COPLEY MEADOWS STORM WATER DETENTION AND WETLAND AREAS

60% Design Report
Copley Township, Summit Co., OH
HUC-12 05040001 01 02

Prepared for:

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Preliminary Design Report

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Authorization for Release

The analyses, opinions, and conclusions in this document are based entirely on EnviroScience, Inc.'s unbiased, professional judgement. EnviroScience, Inc.'s compensation is not in any way contingent on any action or event resulting from this study.

The undersigned attest, to the best of their knowledge, that this document and the information contained herein is accurate and conforms to EnviroScience, Inc.'s internal Quality Assurance standards.

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LIST OF ACRONYMS

2D	2-Dimensional
BFE	Base Flood Elevation
C-CAP	Coastal Change Analysis Program
CN	Curve Number
DEM	Digital Elevation Model
EPA	Environmental Protection Agency
ES	EnviroScience, Inc.
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GIS	Geographic Information System
HEC	Hydraulic Engineering Center
HEC-GeoHMS	Hydrologic Engineering Center-Geospatial Hydraulic Modeling Extension
HEC-HMS	Hydrologic Engineering Center-Hydraulic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HSG	Hydrologic Soil Groups
HUC	Hydrologic Unit Code
KEM	K.E. McCartney & Associates
LAS	Point Cloud Data (Laser)
LF	Linear Feet
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration

NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS-IS	Nine-Element Nonpoint Source Implementation Strategic Plan
NRCS	Natural Resources Conservation Service
NWP	Nationwide Permit
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OGRIP	Ohio Geographically Referenced Information Program
OHPO	Ohio Historical Preservation Office
OHWM	Ordinary High-Water Mark
ORAM	Ohio Rapid Assessment Method
OSIP	Ohio Statewide Imagery Program
OUPS	Ohio Utilities Protection Service
PCT2	Pigeon Creek Tributary 2
SCE	Summit County Engineer
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area
SWPPP	Stormwater Pollution Prevention Plan
T & E	Threatened and Endangered
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WQC	Water Quality Certification
WSEL	Water Surface Elevations

EXECUTIVE SUMMARY

EnviroScience, Inc. (ES) is developing preliminary improvement plans for the Copley Meadows project area, located in Copley Township, Summit County, Ohio. The watercourse of study, designated by the Federal Emergency Management Agency (FEMA) as Pigeon Creek Tributary 2, is also referred to as Petition Ditch #38 and is the upstream reach of Copley Ditch. The project reach, located within the Pigeon Creek Watershed (HUC-12 05040001 01 02) includes approximately 5,270 linear feet (LF) of Pigeon Creek Tributary 2. The upstream end of the study area is approximately 1,440 LF west of Jacoby Rd., with the downstream limit being the confluence point with the Copley Ditch reach situated just west of the Titan Rd. cul-de-sac. This study terminates at the upstream limits of the Copley Ditch & Black Pond Outlet Study completed by ES, dated 8/2/2023. This study area has seen frequent flooding, particularly along Sunnyacres Rd., south of Wealthy Dr.

The goal of this study is to reduce peak flows and pollutants in stormwater runoff flowing into Copley Ditch. The study evaluates potential solutions for stormwater storage as well as addressing erosional issues which contribute to the pollutant loading in the stream. Potential improvements that were considered are stormwater detention basins, wetland creation, stream restoration, two-stage ditches, bank stabilizations, and in-stream grade controls.

The project team walked the entire study reach and observed significant areas of erosion, log jams, leveed or filled areas near the channel, and previous attempts at stabilizations. However, the team also took note of positive features such as the large existing wetland areas, especially south of Sunnyacres Rd., and a fairly stable, natural patterned channel which extends just upstream of Plainview Dr. Review of the FEMA 100-yr floodplain shows many of the homes in the downstream reach to be within its limits. Further analysis of the FEMA data in addition to hydraulic modeling brings this 100-yr floodplain limit into question, although it may not have any significant implications on the homes identified as being within the FEMA zone. ES also reviewed previously completed studies of this reach to collect additional observations and suggested solutions from other consultants.

