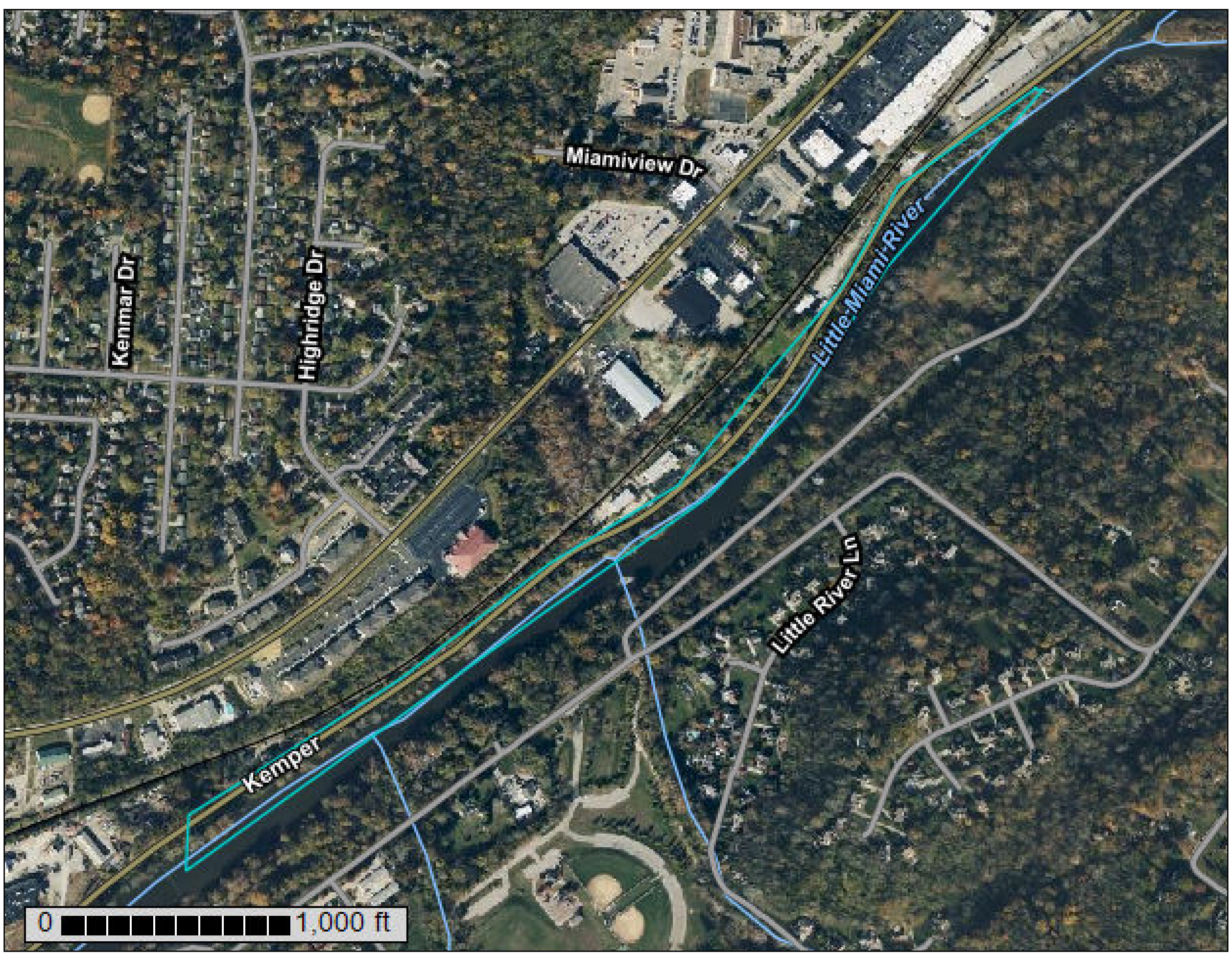
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Clermont County, Ohio, and Hamilton County, Ohio

Loveland CAP Section 14 Bank Stabilization Project



September 12, 2023

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map


84° 17' 2" W
84° 15' 41" W
39° 15' 51" N
39° 15' 11" N
734400
734600
734800
735000
735200
735400
735600
735800
736000
736200
4349600
4349400
4349200
4349000
4348800
4348600
4348400
Miamiview Dr
Debra Ln
Highridge Dr
Loveland Madeira
Little River Ln
W Hanna Ave
W
UrUXC
Soil Map may not be valid at this scale.
Map Scale: 1:8,820 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 100 200 400 600
Feet
0 400 800 1600 2400
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:15,800 to 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Clermont County, Ohio
Survey Area Data: Version 22, Sep 8, 2022

Soil Survey Area: Hamilton County, Ohio
Survey Area Data: Version 22, Sep 9, 2022

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

MAP LEGEND

MAP INFORMATION

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

Date(s) aerial images were photographed: Oct 28, 2019—Dec 5, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
W	Water	1.6	9.2%
Subtotals for Soil Survey Area		**1.6**	**9.2%**
Totals for Area of Interest		**16.8**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
UrUXC	Urban land-Udorthents complex, 0 to 12 percent slopes	9.9	58.8%
W	Water	5.4	31.9%
Subtotals for Soil Survey Area		**15.3**	**90.8%**
Totals for Area of Interest		**16.8**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

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

Clermont County, Ohio

W—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Hamilton County, Ohio

UrUXC—Urban land-Udorthents complex, 0 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2q6yr
Elevation: 480 to 1,000 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 172 to 204 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 60 percent
Udorthents and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Properties and qualities

Slope: 0 to 12 percent
Depth to restrictive feature: More than 80 inches
Runoff class: High
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

W—Water

Map Unit Composition

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

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Ground-Water Resources of HAMILTON COUNTY

by
Alfred C. Walker

0 1 2 Miles
0 1 2 3 Kilometers

1:62,500

Well Site Symbols

- ● Well Site
- ○ Municipal-Industrial Well
- △ Test Well*
- □ Observation Well**
- **A** Chemical Analyses

S - Sand
CL - Clay
SH - Shale
LS - Limestone
SG - Sand & Gravel

Depth (ft.) - Water-bearing Formation - Yield (gpm)
290-SG-10
224
Depth to Bedrock (ft.)

Chemical Analysis Table

Well Site	A	B	C	D	H-5	H-6	H-9	H-11
Depth of well (ft.)	76	125	197	118	122	167	168	148
Aquifer	SG	SG	SG	SG	SG	SG	SG	SG
pH	7.5	7.8	7.6	7.6	7.1	7.6	7.1	7.4
Total hardness ($CaCO^3$)	376.0	146.0	—	350.0	440	280	410	310
Sulfate (SO_4)	50.0	52.0	101.0	79.9	61	6.1	97	290
Iron (Fe)	—	—	4.2	0.08	2.6	4.5	2.6	1.9
Manganese (Mn)	—	0.08	0.37	0.38	0.11	0.09	0.18	1.1
Fluoride (F)	0.11	0.23	0.21	0.30	0.10	0.30	0.30	0.10
Chloride (Cl)	40.0	21.0	32.0	36.0	31	9.8	65	200
Calcium (Ca)	105.6	45.0	129.0	110.0	120	78	100	78

Chemical constituents as milligrams per liter (mg/l).

Well Yields

AREAS IN WHICH YIELDS OF MORE THAN 500 GALLONS PER MINUTE CAN BE DEVELOPED.

Best ground-water areas in Hamilton County. Permeable sand and gravel deposits in ancient stream channels, suitable for large industrial well field development. Yields of as much as 1,000 gallons per minute have been reported.

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE CAN BE DEVELOPED.

Sand and gravel deposits, generally well sorted, may yield several hundred gallons per minute. Highest yields are reported where recharge is available from nearby streams. Exploratory drilling is necessary to locate coarser materials.

AREAS IN WHICH YIELDS OF 25 TO 100 GALLONS PER MINUTE CAN BE DEVELOPED.

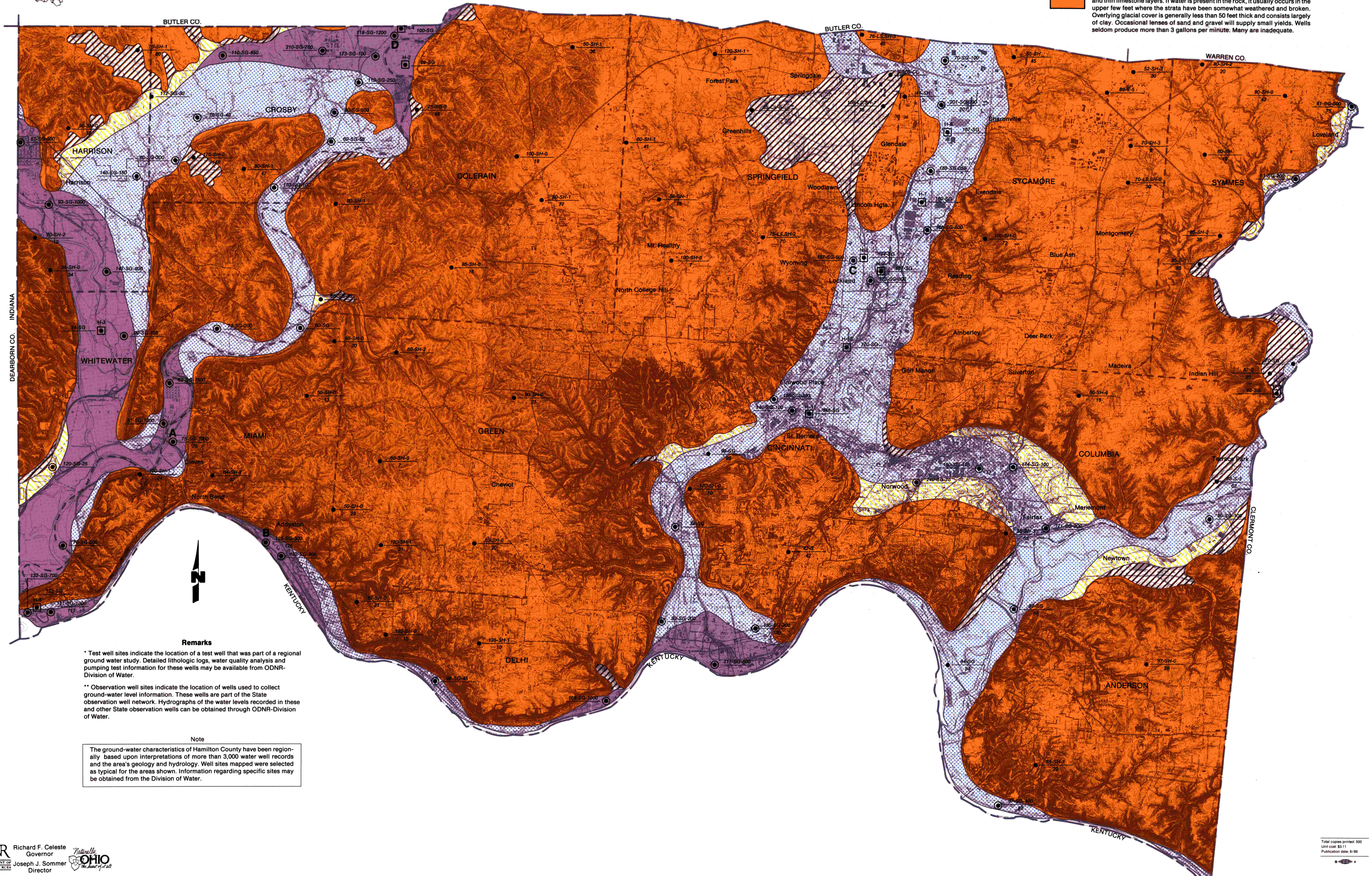
Valley fill contains thick local deposits of sand and gravel. Screened wells encountering permeable deposits yield less than 100 gallons per minute. Shale bedrock will supply very limited yields.

AREAS IN WHICH YIELDS OF 3 TO 10 GALLONS PER MINUTE MAY BE DEVELOPED.

Thick deposits of clay with thin lenses of sand and gravel will yield less than 10 gallons per minute. Wells not encountering sand and gravel produce less than 3 gallons per minute from the underlying limey shale at depths of less than 100 feet.

AREAS IN WHICH YIELDS SELDOM EXCEED 3 GALLONS PER MINUTE.

Poor source of ground water. Bedrock consists of interbedded plastic shales and thin limestone layers. If water is present in the rock, it usually occurs in the upper few feet where the strata have been somewhat weathered and broken. Overlying glacial cover is generally less than 50 feet thick and consists largely of clay. Occasional lenses of sand and gravel will supply small yields. Wells seldom produce more than 3 gallons per minute. Many are inadequate.



Remarks

* Test well sites indicate the location of a test well that was part of a regional ground water study. Detailed lithologic logs, water quality analysis and pumping test information for these wells may be available from ODNR-Division of Water.

** Observation well sites indicate the location of wells used to collect ground-water level information. These wells are part of the State observation well network. Hydrographs of the water levels recorded in these and other State observation wells can be obtained through ODNR-Division of Water.

Note

The ground-water characteristics of Hamilton County have been regionally based upon interpretations of more than 3,000 water well records and the area's geology and hydrology. Well sites mapped were selected as typical for the areas shown. Information regarding specific sites may be obtained from the Division of Water.

ODNR OHIO DEPARTMENT OF NATURAL RESOURCES
Richard F. Celeste
Governor
Joseph J. Sommer
Director

Naturally OHIO the heart of it all

Total copies printed: 500
Unit cost: $3.11
Publication date: 8/86

Cartography: David S. Orr

Published, 1986

Invasive species documented in Hamilton County, Ohio

Common Name	Scientific Name	Number of Records
garlic mustard	*Alliaria petiolata*	78
multicolored Asian lady beetle	*Harmonia axyridis*	74
Japanese beetle	*Popillia japonica*	58
tree-of-heaven	*Ailanthus altissima*	46
white clover	*Trifolium repens*	39
Amur honeysuckle	*Lonicera maackii*	27
common pokeweed	*Phytolacca americana*	24
red clover	*Trifolium pratense*	21
lesser celandine, fig buttercup	*Ficaria verna*	19
Queen Anne's lace, wild carrot	*Daucus carota*	15
common purslane	*Portulaca oleracea*	15
eastern poison-ivy	*Toxicodendron radicans*	14
brown marmorated stink bug	*Halyomorpha halys*	12
chicory	*Cichorium intybus*	12
multiflora rose	*Rosa multiflora*	12
mugwort	*Artemisia vulgaris*	12
osage-orange	*Maclura pomifera*	11
henbit	*Lamium amplexicaule*	11
kudzu	*Pueraria montana var. lobata*	9
northern catalpa	*Catalpa speciosa*	9
spotted spurge	*Euphorbia maculata*	9
English ivy	*Hedera helix*	9
winter creeper	*Euonymus fortunei*	9
false strawberry	*Potentilla indica*	8
buckhorn plantain	*Plantago lanceolata*	8
Oriental lady's thumb	*Persicaria longiseta*	8
Japanese knotweed	*Reynoutria japonica*	8
Japanese stiltgrass	*Microstegium vimineum*	7
black locust	*Robinia pseudoacacia*	7
european starling	*Sturnus vulgaris*	7
emerald ash borer	*Agrilus planipennis*	6
Canada thistle	*Cirsium arvense*	6
Japanese honeysuckle	*Lonicera japonica*	6
round leaf bittersweet	*Celastrus orbiculatus*	6
winged burning bush	*Euonymus alatus*	6
yellow woodsorrel	*Oxalis stricta*	5
Callery pear (Bradford pear)	*Pyrus calleryana*	5
bull thistle	*Cirsium vulgare*	5
common chickweed	*Stellaria media*	5

Common Name	Scientific Name	Number of Records
bittersweet nightshade	*Solanum dulcamara*	5
giant ragweed	*Ambrosia trifida*	5
great burdock	*Arctium lappa*	5
dames rocket	*Hesperis matronalis*	5
dandelion	*Taraxacum officinale*	4
curly dock	*Rumex crispus*	4
common teasel	*Dipsacus fullonum*	4
creeping yellow loosestrife	*Lysimachia nummularia*	4
ground ivy	*Glechoma hederacea*	4
Amur corktree	*Phellodendron amurense*	4
Asiatic dayflower	*Commelina communis*	4
common buckthorn	*Rhamnus cathartica*	4
burcucumber	*Sicyos angulatus*	4
Canadian horseweed	*Erigeron canadensis*	4
purple deadnettle	*Lamium purpureum*	4
purple loosestrife	*Lythrum salicaria*	4
spearmint	*Mentha spicata*	4
tall morning-glory	*Ipomoea purpurea*	4
ladysthumb	*Persicaria maculosa*	4
perennial ryegrass	*Lolium perenne*	4
poison hemlock	*Conium maculatum*	4
musk thistle, nodding thistle	*Carduus nutans*	4
moth mullein	*Verbascum blattaria*	4
white mulberry	*Morus alba*	4
watercress	*Nasturtium officinale*	4
true forget-me-not	*Myosotis scorpioides*	3
white campion	*Silene latifolia*	3
yellow foxtail	*Setaria pumila*	3
yellow groove bamboo	*Phyllostachys aureosulcata*	3
perennial sowthistle	*Sonchus arvensis*	3
Japanese hop	*Humulus japonicus*	3
Japanese chaff flower	*Achyranthes japonica*	3
spring whitlowgrass	*Draba verna*	3
sweet autumn virginsbower	*Clematis terniflora*	3
spiny sowthistle	*Sonchus asper*	3
spotted knapweed	*Centaurea stoebe ssp. micranthos*	3
spotted lanternfly	*Lycorma delicatula*	3
pitted morning-glory	*Ipomoea lacunosa*	3
scarlet pimpernel	*Anagallis arvensis*	3
rose of Sharon	*Hibiscus syriacus*	3
autumn olive	*Elaeagnus umbellata*	3

Common Name	Scientific Name	Number of Records
black medic	*Medicago lupulina*	3
bouncingbet	*Saponaria officinalis*	3
hairy galinsoga	*Galinsoga quadriradiata*	3
five-leaf aralia	*Eleutherococcus sieboldianus*	3
dwarf snapdragon	*Chaenorhinum minus*	3
cup rosinweed	*Silphium perfoliatum*	3
common duckweed	*Lemna minor*	3
common selfheal	*Prunella vulgaris*	3
Deptford pink	*Dianthus armeria*	3
eastern redcedar	*Juniperus virginiana*	3
cutleaf teasel	*Dipsacus laciniatus*	3
cypress spurge	*Euphorbia cyparissias*	2
dog rose	*Rosa canina*	2
eclipta	*Eclipta prostrata*	2
curly dock	*Rumex crispus ssp. crispus*	2
cutleaf evening-primrose	*Oenothera laciniata*	2
cutleaf geranium	*Geranium dissectum*	2
common vetch	*Vicia sativa*	2
common viper's bugloss	*Echium vulgare*	2
common St. Johnswort	*Hypericum perforatum*	2
common tansy	*Tanacetum vulgare*	2
corn gromwell	*Buglossoides arvensis*	2
corn speedwell	*Veronica arvensis*	2
cornflower	*Centaurea cyanus*	2
creeping bellflower	*Campanula rapunculoides*	2
creeping waterprimrose	*Ludwigia peploides*	2
common cattail	*Typha latifolia*	2
elecampane	*Inula helenium*	2
field bindweed	*Convolvulus arvensis*	2
field pennycress	*Thlaspi arvense*	2
garlic mustard aphid	*Lipaphis alliariae*	2
giant chickweed	*Myosoton aquaticum*	2
giantseed goosefoot	*Chenopodiastrum simplex*	2
goat willow	*Salix caprea*	2
greater celandine	*Chelidonium majus*	2
green sunfish	*Lepomis cyanellus*	2
hedge mustard	*Sisymbrium officinale*	2
bristly foxtail	*Setaria verticillata*	2
black mustard	*Brassica nigra*	2
apple-mint	*Mentha x villosa*	2
apple-of-Peru	*Nicandra physalodes*	2

Common Name	Scientific Name	Number of Records
balloonvine	*Cardiospermum halicacabum*	2
American bullfrog	*Lithobates catesbeianus*	2
annual sowthistle	*Sonchus oleraceus*	2
birdsrape mustard	*Brassica rapa*	2
catnip	*Nepeta cataria*	2
broadleaf dock	*Rumex obtusifolius*	2
broadleaf plantain	*Plantago major*	2
broomsedge bluestem	*Andropogon virginicus*	2
common burdock	*Arctium minus*	2
Chinese silvergrass	*Miscanthus sinensis*	2
Chinese yam	*Dioscorea polystachya*	2
common chickweed	*Stellaria pallida*	2
common ragweed	*Ambrosia artemisiifolia*	2
common mallow	*Malva neglecta*	2
common mullein	*Verbascum thapsus*	2
common pear	*Pyrus communis*	2
redtop	*Agrostis gigantea*	2
reed canarygrass	*Phalaris arundinacea*	2
red morning-glory	*Ipomoea coccinea*	2
red sorrel	*Rumex acetosella*	2
red-eared slider	*Trachemys scripta elegans*	2
Scotch thistle	*Onopordum acanthium*	2
shepherd's-purse	*Capsella bursa-pastoris*	2
showy fly honeysuckle	*Lonicera x bella*	2
Russian thistle	*Salsola tragus*	2
purple cudweed	*Gamochaeta purpurea*	2
radish	*Raphanus sativus*	2
paradise apple	*Malus pumila*	2
prostrate knotweed	*Polygonum aviculare*	2
spongy moth	*Lymantria dispar*	2
spiny amaranth	*Amaranthus spinosus*	2
slender snakecotton	*Froelichia gracilis*	2
small hop clover	*Trifolium dubium*	2
smallflower galinsoga	*Galinsoga parviflora*	2
smallflower morningglory	*Jacquemontia tamnifolia*	2
smallseed falseflax	*Camelina microcarpa*	2
southern catalpa	*Catalpa bignonioides*	2
tall lettuce	*Lactuca canadensis*	2
stinging nettle	*Urtica dioica*	2
stinking chamomile	*Anthemis cotula*	2
sulfur cinquefoil	*Potentilla recta*	2

Common Name	Scientific Name	Number of Records
spreading hedgeparsley	*Torilis arvensis*	2
tall oatgrass	*Arrhenatherum elatius*	2
thoroughwort pennycress	*Microthlaspi perfoliatum*	2
three-lined land planarian	*Bipalium pennsylvanicum*	2
thymeleaf sandwort	*Arenaria serpyllifolia*	2
thymeleaf speedwell	*Veronica serpyllifolia*	2
Japanese hedge-parsley	*Torilis japonica*	2
Japanese pachysandra	*Pachysandra terminalis*	2
hoary alyssum	*Berteroa incana*	2
hoary cress	*Lepidium draba*	2
houndstongue	*Cynoglossum officinale*	2
indigobush	*Amorpha fruticosa*	2
ivyleaf speedwell	*Veronica hederifolia*	2
lambsquarters	*Chenopodium album*	2
large hop clover	*Trifolium campestre*	2
jimsonweed	*Datura stramonium*	2
johnsongrass	*Sorghum halepense*	2
jumping worm	*Amynthas spp.*	2
lemon balm	*Melissa officinalis*	2
longspine sandbur	*Cenchrus longispinus*	2
perilla mint	*Perilla frutescens*	2
porcelain-berry	*Ampelopsis glandulosa var. brevipedunculata*	2
prickly lettuce	*Lactuca serriola*	2
Oriental lady's thumb	*Polygonum posumbu*	2
oxeye daisy	*Leucanthemum vulgare*	2
pale smartweed	*Persicaria lapathifolia*	2
motherwort	*Leonurus cardiaca*	2
moist sowthistle	*Sonchus arvensis ssp. uliginosus*	2
Mexican fireweed	*Bassia scoparia*	2
mexicantea	*Dysphania ambrosioides*	2
nettleleaf goosefoot	*Chenopodium murale*	2
Norway maple	*Acer platanoides*	2
yellow nutsedge	*Cyperus esculentus*	2
yellow rocket	*Barbarea vulgaris*	2
yellow starthistle	*Centaurea solstitialis*	2
yellow sweet-clover	*Melilotus officinalis*	2
yellow toadflax	*Linaria vulgaris*	2
wild parsnip	*Pastinaca sativa*	2
white horehound	*Marrubium vulgare*	2
yellow fieldcress	*Rorippa sylvestris*	2

Common Name	Scientific Name	Number of Records
water speedwell	*Veronica anagallis-aquatica*	2
white poplar	*Populus alba*	2
wild four-o'clock	*Mirabilis nyctaginea*	2
wild garlic	*Allium vineale*	2
wild mustard	*Sinapis arvensis*	2
tumble mustard	*Sisymbrium altissimum*	2
velvetleaf	*Abutilon theophrasti*	2
Venice mallow	*Hibiscus trionum*	2
Virginia pepperweed	*Lepidium virginicum*	2
waterpurslane	*Ludwigia palustris*	2
wandering broadhead planarian	*Bipalium adventitium*	2
water knotweed	*Polygonum amphibium*	1
water mint	*Mentha aquatica*	1
West Indian nightshade	*Solanum ptychanthum*	1
wallflower mustard	*Erysimum cheiranthoides*	1
wild onion	*Allium canadense*	1
white cockle	*Silene latifolia ssp. alba*	1
wirestem muhly	*Muhlenbergia frondosa*	1
yellow alyssum	*Alyssum alyssoides*	1
willowleaf lettuce	*Lactuca saligna*	1
wine raspberry	*Rubus phoenicolasius*	1
winter aconite	*Eranthis hyemalis*	1
yellow foxtail	*Setaria pumila ssp. pumila*	1
oakleaf goosefoot	*Oxybasis glauca*	1
orchardgrass	*Dactylis glomerata*	1
nimblewill	*Muhlenbergia schreberi*	1
nipplewort	*Lapsana communis*	1
mimosa	*Albizia julibrissin*	1
mimosa webworm	*Homadaula anisocentra*	1
mollusc-eating hammerhead worm	*Bipalium vagum*	1
panicled hydrangea	*Hydrangea paniculata*	1
paper-mulberry	*Broussonetia papyrifera*	1
mulberryweed	*Fatoua villosa*	1
princesstree	*Paulownia tomentosa*	1
piedmont bedstraw	*Cruciata pedemontana*	1
low cudweed	*Gnaphalium uliginosum*	1
longleaf groundcherry	*Physalis longifolia*	1
longleaf speedwell	*Pseudolysimachion longifolium*	1
lesser celandine	*Ficaria verna spp. verna*	1
kudzu bug	*Megacopta cribraria*	1
Kentucky bluegrass	*Poa pratensis*	1

Common Name	Scientific Name	Number of Records
jointed goatgrass	*Aegilops cylindrica*	1
leatherleaf mahonia	*Mahonia bealei*	1
Japanese barberry	*Berberis thunbergii*	1
ivyleaf morning-glory	*Ipomoea hederacea*	1
horsenettle	*Solanum carolinense*	1
Japanese snowball	*Viburnum plicatum*	1
jetbead	*Rhodotypos scandens*	1
thymeleaf speedwell	*Veronica serpyllifolia ssp. serpyllifolia*	1
timothy	*Phleum pratense*	1
toothed spurge	*Euphorbia dentata*	1
tall thistle	*Cirsium altissimum*	1
teasel	*Dipsacus*	1
spreading hedgeparsley	*Torilis arvensis ssp. arvensis*	1
star-of-Bethlehem	*Ornithogalum umbellatum*	1
spanishneedles	*Bidens bipinnata*	1
smooth brome	*Bromus inermis*	1
smallflower sweetbrier	*Rosa micrantha*	1
spotted waterhemlock	*Cicuta maculata*	1
purple crown-vetch	*Securigera varia*	1
pearl gromwell	*Lithospermum officinale*	1
peppermint	*Mentha x piperita*	1
purpleosier willow	*Salix purpurea*	1
quackgrass	*Elymus repens*	1
ragweed parthenium	*Parthenium hysterophorus*	1
ravennagrass	*Saccharum ravennae*	1
red fox	*Vulpes vulpes*	1
sacred bamboo	*Nandina domestica*	1
scarlet firethorn	*Pyracantha coccinea*	1
Siberian elm	*Ulmus pumila*	1
sericea lespedeza	*Lespedeza cuneata*	1
redroot pigweed	*Amaranthus retroflexus*	1
red swamp crayfish	*Procambarus clarkii*	1
rescuegrass	*Bromus catharticus*	1
roughstalk bluegrass	*Poa trivialis*	1
common pine shoot beetle	*Tomicus piniperda*	1
common reed	*Phragmites australis*	1
common cocklebur	*Xanthium strumarium*	1
common cornsalad	*Valerianella locusta*	1
common dandelion	*Taraxacum officinale ssp. officinale*	1
coltsfoot	*Tussilago farfara*	1
common caraway	*Carum carvi*	1

Common Name	Scientific Name	Number of Records
bulbous bluegrass	*Poa bulbosa*	1
bush honeysuckles (exotic)	*Lonicera spp.*	1
calico scale	*Eulecanium cerasorum*	1
Chinese elm	*Ulmus parvifolia*	1
canarygrass	*Phalaris canariensis*	1
Canada bluegrass	*Poa compressa*	1
annual wormwood	*Artemisia annua*	1
autumn olive	*Elaeagnus umbellata var. parvifolia*	1
bald brome	*Bromus racemosus*	1
Amur maple	*Acer ginnala*	1
annual bluegrass	*Poa annua*	1
annual ragweed	*Ambrosia artemisiifolia var. elatior*	1
alfalfa	*Medicago sativa*	1
alfalfa	*Medicago sativa ssp. sativa*	1
alsike clover	*Trifolium hybridum*	1
bermudagrass	*Cynodon dactylon*	1
biennial wormwood	*Artemisia biennis*	1
bigroot morning-glory	*Ipomoea pandurata*	1
birdsfoot trefoil	*Lotus corniculatus*	1
bittersweets	*Celastrus spp.*	1
Black dog-strangling vine	*Vincetoxicum nigrum*	1
black vine weevil	*Otiorhynchus sulcatus*	1
bristly oxtongue	*Helminthotheca echioides*	1
bristlegrass	*Setaria spp.*	1
hemp dogbane	*Apocynum cannabinum*	1
hairy vetch	*Vicia villosa*	1
halberdleaf orach	*Atriplex patula*	1
hedge bindweed	*Calystegia sepium*	1
golden bamboo	*Phyllostachys aurea*	1
goosegrass	*Eleusine indica*	1
gray poplar	*Populus x canescens*	1
field pepperweed	*Lepidium campestre*	1
field thistle	*Cirsium discolor*	1
field horsetail	*Equisetum arvense*	1
European sticktight	*Lappula squarrosa*	1
fall panicum	*Panicum dichotomiflorum*	1
feverfew	*Tanacetum parthenium*	1
elm leafminer	*Kaliofenusa ulmi*	1
European pine shoot moth	*Rhyacionia buoliana*	1
European privet	*Ligustrum vulgare*	1
European spindletree	*Euonymus europaeus*	1

Common Name	Scientific Name	Number of Records
common yarrow	*Achillea millefolium*	1
corn chamomile	*Anthemis arvensis*	1
corn cockle	*Agrostemma githago*	1
common speedwell	*Veronica officinalis*	1
common flax	*Linum usitatissimum*	1
common groundsel	*Senecio vulgaris*	1
curlycup gumweed	*Grindelia squarrosa*	1
devil's-claw	*Proboscidea louisianica*	1
Elaeagnus	*Elaeagnus spp.*	1
doubtful knight's-spur	*Consolida ajacis*	1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ohio Ecological Services Field Office
4625 Morse Road, Suite 104
Columbus, OH 43230-8355
Phone: (614) 416-8993 Fax: (614) 416-8994

In Reply Refer To: August 03, 2023
Project Code: 2023-0112939
Project Name: City of Loveland CAP Shoreline Stabilization Project, Hamilton County, Ohio

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

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

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

This species list is provided by:

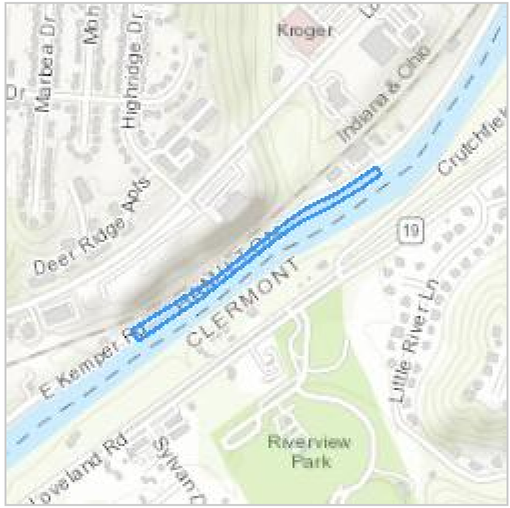
Ohio Ecological Services Field Office
4625 Morse Road, Suite 104
Columbus, OH 43230-8355
(614) 416-8993

PROJECT SUMMARY

Project Code:	2023-0112939
Project Name:	City of Loveland CAP Shoreline Stabilization Project, Hamilton County, Ohio
Project Type:	Road Repair
Project Description:	In April 2021, the City of Loveland, Ohio issued a Letter of Intent (LOI) requesting assistance from the United States Army Corps of Engineers (USACE) under the Planning Assistance to States (PAS) Program for bank stabilization of the Little Miami River adjacent to portions of Riverside Drive and East Kemper Road. Erosion and distress are occurring in three areas on the right (northwestern) bank of the Little Miami River along the streambank and E. Kemper Road (Figure 3, Section 1.4). The issue is affecting the public utilities and the public roadway. In partnership with the City of Loveland (the Non-Federal Sponsor), the Louisville District USACE developed a hydraulic model to determine pertinent information needed for bank stabilization in the project area. This information, along with existing conditions data and data gathered from geotechnical explorations at the erosion sites, was used to formulate potential alternatives to improve slope stability and prevent continued and future erosion at the project site as well as other areas with similar geology. The Best Value Alternative for remediation of the erosion issue was determined using relative comparisons across a matrix of measures of effectiveness and relative cost. A preliminary design using riprap or shot rock to reconstruct the upper slope was chosen as the Best Value Alternative for the three areas included in this study. This method of remediation includes removal and replacement of failed slope materials. It is assumed that during the remediation of the slopes that the significant joint separations in the storm sewer lines underneath East Kemper Road would be repaired as part of the remediation. This is anticipated to require the removal and replacement of at least one lane of East Kemper Road. Depending on the extents of the repair area, additional utility removal/relocation may be required.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.257096950000005,-84.27462957827254,14z



Counties: Hamilton County, Ohio

ENDANGERED SPECIES ACT SPECIES

There is a total of 4 threatened, endangered, or candidate species on this species list.

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

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

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

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

MAMMALS

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

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

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

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

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Jeffrey Hawkins
Address: 600 Dr. Martin Luther King Jr. Place
City: Louisville
State: KY
Zip: 40202
Email jeffrey.a.hawkins@usace.army.mil
Phone: 8593399414

Hamilton County

Scientific Name	Common Name	Last Observed	State Status	Federal Status
Corallorhiza wisteriana	Spring Coral-root	2006-06-26	P	
Cyperus acuminatus	Pale Umbrella-sedge	2011-09-05	P	
Descurainia pinnata	Tansy Mustard	2006-04-23	T	
Echinodorus berteroi	Burhead	2007-07-17	P	
Lipocarpha micrantha	Dwarf Bulrush	2007-07-17	T	
Orobanche riparia	Louisiana Broom-rape	2010-09-06	E	
Paspalum repens	Riverbank Paspalum	1993-10-26	T	
Passiflora incarnata	Maypop	2010-07-01	T	
Phacelia bipinnatifida	Fern-leaved Scorpion-weed	2007-04-16	P	
Ribes missouriense	Missouri Gooseberry	2010-04-06	T	
Sida hermaphrodita	Virginia-mallow	2005-08-23	P	
Spermacoce glabra	Smooth Buttonweed	2010-10-17	P	
Terrapene carolina	Eastern Box Turtle	2011-07-07	SC	
Trifolium reflexum	Buffalo Clover	2012-05	E	
Trifolium stoloniferum	Running Buffalo Clover	2013-05-25	E	FE
Trillium recurvatum	Prairie Wake-robin	2007-05-08	P	
Triphora trianthophora	Three-birds Orchid	2003-08-08	P	
Viburnum rufidulum	Southern Black-haw	1989-10-22	P	

Ohio Division of Wildlife
Ohio Natural Heritage Database
Date Accessed: March 6, 2015
Status based on 2014-15 Rare Plant List.

Hamilton County

Scientific Name	Common Name	Last Observed	State Status	Federal Status
Status:	List Created: July 2016			
X = Extirpated				
E = Endangered				
T = Threatened				
P = Potentially Threatened				

Hamilton County State Listed Animal Species

Common Name	Scientific Name	Group	State Status	Federal Status
Blanchard's Cricket Frog	*Acris blanchardi*	Amphibian	Species of Concern	
Cave Salamander	*Eurycea lucifuga*	Amphibian	Endangered	
Cobblestone Tiger Beetle	*Cicindela marginipennis*	Beetle	Threatened	
American Bittern	*Botaurus lentiginosus*	Bird	Endangered	
Lark Sparrow	*Chondestes grammacus*	Bird	Endangered	
Loggerhead Shrike	*Lanius ludovicianus*	Bird	Endangered	
Black-crowned Night-heron	*Nycticorax nycticorax*	Bird	Threatened	
Barn Owl	*Tyto alba*	Bird	Threatened	
Lyre-tipped Spreadwing	*Lestes unguiculatus*	Damselfly	Species of Concern	
Eastern Ringtail	*Erpetogomphus designatus*	Dragonfly	Species of Concern	
Plains Clubtail	*Gomphus externus*	Dragonfly	Threatened	
Blue corporal	*Ladona deplanata*	Dragonfly	Species of Concern	
Smoky Shadowdragon	*Neurocordulia molesta*	Dragonfly	Endangered	
Blue Sucker	*Cycleptus elongatus*	Fish	Threatened	

Data from the Ohio Natural Heritage Database

Species reported extant in county since 1980

6/23/2023

Absence of a species on this list does not indicate absence from the county. The information contained in this list does not represent coordination with ODNR or fulfill NEPA or other federal/state requirements. All federally and/or state listed bat species have ranges that encompass the entire state and are not included on county lists. For further information on current listed species, please use the following link:

[State Listed Species | Ohio Department of Natural Resources (ohiodnr.gov)]

Common Name	Scientific Name	Group	State Status	Federal Status
Least Darter	*Etheostoma microperca*	Fish	Species of Concern	
Shortnose Gar	*Lepisosteus platostomus*	Fish	Endangered	
Shoal chub	*Macrhybopsis hyostoma*	Fish	Endangered	
Mountain Madtom	*Noturus eleutherus*	Fish	Threatened	
Northern Madtom	*Noturus stigmosus*	Fish	Endangered	
Channel Darter	*Percina copelandi*	Fish	Threatened	
River Darter	*Percina shumardi*	Fish	Threatened	
Paddlefish	*Polyodon spathula*	Fish	Threatened	
Elktoe	*Alasmidonta marginata*	Mollusk	Species of Concern	
Wartyback	*Cyclonaias nodulata*	Mollusk	Endangered	
Purple Wartyback	*Cyclonaias tuberculata*	Mollusk	Species of Concern	
Butterfly	*Ellipsaria lineolata*	Mollusk	Endangered	
Elephant-ear	*Elliptio crassidens*	Mollusk	Endangered	
Snuffbox	*Epioblasma triquetra*	Mollusk	Endangered	Endangered
Pocketbook	*Lampsilis ovata*	Mollusk	Endangered	
Black Sandshell	*Ligumia recta*	Mollusk	Species of Concern	

Data from the Ohio Natural Heritage Database

Species reported extant in county since 1980

6/23/2023

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[State Listed Species | Ohio Department of Natural Resources (ohiodnr.gov)]

Common Name	Scientific Name	Group	State Status	Federal Status
Washboard	*Megalonaias nervosa*	Mollusk	Endangered	
Threehorn Wartyback	*Obliquaria reflexa*	Mollusk	Species of Concern	
Sheepnose	*Plethobasus cyphyus*	Mollusk	Endangered	Endangered
Ohio Pigtoe	*Pleurobema cordatum*	Mollusk	Endangered	
Round Pigtoe	*Pleurobema sintoxia*	Mollusk	Species of Concern	
Ebonyshell	*Reginaia ebenus*	Mollusk	Endangered	
Rabbitsfoot	*Theliderma cylindrica*	Mollusk	Endangered	Threatened
Monkeyface	*Theliderma metanevra*	Mollusk	Endangered	
Fawnsfoot	*Truncilla donaciformis*	Mollusk	Species of Concern	
Deertoe	*Truncilla truncata*	Mollusk	Species of Concern	
Kirtland's Snake	*Clonophis kirtlandii*	Reptile	Threatened	
Eastern Hognose Snake	*Heterodon platirhinos*	Reptile	Species of Concern	
Northern Rough Greensnake	*Opheodrys aestivus*	Reptile	Species of Concern	
Woodland Box Turtle	*Terrapene carolina carolina*	Reptile	Species of Concern	

Data from the Ohio Natural Heritage Database

Species reported extant in county since 1980

6/23/2023

Absence of a species on this list does not indicate absence from the county. The information contained in this list does not represent coordination with ODNR or fulfill NEPA or other federal/state requirements. All federally and/or state listed bat species have ranges that encompass the entire state and are not included on county lists. For further information on current listed species, please use the following link:

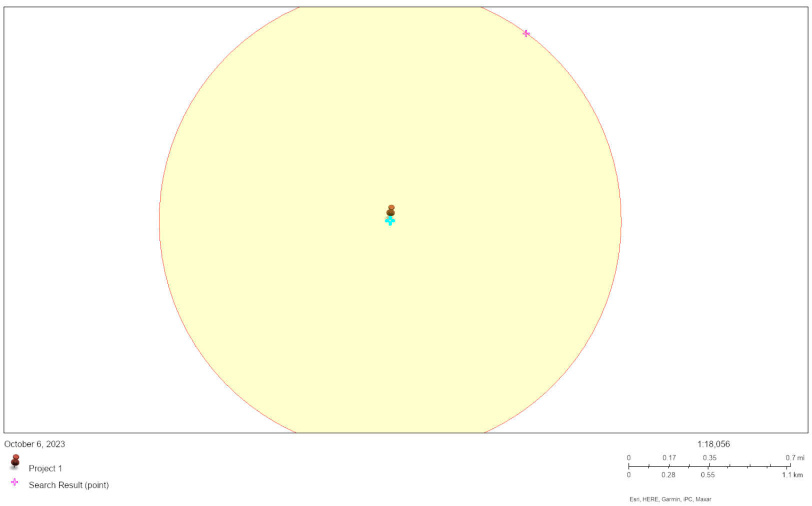
State Listed Species | Ohio Department of Natural Resources (ohiodnr.gov)

EJScreen Community Report

This report provides environmental and socioeconomic information for user defined areas, and combines that data into environmental justice and supplemental indexes.

Loveland, OH

1 mile Ring Centered at 39.257267, 84.274573
Population: 6,320
Area in square miles: 3.14



LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	95%
Spanish	2%
Other Indo-European	1%
Other Asian and Paci c Island	2%
Total Non-English	5%

COMMUNITY INFORMATION

Low income: 21 percent
People of color: 13 percent
Less than high school education: 2 percent
Limited English households: 0 percent
Unemployment: 4 percent
Persons with disabilities: 7 percent
Male: 45 percent
Female: 55 percent
81 years Average life expectancy
$49,998 Per capita income
Number of households: 2,475
Owner occupied: 72 percent

BREAKDOWN BY RACE

White: 87%
Black: 3%
American Indian: 0%
Asian: 2%
Hawaiian/Pacific Islander: 0%
Other race: 0%
Two or more races: 2%
Hispanic: 5%

BREAKDOWN BY AGE

From Ages 1 to 4	4%
From Ages 1 to 18	24%
From Ages 18 and up	76%
From Ages 65 and up	13%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	0%
Speak Other Indo-European Languages	0%
Speak Asian-Paci c Island Languages	0%
Speak Other Languages	0%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race. Source: U.S. Census Bureau, American Community Survey (ACS) 2017 -2021. Life expectancy data comes from the Centers for Disease Control.

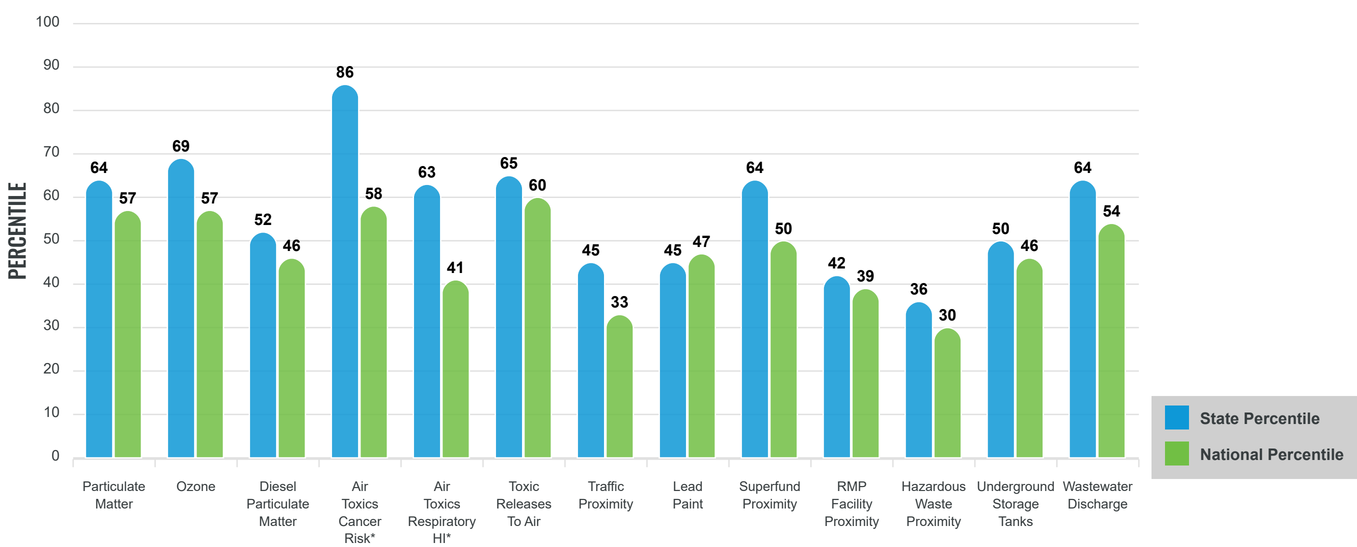
Environmental Justice & Supplemental Indexes

The environmental justice and supplemental indexes are a combination of environmental and socioeconomic information. There are thirteen EJ indexes and supplemental indexes in EJScreen re ecting the 13 environmental indicators. The indexes for a selected area are compared to those for all other locations in the state or nation. For more information and calculation details on the EJ and supplemental indexes, please visit the EJScreen website.

EJ INDEXES

The EJ indexes help users screen for potential EJ concerns. To do this, the EJ index combines data on low income and people of color populations with a single environmental indicator.

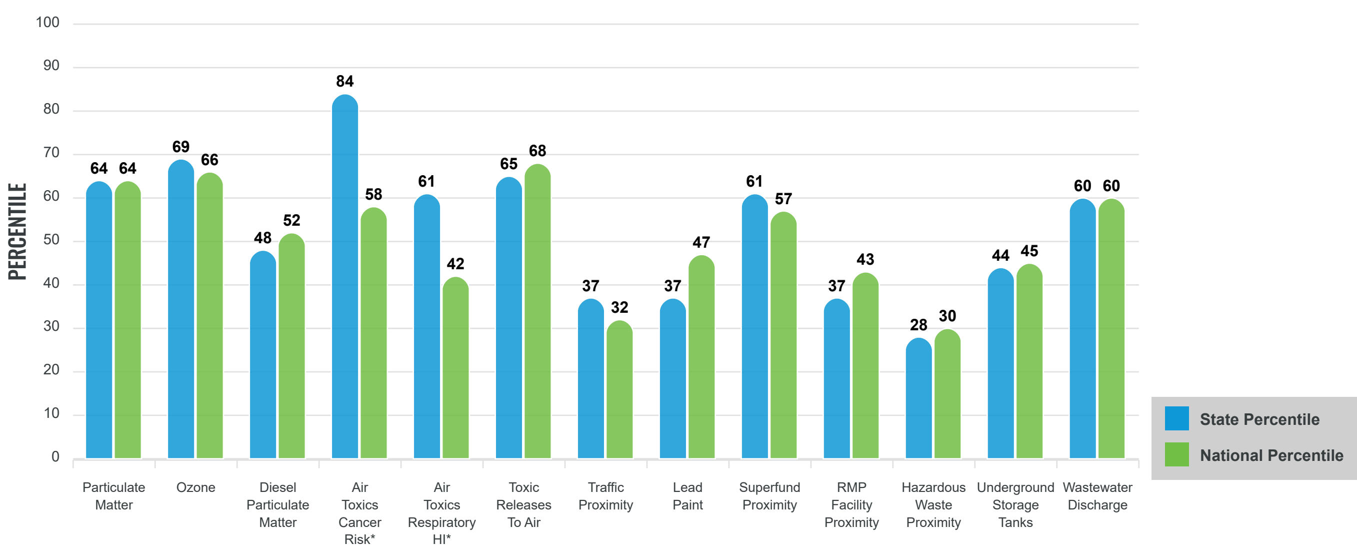
EJ INDEXES FOR THE SELECTED LOCATION



SUPPLEMENTAL INDEXES

The supplemental indexes offer a different perspective on community level vulnerability. They combine data on percent low income, percent linguistically isolated, percent less than high school education, percent unemployed, and low life expectancy with a single environmental indicator.

SUPPLEMENTAL INDEXES FOR THE SELECTED LOCATION



These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation.

Report for 1 mile Ring Centered at 39.257267,-84.274573

EJScreen Environmental and Socioeconomic Indicators Data

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
POLLUTION AND SOURCES					
Particulate Matter ($\mu g/m^3$)	9.83	9.18	81	8.08	88
Ozone (ppb)	68	61.4	99	61.6	89
Diesel Particulate Matter ($\mu g/m^3$)	0.264	0.261	57	0.261	61
Air Toxics Cancer Risk* (lifetime risk per million)	27	22	0	25	5
Air Toxics Respiratory HI*	0.3	0.25	51	0.31	31
Toxic Releases to Air	14,000	10,000	87	4,600	94
Tra c Proximity (daily tra c count/distance to road)	40	110	41	210	35
Lead Paint (% Pre-1960 Housing)	0.31	0.44	39	0.3	59
Superfund Proximity (site count/km distance)	0.11	0.094	80	0.13	69
RMP Facility Proximity (facility count/km distance)	0.17	0.49	44	0.43	50
Hazardous Waste Proximity (facility count/km distance)	0.17	1.3	29	1.9	31
Underground Storage Tanks (count/km^2)	2	2.9	58	3.9	59
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.092	0.47	84	22	81
SOCIOECONOMIC INDICATORS					
Demographic Index	17%	28%	38	35%	25
Supplemental Demographic Index	9%	14%	25	14%	27
People of Color	13%	24%	50	39%	27
Low Income	21%	33%	36	31%	39
Unemployment Rate	4%	6%	50	6%	48
Limited English Speaking Households	0%	1%	0	5%	0
Less Than High School Education	2%	10%	16	12%	17
Under Age 5	4%	6%	37	6%	38
Over Age 64	13%	18%	35	17%	40
Low Life Expectancy	17%	21%	14	20%	28

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

Sites reporting to EPA within defined area:

Superfund 0
Hazardous Waste, Treatment, Storage, and Disposal Facilities 0
Water Dischargers 1
Air Pollution 0
Brown elds 1
Toxic Release Inventory 2

Other community features within defined area:

Schools 4
Hospitals 0
Places of Worship 2

Other environmental data:

Air Non-attainment .... Yes
Impaired Waters .... Yes

Selected location contains American Indian Reservation Lands* .... No
Selected location contains a "Justice40 (CEJST)" disadvantaged community .... No
Selected location contains an EPA IRA disadvantaged community .... Yes

Report for 1 mile Ring Centered at 39.257267,-84.274573

EJScreen Environmental and Socioeconomic Indicators Data

HEALTH INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Low Life Expectancy	17%	21%	14	20%	28
Heart Disease	4.9	7.2	9	6.1	26
Asthma	9.6	10.7	19	10	40
Cancer	5.8	6.6	24	6.1	41
Persons with Disabilities	6.8%	14.8%	7	13.4%	12

CLIMATE INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Flood Risk	9%	7%	75	12%	62
Wild re Risk	0%	0%	0	14%	0

CRITICAL SERVICE GAPS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Broadband Internet	7%	15%	29	14%	36
Lack of Health Insurance	3%	7%	18	9%	17
Housing Burden	No	N/A	N/A	N/A	N/A
Transportation Access	No	N/A	N/A	N/A	N/A
Food Desert	No	N/A	N/A	N/A	N/A

Footnotes

Report for 1 mile Ring Centered at 39.257267,-84.274573

City of Loveland, Ohio
Continuing Authorities Program Section 14
Feasibility Study

Appendix C Cost Engineering

June 2024

TABLE OF CONTENTS

1 INTRODUCTION

This Appendix presents cost estimates that have been assembled for the proposed Emergency Streambank Stabilization Feasibility Study for Loveland, OH. This project falls under Section 14 of the Continuing Authorities Program (CAP). A discussion regarding cost, schedule and risk is included in this Appendix which contains all appropriate feature accounts. What follows is a discussion regarding the methodology used to develop the first cost for the Recommended Plan.

2 REFERENCES

- ER 1110-1-1300, Cost Engineering Policy & General Requirements, 26 Mar 1993.
- ER 1110-2-1302, Civil Works Cost Engineering, 30 June 2016.
- EI 01D010, Construction Cost Estimates, 1 Sept 1997.
- ER 1110-2-1150, Engineering & Design for Civil Works Projects, 31 Aug 1999.
- ER 37-2-10 Change 89, Accounting And Reporting – Civil Works Activities, 31 Oct 2000.
- EC 11-2-187, Corps of Engineers Civil Works Direct Program: Program Development Guidance – Fiscal Year 2009, 30 Mar 2007.
- EP 1110-1-8 Volume 2, Construction Equipment Ownership and Operating Expense Schedule – Region II, July 2007.
- EC Bulletin No 2007-17, Application of Cost Risk Analysis Methods to develop Contingencies for Civil Works Total Project Costs, 10 Sep 2007.
- EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS), 30 Sept 2020.
- EC 1105-2-410, Review of Decision Documents, 22 Aug 2008
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 Sept 2008.

3 METHODOLOGY

3.1 GENERAL

The cost estimate was prepared using the Micro-computer Aided Cost Estimating System (MCACES) Second Generation (MII), version 4.4.4 for all feature accounts associated with construction. Applicable crews and equipment were applied in the estimate to correspond with the work being performed. Material prices were developed using the 2023 MII Cost Book and quotes were obtained from suppliers, when available.

3.2 COST METHODOLOGY

3.2.1 Historical Unit Pricing

In some instances, historical cost information was referenced and documented accordingly. These historical references include past contract bid prices for projects of similar design and magnitude and recent government studies and cost estimates.

3.2.2 Quote-in-Place

In some instances, a quote from a subcontractor may have been received that included overhead and profit. In that case, no additional markups were included for subcontractor's overhead.

3.2.3 Detailed MII Cost Estimate

The MII estimating software was used to develop a construction sequence for each item of work and applying detailed line items and crews to perform the work. Crews were developed in correspondence with the work being performed and estimated productivities. Wage rates were taken from the local Davis Bacon rates. The latest MII equipment database was also used and adjusted for current fuel and energy costs. Material prices were obtained through solicitations with vendors via telephone or via email, online pricing searches, the MII Cost Book, and RS MEANS data. A summary level report of the MII cost estimate for the TSP can be found in Attachment A.

3.3 DIRECT COSTS

Direct costs are based on anticipated equipment, labor, and materials necessary to construct this project. Following formulation of the direct cost, a determination is made as to whether the work would be performed by the prime contractor or a subcontractor.

3.3.1 Labor - Wage Determination

Wage rates were taken from the latest Davis-Bacon wage determination - OH20240001 04/05/2024 were used for determining wage rates.

3.3.2 Equipment Costs

The 2022 Equipment database, based on EP 1110-1-8, Construction Equipment Ownership and Operation Expense Schedule, Region II Revision 1, was used and adjusted for current, local fuel and energy costs.

3.3.3 Vendor Quotes

Vendor quotes have been acquired and documented for the anticipated material costs for most features of work.

3.3.4 Crews

Project specific crews have been developed and applied to the detailed line items as appropriate. Crew members consist of selected complements of labor classifications and equipment pieces assembled to perform specific tasks. Productivity has been assigned to each crew reflective of the expected output per unit of measure for the specific activities listed in the cost estimate. In considering the crews and productivities, the engineer typically referenced other, similar work found in national reference manuals such as RS MEANS construction data, the MII Cost book, and other projects developed by USACE.

3.3.5 Quantities

Quantities were developed through close coordination with appropriate PDT members, primarily provided by the civil engineer. Quantities were checked / verified by the estimator and adjusted to account for construction methodology, shrink, swell, waste, etc. Other associated sub-quantities were also developed by the estimator, as needed.

3.4 INDIRECT COSTS

3.4.1 Contract Acquisition Strategy

Through discussions with the Project Manager (PM) & PDT, one contract is planned for the work. The assumption is that the project will be solicited as a Small Business or MATOC contract.

3.4.2 Prime Contractors

3.4.2.1 Job Office Overhead (JOOH)

Job Office Overhead (JOOH) is estimated by percentage within the estimate for the Prime contractor. The estimate of 25% is an allowance based on similar-sized projects and includes such items as project supervision, contractor quality control, contractor field office supplies, personal protective equipment, field engineering, and other incidental field overhead costs.

3.4.2.2 Home Office Overhead (HOOH)

For Home Office Overhead (HOOH) expense, the cost estimate includes an allowance applied as percentage at 15% of direct cost, plus field overhead. HOOH includes items such as office rental / ownership costs, utilities, office equipment ownership/maintenance, office staff (managers, accountants, clerical, etc.), insurance, and miscellaneous. The range of home office overhead can be quite broad and depends largely on the contractor’s annual volume of work and the type of work that is generally performed by the contractor.

3.4.2.3 Profit

Profit was calculated as a running percentage at 8%, based on the estimator’s judgement and past project experience.

3.4.2.4 Bonding

Bond was calculated as a running percentage at 1.50%, based on the estimator’s judgement and past project experience.

3.4.3 Subcontractors

3.4.3.1 Overhead

All subcontractor overhead costs are set to 10% and 5% of direct cost to account their JOOH and HOOH costs, respectively. The exception is where a subcontractor has provided a quoted price including overhead. In that case, no additional markups have been included for subcontractor's overhead.

3.4.3.2 Profit

Subcontractor Profit was included as a running percentage of 10% based on estimator judgement and past project experience.

3.4.4 Escalation

The contract was escalated to the mid-point of construction using EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS), to account for potential inflation during construction. This is included in the TPCS file, not the cost estimate in MII. The estimated mid-point of construction was identified through the development of a rough order of magnitude (ROM) construction schedule and can be seen in Attachment D, of this Appendix.

3.4.5 Contingency

Contingency was applied on the individual Civil Works WBS Feature Accounts because of an Abbreviated Risk Analysis, conducted February 12th, 2024 (revised May 6th, 2024). The details, including the risk register can be seen in Attachment B of this Appendix.

4 PROJECT FEATURE ACCOUNTS AND ASSOCIATED SCOPE

4.1 (01) LANDS & DAMAGES

- This feature account covers all costs associated with Real Estate, including lands, easements, rights of way, etc. The cost estimate for this account was provided by the Real Estate PDT team member and inserted into the MII estimate and TPCS. More information can be found in the RE appendix/tab.

4.2 (06) FISH & WILDLIFE FACILITIES

- Environmental mitigation costs are included in this account for the restoration of the affected project areas. This includes Special Status Species Surveys, Early PED Phase ENV Work, Potential Mitigation, and Potential Permitting.

4.3 (30) PLANNING, ENGINEERING, AND DESIGN

- The work covered under this account includes project management, project planning, preliminary design, final design, geotechnical and HTRW investigations, hydraulic modeling, preparation of plans & specifications, engineering during construction, adaptive management, coordination efforts, contract advertisement, opening of bids, and contract award.
- Cost for the Engineering and Design portion of the PED account were coordinated with the Civil PDT (PE/A) and their supervisor and account for the geotechnical investigations, surveying, geotechnical and civil design, and money for cost engineering to develop current working estimate and the IGE.

4.4 (31) CONSTRUCTION MANAGEMENT (S&A)

- The work covered under this account includes contract supervision, contract administration, construction administration, technical management activities, and District office supervision and administration costs. The cost for this account was estimated with input from the project manager, engineering design branch chief, and historical S&A rates from other similar-sized projects.