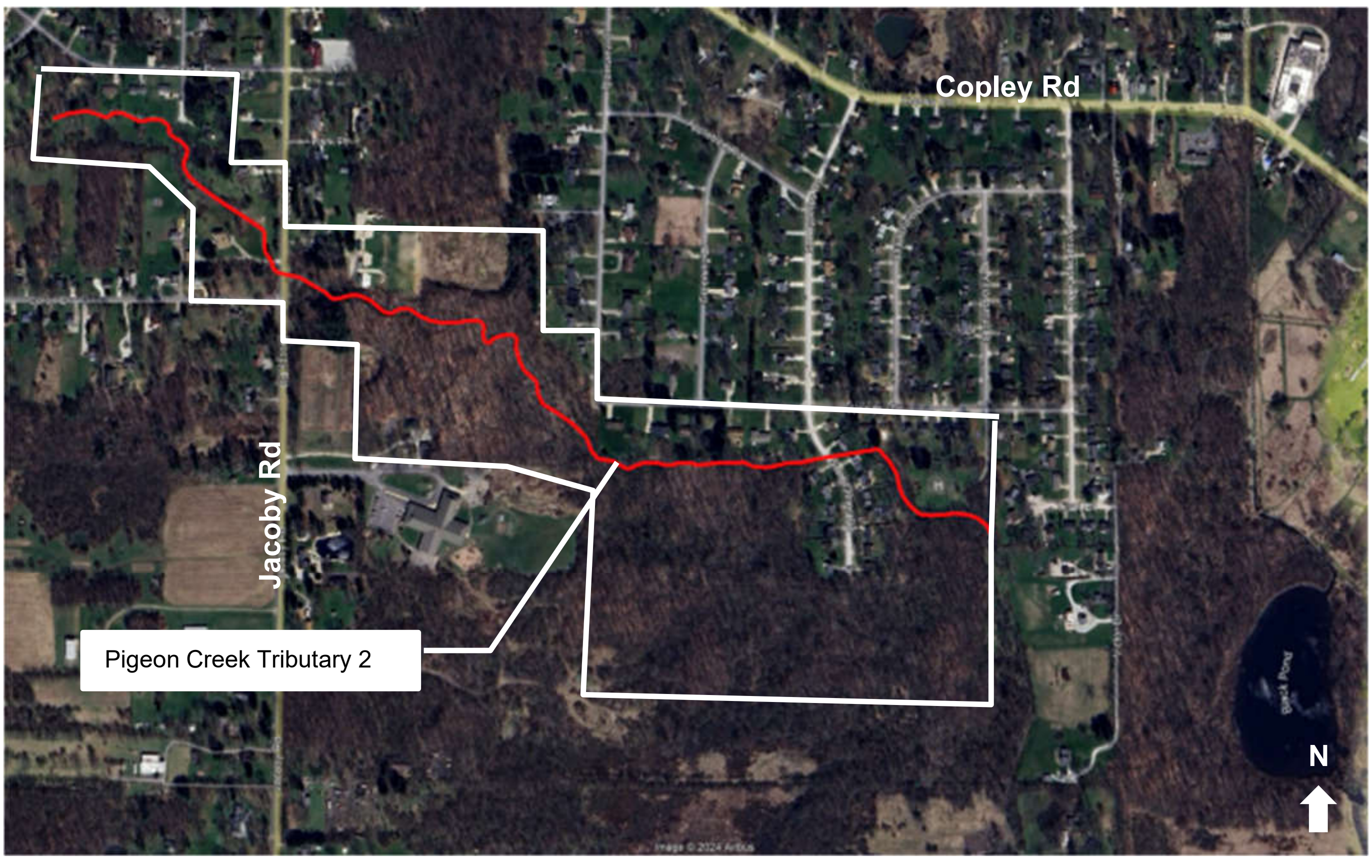
The preliminary designs identify potential improvements that, if implemented, would expand stormwater capacity and reduce peak flows. For the 10-yr event, which was the focus of modeling efforts, the proposed conditions hydraulic model indicates elimination of roadway overtopping at Sunnyacres Rd., reducing the maximum flood depth by 0.52 ft. Additional benefits of the proposed designs are improved habitat and stream functionality resulting in lower overall flood elevations and reduced erosion, thereby improving water quality through the system. Proposed improvements include creation of a wetland swale to divert flows away from the Sunnyacres Rd. culvert where they are currently causing overtopping of the road and flooding of adjacent properties, creation of a two-stage ditch to simultaneously improve stream function through restored geometry and channel size while also providing a floodplain bench and stabilization of the eroding banks, expansion of flood-prone benches to increase capacity at high-frequency storms, and installation of a riffle at the downstream outlet of the Jacoby Rd. culvert to allow fish passage through the reach.