5 PROJECT SCHEDULE & DURATION

The construction phase of this project is anticipated to take approximately 180 days including submission/approval of submittals, mobilization, placement of fill and vegetation, and demobilization. Additional information can be found in Attachment D of this Appendix.

6 TOTAL PROJECT COST SUMMARY (TPCS)

The feasibility-level cost estimate for the Recommended Federal Plan at the FY24 price level (Project First Cost) is $7,026,000. This estimate was escalated over the implementation schedule to generate a fully funded cost estimate in the amount of $7,664,000. These costs can be found in Attachment B of this Appendix.

ATTACHMENT A

MII SUMMARY REPORT

This information system is approved for Controlled Unclassified Information (CUI)

Print Date Wed 5 June 2024 | U.S. Army Corps of Engineers | Time 15:26:27

Eff. Date 5/16/2024 | Project : 498610 Loveland OH CAP TSP

498610 Loveland Section 14 CAP Feasibility MII Report | Title Page

498610 Loveland OH CAP TSP
P2#: 498610
Location(s): City of Loveland, Hamilton Co, OH

Solicitation Type: Small Business (Assumed)
Proposal Type: RFP (Assumed)
Solicitation #: TBD
Procurement: Design-Bid-Build (Assumed)

Files located at <O:\ED\Public\MCACES\ED-M-C\0 Civil\FY23\498610 - Loveland Section 14 CAP>

EXISTING SITE CONDITIONS:

The Project Area has unstable streambanks that are threatening public infrastructure along the Little Miami River. This issue occurs along steep hillsides and waterways throughout the Cincinnati area due to the prevalence of Kope geology. These conditions cause issues for local hazard mitigation plans to address.

The Project Area on E. Kemper Road covers a total area of approximately 1.5 acres with each site covering approximately 0.5 acres. Slope failures are along steep, heavily wooded slopes at the three sites immediately southeast of East Kemper Road along the Little Miami River. At Sites 1 and 2, East Kemper Road runs along a hillside with steep, wooded slopes to the northwest leading up to railroad tracks. Near Site 3, a structure and parking lot are located on the northwest side of East Kemper Road with a wooded slope leading up to railroad tracks beyond. Also near Site 3, a rock wall was discovered during the cultural resources survey and is being accounted for in feasibility.

SCOPE OF WORK:

Soil filled riprap and shot rock will be used to restore the slope, then topped with vegetation to satisfy the Wild & Scenic river requirements and the National Park Service. Shot rock will be used to reconstruct most of the remediated areas with riprap placed on the outer slopes along the Little Miami River. We are assuming 40 inches of riprap will be placed on the outer surface of the slope. After placement of the riprap, slurry comprised of a mixture of water and topsoil will be pumped into the surface voids of the riprap. After placement of the slurry, topsoil will be placed to create a smooth surface that will support vegetative growth. The topsoil will be hydroseeded with native grasses and plants suitable for the application and site conditions. A choke stone will be placed over the shot rock to provide a working surface for the stone base course of East Kemper Road. Potential future failures within the underlying Kope Formation would disturb the vegetated riprap and shot rock. However, the riprap and shot rock used to initially remediate the slope should be suitable to reconstruct the slope. Depending on the nature of a slope failure, the riprap and shot rock may be sufficient that only a slight modification of the disturbed slope would be necessary to restore stability.

Estimated by	Jacob Dehn, CELRL-ED-M-C
Designed by	
Prepared by	Jacob Dehn, CELRL-ED-M-C
Preparation Date	5/16/2024
Effective Date of Pricing	5/16/2024
Estimated Construction Time	335 Days

This report is not copyrighted, but the information contained herein is For Official Use Only.

<O:\ED\Public\MCACES\ED-M-C\0 Civil\FY23\498610 - Loveland Section 14 CAP>

Checked by: Neal Ralston, PE, TCCE

Labor ID: NLS2022 EQ ID: EP22R02 | Currency in US dollars | TRACES MII Version 4.4

This information system is approved for Controlled Unclassified Information (CUI)

This information system is approved for Controlled Unclassified Information (CUI)
Print Date Wed 5 June 2024 | U.S. Army Corps of Engineers | Time 15:26:27
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498610 Loveland Section 14 CAP Feasibility MII Report | Table of Contents

Labor ID: NLS2022 EQ ID: EP22R02 Currency in US dollars TRACES MII Version 4.4
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Print Date Wed 5 June 2024	U.S. Army Corps of Engineers	Time 15:26:27
Eff. Date 5/16/2024	Project : 498610 Loveland OH CAP TSP	
	498610 Loveland Section 14 CAP Feasibility MII Report	Library Properties Page i

Designed by

Estimated by
Jacob Dehn, CELRL-ED-M-C
Prepared by
Jacob Dehn, CELRL-ED-M-C

Design Document
Document Date 5/16/2024
District Louisville District
Contact Jacob Dehn - jacob.d.dehn@usace.army.mil
Budget Year 2024
UOM System Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
Real Estate
EnvMitigation
Cultural RSS
PED
S&A

Timeline/Currency
Preparation Date 5/16/2024
Escalation Date 5/16/2024
Eff. Pricing Date 5/16/2024
Estimated Duration 335 Day(s)

Currency US dollars
Exchange Rate 1.000000

Costbook CB23EN: 2023 MII English Cost Book

Labor NLS2022: Davis Bacon Act - General Decision Number: OH20240001 04/05/2024
sam.gov is the website for current Davis Bacon & Service Labor Rates. Fringes paid to the laborers are taxable. In a non-union job the whole fringes are taxable. In a union job, the vacation pay fringes a

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP22R02: MII Equipment 2022 Region 02
Note: Fuel prices updated per <https://www.eia.gov/petroleum/gasdiesel/> - Midwest Region - 5/6/2024; Reduced off-road diesel fuel cost by $0.714 to account for federal/state taxes.

Region 02 - MIDEAST, (2022)		Fuel		Shipping Rates	
Sales Tax	7.80	Electricity	0.132	Over 0 CWT	27.64
Working Hours per Year	1,410	Gas	3.533	Over 240 CWT	20.78
Labor Adjustment Factor	1.02	Diesel Off-Road	3.168	Over 300 CWT	17.42
Cost of Money	4.88	Diesel On-Road	3.882	Over 400 CWT	15.25
Cost of Money Discount	25.00			Over 500 CWT	17.78
Tire Recap Cost Factor	1.50			Over 700 CWT	15.23
Tire Recap Wear Factor	1.80			Over 800 CWT	5.22
Tire Repair Factor	0.15				
Equipment Cost Factor	1.00				
Standby Depreciation Factor	0.50				

Labor ID: NLS2022 EQ ID: EP22R02 Currency in US dollars TRACES MII Version 4.4
This information system is approved for Controlled Unclassified Information (CUI)

Date	Author	Note
3/21/2024	JDD	MARK-UPS:Contractor Mark-Ups·Prime ContractoroPRODUCTIVITY: 85% (Site has unique constraint and conditions which will limit access and working room) oPRIME JOOH: 25%oPRIME HOOH: 15%oPRIME PROFIT: 8%oBOND: 1.5%·Subcontractor Mark-Ups (General) [Technical Subs will have higher values]oS/C JOOH - 10%oS/C HOOH - 5%oS/C PROFIT - 10% ·Direct Mark-Upso2023 COST BOOK MATERIAL INFLATION MARKUP: 6.15% - BASED UPON ENGINEERING NEWS RECORD (ENR) MATERIAL COST INDEX (MCI) FROM AUG 2022 TO APR 2024 (PRICE LEVEL OF ESTIMATE DUE TO FY OF REPORT SIGNATURE) - (5888 / 6250)oSALES TAX - 7.80% (Hamilton County, OH)ASSUMED PROJECT TIMELINE - BANK STABILIZATION (12 MONTHS):**utility relocates to be completed by NFS prior to construction start·Estimated Construction Start: MAY 2026·Estimated Midpoint of Construction: DEC 2026·Estimated Construction Complete: MAY 2027

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498610 Loveland Section 14 CAP Feasibility MII Report | Markup Properties Page iii

Direct Cost Markups		Category		Method		
Productivity		Productivity		Productivity		
Overtime		Overtime		Overtime		
	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*0.00*	*0.00*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*No*		
Sunday	*2.00*	*No*		

Sales Tax *Matl/Cost*	TaxAdj	Running % on Selected Costs
Costbook Material Inflation (Aug22-Apr24) *Matl/Cost*	MiscDirect	Running % on Selected Costs

Contractor Markups	**Category**	**Method**
JOOH	JOOH	Running %
Sub JOOH	JOOH	Running %
HOOH	HOOH	Running %
Sub HOOH	HOOH	Running %
Profit	Profit	Running %
Sub Profit	Profit	Running %
Bond	Bond	Running %
Excise Tax	Excise	Running %
Escalation	MiscContract	Running %

Owner Markups	**Category**	**Method**
Contingency	Contingency	Running %
SIOH	SIOH	Running %

Labor ID: NLS2022 EQ ID: EP22R02 | Currency in US dollars | TRACES MII Version 4.4

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Eff. Date 5/16/2024 | Project : 498610 Loveland OH CAP TSP

498610 Loveland Section 14 CAP Feasibility MII Report | Project Summary Page 1

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ContractCost	ProjectCost
Project Summary			3,366,124.61	3,692,771.28	3,713,751.22	5,240,884.32	5,240,884.32
Alternative 6 - Vegetated Riprap/Shot Rock Stabilization	1.00	LS	3,366,124.61	3,692,771.28	3,713,751.22	5,240,884.32	5,240,884.32
01 Lands and Damages	1.00	LS	37,000.00	37,000.00	37,000.00	37,000.00	37,000.00
02 Relocations	1.00	LS	405,982.97	497,893.79	518,873.72	817,634.73	817,634.73
0203 Cemetery, Utilities, & Structure	1.00	LS	405,982.97	497,893.79	518,873.72	817,634.73	817,634.73
06 Fish and Wildlife Facilities	1.00	LS	90,500.00	90,500.00	90,500.00	90,500.00	90,500.00
16 Bank Stabilization	1.00	LS	1,898,641.64	2,133,377.50	2,133,377.50	3,361,749.59	3,361,749.59
160001 Mob, Demob & Preparatory Work	1.00	LS	55,860.10	66,423.60	66,423.60	104,669.48	104,669.48
160002.JDD Shape Embankment, Cut & Fill	1.00	LS	138,869.30	162,991.77	162,991.77	256,840.39	256,840.39
160003.JDD Slope Protection	1.00	LS	1,470,932.06	1,629,199.59	1,629,199.59	2,567,272.35	2,567,272.35
020199 Associated General Items	1.00	LS	232,980.18	274,762.53	274,762.53	432,967.37	432,967.37
			657,000.00	*657,000.00*	*657,000.00*	*657,000.00*	*657,000.00*
30 Planning, Engineering and Design	1.00	EA	657,000.00	657,000.00	657,000.00	657,000.00	657,000.00
			277,000.00	*277,000.00*	*277,000.00*	*277,000.00*	*277,000.00*
31 Construction Management	1.00	EA	277,000.00	277,000.00	277,000.00	277,000.00	277,000.00

Labor ID: NLS2022 EQ ID: EP22R02 | Currency in US dollars | TRACES MII Version 4.4

This information system is approved for Controlled Unclassified Information (CUI)

ATTACHMENT B

ABBREVIATED RISK ANALYSIS

Abbreviated Risk Analysis

Project (less than $40M): **Loveland, Ohio Bank Stabilization**
Project Development Stage/Alternative: **Feasibility (Recommended Plan)**
Risk Category: **Low Risk: Typical Construction, Simple**

Alternative: Vegetated Shot Rock/Rip Rap

Meeting Date: 2/12/2024
Revised Date: 5/6/2024

Total Estimated Construction Contract Cost = $ 4,269,884

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate (Includes Non-Fed Sponsor Incidentals in Total)	$ 37,000		20%	$ 5,000	$ 42,000
1	02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities	Utility Relocates	$ 817,635		22%	$ 182,425	$ 1,000,060
2	06 FISH AND WILDLIFE FACILITIES	Environmental Permits, Surveys, Mitigations	$ 90,500		19%	$ 17,327	$ 107,827
3	16 BANK STABILIZATION	Shape Embankment (Temporary Bench)	$ 103,724		30%	$ 31,245	$ 134,969
4	16 BANK STABILIZATION	Slope Protection (Shot Rock/Rip Rap)	$ 1,763,654		46%	$ 805,806	$ 2,569,460
5	16 BANK STABILIZATION	Slope Protection (Soil Slurry)	$ 680,778		46%	$ 311,045	$ 991,823
6	16 BANK STABILIZATION	Slope Protection (Vegetation, Erosion control)	$ 122,840		42%	$ 51,280	$ 174,120
7			$ -		0%	$ -	$ -
8			$ -		0%	$ -	$ -
9			$ -		0%	$ -	$ -
10			$ -		0%	$ -	$ -
11			$ -		0%	$ -	$ -
12	All Other	Remaining Construction Items	$ 690,753	19.3%	23%	$ 156,958	$ 847,711
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 657,000		16%	$ 105,726	$ 762,726
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 277,000		14%	$ 38,254	$ 315,254
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals				
Real Estate	$ 37,000	14%	$ 5,000	$ 42,000.00
Total Construction Estimate	$ 4,269,884	36%	$ 1,556,087	$ 5,825,971
Total Planning, Engineering & Design	$ 657,000	16%	$ 105,726	$ 762,726
Total Construction Management	$ 277,000	14%	$ 38,254	$ 315,254
Total Excluding Real Estate	**$ 5,203,884**	**33%**	**$ 1,700,066**	**$ 6,903,950**

ATTACHMENT C

TOTAL PROJECT COST SUMMARY SHEET (TPCS)

PROJECT: **City of Loveland, Ohio Emergency Bank Stabilization, CAP Section 14**
PROJECT NO: **498610**
LOCATION: **Loveland, OH**

DISTRICT: **Louisville, LRL** PREPARED: **6/5/2024**
POC: **CHIEF, COST ENGINEERING, JIM VERMILLION, TCCC**

This Estimate reflects the scope and schedule in report; Report Name and date

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
							Program Year (Budget EC):			2024					
							Effective Price Level Date:			1-Oct-23					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 1-Oct-24 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
02	RELOCATIONS	$818	$180	22%	$998		$818	$180	$998		$998	4.7%	$856	$188	$1,045
06	FISH & WILDLIFE FACILITIES	$91	$17	19%	$108		$91	$17	$108		$108	5.4%	$95	$18	$113
16	BANK STABILIZATION	$3,362	$1,244	37%	$4,606		$3,362	$1,244	$4,606		$4,606	8.1%	$3,635	$1,345	$4,979
	CONSTRUCTION ESTIMATE TOTALS:	$4,270	$1,441		$5,711		$4,270	$1,441	$5,711		$5,711	7.5%	$4,586	$1,551	$6,137
01	LANDS AND DAMAGES	$37	$5	14%	$42		$37	$5	$42		$42	6.0%	$39	$5	$45
30	PLANNING, ENGINEERING & DESIGN	$657	$105	16%	$762		$657	$105	$762		$762	7.7%	$707	$113	$820
31	CONSTRUCTION MANAGEMENT	$277	$39	14%	$316	0.0%	$277	$39	$316		$316	10.1%	$305	$43	$348
	PROJECT COST TOTALS:	$5,241	$1,590	30%	$6,831		$5,241	$1,590	$6,831		**$6,831**	7.6%	$5,638	$1,712	$7,350

ESTIMATED TOTAL PROJECT COST:		**$7,350**
ESTIMATED FEDERAL COST:	65%	$4,778
ESTIMATED NON-FEDERAL COST:	35%	$2,573
22 - FEASIBILITY STUDY (CAP studies):		**$100**
ESTIMATED FEDERAL COST:	50%	$100
ESTIMATED NON-FEDERAL COST:	50%	
ESTIMATED FEDERAL COST OF PROJECT		**$4,878**

________________ CHIEF, COST ENGINEERING, JIM VERMILLION, TCCC

________________ PROJECT MANAGER, LACEY GABBARD

________________ CHIEF, REAL ESTATE, ASHLEY KLIMASZEWSKI

________________ CHIEF, PLANNING, NATE MOULDER

________________ CHIEF, ENGINEERING, IAN MITCHELL, PE

________________ CHIEF, OPERATIONS, WAYLON HUMPHREY

________________ CHIEF, CONSTRUCTION, KEVIN JEFFERSON, PE

________________ CHIEF, CONTRACTING, MISTY BOCK

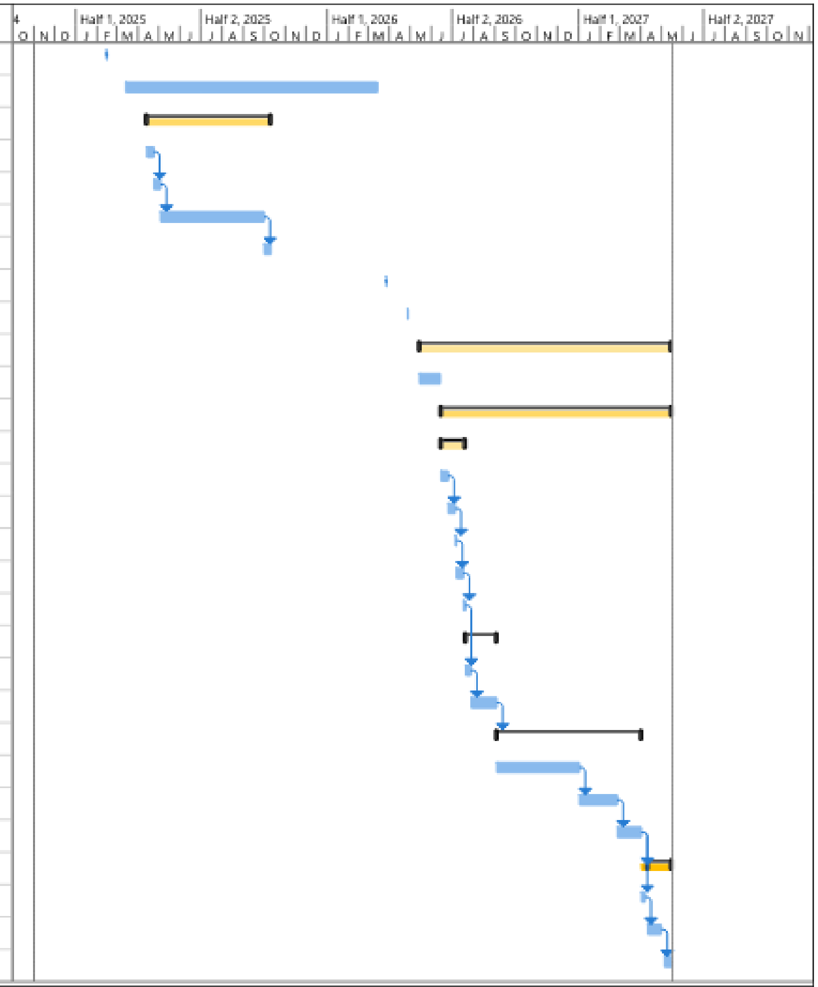
________________ CHIEF, PM-PB, MATT SCHEULLER

________________ CHIEF, DPM, JOHN BOCK, PE

ATTACHMENT D

CONSTRUCTION SCHEDULE

ID	Task Mode	Task Name	Duration	Start	Finish
1		Project Partnership Agreement (PPA) Signed & Executed (A1110M)	1 day	Fri 2/14/25	Sat 2/15/25
2		Prepare Plans & Specs	365 days	Fri 3/14/25	Sat 3/14/26
3		**Utility Relocates (Non-Fed Cost)**	**180 days**	**Mon 4/14/25**	**Sat 10/11/25**
4		Contractor Mobilization	10 days	Mon 4/14/25	Thu 4/24/25
5		Prep Work	10 days	Thu 4/24/25	Sun 5/4/25
6		Utility Relocates	150 days	Sun 5/4/25	Wed 10/1/25
7		Contractor Demobilization	10 days	Wed 10/1/25	Sat 10/11/25
8		Contract RTA (A2240M)	1 day	Fri 3/27/26	Sat 3/28/26
9		Construction Contract Award (A2280M)	1 day	Mon 4/27/26	Tue 4/28/26
10		**Construction Phase**	**365 days**	**Fri 5/15/26**	**Sat 5/15/27**
11		Contractor Pre-Construction Activities (Submittals)	30 days	Fri 5/15/26	Sun 6/14/26
12		**Bank Stabilization**	**335 days**	**Mon 6/15/26**	**Sat 5/15/27**
13		**Contractor Mobilization & Site Prep**	**35 days**	**Mon 6/15/26**	**Mon 7/20/26**
14		Equipment Mobilization	10 days	Mon 6/15/26	Thu 6/25/26
15		Traffic Control / Road Demo	10 days	Thu 6/25/26	Sun 7/5/26
16		Erosion Control, Silt Fence	2 days	Sun 7/5/26	Tue 7/7/26
17		Clear & Grubbing	10 days	Tue 7/7/26	Fri 7/17/26
18		Laydown Storage Area	3 days	Fri 7/17/26	Mon 7/20/26
19		**Earthwork**	**45 days**	**Tue 7/21/26**	**Thu 9/3/26**
20		Top Soil Stripping	8 days	Tue 7/21/26	Tue 7/28/26
21		Temporary Bench / Shape Embankment	37 days	Wed 7/29/26	Thu 9/3/26
22		**Slope Protection**	**210 days**	**Fri 9/4/26**	**Thu 4/1/27**
23		Riprap/Shot Rock	120 days	Fri 9/4/26	Fri 1/1/27
24		Soil Slurry	55 days	Sat 1/2/27	Thu 2/25/27
25		Vegetation	35 days	Fri 2/26/27	Thu 4/1/27
26		**Site Remediation/Cleanup**	**35 days**	**Sun 4/11/27**	**Sat 5/15/27**
27		Remediate Laydown Area / Work Site Cleanup	5 days	Fri 4/2/27	Wed 4/7/27
28		Traffic Control / Road Remediation	20 days	Sun 4/11/27	Fri 4/30/27
29		Contractor De-mobilization	10 days	Wed 5/5/27	Sat 5/15/27



Project: Loveland OH ROM Sch
Date: Wed 6/5/24

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Page 1

Little Miami River, Loveland, Ohio
Continuing Authorities Program (CAP) Section 14
Emergency Streambank Stabilization Project

Draft Real Estate Plan

Appendix D

Real Estate Division

Louisville District

US Army Corps of Engineers

June 2024

Little Miami River, Loveland, Ohio
CAP Section 14
Draft Real Estate Plan

1. PURPOSE:

This Real Estate Plan (REP) presents the real estate requirements for the Loveland, OH CAP Section 14 Emergency Streambank Stabilization Project (Project) in accordance with ER 405-1-12. This REP supports the Detailed Project Report. It is tentative in nature and preliminary for planning purposes only. The plan includes estimated land values and costs associated with the acquisition of lands, easements, and rights-of-way. It also identifies any facility/utility relocations necessary to implement the project. Anticipated requirements for lands, easements, rights-of-way, relocations and disposal areas (LERRD) are based on information furnished by the project development team. The final real property acquisition lines and estimates of value are subject to change even after approval of the report.

2. PROJECT AUTHORIZATION:

This study is authorized by Section 14 of the 1946 Flood Control Act (P.L. 79-526) as amended. Section 14 allows the US Army Corps of Engineers (USACE) to study, design, and construct emergency streambank and shoreline protection projects to protect public facilities and services including, but not limited to, streets, bridges, schools, churches, water and sewer lines, National Register of Historic Places sites, and other public non-profit facilities from damage and/or loss by natural erosion.

The Non-Federal Sponsor (NFS) is the City of Loveland, OH. The facility being protected by the Project is a public road in southeast Loveland called E. Kemper Road. A Letter of Intent dated 28 April 2021 was provided by the NFS.

3. PROJECT DESCRIPTION:

The purpose of the Project is to address streambank erosion along the northwestern bank of the Little Miami River that is threatening E. Kemper Road. Specifically, the NFS has identified three separate areas of erosion along the road between river miles 23.7 and 22.9 identified as Worksites 1 through 3. See Exhibit D-1 for project area mapping.

The tentatively selected plan (TSP) for the Project is a vegetated riprap installation. Several layers of riprap will be installed with the voids filled with topsoil between layers. After placement of the final riprap layer, the surface will be covered with topsoil and planted with native plantings. See the Engineering Appendix A of the DPR for a detailed description of the TSP.

The Project will require the NFS to make four acquisitions from four private landowners along the bank of the Little Miami River totaling approximately 0.7 acres of shoreline. The standard estate Bank Protection Easement will be used for the acquisitions along the bank. The NFS owns sufficient real estate interests in the remaining project land to support Project construction, operation, and maintenance without further acquisitions. The NFS owns and maintains the right-of-way of E. Kemper Road. They also own the laydown area in fee. The laydown area is located on E. Kemper Road approximately 0.75 miles southwest from Worksite 1. It is an approximately 1.3-acre open field adjacent to a municipal water treatment plant with direct access to E. Kemper Road.

Acquisitions			
Worksite	**Estate**	**# of Acquisitions**	**Acres**
1	Bank Protection Easement	1	0.17
2	Bank Protection Easement	1	0.18
3	Bank Protection Easement	2	0.32
TOTAL		4	0.67

One lane of E. Kemper Road will be closed during construction with periodic closings of the entire road when construction requires. As the road is the public facility being protected by this Project, the NFS is not entitled to LERRD credit for its value. While the NFS owns the laydown area in fee, they will only be entitled to LERRD credit for the value of a temporary work area easement over the site.

Several utilities will likely be impacted by project construction, particularly underground storm water and sanitary sewer lines as well as overhead electric and telecom lines. At this time, utility relocations are not expected to require acquisition of additional real estate.

4. ESTATES:

The standard estate Bank Protection Easement will be required for all acquisitions. The NFS will be entitled to LERRD credit only for the value of a Temporary Work Area Easement over the laydown area. The standard estate language of each estate is below.

Bank Protection Easement

A perpetual and assignable easement and right-of-way in, on, over and across the land hereinafter described for the location, construction, operation, maintenance, alteration, repair, rehabilitation and replacement of a bank protection works, and for the placement of stone, riprap and other materials for the protection of the bank against erosion; together with the continuing right to trim, cut, fell, remove and dispose therefrom all trees, underbrush, obstructions, and other vegetation; and to remove and dispose of structures or obstructions within the limits of the right-of-way; and to place thereon dredged, excavated or other fill material, to shape and grade said land to desired slopes and contour, and to prevent erosion by structural and vegetative methods and to do any other work necessary and incident to the project; together with the right of ingress and egress for such work; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines.

Temporary Work Area Easement

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract Nos. _____, _____ and _____), for a period not to exceed __________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the ____________ Project, together with the *right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.*

5. NON-STANDARD ESTATES:

No non-standard estates are required to complete the Project.

6. NON-FEDERAL SPONSOR LANDS:

The NFS owns the laydown area in fee and has sufficient real estate interest in the E. Kemper Road right-of-way to support Project construction, operation, and maintenance.

7. EXISTING FEDERAL PROJECTS/LANDS:

No Federal projects are located within or near the Project area.

8. NAVIGATION SERVITUDE:

The Little Miami River is a navigable waterway and construction will likely take place below the ordinary high water mark; however, this project is not in aid of commerce or flood control, so navigation servitude does not apply.

9. PROJECT AREA MAPS:

See Exhibit D-1 for the project area mapping.

10. POSSIBLE INDUCED FLOODING:

Induced flooding is not anticipated as a result of project construction or maintenance.

11. BASELINE COST ESTIMATE FOR REAL ESTATE:

According to Article V.D of the model Section 14 Project Partnership Agreement (PPA), the NFS is not entitled to credit for real property interests that are part of the tract of land on which the facility to be protected is located if such tract of land was owned by the NFS on the effective date of the PPA. The relevant sections of E. Kemper Road were annexed by the City of Loveland in 1942 and 1959. The NFS will not receive any credit for the road itself. The estimated cost for Project LERRDs is approximately $900,000. The table below provides details of the cost estimate. The Lands & Damages estimate was reviewed and approved by the LRL-RE appraiser. The estimated utility relocation cost was prepared by the LRL Cost Engineer and is based on the size and linear feet of utilities located within the Project work limits. During the Design phase, a more detailed investigation of actual utility impacts will be conducted, and this estimate will be updated to accurately reflect the anticipated costs of utility relocations.

01 Lands & Damages

Lands	$25,000

Damages			$0.00
P.L. 91-646 Relocation Benefits			$0.00
Non-Fed Sponsor Incidental Costs	4 Acquisitions	4 @ $3,000	$12,000
Contingency		20%	$5,000
		Subtotal	$42,000
02 Relocations (Utility/Facility)			$850,000
30 Federal (Real Estate) Administrative Costs			$8,000
LERRD Total			**$900,000**

12. RELOCATION ASSISTANCE BENEFITS (P.L. 91-646):

Relocation benefits issued in accordance with Public Law 91-646 are not anticipated to support the proposed project. The proposed acquisitions will not result in the displacement of any persons, businesses, or personal property.

13. MINERAL / TIMBER ACTIVITY:

There is no mineral or timber activity in the project area.

14. SPONSOR CAPABILITY:

The NFS has been deemed moderately capable of acquiring the necessary real estate for project purposes. The Sponsor Capability Assessment was completed on 19 April 2023 and is attached as Exhibit D-2.

15. ZONING ORDINANCES ENACTED:

No application or enactment of zoning ordinances is proposed in lieu of, or to facilitate, acquisition in connection with the project.

16. ACQUISITION SCHEDULE WITH MILESTONES:

While a timeline with specific dates is unavailable at this time, the NFS is expected to be able to adhere to the following general acquisition schedule.

Activity (as needed)	Duration
Notice to proceed with real estate acquisitions issued	After PPA execution and finalized design
Real estate acquisitions	12 to 18 months
Certification of real estate interests	1 month

Process LERRD Credit requests	As requests are received

17. UTILITIES / FACILITIES TO BE RELOCATED:

Overhead electrical and telecom lines as well as underground storm water and sanitary sewer lines are located within the Project footprint. No utilities are expected to require permanent relocation as a result of the Project. The underground utilities will likely require modification and/or protection during construction; however, they will remain within their existing footprints. The overhead utilities will remain in place and be avoided during construction. If the overhead utilities cannot be avoided, they will be temporarily relocated. If temporary relocation is necessary, the NFS will relocate them within their existing right-of-way or acquire temporary work area easements for their placement during construction. All utility/facility relocations are the responsibility of the NFS.