Based upon the preliminary designs generated as part of this study, a cost estimate has been developed. It is anticipated that these projects will not be released for bid until the year 2027, so an inflation factor of 20% has been added to the project totals to account for the projected cost increase. The Copley Meadows estimated construction cost including a 20% contingency due to the early design stage is $1,326,773.

1.0 INTRODUCTION

The Summit County Engineer (SCE) contracted EnviroScience, Inc (ES) to develop preliminary improvement plans for the Copley Meadows project area, located in Copley Township, Summit County, Ohio (Figure 1.1). The watercourse of study, designated by FEMA as Pigeon Creek Tributary 2, is also referred to as Petition Ditch #38 and is the upstream reach of Copley Ditch. For clarity, and to maintain consistency with previous studies, this document refers to the reach as Pigeon Creek Tributary 2 (PCT2). The project reach includes approximately 5,270 LF of PCT2. The upstream end of the study area is approximately 1,440 LF west of Jacoby Rd., with the downstream limit being the confluence point with the Copley Ditch reach situated just west of the Titan Rd. cul-de-sac. This area has seen frequent flooding, particularly along Sunnyacres Rd., south of Wealthy Dr. The topography and soil conditions of this region of Summit County make this area prone to poor drainage and flooding, as the area was a large wetland historically. Beginning nearly a century ago, development pressures for roads, small farms, homes, and infrastructure resulted in systematic stream ditching (*i.e.*, straightening, deepening, and widening), causing significant disruption to the natural stream, floodplain, and wetland system of this region of Summit County.

Figure 1.1: Copley Meadows Study Area Location Map



The practice of channelization and ditching by theory maximizes the available gradient energy by shortening the flow path (*i.e.*, straightening) while simultaneously increasing capacity with an overwide trapezoidal condition. River systems transport both water and sediment, and the latter causes the need for ditch maintenance. Fundamentally, an overwide ditch condition does not function as a sediment transport mechanism due to the relationship of shape in comparison to its daily and common flow rate. Trapezoidal ditch design is solely created for large volume flow events. At lower flow volumes the overwide shape of the ditch facilitates shallow low energy flow making it inefficient at sediment transport for a majority of the year. During the long periods between high flow events, the ditch accumulates sediment and organic matter, thereby starting an aggradation process. This channel evolution process is the watercourse's attempt to establish specific channel morphology based on its watershed size and sediment regime to re-balance the scale of water and sediment transport. Over time, this evolution typically resolves as the channel reaches equilibrium by creating a narrower bankfull channel and developing a floodplain within the overwide ditch footprint. At the same time, this deposition can facilitate erosion and pattern adjustment depending on the local gradient and energy of the system.

The practice of ditching also routes water quickly to downstream areas from the headwaters, thereby increasing water volumes at downstream locations. Storing water or changing routing times of water in headwater areas such as Copley Ditch can have positive implications within the local watershed as well as downstream. Leveraging areas adjacent to the ditch locations, changing the storage potential and routing times in these headwater areas, can be cost effective solutions as opposed to large regional detention facilities. In other words, re-vitalizing the floodplains and potential storage areas in the headwaters involves fewer potential impacts and disturbance as opposed to dealing with larger volumes of water at one location.

The Summit County Engineer has requested ES evaluate potential solutions for stormwater storage, focused on reducing peak flows and pollutants in stormwater runoff flowing into Copley Ditch. The preliminary design study assessed stormwater detention basins, wetland areas, two-stage ditches, bank stabilizations, flood-prone bench creation, and in-stream grade control structures to achieve the project goals.