In accordance with Real Estate Policy Guidance Letter No. 31 – Real Estate Support to Civil Works Planning, dated 11 January 2019, a real estate assessment of the impacted utilities' potential compensability was prepared in lieu of preliminary attorney's opinions of compensability. The assessment notes that the impacted utilities are of a type that is generally eligible for compensation under the substitute facilities doctrine and identifies the utility owners' likely compensable real estate interests. Final attorney's opinions of compensability will be prepared during the design phase. Only costs associated with the relocation of utilities which are found to have a compensable real estate interest will be creditable LERRD items and included in total project costs.

ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REAL ESTATE PLAN, OR ELSEWHERE IN THIS PROJECT REPORT, THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES.

18. HTRW CONSIDERATIONS:

The USEPA Envirofacts database was queried to identify hazardous, toxic, and radioactive waste (HTRW) sources within one mile of the project footprint (USEPA 2024). A total of 10 USEPA facilities were documented near the project footprint. Considering the urbanized nature of the area, a relatively conservative buffer was utilized based on the scope and design of the project and its potential to impact or be impacted by HTRWs near the site. The list of facilities placed on the USEPA facilities list includes generators, transporters, treaters, storers, or disposers of HTRW materials. There is a record of a brownfield site approximately 0.53-miles to the northeast of proposed Work Site 3. A Phase 1 Environmental Assessment of the site was conducted in 2018 and no institutional controls are in place at this time, potentially indicating that the site is stable and of little threat to the surrounding area. Another facility was classified as a toxic waste emitter, with the last recorded release (of aerosolized hydrochloric acid) in 1995. None of the listed sites are expected to be disturbed during the demolition or construction of the proposed project. See the main report for a complete list of facilities within the 1-mile buffer of the proposed Project.

The NFS is responsible for undertaking any investigations to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act that may exist in, on, or under real property interests required for construction, operation, and maintenance of the Project.

19. OWNER ATTITUDE / ISSUES:

The surrounding property owners and residents are familiar with the erosion happening along E. Kemper Road as the City must regularly perform temporary fixes to the roadway. The Project has been described in the local newsletter and on the NFS's website. The community is supportive of the Project, and no objections have been received.

20. SPONSOR NOTIFIED OF RISK OF ADVANCED ACQUISITIONS:

The NFS was notified in writing of the risk of advance acquisition on 21 February 2024.

21. ANY OTHER REAL ESTATE ISSUE:

None at the time of report writing.

Prepared by:

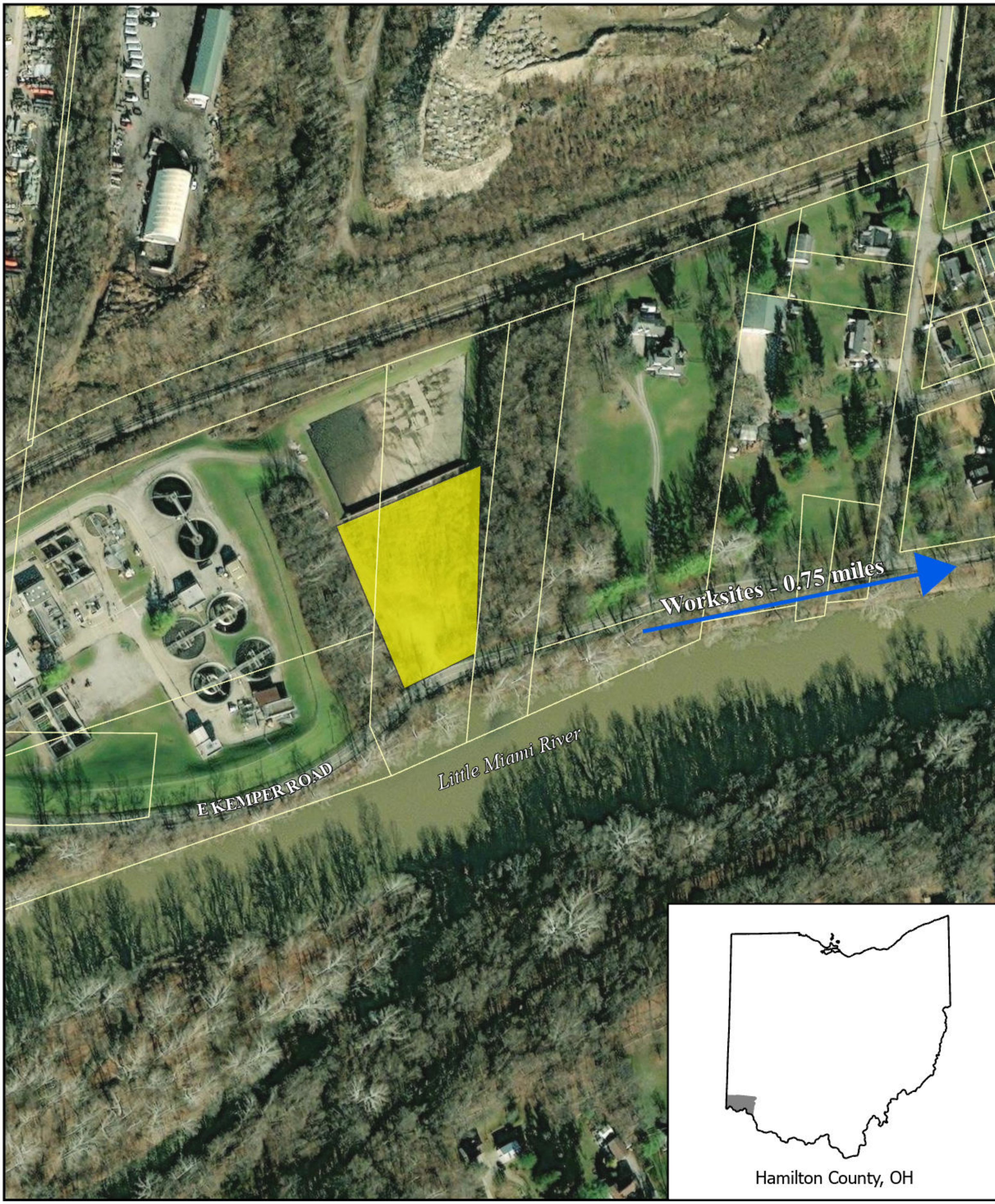
____

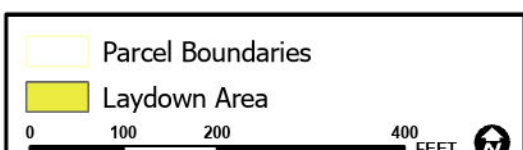
Carrie Fry
Realty Specialist
Louisville District

This REP is in compliance with applicable regulations, policy, and delegations.

____

Ashley N. Klimaszewski
Chief, Real Estate
Louisville District



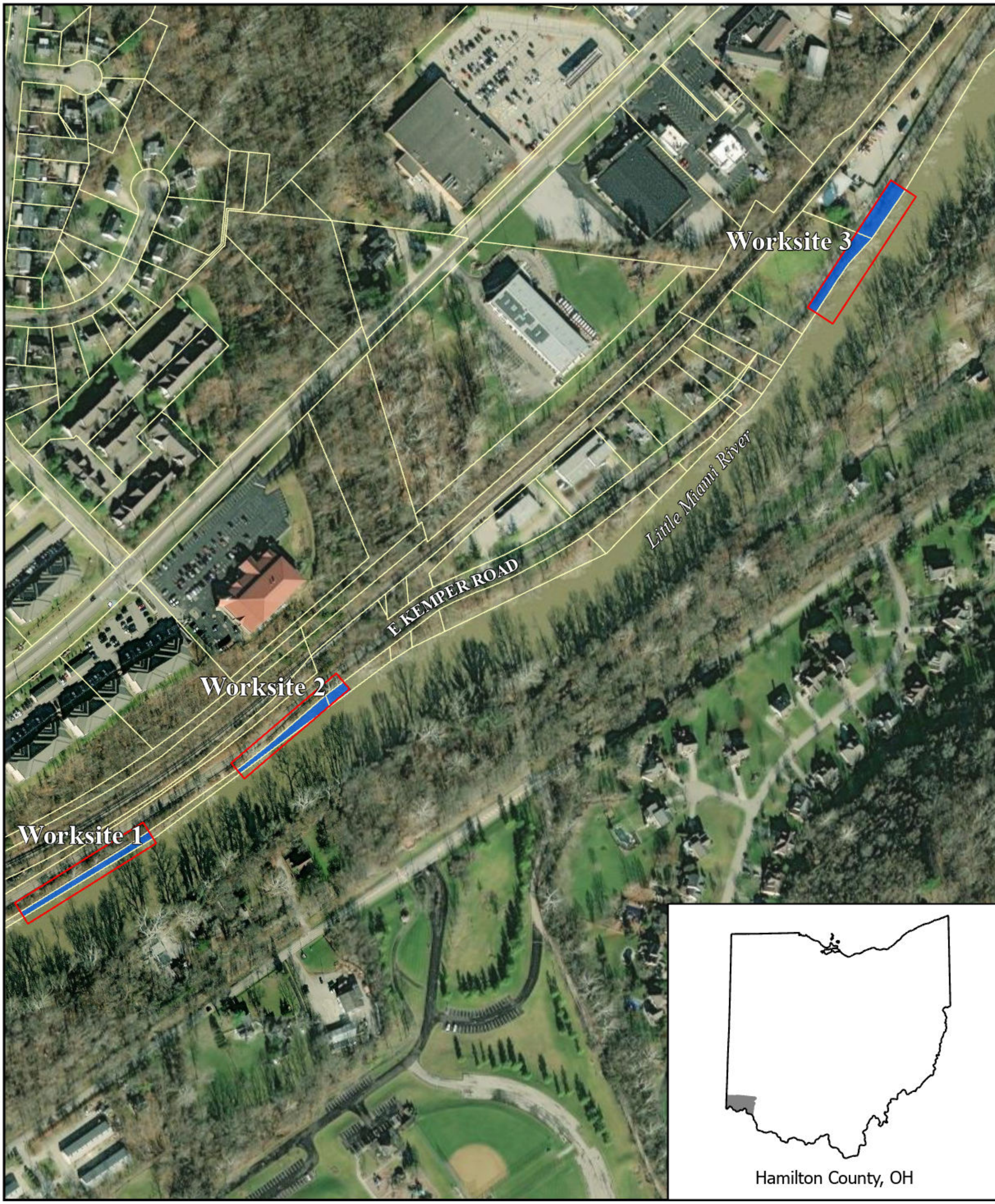


CITY OF LOVELAND
HAMILTON COUNTY, OH
CAP SEC 14
EMERGENCY STREAMBANK
STABILIZATION PROJECT

US ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
REAL ESTATE DIVISION

MARCH 2024

EXHIBIT D-1



Contractor Work Limits
Parcel Boundaries
Bank Protection Easement

0 150 300 600 FEET

CITY OF LOVELAND
HAMILTON COUNTY, OH
CAP SEC 14
EMERGENCY STREAMBANK
STABILIZATION PROJECT

US ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
REAL ESTATE DIVISION

MARCH 2024

EXHIBIT D-1

LOVELAND, OH STREAMBANK STABILIZATION PROJECT
CAP SECTION 14

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

Sponsor(s): Loveland, OH

Authority:
CAP Section 14

Non-Federal Sponsor Real Estate Contact:
David Kennedy, City Manager
120 West Loveland Avenue
Loveland, Ohio 45140
513-707-1454 - dkennedy@lovelandoh.gov

I. Legal Authority

a. **Does the non-Federal Sponsor have legal authority to acquire and hold title to real property for project purposes?**

Yes XX No____ **Per Section 107.01 of the Codified Codes of the City of Loveland and the Ohio Constitution, Article I, Section 19.**

Non-Federal Sponsor is authorized to acquire and own land by authority of ______________________.

Note: If NO; who will acquire LERRD? Who will hold title?

b. **Does the non-Federal Sponsor have the power of eminent domain for this project?**

Yes XX No____

The use of eminent domain is authorized by Loveland City Council.

Note: If NO, who will acquire tracts if condemnation is required?

c. **Does the non-Federal Sponsor have "quick-take" authority for this project?**

Yes____ No XX

Non-Federal Sponsor's "quick-take" authority is authorized by ______________________.

Note: If NO; will lack of "quick take" authority impact the project schedule?

d. The non-Federal Sponsor has reviewed the project maps and confirmed that all of the lands/ interests in land required for the project are located inside of their political boundary.

Yes **XX** No_____

Note: If NO; what is the plan for acquiring? Can the non-Federal Sponsor hold title to land outside of their political boundary?

e. Are any of the lands/ interests in land required for the project owned by an entity whose property the non-Federal Sponsor cannot condemn?

Yes_____ No **XX**

Note: If YES; what is the plan for acquiring?

Section I. ______________________ Date: 4 / 20 / 23
Realty Specialist

II. Financial Capability

a. The non-Federal Sponsor has reviewed and concurs with the real estate cost estimates.

Yes **XX** No_____

Note: If NO; provide the anticipated resolution.

b. It has been established by the responsible district element that the non-Federal Sponsor is financially capable of fulfilling all requirements identified in the Project Partnership Agreement (PPA).

Yes **XX** No_____

Note: If NO; is another entity going to provide the non-Federal Sponsor with financial assistance?

Section II. ______________________ Date: 4 / 20 / 23
Realty Specialist

III. Willingness To Participate

a. **The non-Federal Sponsor has stated in writing its general willingness to participate in the project and its understanding of the general scope of the project and its part of the project.**

Yes **XX**

Letter of Intent from the NFS dated 9/08/2021.

Note: If more than one sponsor is to be involved explain the Real Estate roles of each non-Federal Sponsor.

b. **The non-Federal Sponsor is agreeable to signing a project partnership agreement and supplying funding as stipulated in the agreement.**

Yes **XX**

c. **The non-Federal Sponsor was provided the Local Sponsors Toolkit on 04/14/2023.**
http://www.lrd.usace.army.mil/Portals/73/docs/RealEstate/Non-Federal_Sponsor_Package.pdf

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Section III. ______________________ Date: 4 / 20 / 23
Realty Specialist

IV. Acquisition Experience and Capability

a. **Taking into consideration the project schedule and complexity, the non-Federal Sponsor has the capability with in-house staffing or contract capability, to provide the necessary services such as surveying, appraising, title, negotiating, condemnation, closings, and relocation assistance that will be required for the acquisition of properties for this project.**

Yes **XX** No_____

Note: If work will be done in-house give brief summary, staff size, expertise, experience, etc.

b. **The non-Federal Sponsor's staff is familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended.**
Yes **XX** No_____

Note: If NO; additional funding for USACE training/ oversight will be required.

c. **The non-Federal Sponsor can obtain contractor support and meet project schedules.**
Yes **XX** No_____

Note: If NO; does the acquisition timeline account for this?

d. **The non-Federal Sponsor's staff is located within a reasonable proximity to the project site.**

Yes **XX** No_____

Note: If NO; provide summary of plan to make contact; i.e., project office, travel, local contractors etc.

e. **Will USACE assistance likely be requested by the non-Federal Sponsor in acquiring real estate?**

Yes_____ No **XX**

Note: If YES; provide a summary of the level of support that will be requested. Will a Memorandum of Agreement be required in accordance with the Project Partnership Agreement?

Section IV. ____________________ Date: 4 / 20 / 23
Realty Specialist

V. **Schedule Capability**

The non-Federal Sponsor has approved the tentative project/ real estate schedule/ milestones and has indicated its willingness and ability to incorporate its financial, acquisition, and condemnation capability to provide the necessary project LERRDs in accordance with proposed project schedules so the Government can advertise and award the construction contract as required by overall project schedules and funding limitations.

Yes **XX**

Section V. ______________ Date: 4 / 20 / 23
Realty Specialist

VI. LERRD Credits

The sponsor has indicated its understanding of LERRD credits and its capability and willingness to gather the necessary information to submit as LERRD credits in within six months after possession of all real estate and completion of relocations in order that the project can be financially closed and there can be a final financial accounting with a proper settlement with the non-Federal Sponsor.

Yes **XX**

Note: If a multi-year phased project discuss plan for interim submittals.

Section VI. ______________ Date: 4 / 20 / 23
Realty Specialist

VII. Capability

With regard to this project, the non-Federal Sponsor is anticipated to be:
Moderately Capable______.

Note: Choices are: fully capable, moderately capable, marginally capable, and insufficiently capable.

a. Fully Capable: *Previous experience. Financially capable. Authority to hold title. Can perform, with in house staff, the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance, condemnation & "quick-take" authority) required to provide LERRD.*

b. Moderately Capable: *Financially capable. Authority to hold title. Can provide, with contractor support, the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance and condemnation authority) required to provide LERRD. Quick-take authority will be provided by*______________________________.

c. Marginally Capable: *Financially capable. Authority to hold title. Will rely on approved contractors to provide the necessary services (survey, appraisal, title, negotiation, closing, and relocation assistance). Quick-take authority and authority to condemn will be provided by*______________________.

d. Insufficiently Capable: *Financially capable. Will rely on approved contractors to provide the necessary services (survey, appraisal, title, negotiation, closing, and relocation assistance). Quick-take authority and authority to condemn will be provided by*______________________________.
*Will rely on*___________________________*to hold title.*

Summarize what support will be provided to the non-Federal Sponsor to ensure project success.

VIII. Coordination

This assessment has been coordinated with the non-Federal Sponsor and it concurs with the assessment.

Yes **XX**

This assessment has been coordinated with:

Name: **David Kennedy**
Title: **City Manager**

Prepared by:

Carrie Fry
Realty Specialist
Real Estate Division
Louisville District

Considering the capability of the non-Federal Sponsor and the ancillary support to be provided by N/A, and identified above, it is my opinion that the risks associated with LERRD acquisition and closeout have been properly identified and appropriately mitigated.

Chief, Real Estate Division
Louisville District

Non-Federal Sponsor Representative:

Signature:

Name: David Kennedy

Title: City Manager

Date: 04 / 19 / 2023

City of Loveland, Ohio
Continuing Authorities Program Section 14 Feasibility Study

Appendix E
Public and Stakeholder Comments

June 2024

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR PL
LOUISVILLE, KY 40202

July 27, 2023

Planning, Programs and
Project Management Division

Ms. Megan Wood
Ohio State Historic Preservation Officer
Ohio History Connection
800 E 17th Avenue
Columbus, Ohio 43211

Dear Ms. Wood:

The U.S. Army Corps of Engineers, Louisville District (Corps) is initiating consultation under Section 106 of the National Historic Preservation Act (NHPA) regarding the proposed City of Loveland, Ohio, Continuing Authorities Program (CAP) Section 14 Emergency Streambank Stabilization Project in Hamilton County, Ohio (Figure 1). This project was initiated under the authority of Section 14 of the Water Resources Development Act of 1996 and is a cooperative effort between the Corps and the City of Loveland, Ohio (Non-Federal Sponsor). The Project as described below is considered an Undertaking as defined in 36 CFR 800.3(a) of the NHPA.

The Undertaking will consist of designing and constructing streambank erosion protection at three erosion sites on E. Kemper Road, specifically along the right (northwestern) bank of the Little Miami River at approximate river mile 23.7 to 22.9 (Figure 2). These slope failures are located on steep, heavily wooded slopes and cover a total area of approximately 1.5 acres with each site covering approximately 0.5 acre (see Figure 2). Designs being considered for erosion protection may include measures such as walls with tieback anchors, soil anchors, chemical grouting, and riprap/shot rock. The Area of Potential Effects (APE) consists of the three proposed erosion sites and the areas in between them along the Little Miami River as shown on Figure 2.

A number of steps were taken in an effort to identify cultural resources within the proposed APE. These included a background check of the National Register of Historic Places (NRHP), the Louisville District Geographic Information System, the Ohio History Connection's Ohio Archaeological Inventory and Ohio Historic Inventory (both available online), and previous cultural resource survey reports that have occurred near the vicinity of the APE. The purpose of this records search was to identify and locate any cultural resources or historic properties that could be affected by the proposed Undertaking. The online records review of the Ohio Archaeological and Historic Inventories occurred on July 3, 2023. The online search found no known prehistoric or historic archaeological sites or above ground structures within the APE. It also determined that no previously recorded historic properties listed on the NRHP are located within the APE. No archaeological sites were located within a 0.5-mile radius of the proposed APE. No archaeological surveys have been previously conducted with the APE. One archaeological survey for a private development was conducted within a 0.5-mile radius of the Undertaking. The Corps plans on conducting an archaeological survey of the APE according to Ohio State Historic Preservation Office (OSHPO) standards and will coordinate the results with the OSHPO and the Indian tribes. Three above ground structures (HAM-5191-51 [Loveland Middle School], HAM-5192-51 [Miami Supply /Howard's Supply], and HAM-5193-51 [Presto Outing Club House]) have been previously recorded within a 0.25-mile radius of the APE. The records review of the NRHP database found no evidence of any previously recorded properties listed on the NRHP within a 0.25-mile radius of the APE.

The Undertaking has the potential to affect cultural resources and historic properties within the APE. We ask for your concurrence with the APE and the proposed archaeological survey of the APE. We also invite your participation in providing comments or any information on any known cultural resources and historic properties within the Undertaking and APE as defined above to assist in our identification efforts.

We are also developing a consulting party's list for the project. If you know of any consulting parties who wish to participate in this process, please let us know. Please provide a response no later than 30 days upon receipt of this letter. If you have any questions or comments, please contact Mr. Jared Barrett, archaeologist by telephone at 502-315-6480, or by email at Jared.L.Barrett@usace.army.mil.

Sincerely,

Ann Howard Digitally signed by Ann Howard Date: 2023.07.26 15:24:16 -04'00'

Ann Howard
Chief, Environmental Resources Section

Enclosures:
1. Figures 1 and 2

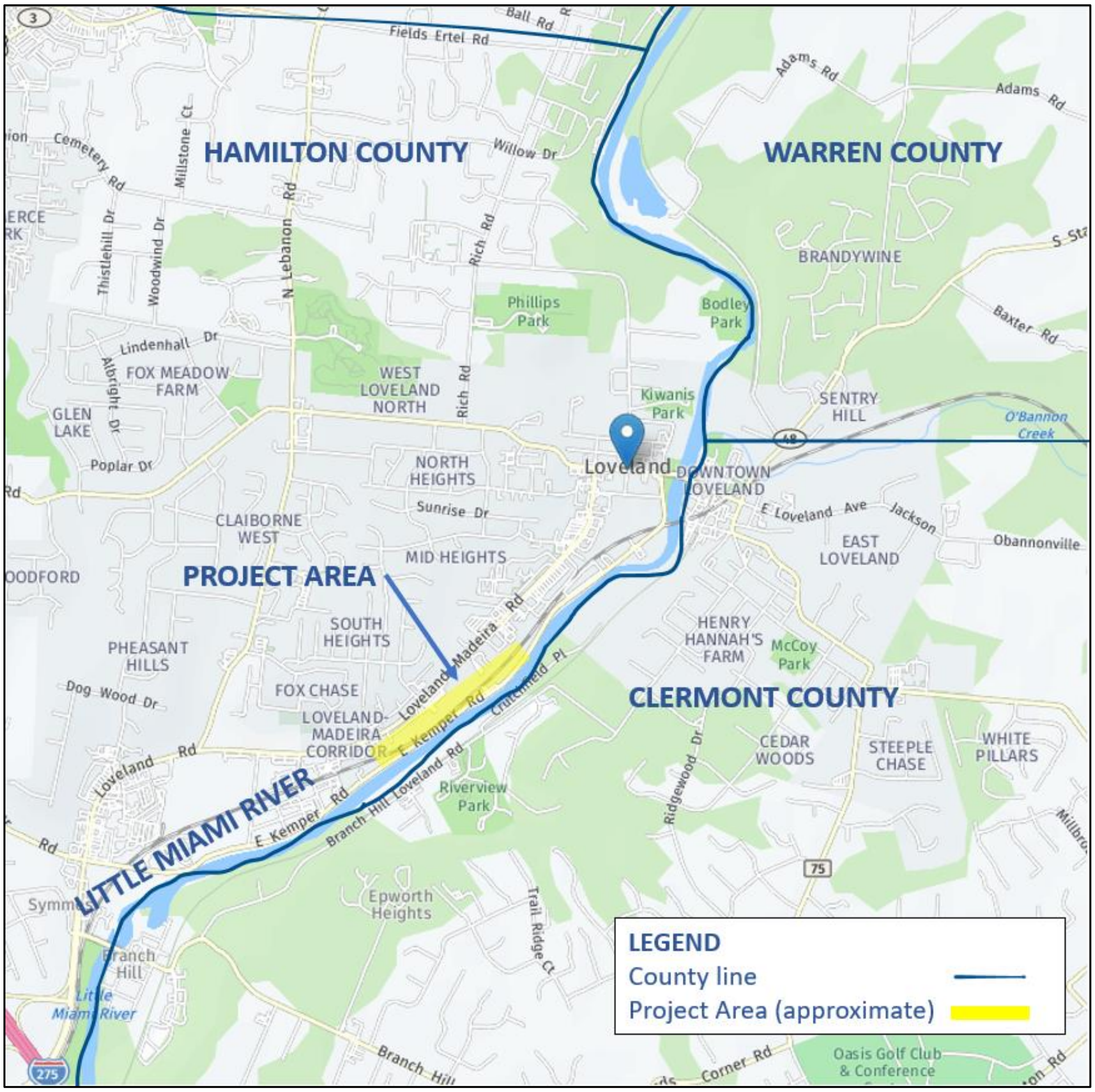

Figure 1. Map showing general location of the Loveland, Ohio CAP 14 Project Area (Undertaking).

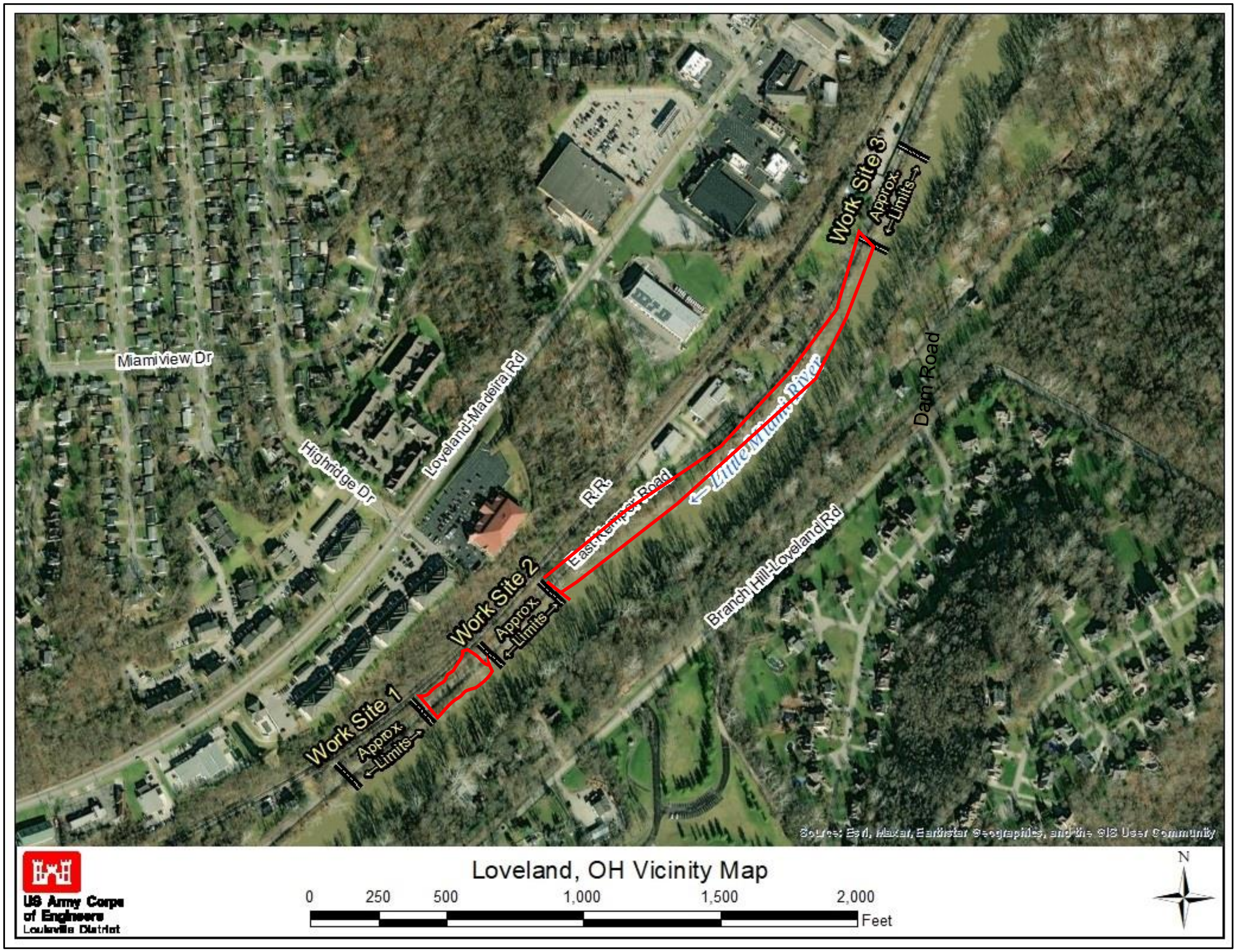

Figure 2. Aerial view showing the location of the proposed erosion sites (labeled as Work Sites 1–3) and additional areas in between (highlighted in red) that are part of the proposed APE for the Undertaking.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR PL
LOUISVILLE, KY 40202

July 27, 2023

Planning, Programs and
Project Management Division

Initiation of Section 106 Consultation of the National Historic Preservation Act for the City of Loveland, Ohio Continuing Authorities Program Section 14 Emergency Streambank Stabilization Project in Hamilton County, Ohio

The U.S. Army Corps of Engineers, Louisville District (Corps) is initiating consultation under Section 106 of the National Historic Preservation Act (NHPA) regarding the proposed City of Loveland, Ohio, Continuing Authorities Program (CAP) Section 14 Emergency Streambank Stabilization Project in Hamilton County, Ohio (Figure 1). This project was initiated under the authority of Section 14 of the Water Resources Development Act of 1996 and is a cooperative effort between the Corps and the City of Loveland, Ohio (Non-Federal Sponsor). The Project as described below is considered an Undertaking as defined in 36 CFR 800.3(a) of the NHPA.

The Undertaking will consist of designing and constructing streambank erosion protection at three erosion sites on E. Kemper Road, specifically along the right (northwestern) bank of the Little Miami River at approximate river mile 23.7 to 22.9 (Figure 2). These slope failures are located on steep, heavily wooded slopes and cover a total area of approximately 1.5 acres with each site covering approximately 0.5 acre (see Figure 2). Designs being considered for erosion protection may include measures such as walls with tieback anchors, soil anchors, chemical grouting, and riprap/shot rock. The Area of Potential Effects (APE) consists of the three proposed erosion sites and the areas in between them along the Little Miami River as shown on Figure 2.

A number of steps were taken in an effort to identify cultural resources within the proposed APE. These included a background check of the National Register of Historic Places (NRHP), the Louisville District Geographic Information System, the Ohio History Connection's Ohio Archaeological Inventory and Ohio Historic Inventory (both available online), and previous cultural resource survey reports that have occurred near the vicinity of the APE. The purpose of this records search was to identify and locate any cultural resources or historic properties that could be affected by the proposed Undertaking. The online records review of the Ohio Archaeological and Historic Inventories occurred on July 3, 2023. The online search found no known prehistoric or historic archaeological sites or above ground structures within the APE. It also determined that no previously recorded historic properties listed on the NRHP are located within the APE. No archaeological sites were located within a 0.5-mile radius of the proposed APE. No archaeological surveys have been previously conducted with the APE. One archaeological survey for a private development was conducted within a 0.5-mile radius of the Undertaking. The Corps plans on conducting an archaeological survey of the APE according to Ohio State Historic Preservation Office (OSHPO) standards and will coordinate the results with the OSHPO and the Indian tribes. Three above ground structures (HAM-5191-51 [Loveland Middle School], HAM-5192-51 [Miami Supply /Howard's Supply], and HAM-5193-51 [Presto Outing Club House]) have been previously recorded within a 0.25-mile radius of the APE. The records review of the NRHP database found no evidence of any previously recorded properties listed on the NRHP within a 0.25-mile radius of the APE.

The Undertaking has the potential to affect cultural resources and historic properties within the APE. We ask for your concurrence with the APE and the proposed archaeological survey of the APE. We also invite your participation in providing comments or any information on any known cultural resources and historic properties within the Undertaking and APE as defined above to assist in our identification efforts.

We are also developing a consulting party's list for the project. If you know of any consulting parties who wish to participate in this process, please let us know. Please provide a response no later than 30 days upon receipt of this letter. If you have any questions or comments, please contact Mr. Jared Barrett, archaeologist by telephone at 502-315-6480, or by email at Jared.L.Barrett@usace.army.mil.

Sincerely,

Ann Howard Digitally signed by Ann Howard Date: 2023.07.26 15:26:15 -04'00'

Ann Howard
Chief, Environmental Resources Section

Enclosures:
Figures 1 and 2

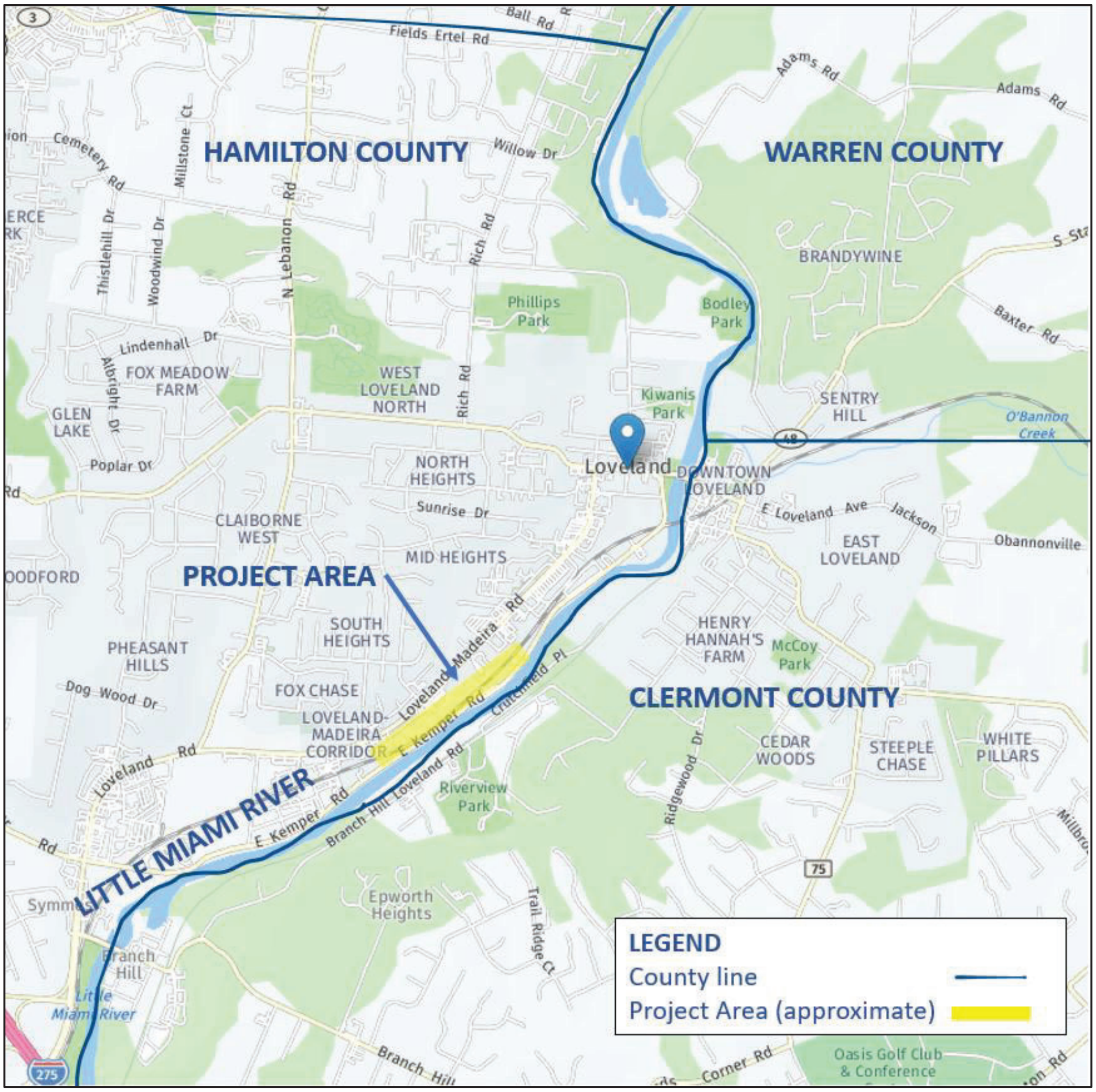

Figure 1. Map showing general location of the Loveland, Ohio CAP 14 Project Area (Undertaking).

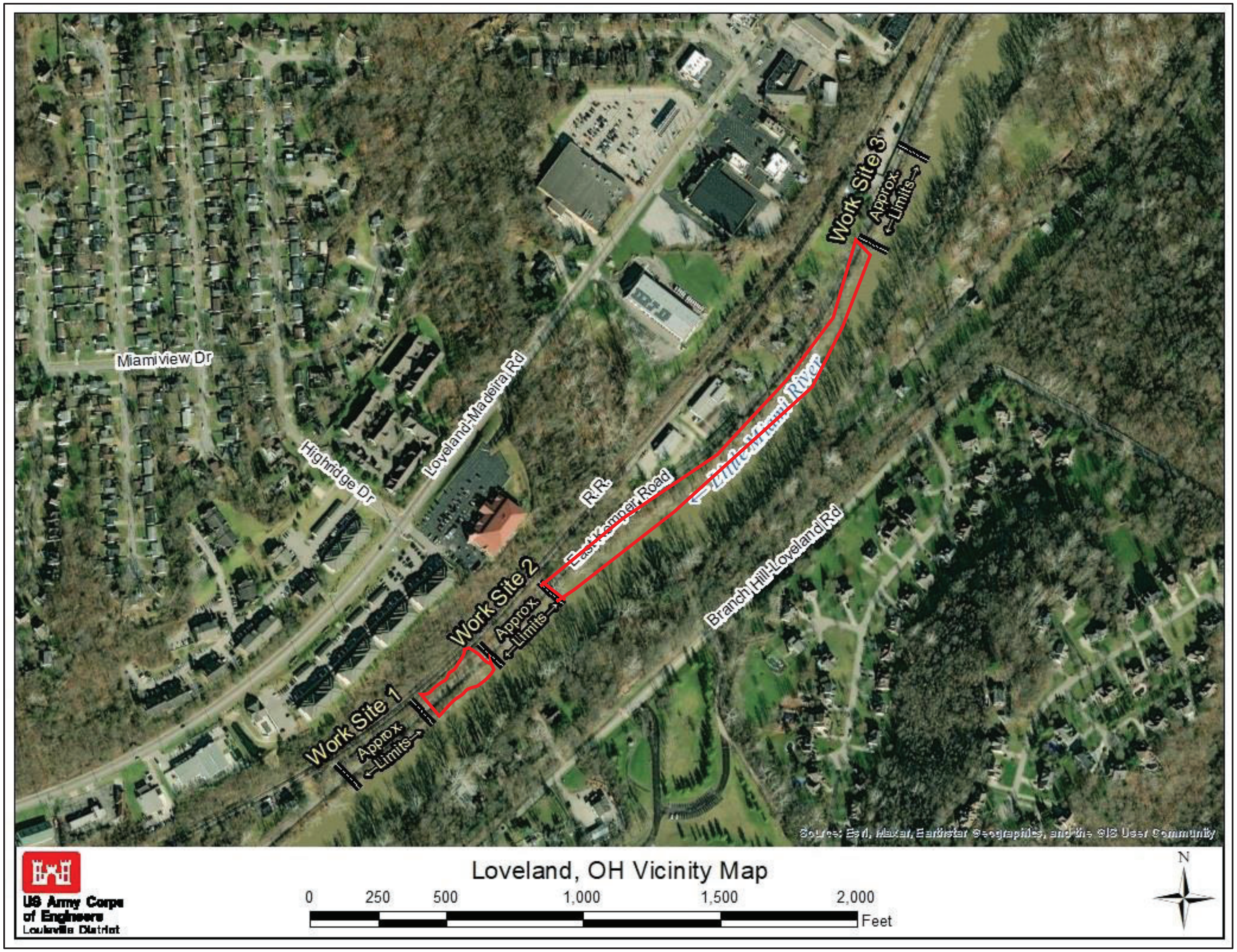

Figure 2. Aerial view showing the location of the proposed erosion sites (labeled as Work Sites 1–3) and additional areas in between (highlighted in red) that are part of the proposed APE for the Undertaking.

In reply refer to:
2023-HAM-58622

August 22, 2023

Jared Barrett, MA, PMP
Archaeologist
U.S. Army Corps of Engineers, Louisville District
600 Dr. Martin Luther King Jr. Place
Louisville, Kentucky 40202
Email: jared.l.barrett@usace.army.mil

RE: Section 106 Review – CAP Section 14 Emergency Streambank Stabilization Project, Loveland, Hamilton County, Ohio

Dear Mr. Barrett:

This letter is in response to correspondence received on July 27, 2023 regarding the above referenced project in Hamilton County, Ohio. We appreciate the opportunity to comment on this project. The comments of the Ohio State Historic Preservation Office (SHPO) are submitted in accordance with the provisions of Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. 306108 [36 CFR 800]). The United States Army Corps of Engineers, Louisville District (Corps) has determined that the project is an undertaking as described in 36 CFR 800.3(a). Therefore, the Corps is the lead federal agency for the undertaking. The project will involve the designing and construction of streambank erosion measures along three separate portions of the right bank of the Little Miami River near river mile 23.7 to 22.9.

According to the submission, the Corps has determined that the Area of Potential Effect (APE) is approximately 1.5-acres, which is comprised of three separate erosion areas, each being nearly 0.5-acres in size. The Corps is requesting the SHPO's concurrence of the APE and the proposed archaeological survey. The SHPO agrees with the archaeological survey, however it is not indicated whether there are any additional temporary workspace, access roads, staging, and/or laydown areas needed for the project. If such temporary areas are needed and are outside of the current delineated APE, then the SHPO recommends these areas be included as part of the APE and subsequently surveyed as part of the overall project. Finally, the Corps is compiling a consulting party's list for the project. The SHPO recommends that the Corps contact the Ohio Archaeological Council (https://ohioarchaeology.org/). Inquiries should be directed to Mr. Eric Olson, President (eols.eric@gmail.com). The Corps should also contact all federally recognized American Indian tribes associated with Southwest Ohio along with local historical societies. We look forward to continued consultation regarding this project. If you have any questions concerning this review, please contact me via email at sbiehl@ohiohistory.org. Thank you for your cooperation.

Sincerely,

Stephen M. Biehl

Stephen M. Biehl, Project Reviews Coordinator (archaeology)
Resource Protection and Review
State Historic Preservation Office

RPR Serial No. 1099191

"Please be advised that this is a Section 106 decision. This review decision may not extend to other SHPO programs."

Miami Tribe of Oklahoma
3410 P St. NW, Miami, OK 74354 ● P.O. Box 1326, Miami, OK 74355
Ph: (918) 541-1300 ● Fax: (918) 542-7260
www.miamination.com

Via email: Jared.L.Barrett@usace.army.mil

August 14, 2023

Jared Barrett, MA, PMP
Archaeologist
US Army Corps of Engineers, Louisville District
Environmental Resources Section
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202

Re: OH CAP 14 Emergency Streambank Stabilization Project, Hamilton County, Ohio – Comments of the Miami Tribe of Oklahoma

Dear Mr. Barrett:

Aya, kweehsitoolaani– I show you respect. The Miami Tribe of Oklahoma, a federally recognized Indian tribe with a Constitution ratified in 1939 under the Oklahoma Indian Welfare Act of 1936, respectfully submits the following comments regarding OH CAP 14 Emergency Streambank Stabilization Project in Hamilton County, Ohio.

The Miami Tribe offers no objection to the above-referenced project at this time, as we are not currently aware of existing documentation directly linking a specific Miami cultural or historic site to the project site. However, given the Miami Tribe's deep and enduring relationship to its historic lands and cultural property within present-day Ohio, if any human remains or Native American cultural items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) or archaeological evidence is discovered during any phase of this project, the Miami Tribe requests immediate consultation with the entity of jurisdiction for the location of discovery. In such a case, please contact me at 918-541-7885 or by email at THPO@miamination.com to initiate consultation.

The Miami Tribe accepts the invitation to serve as a consulting party to the proposed project. In my capacity as Tribal Historic Preservation Officer I am the point of contact for consultation.

Respectfully,

Logan York

Logan York
Tribal Historic Preservation Officer
Miami Tribe of Oklahoma

MATCH-E-BE-NASH-SHE-WISH
2872 Mission Drive, Shelbyville, MI 49344 | {p} 269.397.1780 | gunlaketribe-nsn.gov

August 2, 2023

Ann Howard
Chief, Environmental Resources Section
USACE Louisville
600 Dr. Martin Luther King Jr Pl
Louisville, KY 40202

Re: Continuing Authorities Program (CAP) Section 14 Emergency Streambank Stabilization Project

Dear Ms. Howard:

The Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians' Tribal Historic Preservation Office has received the Section 106 consultation request for comments regarding the proposed CAP Section 14 project involving streambank erosion protection at three sites on the bank of the Little Miami River in Loveland, Hamilton County, OH. At present, we are not providing any additional comments. We have not identified any information concerning the presence of any cultural resources significant to the Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians within the Area of Potential Effect (APE). This is not to say that such a site may not exist, just that this office does not have any available information for the area(s) at this point in time.

This office will be available to assist you in the future or during the project if there is a discovery of human remains, funerary objects, and artifacts. The discovery will require reinitiating Section 106 consultation related to all ongoing and proposed project work and the handling of the inadvertent discovery per the National Historic Preservation Act (NHPA) implementing regulations, 36 CFR Part 800, and, as applicable, the Native American Graves and Repatriation Act (NAGPRA) and its implementing regulations, 43 CFR Part 10. In the event of a discovery of artifacts, human remains, or funerary objects, we request to be notified within 10 days. At that time, the Tribe will determine if further consultation is necessary. Also, please provide any results or reports from the archaeological survey of the APE.

Please keep in mind that there may be other Tribal Nations, including, but not limited to the Miami Tribe of Oklahoma (Logan York, THPO), Osage Nation (Dr. Andrea Hunter, THPO), Shawnee Tribe (Tonya Tipton, THPO), Absentee Shawnee Tribe of Oklahoma, and Eastern Shawnee Tribe of Oklahoma, that have interest that we may not know about. We thank you for including the Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians in your outreach.

Sincerely,

Lakota Hobia

Lakota Hobia
Tribal Historic Preservation Officer
2872 Mission Drive

Shelbyville, Michigan 49344
Lakota.Hobia@glt-nsn.gov
Mbpi_thpo@glt-nsn.gov
Phone: (269) 397-1780

CC: Jared Barrett, Archaeologist, USACE Louisville

From: Benjamin Rhodd
To: Barrett, Jared L CIV USARMY CELRL (USA)
Subject: [URL Verdict: Neutral][Non-DoD Source] RE: USACE - Initiate NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio
Date: Thursday, July 27, 2023 2:17:50 PM

Mr. Barrett,

Pursuant to consultation under Section 106 of the National Historic Preservation Act (1966 as amended) the Forest County Potawatomi Community (FCPC), a Federally Recognized Native American Tribe, reserves the right to comment on Federal undertakings, as defined under the act.

The Tribal Historic Preservation Office (THPO) staff has reviewed the information you provided for this project. Upon review of site data and supplemental cultural history within our Office, the FCPC THPO is pleased to offer a finding of No Historic Properties affected of significance to the FCPC, however, we request to remain as a consulting party for this project.

As a standard caveat sent with each proposed project reviewed by the FCPC THPO, the following applies. In the event an Inadvertent Discovery (ID) occurs at any phase of a project or undertaking as defined, and human remains or archaeologically significant materials are exposed as a result of project activities, work should cease immediately. The Tribe(s) must be included with the SHPO in any consultation regarding treatment and disposition of an ID find.

Thank you for protecting cultural and historic properties and if you have any questions or concerns, please contact me at the email or number listed below.

Respectfully,

Ben Rhodd, MS, RPA, Tribal Historic Preservation Officer
Forest County Potawatomi
Historic Preservation Office
8130 Mish ko Swen Drive, P.O. Box 340, Crandon, Wisconsin 54520
P: 715-478-7354 C: 715-889-0202 Main: 715-478-7474
Email: Benjamin.Rhodd@fcp-nsn.gov
www.fcpotawatomi.com

From: Barrett, Jared L CIV USARMY CELRL (USA) <Jared.L.Barrett@usace.army.mil>
Sent: Thursday, July 27, 2023 6:19 AM
To: 106NAGPRA@astribe.com; PBarton@estoo.net; Erin Paden <epaden@shawnee-tribe.com>; Benjamin Rhodd <Benjamin.Rhodd@fcp-nsn.gov>; cpnthpo@potawatomi.org; Hannahville Indian Community, Michigan <earlmeshigaud@hannahville.org>; Douglas Taylor <Douglas.Taylor@nhbp-nsn.gov>; Pokagon Band of Potwatomi Indians, Michigan and Indiana <matthew.bussler@pokagonband-nsn.gov>; Raphael Wahwassuck <RaphaelWahwassuck@pbpnation.org>; Gun Lake Tribe - THPO Shared <mbpi_thpo@glt-nsn.gov>; THPO@miamination.com; mlhadden@sagchip.org; 'ldfthpo@ldftribe.com' <ldfthpo@ldftribe.com>; Edith Leoso <thpo@badriver-nsn.gov>; 'gloonsfoot@kbic-nsn.gov' <gloonsfoot@kbic-nsn.gov>; Brian.Bisonette@lco-nsn.gov; marvin.defoe@redcliff-nsn.gov; Michael LaRonge <michael.laronge@scc-nsn.gov>; wandam@stcroixtribalcenter.com; evanschroeder@fdlrez.com;

From: Joe Stahlman
To: Barrett, Jared L CIV USARMY CELRL (USA)
Subject: [URL Verdict: Neutral][Non-DoD Source] RE: USACE - Initiate NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio
Date: Monday, August 7, 2023 9:58:32 AM
Attachments: image002.png

Hi Jared,
SNI THPO has reviewed the project. At this time, we have no concerns or comments.

Take care,

Joe

Dr. Joe Stahlman
Tribal Historic Preservation Office
Seneca Nation
82 W. Hetzel Street
Salamanca, NY 14779
Phone (716) 945-1760
Joe.Stahlman@sni.org

From: Barrett, Jared L CIV USARMY CELRL (USA) <Jared.L.Barrett@usace.army.mil>
Sent: Thursday, July 27, 2023 7:21 AM
To: Joe Stahlman <Joe.Stahlman@sni.org>
Subject: USACE - Initiate NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton,

From:	Douglas Taylor
To:	Barrett, Jared L CIV USARMY CELRL (USA)
Subject:	[URL Verdict: Neutral][Non-DoD Source] RE: USACE - Initiate NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio
Date:	Thursday, August 17, 2023 1:42:02 PM
Attachments:	image001.png

Greetings,

Ref: USACE - Initiate NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio

Thank you for including the Nottawaseppi Huron Band of the Potawatomi (NHBP) in your consultation process. From the description of your proposed project, it does not appear as if any cultural or religious concerns of the Tribe's will be affected. We therefore have no objection to the project. Of course, if the project scope is significantly changed or inadvertent findings are discovered during the course of the project, please contact us for further consultation.

Respectfully
Douglas R. Taylor

Douglas R. Taylor | Tribal Historic Preservation Officer (THPO) & NAGPRA Representative
Pine Creek Indian Reservation
1301 T Drive S, Fulton, MI 49052
o: 269-704-8347 | c: 269-419-9434 | f: 269-729-5920
Douglas.Taylor@nhbp-nsn.gov | www.nhbp-nsn.gov

NOTTAWASEPPI HURON BAND OF THE POTAWATOMI
A FEDERALLY RECOGNIZED TRIBAL GOVERNMENT

From: Barrett, Jared L CIV USARMY CELRL (USA) <Jared.L.Barrett@usace.army.mil>
Sent: Thursday, July 27, 2023 7:19 AM
To: 106NAGPRA@astribe.com; PBarton@estoo.net; Erin Paden <epaden@shawnee-tribe.com>; Benjamin Rhodd <Benjamin.Rhodd@fcp-nsn.gov>; cpnthpo@potawatomi.org; Hannahville Indian

Barrett, Jared L CIV USARMY CELRL (USA)

From:	Barrett, Jared L CIV USARMY CELRL (USA)
Sent:	Thursday, January 25, 2024 4:23 PM
To:	section106@ohiohistory.org
Subject:	USACE - NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio - Cultural Resources Survey Report
Attachments:	LovelandOH CAP14 Cultural Resoruces survey report.pdf

Good afternoon,

The U.S. Army Corps of Engineers, Louisville District (Corps) is submitting for review and consultation titled *Phase I Cultural Resource Survey of the Loveland Streambank Erosion Project in Hamilton County, Ohio.*

The survey report is in support of the proposed Loveland, OH CAP 14 Project in Hamilton County, Ohio. This Undertaking will involve several sections of proposed erosion measures along the Little Miami River in Hamilton County, Ohio. The results of this survey identified site 33HA902 within the Area of Potential Effects. Site 33HA902 consists of a dry laid stacked limestone retaining wall along the Little Miami River dating to the nineteenth century. Based on the results of the survey and background historical research, the Corps has made the determination that site 33HA902 is not eligible for listing to the National Register of Historic Places (NRHP). After revising project design plans, the Corps is now avoiding site 33HA902 during construction of the undertaking. Given the redesign of the project to avoid site 33HA902 and the results of the survey, the Corps has made the determination that the proposed undertaking will have no effect to historic properties eligible for listing to the NRHP (36CFR part 800.4 (d)(1)). Therefore, the Corps has made the recommendation that no additional cultural resource surveys are needed for the undertaking.

Site 33HA902 has already been entered into the Ohio History Connection GIS online database.

After review of the attached report, please provide a response to our determination of no effect to historic properties no later than 30 days upon receipt of this email. Email or call if you have any questions for me regarding the attached documentation.

Thanks and have a great evening,

Jared Barrett, MA, PMP
Archaeologist
US Army Corps of Engineers, Louisville District
Environmental Resources Section
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202
Office Phone 502.315.6480
Email: Jared.L.Barrett@usace.army.mil
http://www.lrl.usace.army.mil/

Barrett, Jared L CIV USARMY CELRL (USA)

From: Barrett, Jared L CIV USARMY CELRL (USA)
Sent: Thursday, January 25, 2024 4:21 PM
To: 106NAGPRA@astribe.com; PBarton@estoo.net; Erin Paden; Benjamin Rhodd; cpnthpo@potawatomi.org; 'Hannahville Indian Community, Michigan'; Pokagon Band of Potwatomi Indians, Michigan and Indiana; Raphael Wahwassuck; Gun Lake Tribe - THPO Shared; THPO@miamination.com; mlhadden@sagchip.org; 'ldfthpo@ldftribe.com'; Edith Leoso; 'gloonsfoot@kbic-nsn.gov'; Brian.Bisonette@lco-nsn.gov; marvin.defoe@redcliff-nsn.gov; Michael LaRonge; wandam@stcroixtribalcenter.com; evanschroeder@fdlrez.com; jaylen.strong@boisforte-nsn.gov; maryanng@granportage.com; amyburnette@llojibwe.org; terry.kemper@millelacsband.com; bfletcher@peoriatribe.com; cindy.winslow@gtbindians.com; jsay@lrb-nsn.gov; rhonda.oto@gmail.com; MWiatrolik@LTBBODAWA-NSN.GOV; director.historic@meskwaki-nsn.gov; mark.junker@sacfoxenviro.org; secondchief@sacandfoxnation-nsn.gov; Carissa Speck; sbachor@delawaretribe.org; sclemons@wyandotte.org; s106@osagenation-nsn.gov; Joe Stahlman; Katelyn Lucas; Frederick.Jacko@nhbp-nsn.gov; THPO@miamination.com
Subject: USACE - NHPA Section 106 Consultation - Loveland, OH CAP 14 Project in Hamilton, Ohio - Cultural Resources Survey Report
Attachments: LovelandOH CAP14 Cultural Resoruces survey report.pdf

Good afternoon,

The U.S. Army Corps of Engineers, Louisville District (Corps) is submitting for review and consultation titled *Phase I Cultural Resource Survey of the Loveland Streambank Erosion Project in Hamilton County, Ohio.*

The survey report is in support of the proposed Loveland, OH CAP 14 Project in Hamilton County, Ohio. This Undertaking will involve several sections of proposed erosion measures along the Little Miami River in Hamilton County, Ohio. The results of this survey identified site 33HA902 within the Area of Potential Effects. Site 33HA902 consists of a dry laid stacked limestone retaining wall along the Little Miami River dating to the nineteenth century. Based on the results of the survey and background historical research, the Corps has made the determination that site 33HA902 is not eligible for listing to the National Register of Historic Places (NRHP). After revising project design plans, the Corps is now avoiding site 33HA902 during construction of the undertaking. Given the redesign of the project to avoid site 33HA902 and the results of the survey, the Corps has made the determination that the proposed undertaking will have no effect to historic properties eligible for listing to the NRHP (36CFR part 800.4 (d)(1)). Therefore, the Corps has made the recommendation that no additional cultural resource surveys are needed for the undertaking.

After review of the attached report, please provide a response to our determination of no effect to historic properties no later than 30 days upon receipt of this email. Email or call if you have any questions for me regarding the attached documentation.

Thanks and have a great evening,

Jared Barrett, MA, PMP
Archaeologist
US Army Corps of Engineers, Louisville District
Environmental Resources Section
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202
Office Phone 502.315.6480

Barrett, Jared L CIV USARMY CELRL (USA)

From: Laserfiche Notification <donotreply@laserfiche.com>
Sent: Monday, February 12, 2024 2:38 PM
To: Barrett, Jared L CIV USARMY CELRL (USA)
Subject: [Non-DoD Source] Section 106 Consultation - Loveland Streambank Erosion Project

This email is in response to Loveland Streambank Erosion Project.
The Shawnee Tribe's Tribal Historic Preservation Department concurs that no known historic properties will be negatively impacted by this project. However, there is still potential for the discovery of unknown resources.

We have no issues or concerns at this time. Please continue with the project as planned, but in the event archaeological materials are encountered during construction, use, or maintenance of this location, please re-notify us at that time as we would like to resume immediate consultation under such a circumstance.

If you have any questions, you may contact me via email at Section106@shawnee-tribe.com

Thank you for giving us the opportunity to comment on this project

Erin Paden
TRIBAL HISTORIC PRESERVATION
SPECIALIST
Office: (918) 542-2441, x140
Email: epaden@shawnee-tribe.com
29 S Hwy 69A
Miami, OK 74354
shawnee-tribe.com

In reply refer to:
2023-HAM-58622

February 21, 2024

Jared Barrett, MA, PMP
Archaeologist
U.S. Army Corps of Engineers, Louisville District
600 Dr. Martin Luther King Jr. Place
Louisville, Kentucky 40202
Email: jared.l.barrett@usace.army.mil

RE: Section 106 Review – CAP Section 14 Emergency Streambank Stabilization Project, Loveland, Hamilton County, Ohio

Dear Mr. Barrett:

This letter is in response to the receipt on January 25, 2024, of *Phase I Cultural Resource Survey of the Loveland Streambank Erosion Project in Hamilton County, Ohio* (Barrett 2024). We appreciate the opportunity to comment on this project. The comments of the Ohio State Historic Preservation Office (SHPO) are submitted in accordance with the provisions of Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. 306108 [36 CFR 800]). The United States Army Corps of Engineers, Louisville District (Corps) has determined that the project is an undertaking as described in 36 CFR 800.3(a). Therefore, the Corps is the lead federal agency for the undertaking. The project will involve the designing and construction of streambank erosion measures along three separate portions of the right bank of the Little Miami River near river mile 23.7 to 22.9.

The current survey involved a literature review and visual inspection within three (3) separate locations along the right bank of the Little Miami River. These sections total 1.36-acres. In addition, a 1.3-acre parcel will be used as a laydown/staging area. Therefore, combined, the Area of Potential Effect (APE) is defined as 2.66-acres. The literature review identified no previously documented cultural resources within or adjacent to the project locations. The archaeological field work involved visual inspection due to the steep slope within the three locations and previous disturbances within the laydown area. The results of the survey identified one previously undocumented cultural resource within the APE. This resource has been recorded in the Ohio Archaeological Inventory as site 33HA902. This site is represented by a segment of dry laid stone wall dating to the 19th century. Extensive research revealed no significance associated with the wall. Based on this information, the Corps has determined that site 33HA902 is not eligible for listing to the National Register of Historic Places (NRHP). However, the Corps has decided to redesign the project to avoid impacts to this resource.

After careful review of the above referenced report, the SHPO agrees with the Corps that site 33HA902 is not eligible for the NRHP. Furthermore, the SHPO agrees that, as proposed, the proposed undertaking will have no effect on historic properties and that no further cultural resource investigations are warranted for the project unless the scope of work changes or archaeological deposits are discovered during construction activities. In such a situation, this office should be contacted as required by 36 CFR § 800.13. If you have any questions concerning this review, please contact me via email at sbiehl@ohiohistory.org. Thank you for your cooperation.

Sincerely,

Stephen M. Biehl, Project Reviews Coordinator (archaeology)
Resource Protection and Review
State Historic Preservation Office

RPR Serial No. 1101576

"Please be advised that this is a Section 106 decision. This review decision may not extend to other SHPO programs."

United States Department of the Interior
NATIONAL PARK SERVICE
Interior Regions 3, 4, 5
601 Riverfront Drive
Omaha, NE 68102

April 4, 2024

Lacey A. Gabbard, AICP
Community Planner
Civil Works: Planning, Programs
and Project Management Branch
U.S. Army Corps of Engineers, Louisville
P.O. Box 59
Louisville, KY 40201-0059

Dear Ms. Gabbard:

The National Park Service (NPS) has reviewed the "Loveland Ohio Planning Assistance to States Project Report" as prepared by the Louisville District United States Army Corps of Engineers (USACE) with attention to the Little Miami National Scenic River (River) and the values for which it was added to the National Wild and Scenic Rivers System (System).

The River is a State-administered component of the System, as designated by the Secretary of the Interior (Secretary) under Section 2(a)(ii) of the Wild and Scenic Rivers Act (Public Law 90-542) (Act). The lower 28-mile segment (from Foster/Glen Island to the Ohio River) was added in 1980. As the River managing agency, the State of Ohio is responsible for ensuring that the provisions of the Act are met. The NPS, retains responsibility for evaluating federal actions and making determinations of effect on State-administered National Wild and Scenic Rivers without adjacent Federal ownership in accordance with Section 7(a) of the Act.

Section 7(a) of the Act affords substantial protection to rivers included in the System and to congressionally authorized study rivers. Section 7(a) states, in part:

> *No department or agency of the United States shall assist by loan, grant, license, or otherwise in the construction of any water-resources project that would have a direct and adverse effect on the values for which such river was established, as determined by the*

Secretary charged with its administration. Nothing contained in the foregoing sentence, however, shall preclude licensing of, or assistance to, developments below or above a wild and scenic or recreational river areas or on any stream tributary thereto which will not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area on the date of designation.

A Section 7(a) determination is prepared to evaluate whether a proposed water-resources project would have a direct and adverse effect on the values for which a designated river was established, namely its free-flowing condition, water quality, and outstandingly remarkable values (ORV). The River ORVs are: scenic, recreational, geologic, fish and wildlife, historic, cultural, archeological, scientific, and other similar resources. Water-resources projects that are determined to have a direct and adverse effect on the values for which designated rivers were added to the System are prohibited. Water-resources projects include, but are not limited to, dams, water-diversion projects, fisheries habitat, watershed restoration/enhancement projects, bridge construction or demolition, bank-stabilization projects, boat ramps, and other activities within the bed and bank of the River that typically require a Section 404 or Section 10 Permit from the U.S. Army Corps of Engineers (USACE).

Equally important is Section 10(a) of the Act (16 U.S.C. 1281(a)). Considered as the non-degradation and enhancement policy, Section 10(a) of the Act states the following:

Each component of the National Wild and Scenic Rivers System shall be administered in such manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values.

The NPS encourages and appreciates coordination early and often in order to ensure proposed federally-assisted water resources projects are designed in a manner that meets the public need and avoids or eliminates adverse effects to river values, consistent with the Act's anti-degradation and enhancement policy. The NPS offers the following comments and preliminary findings with respect to Section 7(a). These comments are not a final determination.

1. **Site Visit** - On Friday, August 11, 2023, Regional Rivers Coordinator, Hector Santiago, visited the site(s). As observed from the River, the bank toe of the streambank appeared stable and generally free of undercutting or severe riverine erosion, except where some stormwater outlets were being undermined by road drainage or otherwise outfalls and piping were in disrepair above the river. Most erosion and instability appeared to be located higher on the banks and not attributable to the River. Likewise, any separation of stormwater pipes was not clearly attributable to fluvial processes, where riprap may provide an effective solution to impede lateral movement and bank scour. The slope was vegetated with a combination of large diameter trees including American Sycamore, Hackberry, Silver Maple, Black Walnut, Cottonwood, and Black Locust. There was also

invasive honeysuckle, which shades more rooted understory and does not contribute much to slope or bank stability. This vegetation is providing significant screening from the road and canopy to the River.

2. **Riprap as Slope Failure Protection** – The stability of the soil and slope should be certain if riprap is to be used as surface stabilization. Riprap application may not provide effective resistance to slope failure and in some cases could trigger a slope failure instead of preventing one. The uncertainty of the effectiveness of the proposed practice in comparison to the certain effects of the removal of large mature and rooted trees that provide visual screening, ecological benefits, and contribute to the riverine character within an otherwise urbanized environment should be considered. The true benefit to long-term viability of public infrastructure should also be considered as the practice is proposed to support the road.

3. **Preliminary 7(a) Findings**

    a. **Free-Flowing Condition** - "Free-flowing" as defined in the Act is "*...existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.*" The use of rock channel protection (riprap) as a bank armoring practice is discouraged under the Act and is generally inconsistent with the antidegradation and enhancement policy. Riprap must be of last resort and the least amount necessary to protect existing infrastructure. Additionally, when the use of riprap is unavoidable, vegetative elements, gap filling, interplantings, and other bioengineering techniques are typically required to reduce the profile of the rock and increase ecological benefits to the river. The project does not propose to change channel geometry but would increase the armor along a streambank that appears to be stable. The installation of rock beyond that which is necessary to address the failing stormwater outfalls within the existing rights of way may be excessive and warrants careful consideration.

    b. **Scenic Value** –Although human activities are evident along many parts of the River's edge, including at the project location, the River is relatively undeveloped compared to other rivers in Ohio. At the immediate project site, conditions are more urban but separation between the riverine setting and the transportation corridor remain. Although E. Kemper road is audible and visible from the River at times, the existing trees and shrubs provide a meaningful and effective screen from road traffic. Stormwater outfalls are not wholly conspicuous as they are screened by vegetation and blend into the slope. Paddlers can enjoy some visual separation between the urban activity and riverine character of the channel. The removal of vegetation and replacement with rock may result in direct and adverse effects to the Scenic ORV. Avoiding the removal of native, mature riparian vegetation, especially large diameter, well-rooted trees and the integration of vegetation, minimizing the extent of riprap along the riverbanks and on the slope, as well as integrating native vegetation into riprap to reduce the visible rock may reduce the impacts to scenery in the affected area.

c. **Recreational Value** - The River provides a significant base for several recreational activities for the large populations in and near Cincinnati, Dayton, Hamilton, Springfield and Columbus, Ohio, where there are few river-oriented recreation developments and only minimal river areas under protection. Popular recreational activities near the project area include canoeing, tubing, fishing, and general enjoyment of the River's scenic beauty. These recreational opportunities are distinctive, of relatively high quality, in a natural environment, and not readily available elsewhere. Yearly recreational activities peak during the summer months. Noise and visual impacts associated with construction are unlikely to permanently impact the quality of the recreational experience on the River. The removal of mature trees and or visual screening may degrade the current scenic and riverine character of the river at this location. The scenic character of the River is inherent to visitor experience and public enjoyment.

d. **Geologic Value** – The Little Miami Valley is an area of considerable geological interest. The basin is crossed by what was the southern boundary of the Wisconsin glaciation and by the boundaries of rock formations from two major geological periods – the Ordovician and the Silurian. Collecting sites for invertebrate fossils are numerous at a variety of locations near the River. The project itself is experiencing geological processes associated with the interaction of water and the Kope Formation, which result in the instability that is proposed to be addressed by the project. It is not clear that the application of rock channel protection on the banks and slopes would address the instability. The project will not otherwise affect the geologic values of the River.

e. **Fish and Wildlife Value** – The River and its immediate environs support a diversity of fish and wildlife. When the River was first designated, over 90 fish species and 35 shellfish (primarily mussels) were found in the River, many of which are considered rare. The Clubshell Mussel (*Pleurobema clava*), listed as endangered, and Snuffbox Mussel (*Epioblasma triquetra*), a species of concern will not be affected by the project. A significant sport fishery exists for smallmouth bass, spotted bass, channel catfish, flathead catfish, rock bass, and bluegill. Reptiles and amphibians are well represented in the area, as are mammals, with 44 species of mammals present. Terrestrial wildlife potentially found in the project area includes raccoons, muskrats, turtles, beavers, snakes, deer, and a variety of small mammals and birds. Without a conscientious effort to minimize the risk of sedimentation through proper construction site management, the proposed project could result in localized, minor increases in turbidity and suspended solids in aquatic and shallow water habitat. Temporary and localized impacts associated with streambank disturbance would be minimized with a successfully implemented stormwater and sediment erosion control plan. The loss of riparian vegetation, especially mature trees or other woody growth, where little exists currently along a heavily used transportation corridor may affect the viability of the area as habitat and refuge for local wildlife for an extended period of time, depending on the extent of recovery. The streambed of the River would be minimally disturbed during construction provided the use of heavy equipment within the channel is minimized. The U.S. Fish and Wildlife Service Ecological Services should be consulted for further guidance with respect to the effects of the proposed project on federally listed species and Section 7 of the Endangered Species Act.

f. **Cultural, Historic, and Archaeological Values**– There are numerous sites of historical interest within the River. Prehistoric people and, later, the American Indians generally migrated to well-watered valleys, such as the River, which provided abundant natural resources necessary for maintaining their cultures. Although the project is not likely to impact cultural, historic, and archeological values, the Ohio State Historic Preservation Office should be consulted if any cultural artifacts are discovered during construction pursuant to Section 106 of the National Historic Preservation Act.

g. **Scientific Value** - Two National Natural Landmarks (Clifton Gorge and Glen Helen), one National Historic Landmark (Fort Ancient), and numerous sites of paleontological interest are located within the River valley. The project will not affect either of these areas.

Section 10(a) Consistency Statement:

Section 10(a) of the Act directs river administering agencies to "protect and enhance" the values for which these rivers are designated. The "protect and enhance" language in Section 10 (a) is interpreted by the Secretary's Guidelines as "a non-degradation and enhancement policy for all designated river areas, regardless of classification." The project is located within the lower segment of the River and is classified as "recreational".

The project as proposed would introduce a visible intrusion to the view from the perspective of a paddler. In the absence of enhancement measures that would screen the project from view, the project does not protect or enhance the River or its values to the greatest extent possible and is not fully consistent with Section 10 (a) of the Act.

NPS recommends the following ameliorating measures consistent with the intent of Section 10(a) of the Wild and Scenic Rivers Act:

1. Consider the relocation of E. Kemper Road away from the top of the slope and address roadbed stability and stormwater pipes and routing at the top of the slope to re-establish pipe connections and minimize seepage of stormwater within the slope.

2. Repair stormwater outfalls within their existing rights of way

3. Reduce the amount of rock channel protection to that which is necessary protect and repair the stormwater outfalls within their existing rights of way

4. Any rock channel protection or riprap beyond the stormwater rights of way should be gap-filled and planted with native vegetation, including woody shrubs, trees, grasses and forbes; consider the use of brush mattresses and similar bioengineering solutions for slope cover in lieu of riprap.

The NPS looks forward to continued coordination with USACE on this important and consequential project. Should you have any questions or comments, please direct them to Regional Rivers Coordinator Hector Santiago of my staff at 402-661-1848 or hector_santiago@nps.gov.

Sincerely,

James Lange, Planning and Compliance Division Manager
National Park Service, DOI Regions 3, 4, and 5

JAMES LANGE Digitally signed by JAMES LANGE
Date: 2024.04.04 09:18:57 -05'00'

Electronic Copy:

Jeffrey A. Hawkins, Wildlife Biologist
USACE-Louisville District, Environmental Resources Section

Robert Gable, Ohio Scenic Rivers Program Manager
Division of Natural Areas and Preserves
Ohio Department of Natural Resources

Aaron Rourke, Assistant Regional Scenic River Program Manager
Division of Natural Areas and Preserves
Ohio Department of Natural Resources

Markert, Tammy O CIV USARMY CELRL (USA)

From: Santiago, Hector R <Hector_Santiago@nps.gov>
Sent: Friday, June 14, 2024 4:13 PM
To: Markert, Tammy O CIV USARMY CELRL (USA)
Cc: Lange, James
Subject: [Non-DoD Source] NPS Follow up communication: Loveland Ohio Planning Assistance to States Project Report

Tammy,

As we've discussed, the National Park Service (NPS) has reviewed the (Report) as prepared by the Louisville District United States Army Corps of Engineers (USACE) with attention to the Little Miami National Scenic River (River) and the values for which it was added to the National Wild and Scenic Rivers System (System).

The River is a State-administered component of the System, as designated by the Secretary of the Interior (Secretary) under Section 2(a)(ii) of the Wild and Scenic Rivers Act (Public Law 90- 542) (Act). The lower 28-mile segment (from Foster/Glen Island to the Ohio River) was added in 1980. As the River managing agency, the State of Ohio is responsible for ensuring that the provisions of the Act are met. The NPS, retains responsibility for evaluating federal actions and making determinations of effect on State-administered National Wild and Scenic Rivers without adjacent Federal ownership in accordance with Section 7(a) of the Act.

In a letter dated April 4, 2024, the NPS provided preliminary comments regarding the findings in the report. These comments do not represent a final determination under section 7(a) of Act. The NPS will provide a final determination of effect upon receipt of a notice of application from USACE for a pending 404 permit, including nationwide permits. Should you have any further questions or concerns, please do not hesitate to call me at 402-661-9112. The NPS appreciates your continued coordination and efforts to minimize potential impacts to the River and its values to the greatest extent possible, consistent with the Act's non-degradation and enhancement policy. The NPS shares in the desire to both meet public need for reliable infrastructure at this location and to protect the values for which the River was designated.

Sincerely,

Hector Santiago
Regional Rivers Coordinator
National Park Service, Omaha, NE

City of Loveland Ohio Emergency Streambank Stabilization Continuing Authorities Program – Section 14

Appendix F - Climate Assessment

June 2024

U.S. ARMY CORPS OF ENGINEERS

LOUISVILLE DISTRICT

Table of Contents

List of Figures:

List of Tables:

1. General

This qualitative assessment of climate change impacts is required by U.S. Army Corps of Engineers (USACE, “the Corps”) Engineering and Construction Bulletin (ECB) 2018-14, “Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects.” This assessment documents the qualitative effects of climate change on hydrology in the region and informs the Loveland Ohio Section 14 Emergency Streambank Stabilization project of the potential impacts and risk drivers which can potentially be attributed to climate change.

The city of Loveland is located in southwestern Ohio, 17 miles northeast of downtown Cincinnati in Hamilton, Clermont, and Warren Counties. The project is located entirely in Hamilton County. Erosion and distress are occurring in three areas on the right (northwestern) bank of the Little Miami River along the streambank and E. Kemper Road. The sites are located between river mile 23.7 and 22.9 of the Little Miami River. For the project, multiple options were explored to remediate the streambank erosion. A riprap/shot rock alternative was determined to be the best value alternative. This alternative includes using riprap or shot rock to reconstruct the upper slope with the addition of vegetative planting to comply with the Wild and Scenic River Designation. Increase in precipitation magnitude and intensity resulting in increased peak streamflow eroding the riprap of shot rock due to higher velocities are considered climate factors which could impact the success of the project and are a focus of this report.

Table 1 provides information about the gages analyzed in this climate analysis. The most relevant stream gage for this study was U.S. Geological Survey (USGS) Gage 03245500, Little Miami River at Milford OH, which is located 7 miles from Loveland. Compared to other gages located closer to the city, the data range for USGS Gage 03245500 is the most extensive. The drainage area to the gage is 1,203 sq miles Annual maximum streamflow data ranges from 1916 – 2022 with a gap from 1918-1925. Due to the large gape in data, the data range analyzed in this report was restricted to 1926 – 2022. Due to Caesar Creek Dam being located upstream of the gage the gage is considered regulated after the impoundment of the lake in 1978. The drainage area into Caesar Creek is 237 sq miles. To understand the impact of regulation of the stream by Caesar Creek Dam and to isolate the effects of climate change on streamflow, an additional unregulated gage (USGS Gage 03240000, Little Miami River Near Oldtown OH) was analyzed. The gage is located 37 miles away from Loveland, Ohio. Gages closer to the project could not be used to due being regulated or have a limited data range.

Table 1: Gages Analyzed

Gage	Period of Record	Number of Observations	Drainage Area (sq mi)	Miles from Loveland	Regulation
USGS 03245500 Little Miami River at Milford OH	1926 – 1978	52	1203	7	Pristine
USGS 03245500 Little Miami River at Milford OH	1978 - 2023	45	1203	7	Regulated
USGS 03240000 Little Miami River Near Oldtown OH	1955 - 2022	70	129	37	Pristine

Observed Trends

2.1 Locally Observed Trends in Precipitation and Temperature

An assessment of historic temperature and precipitation trends was conducted using local climate data available from the National Oceanic and Atmospheric Administration's Climate Data Online (NOAA CDO). The closest station to the city of Loveland with precipitation data is located in Kings Mill, Ohio, which is approximately 7 miles away from the city. The station's data ranges from 1913-2022. Due to the station not having temperature data and missing precipitation data from 2011 to 2016, a different station was analyzed.

Located approximately 13 miles from Loveland, station USW00092812 at Cincinnati Municipal Airport Lunken Field OH was used to analyze annual precipitation, average temperature, and average maximum temperature data. Its data ranges from 1952 to 2022. Note that for 1997, both precipitation and temperature data were missing and that for 1998, precipitation data was missing.

Figure 1 displays total annual precipitation and annual maximum monthly precipitation from 1958 through 2022. Note that there appears to be an increasing trend in total annual rainfall with time. But, the dataset's p-value (0.052) was nearly 0.05, which indicates that the trend is statistically significant at a 95% confidence level. The magnitude of this increasing trend is roughly 0.09 inches/year. A decreasing trend was observed in monthly maximum precipitation; however, the dataset does not exhibit a p-value (0.725) which would indicate a statistically significant trend.

Figure 2 displays average annual temperatures and annual maximum monthly temperatures which were derived from daily temperature records. Note that both average annual and annual maximum monthly temperatures exhibit increasing trends over time. The magnitude of the average annual temperature's increasing trend is 0.0119 °F/year. Meanwhile, the average annual maximum temperature's increasing trend is roughly 0.0176 °F/year. Both are relatively small compared with annual variability in temperature. Additionally, the trends' magnitudes are relatively small, the p-values for both datasets (0.110 for average annual maximum temperatures and 0.055 for average annual temperatures) indicate that these trends are statistically significant.

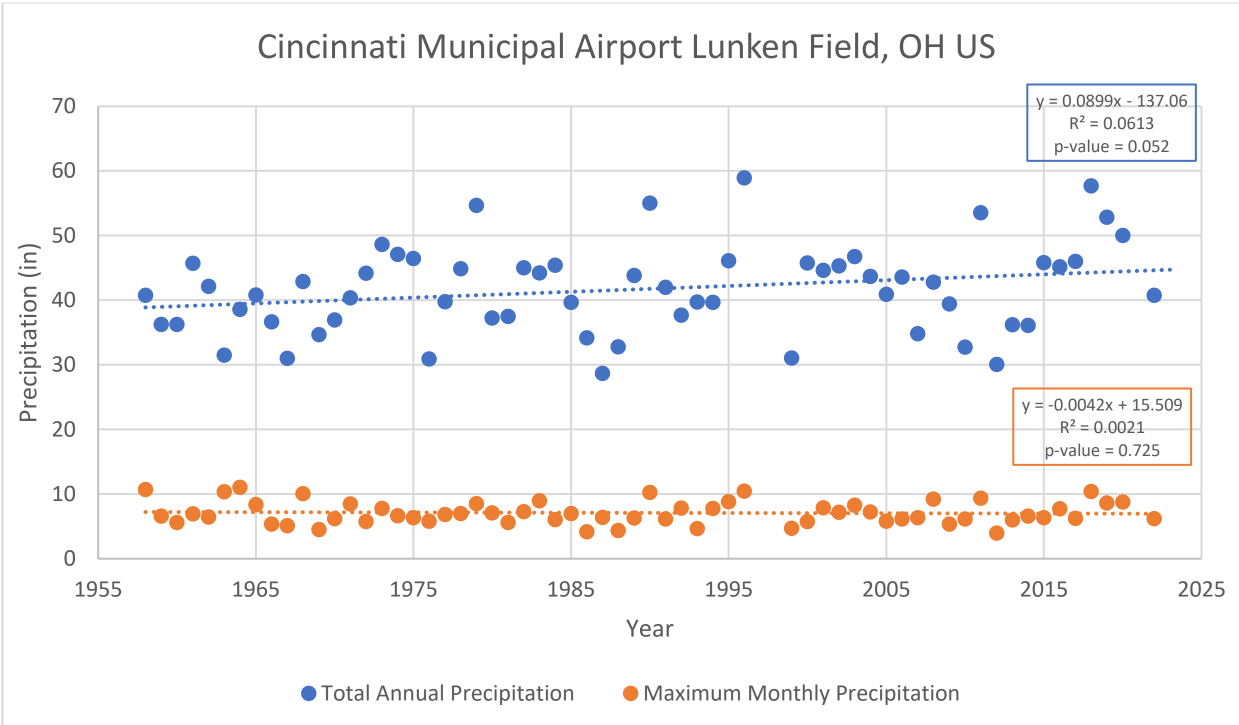

Figure 1: Observed Trends in Precipitation at NOAA Station USW00092812 at Cincinnati Municipal Airport Lunken Field, OH

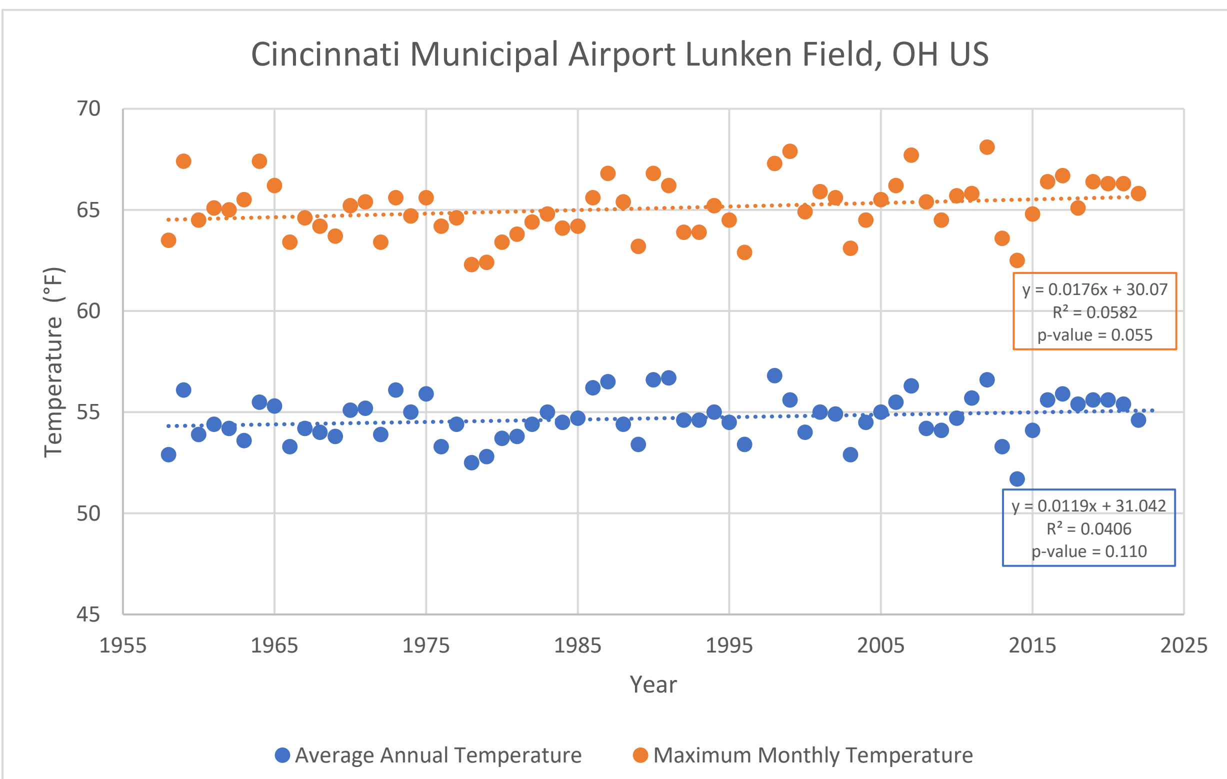

Figure 2: Observed Trends in Temperature at NOAA Station USW00092812 at Cincinnati Municipal Airport Lunken Field, OH

2.2 Literature Review: Historic Trends

2.2.1 Recent U.S. Climate Change and Hydrology Literature Applicable to USACE Missions in Ohio Region 05

Temperature: The 2015 USACE Recent US Climate Change and Hydrology Literature syntheses for Ohio Region 05 summarizes observed climate trends for the Water Resource Region 5, the Ohio Region. It found that the Ohio Region spans in a transition zone between a century-long warming trend towards the north and a cooling trend towards the south. For the majority of studies Loveland Ohio, which is located centrally in the region, was found within the warming region. However, there have been inconsistent findings about the geographic extent and seasonality of the warming and cooling zones in the region. As such, a consensus for observed temperature trends was not found.

Precipitation: In the literature syntheses, multiple authors identified a mild increase in precipitation trends for both annual totals and the occurrence of storm events, but a clear consensus between authors cannot be found. Studies identified increased precipitation for some of the Ohio Region but found decreases for other portions. One study found larger rainfall concentrations during storms in the second half of the 20th century. In most studies, Loveland is located within the region of increasing precipitation.

Hydrology: The USACE Climate Literature synthesis did not find a consensus in streamflow trends. More authors identified an increasing trend in streamflow records than those who indicated a decreasing trend.

2.2.2 Ohio State Climate Summary 2022

Temperature: Ohio's annual average temperature has increase by 1.5 °C since the beginning of the 20th century with warming primarily taking place in winter and spring. The state has not experience substantial warming in the summer. Additionally, the state has experienced an increase in the number of warm nights.

Precipitation: Ohio has experienced an increasing trend in annual precipitation since 1989. Additionally, the state of Ohio has experienced a significant increase in 2-inch extreme precipitation events since the mid-1990s.

2.2.3 Fifth National Climate Assessment (NCA5)

Temperature: Temperatures in the contiguous United States has risen by 2.5°F since 1970. While average temperatures have increased, warming trends are not consistent across seasons as can be seen in figure 3. Winter is warming faster than summer in many northern states. For Loveland Ohio, winter temperatures have increased by more than 1.5 °F while summer temperatures have only increased by 0.5 °F.

While heatwaves are becoming for frequent globally, the number of very hot day (days over 95°F) for the central and eastern United States as decreased. Additionally, cold days has decrease by 5 days (days below 32°F) and warm nights (number of nights bellow 70°F) have increased by 0.6 days for the Midwest.

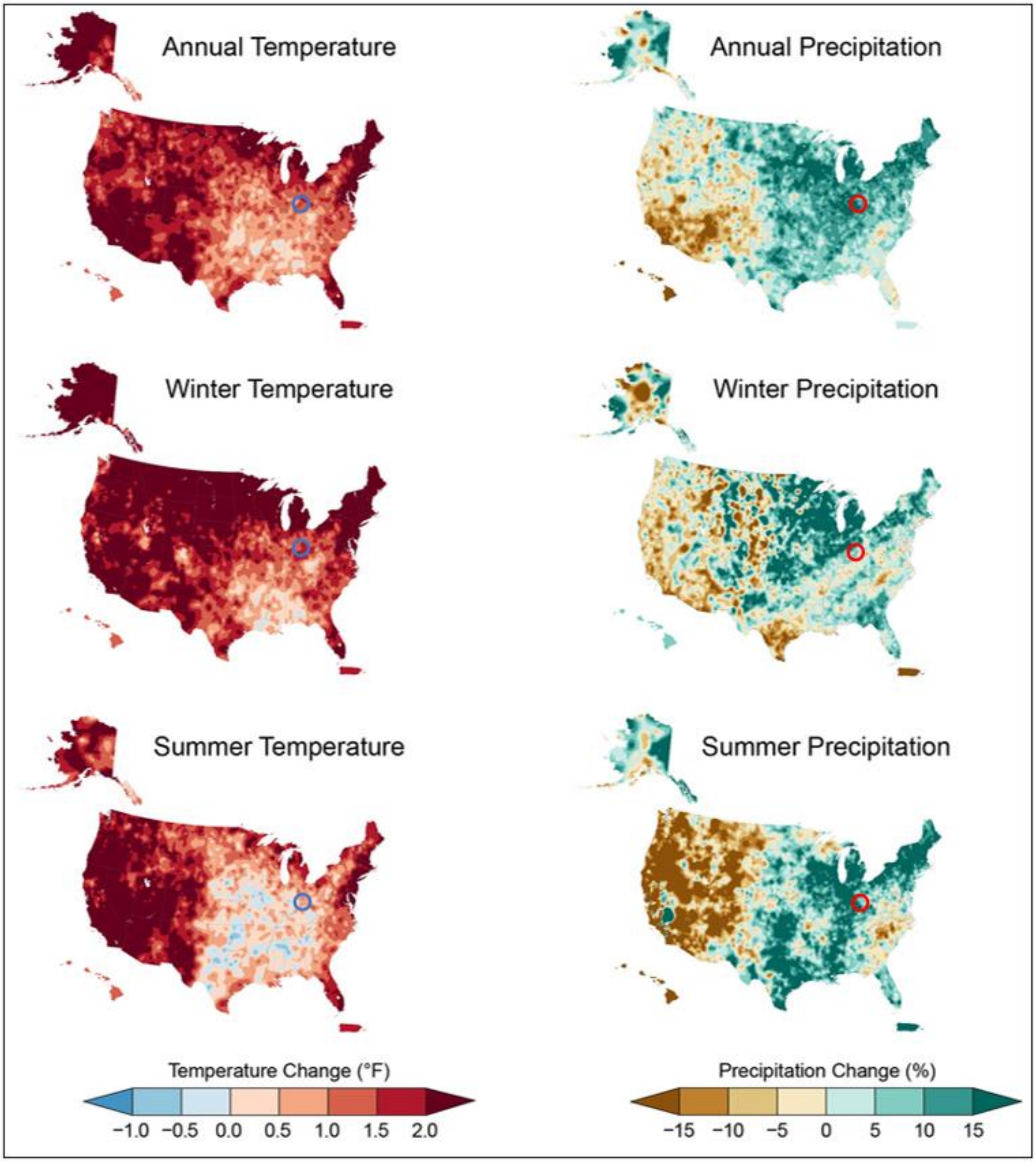

Figure 3: Observed Changes in Annual, Winter, and Summer Temperature and Precipitation

Precipitation. The average annual precipitation from 2002-2021 is 5%-15% higher than the 1901-1960 average for the central and eastern US. The NCA5 notes this trend can be attributed to climate change. The Midwest has experienced wetter conditions for all seasons. Figure 3 shows the observed changes in average annual precipitation, average winter, and average summer precipitation. Loveland Ohio is located in the

Midwest region. While the city has experienced increased precipitation in winter (0-5% increase) the summer precipitation (>15% increase) is much larger.

Since the 1950s an increase trend in heavy precipitation has been experienced across the US. The increasing trend is a result from more frequent precipitation extremes with smaller changes in the intensity of the extreme precipitation events. Figure 4 displays the percentage change in observed total precipitation on heaviest 1% of days, five-year maximum daily precipitation, and the annual maximum daily precipitation. For all three of the observed changes an increase was found for the Midwest with the total precipitation on heaviest 1% of days having the largest increase (increase of 45%).

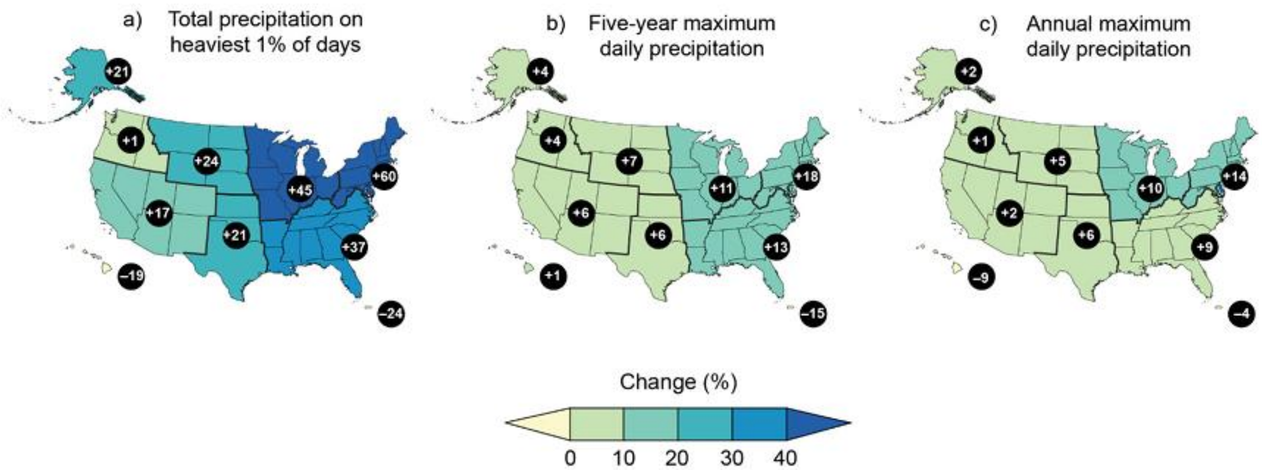

Figure 4: Observed Changes in Precipitation

Streamflow: The Fifth National Climate Assessment noted increases in extreme precipitation events has contributed to increases in river and stream flooding.

2.3 Nonstationary Detection (NSD)

Traditional flow frequency analysis is based on the assumption that discharge datasets are stationary (dataset's statistical characteristics are unchanging with time). Statistical tests can be used to test this assumption using techniques outlined in Engineering Technical Letter (ETL) 1100-2-3. The NSD tool is a web-based tool used to perform these tests on annual peak streamflow datasets at USGS stream gages.

The NSD tool was applied to the annual peak streamflow for the two USGS gages listed in table 1. For USGS Gage 03245500 Little Miami River at Milford OH, the gage's data range was limited to 1926 – 2022 due to the gage missing information for the years 1918-1925. The analysis, found a nonstationary in the streamflow distribution in 1976. This nonstationary detected for USGS gage 03245500 does not show consensus nor robustness as only one statistical test detected a nonstationary. In addition to the nonstationarity showing no consensus or robustness, the single nonstationarity could be attributed to the construction and impoundment of Caesar Creek dam located upstream of the gage which reached full pool in 1978. The dam's primary function is a flood risk reduction, therefore, it reduces peak flows.

To analyze unregulated flows, the NSD tool was applied to the annual peak streamflow of USGS Gage 03240000 Little Miami River near Oldtown OH with data ranging from 1953 – 2022. No nonstationarities were found. This was expected due to the gage being pristine.

2.4 Time Series Toolbox (TST)

The TST was developed by USACE and was utilized to examine trends in observed annual peak streamflow for the various gage locations shown in **Error! Reference source not found.**. The TST is used to fit a linear regression to the peak streamflow data in addition to providing three p-value indicating the statistical significance of a given trend.

USGS Gage 03245500 Little Miami River at Milford OH can be used to illustrate how periods of reservoir regulation influence trends in streamflow (see Figure 5). Due to the gage being considered regulated, the annual peak streamflow cannot be considered homogeneous. As such, it is difficult to draw conclusions based upon trends identified from the entire dataset. To draw conclusions with the dataset, it was split into data pre- and post-reservoir construction. Peak annual flow for this gage is available on a continuous basis from 1926 until 2022 in the TST. Thus, the annual peak data from 1926-1977 represents a pre-regulation dataset due to the Caesar Creek reservoir beginning operation in 1978. After 1978, reservoir operations became established, and once again, the period of record can roughly be considered homogeneous in terms of reservoir operation. The complete dataset for the Little Miami River gage at Milford OH had a decreasing trend that was not statistically significant (p-value > 0.05). The pre-regulated period of record had a decreasing trend and the post-regulated periods of record had an increasing trend. Although, both the pre-regulated and post-regulated p-values were larger than 0.05, and therefore, their trends were not significant. In summary, all of the periods of record for the gage had p-values greater than 0.05, meaning none of the trends are considered statistically significant.

USGS Gage 03240000 Little Miami River near Oldtown OH can be used to analyze a gage with pristine flows. Figure 6 displays the timeseries. The annual peak streamflow was found to have a negative Traditional Slope of -4 and a positive Sen's Slope of 13. The gage did not have any statistically significant trends. None of the observed trends were significantly significant, so the streamflow trends on both gages were determined to be inconclusive. Table 2 summarizes the slope and statistical test for the different gages and period of records.

Table 2: Slope and Statistics test of linear regression line from the TST

Gage Name	**Period of Recorded**	**Trend Line Slope**	**p-value**		
			t-Test	**Mann-Kendall**	**Spearman Rank-Order**
USGS Gage 03245500 Little Miami River at Milford OH	1926 - 2022	-78	0.12589	0.41958	0.46978
	1926 - 1977	-35	0.82398	0.81378	0.81972
	1978 - 2022	22	0.85558	0.91942	0.77299
USGS Gage 03240000 Little Miami River near Oldtown OH	19550 - 2022	-4	0.78427	0.30338	0.30988

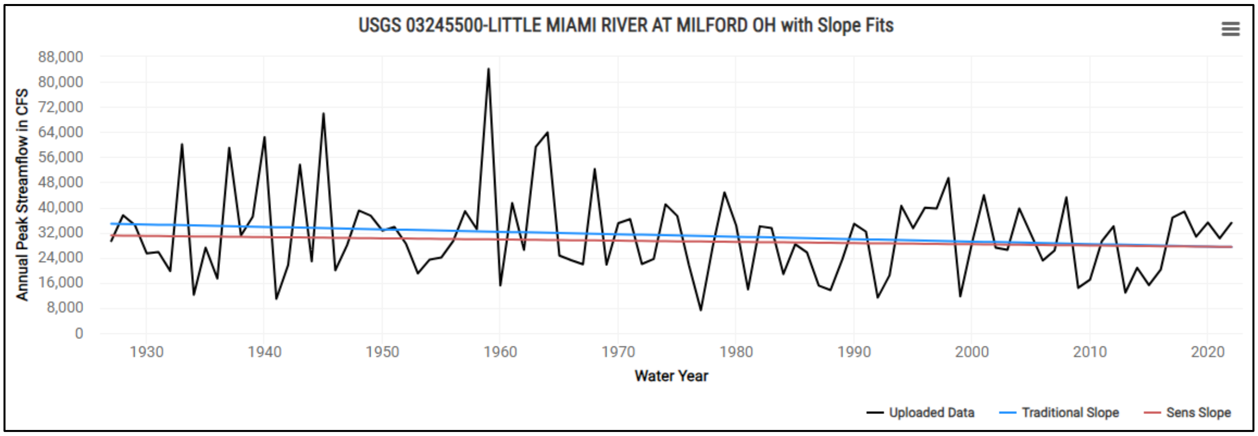

Figure 5: Annual Peak Streamflow for USGS gage 03245500 Little Miami River at Milford Oh

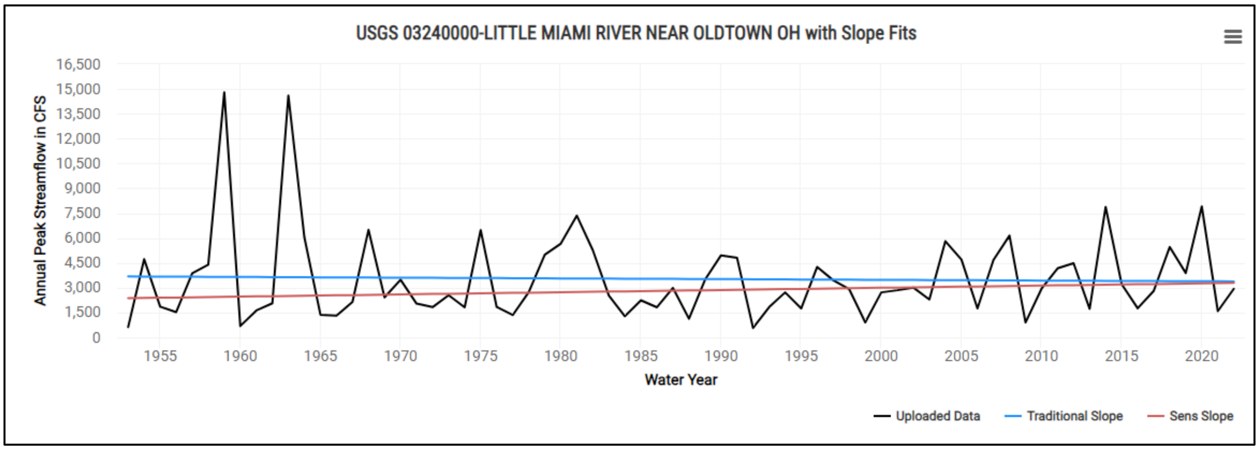

Figure 6: Annual Peak Streamflow for USGS gage 03240000 Little Miami River Near Oldtown Oh

2. Projected Trends

3.1 Literature Review: Projected Trends

3.1.1 Recent US Climate Change and Hydrology Literature Applicable to USACE Missions in Ohio Region 05

Temperature: The 2015 USACE Recent US Climate Change and Hydrology Literature syntheses for Ohio Region 05 found a consensus that the average temperature and extreme temperatures will increase. However, the literature syntheses did not state a consensus for the magnitude of the temperature increases. Additionally, temperatures are expected to increase for all seasons, and the frost-free season is expected to increase in length. Lastly, heat waves are expected to increase in frequency, temperature, and duration.

Precipitation: Most studies found precipitation to increase, but there is not a consensus on the magnitude and location of average or extreme precipitation changes.

Hydrology: Projected streamflow in the Ohio Region varied greatly from study to study, and no conclusions were reached.

3.1.2 Ohio State Climate Summary 2022

Temperature: In addition to the 1.5 °C of warming already experienced, historically unprecedented warming is projected to continue throughout the 21st century. Under a low emissions scenario, 3°F of warming compared to the historical average is expected. Warmest projections are 11°F warmer than the hottest year on record.

Precipitation: Although annual precipitation projections are uncertain, spring and winter precipitation is expected to increase. Additionally, extreme precipitation is expected to increase.

3.1.3 Fifth National Climate Assessment (NCA5)

Temperature: The NCA5 reported on temperature trends based on global warming level (GWL). A GWL is the global average temperature change in degrees Celsius relative to preindustrial temperatures. Figure 7 shows the expected temperature changes for the US for GWL of 1.5°C, 2°C, 3°C, and 4°C. Expected increases in temperatures are not uniform across the globe. Most of the United States is expected to have larger increases in temperature with respect to the global average with the northern and western portions of the country experiencing largest levels of warming. At a GWL of 2°C (3.6 °F) the United States experiences an average increase between 4.4°F to 5.6°F degrees of warming. At a GWL of 2°C (3.6 °F) Loveland Ohio experiences 4°F of warming. As can be seen in figure 7, Loveland Ohio experience high warming for each of the GWL.

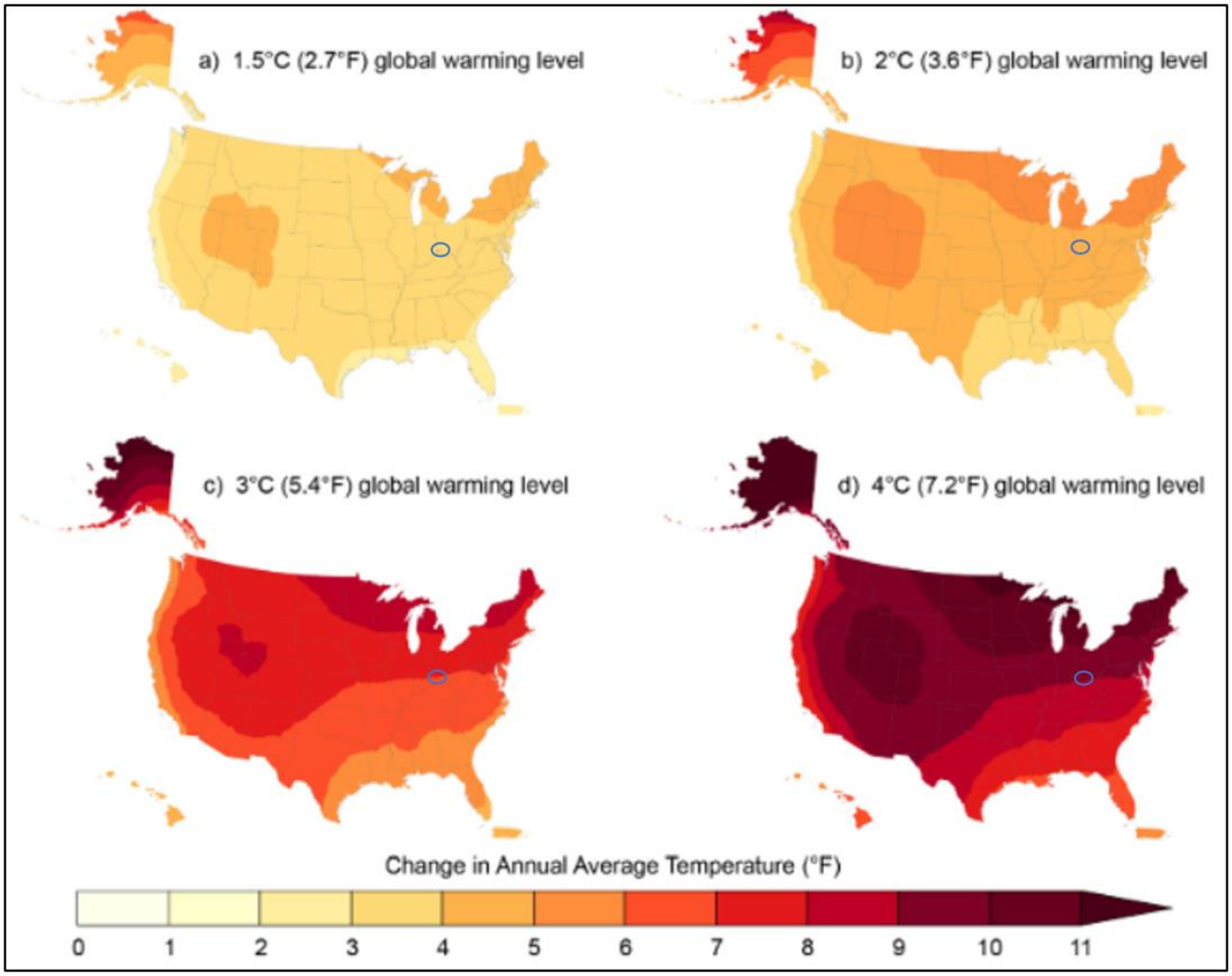

Figure 7: Projected US Temperature Changes for GWL of 1.5°C, 2°C, 3°C, and 4°C

As average temperatures increase the risk of extreme temperatures increase. Figure 8 shows the projected changes to hot and cold extremes for 3 metrics at 2°C of warming relative to the period 1991-2020: number of days ≥ 95°F (hot days), days ≤ 32°F (cold days), and day ≥ 70°F (warm nights). As shown in figure 8, Loveland Ohio is expected to see in increase in around 10 warm days, a decrease of about 25 cold days, and increase in around 10 warm nights.

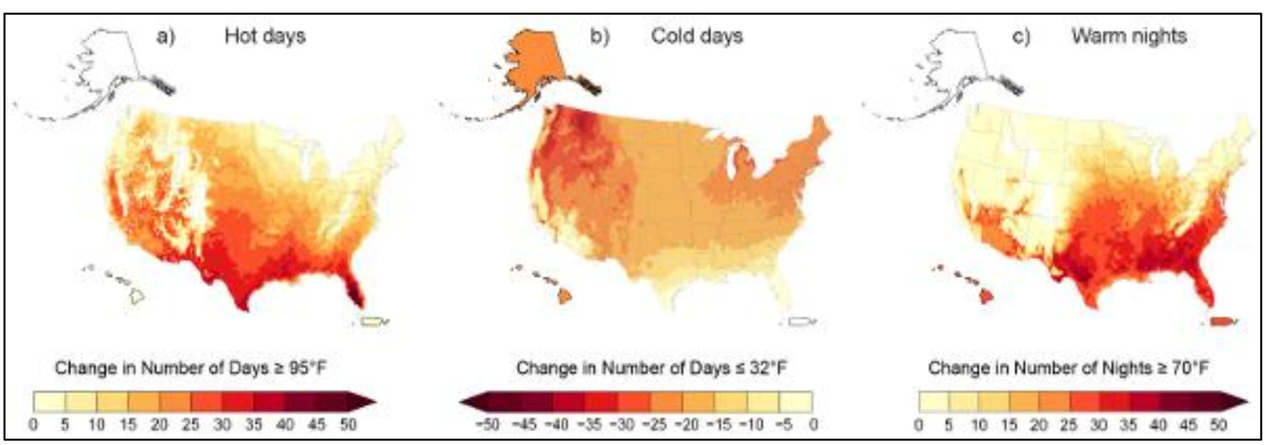

Figure 8: Projected Changes to Jot and Cold Extremes at 2°C of Global Warming.

Precipitation: The NCA5 noted precipitation changes are less certain than temperature changes. For the eastern US annual average precipitation is very likely to increase as global temperatures increase. Figure 9 shows the projected changes in average annual precipitation for different GWL. Areas with hatching indicate where 80% or more of models agree on the sign of the change. As temperatures increase average annual precipitation increases for Loveland Ohio in all of the global warm levels. For the three higher GWL, Loveland Ohio's average annual precipitation are located in areas with hatching.

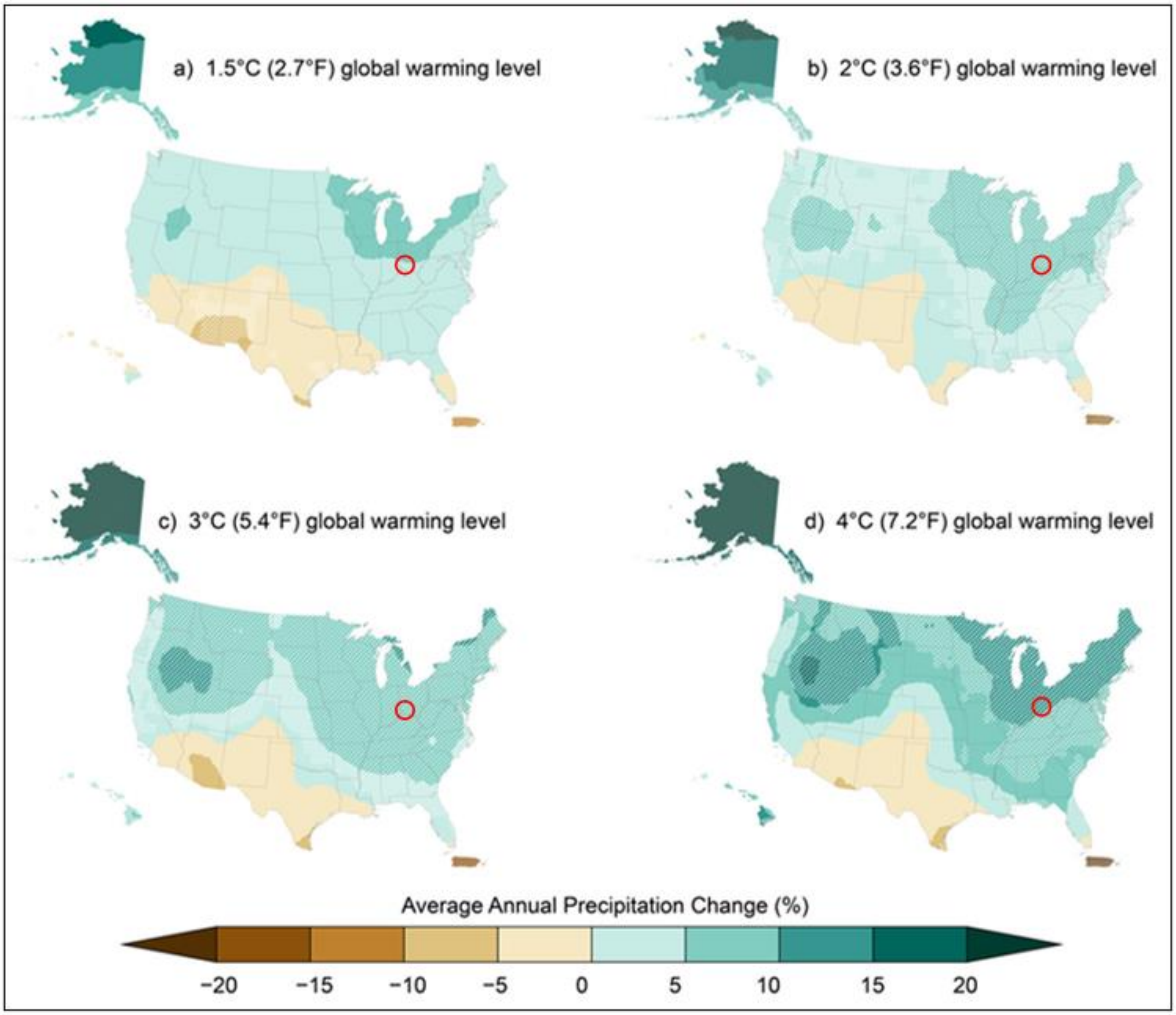

Figure 9: Projected US Precipitation Changes at 1.5°C, 2°C, 3°C, and 4°C of Global Warming

Recent trends in the frequency, severity, and amount of extreme precipitation are expected to continue across the US. Figure 10 displays projected changes in extreme precipitation for Global Warming Levels of 2°C to the period 1991-2020. The image includes 3 metrics to portray projected percentage change in extreme precipitation: total precipitation on heaviest 1% of days, five-year maximum daily precipitation, and annual maximum daily precipitation. Additionally, the NCA5 noted changes in extreme precipitation events differ seasonally. Projected increases in extreme precipitation are larger for winter months due to expected larger warming in the winter months. Extreme precipitation is likely to increase in spring, winter, and fall for Loveland Ohio. Projected changes for the summer season are more uncertain.

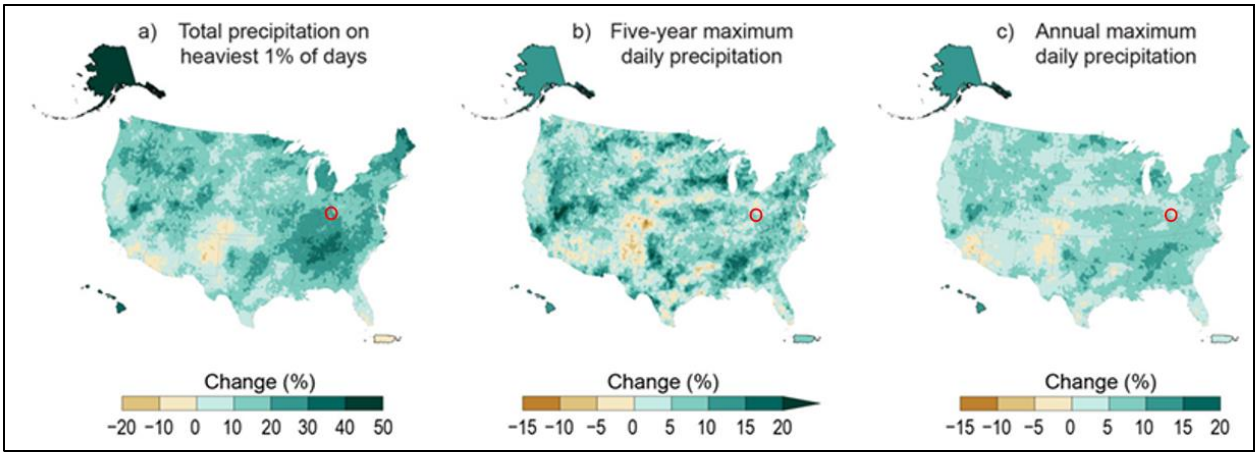

Figure 10: Projected Changes to Total Precipitation on Heaviest 1% of Days, Five-year Maximum Daily Precipitation, and Annual Maximum Daily Precipitation for 2°C of Warming.

Streamflow: Extreme flood events and flood frequencies are difficult to predict due to complex interactions of precipitation amount and timing, soil moisture, snowpack, and land cover. Increases in precipitation do not always translate directly into increases in river flooding due in part to the many processes at the land surface. Figure 11 shows projected changes in annual runoff for 2036 – 2065 relative to 1992-2020. No significant changes in runoff are shown for Loveland Ohio. The average of all available projections found an increase of 0.1 inch. Additionally, the image displays the average wettest 20% and average driest 20% of projections which ranges from a decrease of 0.1 inches to increase of 0.5.

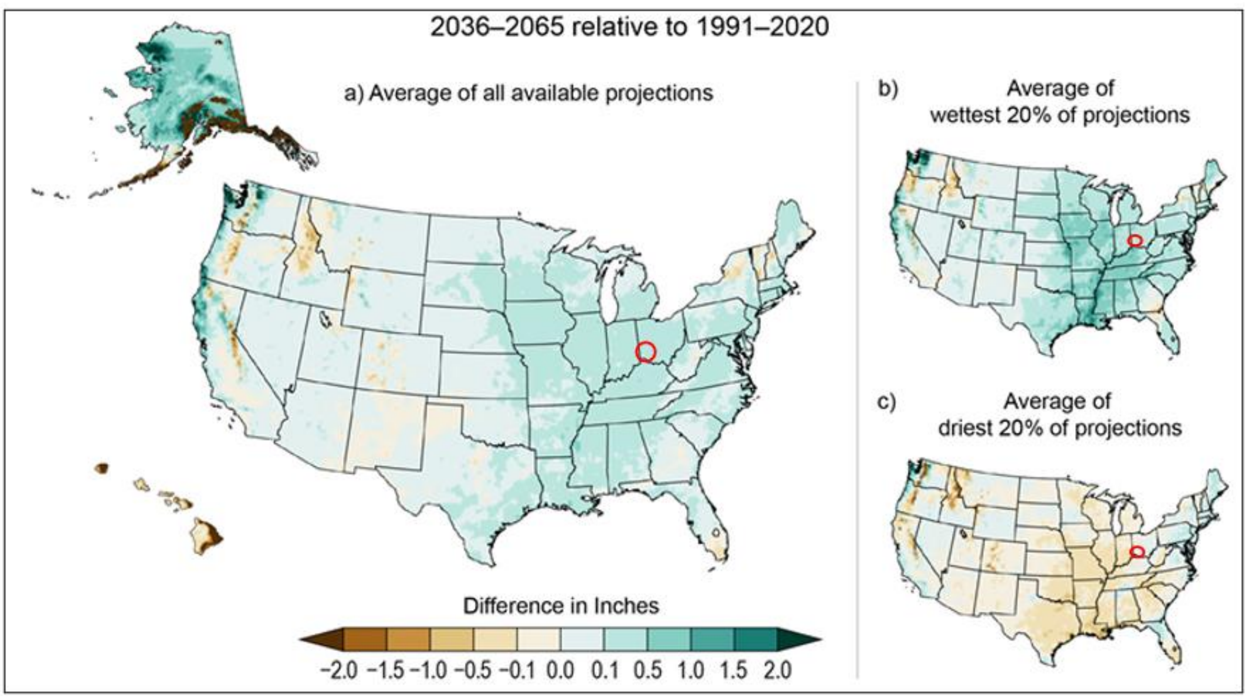

Figure 11: Projected Changes in Annual Runoff by Midcentury (2036-2065 relative to 1991-2020)

3.2 Climate Hydrology Assessment Tool (CHAT)

The USACE CHAT can be used to assess projected, future changes to streamflow, temperature, and precipitation variables in the watershed. The temperature and precipitation variables are derived from meteorological outputs from statistically-downscaled LOCA (Localized Constructed Analogs), CMIP-5 (Coupled Model Intercomparison Project, Phase 5) general circulation models (GCMs) that have been spatially aggregated to a 8-digit HUC resolution. Flows are generated using a Variable Infiltration Capacity (VIC) model from temperature and precipitation data statistically downscaled from GCMs using the Bias Corrected, Spatially Disaggregated (BCSD) method. The VIC model simulates unregulated basin conditions. The tool contains results from RCP 4.5 and RCP 8.5 emission scenarios. The Loveland, OH project is located in HUC 05090202 (Little Miami) on stream segment ID: 05003655. Annual-maximum 1-day precipitation and annual-maximum of mean monthly streamflow variables were assessed for Loveland.

Figures 12 through 15 shows the range and the mean of the simulated results from the 32 GCMs. The years from 1950 – 2005 represent simulated hindsight projections, and the years 2006 – 2099 represent simulated future projections include impacts from climate change. The large range of results is indicative of the uncertainty associated with projected, climate-changed hydrology. Upon examination, the spread of the GCM results indicate increases for all the projected streamflows and precipitation variables compared to the simulated historic GCM results. The streamflow and precipitation RCP 8.5 variables' upper range of result continues to increase throughout the latter half of the century. While the range of results for the project future is larger compared to the historical projections, the RCP 4.5 streamflow and precipitation projections' upper range of results do not continue to increase throughout the 21st century. The lower projections for both of the variables and emission scenarios appears to be relatively stable and unchanging throughout the 21st century.

Figures 16 through 19 display the mean result of the range of the 32 projections of future climate-changed hydrology and precipitation. A linear regression line was fit to this mean and displays an increasing trend for both streamflow and precipitation for both RCP pathways. Table 3 shows the slope for the multiple variables and emission scenarios. For all variables and emissions scenarios, there is an increasing trend. The CHAT tool uses three statistical significances test: the Student t-Test, Mann-Kendall, and Spearman Rank Order. The results of the statistic test for all RCP scenarios and variables are shown in **Error! Reference source not found.**3. A p-value of less than 0.05 indicates that the trend should be considered as statistically significant. All statistic test for every variable and emissions scenario indicated a statistically significant slope.

Table 3: Slope and Statistics test of linear regression line fit to the mean of the 32 GCM projections.

Variable:	**Projected Slope**	**P-value**		
		t-Test	**Mann-Kendall**	**Spearman Rank-Order**
Annual-Maximum of Mean Monthly Streamflow for RCP 4.5	2.6815	0.0113	0.00671	0.00327
Annual-Maximum of Mean Monthly Streamflow for RCP 8.5	8.4165	<2.2E-16	<2.2E-16	<2.2E-16
Annual Maximum 1-day Precipitation for RCP 4.5	0.0012	0.000498	0.00056	0.000648
Annual Maximum 1-day Precipitation for RCP 8.5	0.0033	4.44E-13	<2.2E-16	1.12E-13

The CHAT qualitatively suggests that the Annual Maximum of the Mean Monthly Streamflows and Annual Maximum 1-day Precipitation for the RCP 4.5 and RCP 8.5 emission scenario are expected to increase in the future. An important caveat of the CHAT tool is that it simulates unregulated results. The tool does not consider reservoir operations. An operating reservoir can decrease the variance of flows shown in the CHAT as well as decrease the magnitude of their peaks. Additionally, it is important to consider that the CHAT results do not assess peak stream flow which is more significant to the streambank stabilization project.

While the results indicated by the CHAT suggest an increase in streamflow for both emission scenarios, there is no consensus in the literature review pertaining to the projected future streamflow. While the literature does not find consensus in magnitude and location of precipitation changes, CHAT supports the trend of increasing precipitation found in the literature.

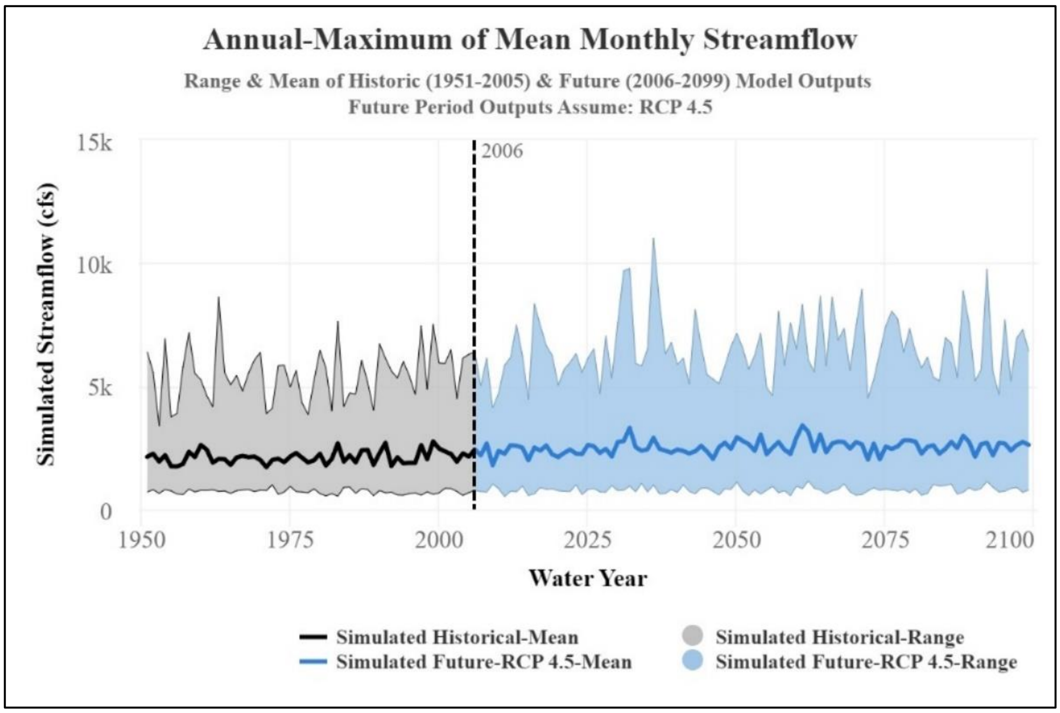

Figure 12: Range of Annual- Maximum of Mean Monthly Streamflow RCP 4.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

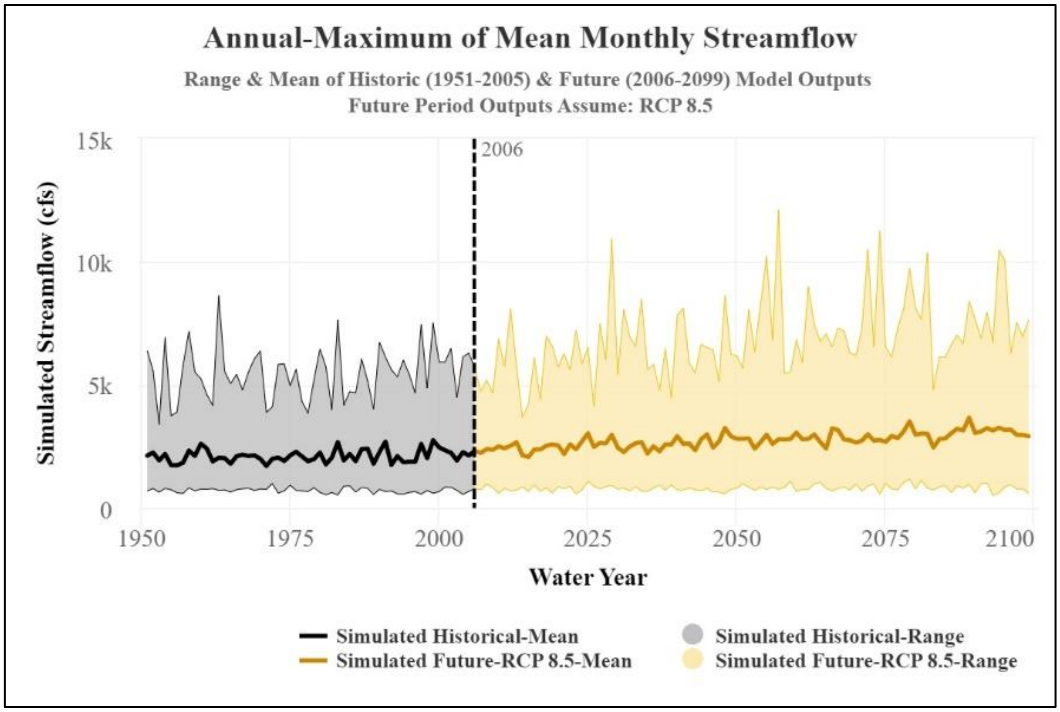

Figure 13: Range of Annual- Maximum of Mean Monthly Streamflow RCP 8.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

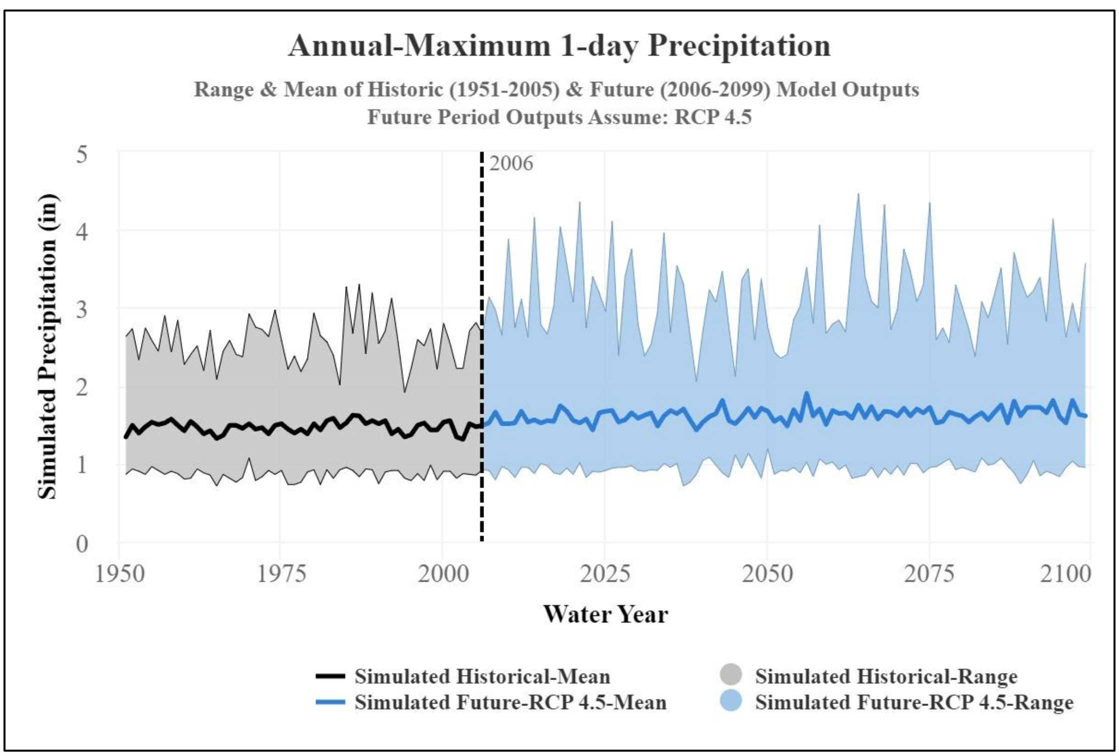

Figure 14: Range of Annual- Maximum 1-day Precipitation RCP 4.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

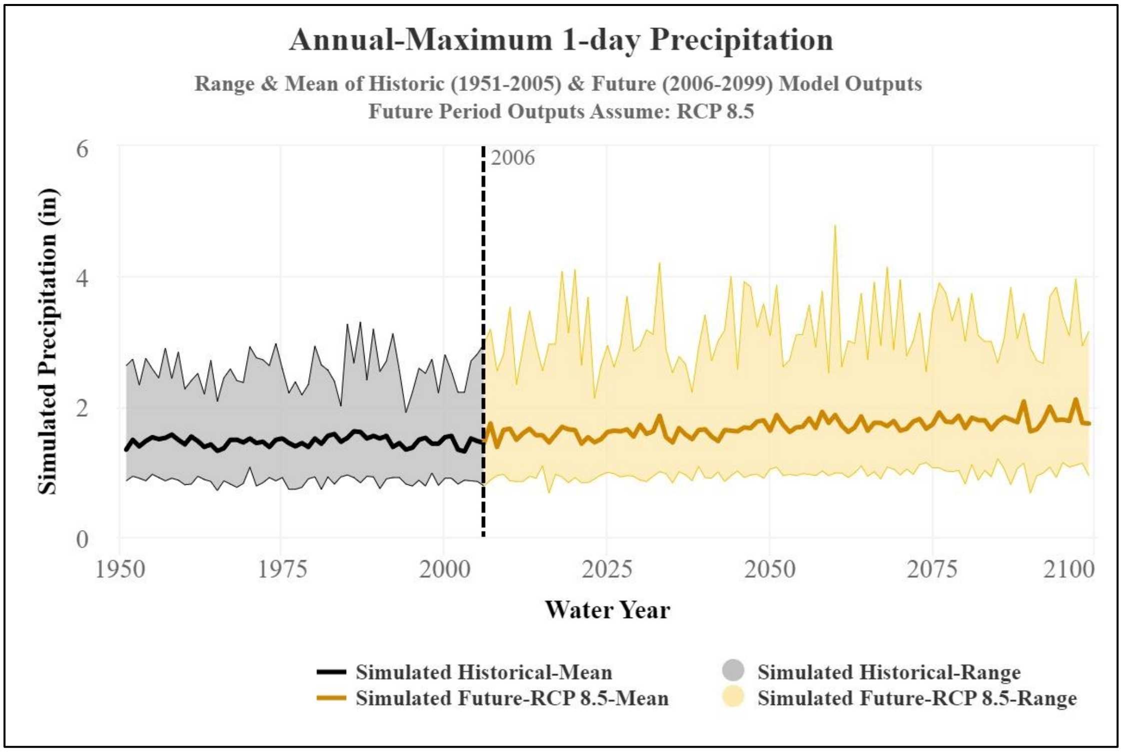

Figure 15: Range of Annual- Maximum 1-day Precipitation RCP 8.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

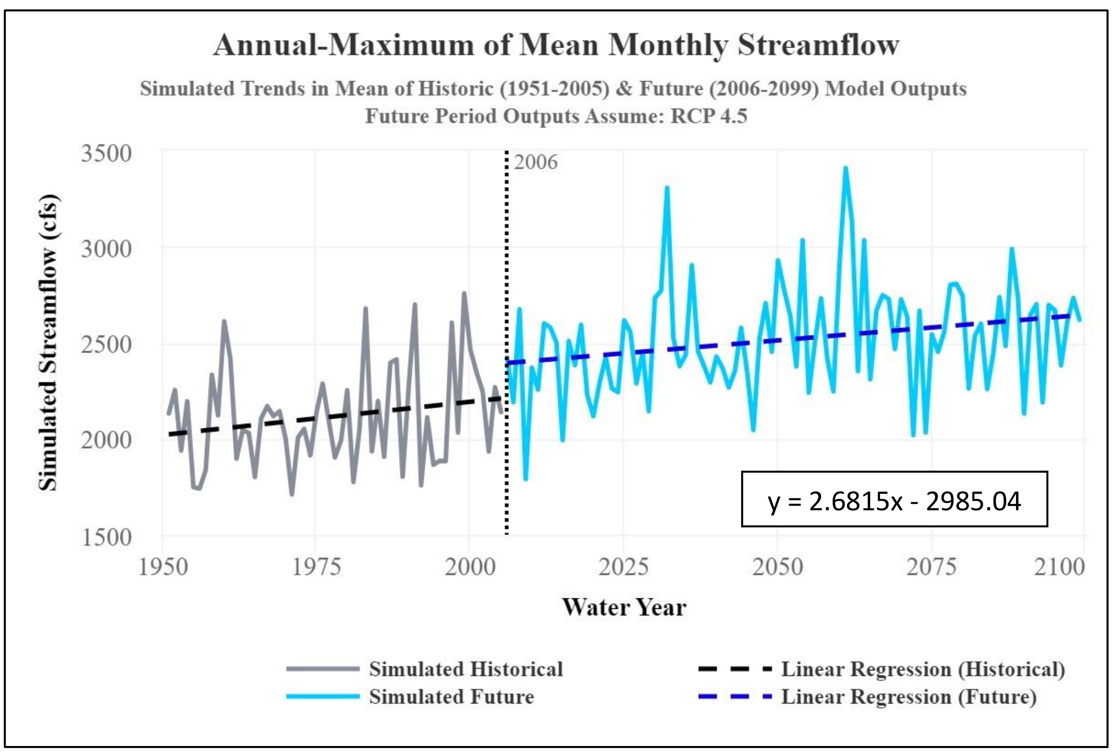

Figure 16: Mean of Annual- Maximum of Mean Monthly Streamflow RCP 4.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

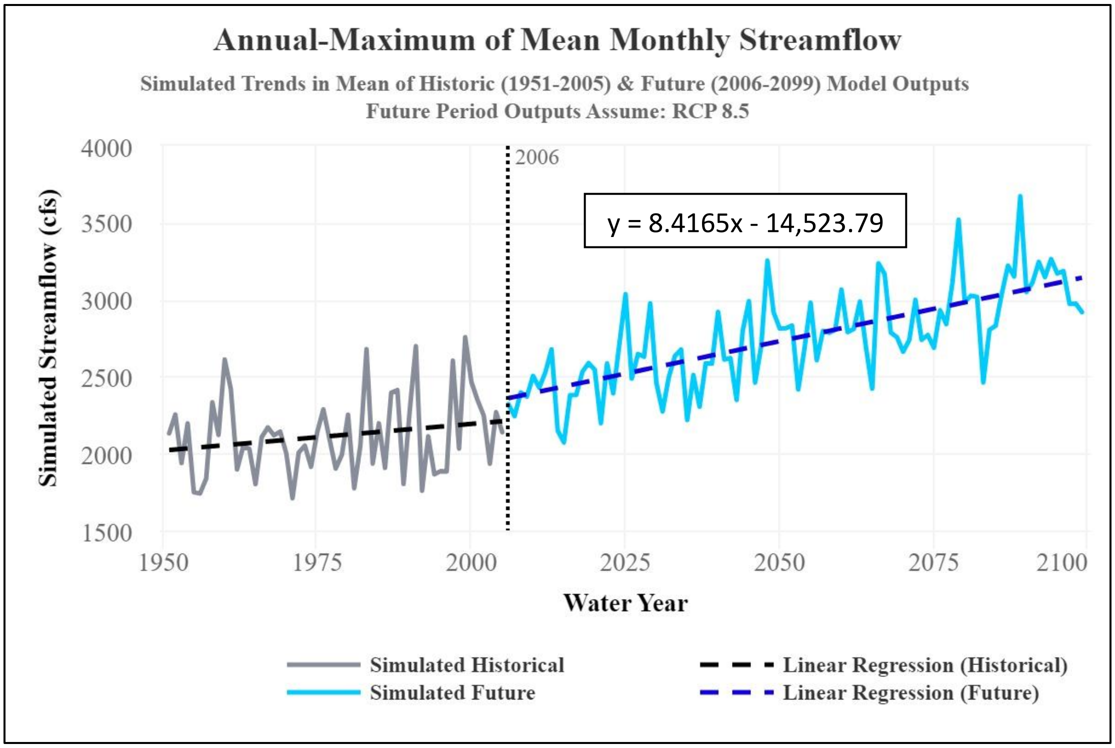

Figure 17: Mean of Annual- Maximum of Mean Monthly Streamflow RCP 8.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

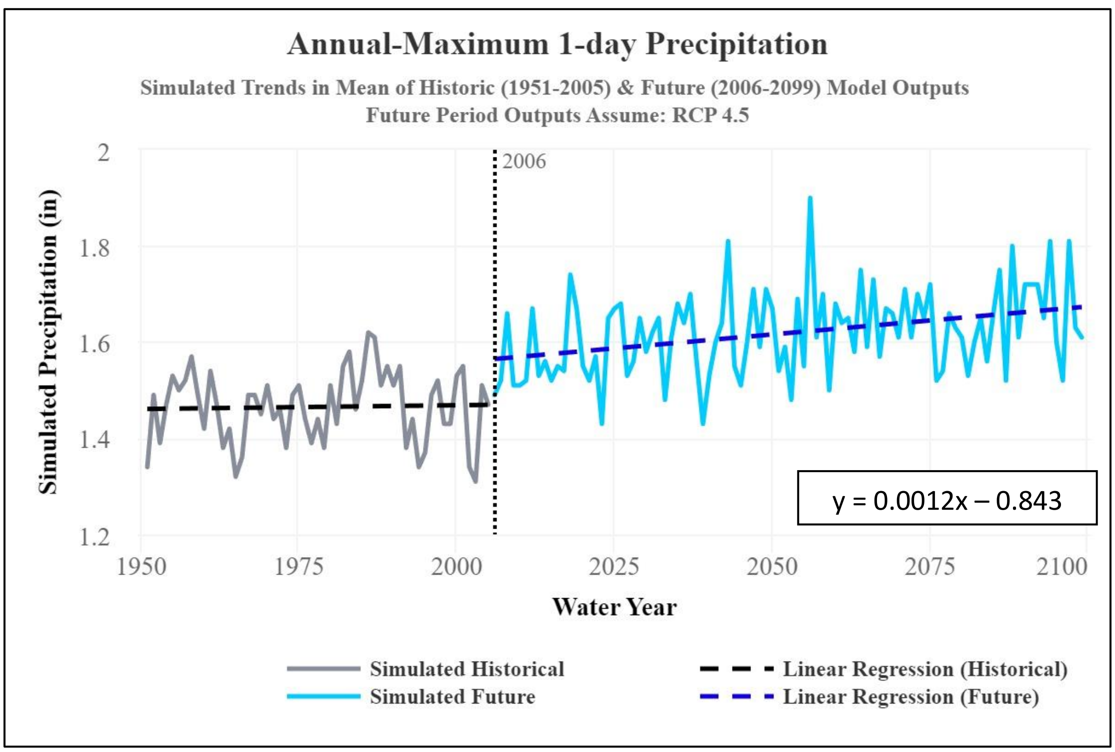

Figure 18: Mean of Annual- Maximum 1-day Precipitation RCP 4.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202.

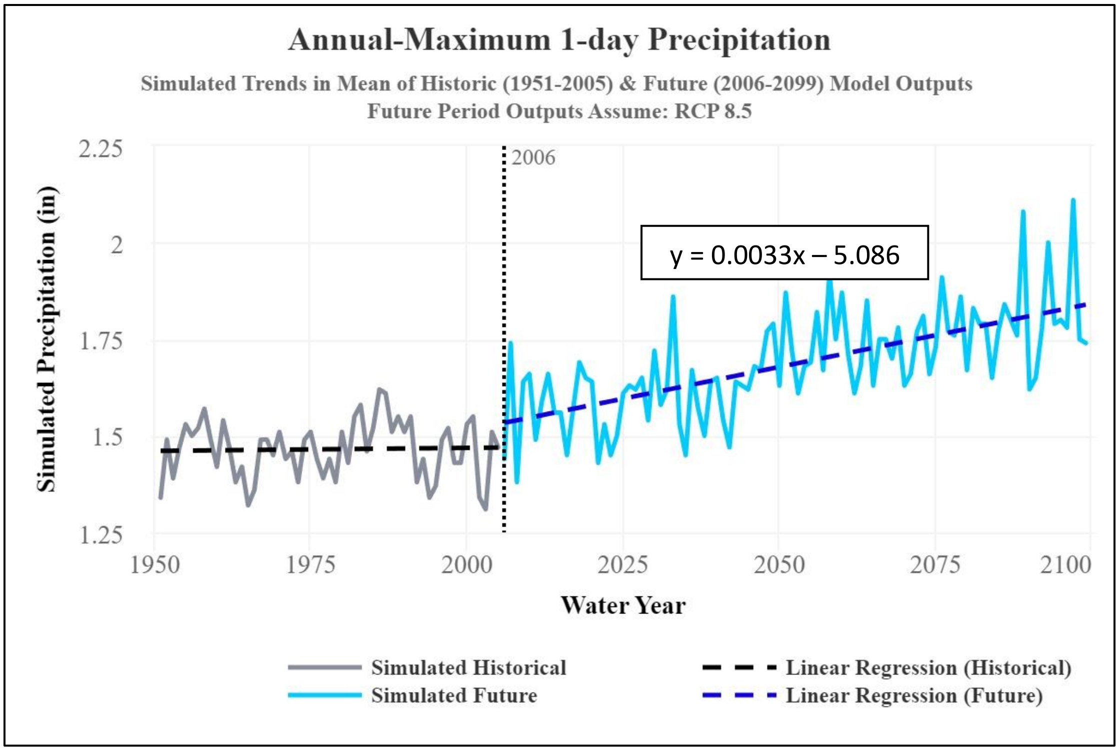

Figure 19: Mean of Annual- Maximum 1-day Precipitation RCP 8.5 GCM projections for Stream Segment ID: 05003655 of Little Miami River, HUC 05090202

3.3 Vulnerability Assessment Tool

The USACE Watershed Climate Vulnerability Assessment Tool (VA Tool) facilitates a screening level, comparative assessment of how vulnerable a given HUC-4 watershed is to the impacts of climate change relative to the other 202 HUC-4 watersheds within the continental United States (CONUS). The tool can be used to assess the vulnerability of a specific USACE business line to projected climate change impacts. The tool uses the Weighted Ordered Weighted Average (WOWA) method to represent a composite index of how vulnerable a given HUC-4 watershed is to climate change specific to a given business line. When assessing future risk projected by climate change, the VA Tool makes an assessment for two 30-year epochs of analysis centered around 2050 and 2085. The VA tool assesses vulnerability using climate hydrology based on a combination of projected climate outputs from the GCMs and RCPs resulting in 100 traces per watershed per time period. The top 50% of the traces is called "wet" and the bottom 50% of the traces is called "dry." Meteorological data projected by the GCMs is translated into runoff using the VIC macro-scale hydrologic model.

The HUC-4 watersheds within the top 20% of WOWA scores are flagged as being vulnerable. Although a watershed may not be deemed vulnerable, this does not mean that climate change will not impact the study area, but rather that climate change is anticipated to impact this region less than other regions in the United States for a particular business line.

For this project, flood risk reduction is the most relevant business line, and it was not flagged as vulnerable. The flood magnification factor (indicator 568C and 568L) and runoff-precipitation elasticity index (indicator 277) were the indicators with the largest impact to the flood risk reduction vulnerability score. The flood magnification factor represents how the monthly flow exceeded 10% of the time is predicted to change in the future. Indicator 568L reflect flow generated only within the Middle Ohio watershed (HUC

0509), whereas indicator 568C reflect flow generated within the HUC-4 watershed and any watersheds upstream of the Middle Ohio watershed. In the case of this watershed, there are upstream watersheds feeding into it. However, the location of Loveland is not influenced by any upstream HUC-4 watershed, and therefore the local indicator is more relevant to the project. The VA tool results for the local flood magnification factor indicates an increase in magnitude of the monthly runoff that is exceeded 10% of the time. The runoff-precipitation elasticity index is defined as the percent change in runoff divided by the percent change in precipitation. The VA tool results indicates that for every 1% increase in monthly precipitation, there is a 2.07-2.33% increase in monthly runoff. Meaning if precipitation increases, there will be an even larger increase in runoff.

The WOWA scores for the Middle Ohio watershed's FRM business line are displayed in Table 4.

Table 4: VA Tool WOWA Scores for HUC 0509 Middle Ohio FRM Business Line

	Flood Risk Reduction	
Epoch	**2050**	**2085**
Dry	47.34	47.06
Wet	51.43	54.87

3. Conclusion

The purpose of the Section 14 Continuing Authorities Program (CAP) study is to evaluate Little Miami River streambank stability at Loveland, OH in Hamilton County. The three project sites have experienced erosion and unstable streambanks due to the Kope geology. Factors contributing to the erodibility of the Kope formation include human activities, low durability of bedrock, undercutting of the slope toe by stream water, and slope steepness.

Analysis of data and toolsets related to climate change indicated that historic and projected future increases in temperature have occurred and are likely to continue in the project area. Increases in temperature could have a detrimental impact on vegetative plantings. However, temperature is not a high priority variable related to streambank stabilization or erosion. Both precipitation and streamflow, which more directly influence streambank stability, have increased uncertainty regarding their historic and projected trends when compared with temperature. Regarding precipitation trends, the literature review and analysis tools found increasing historical and projected trends. No consensus could be reach regarding streamflow trends from the literature review, and no statistically significant trend was found from the timeseries analysis of the Little Miami streamflow data. In addition, no consensus or robustness was found for the nonstationarity of the regulated gage and no nonstationarity was found for the pristine gage on the Little Miami. Although no consensus could be reached on historic streamflow trends, CHAT found increasing trends for the streamflow and precipitation regardless of emissions scenario. Finally, The VA tool did not find the HUC-4 to be with in the top 20% of vulnerable watersheds for the flood risk reduction business line, but indicators which were more relevant to the project indicated an increase in magnitude of large streamflow events and an increase in runoff for the area.

Future projections of hydrologic trends are uncertain, although most projections forecast increases in rainfall and storm events. These increases in the frequency and magnitude of storm events could result in additional runoff which could further exacerbate erosion in the future. The proposed solution to improve streambank stability is to use riprap or shot rock to reconstruct the upper slope of the streambank. This stabilization measure is resilient to future conditions in that it can accommodate slight increases in precipitation, runoff, and streamflow. Slight increases in precipitation, such as those which may occur due to climate change, would not result in failure of the bank protection. Additionally, vegetation or woody material are to be added to the project to be compatible with the national Wild and Scenic River (WSR) designation. Vegetation may be vulnerable to climate change due to warmer, extreme temperatures and summer temperatures, but this should not affect the success of the project. These residual risks associated with potential impacts due to climate change are displayed in Table 5. Based on this assessment, it is recommended that the potential future effects of climate change be considered within the uncertainty range for the current hydrologic analysis.

Table 5: Residual Risk Due to Potential Effects of Climate Change

Feature of Measure	Trigger	Hazard	Harm	Likelihood (Frequent, Occasional, Likely, Seldom, Unlikely)	Consequence (Catastrophic, Critical, Marginal, Negligible)	Adaptation
Riprap/ Shot Rock	Increase in magnitude or frequency of precipitation	Increased streamflow frequency and magnitude.	Higher velocities eroding away riprap/ shot rock	Seldom (Depends on sensitivity of riprap/shot rock to high velocities)	Marginal	Design for higher velocities
Planting Vegetation	Increase in extreme temperatures and warmer winter temperatures Increase intensity of precipitation	Increase drought conditions due increase evaporation. Increase pests or invasive species. Increase magnitude and velocities of streamflow	Vegetative plantings cannot succeed and die off due to temperature changes. Increased streamflow and higher velocities damaging vegetative planting	Likely or Seldom (Depends on the sensitivity of the vegetation)	Marginal or Negligible (Depends on the sensitivity of the vegetation)	Plant resilient vegetation

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