2.0 EXISTING CONDITIONS

2.1 EXISTING SITE AND DRAINAGE CONDITIONS

2.1.1 FEMA Special Flood Hazard Area

Pigeon Creek Tributary 2 (PCT2) is located within the Pigeon Creek Watershed (HUC-12 05040001 01 02). The project area is mostly defined as a Zone AE FEMA Special Flood Hazard Area (SFHA) for an extensive footprint outside the channel, with the channel itself designated "Regulatory Floodway," subject to a "No Rise" condition for improvements. However, the upstream FEMA Limit of Study is approximately 60 feet west of Jacoby Rd., with the section of PCT2 west of Jacoby Rd. not being mapped.

During the review of the FEMA SFHA mapping, our team observed that the profile for PCT2 incorrectly shows a crossing at S. Plainview Dr. and not at Sunnyacres Rd. The existing culverts under Sunnyacres Rd. have been in place since approximately 1972, according to the Copley Meadows No.1 plans (Appendix H), and should therefore have been captured in the 1979 initial study of Summit County's unincorporated areas. Additionally, it does not appear that a road or culvert was ever in place at S. Plainview Dr. after review of historic aerials. The culvert under Sunnyacres Rd. is a 4-FT x 8-FT box culvert which transitions to a 72" rigid concrete pipe, a span of roughly 215 LF. See Figure 2.1 below for a snapshot of the current FEMA Map, indicating the incorrect culvert crossing. Figures 2.2 and 2.3 show the upstream and downstream sides of the Sunnyacres Rd. culvert. The existing culvert is in good condition and appears to be mostly free of debris and sediment. Figure 2.4 shows the existing FEMA Special Flood Hazard Area map for the project area.

Figure 2.1: FEMA Map, Incorrect Culvert Crossing

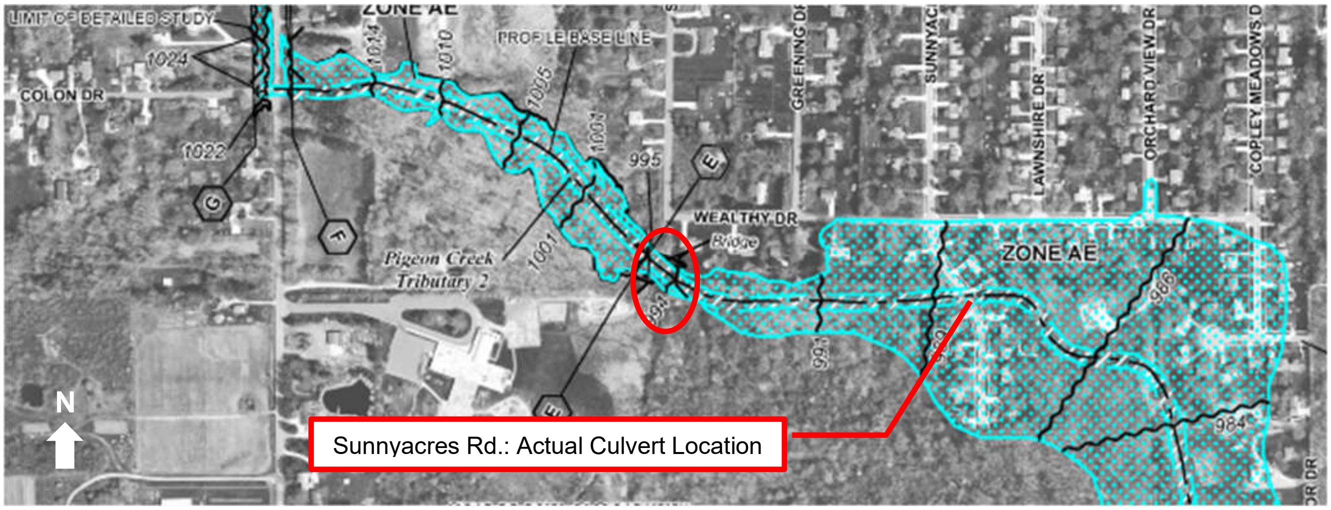
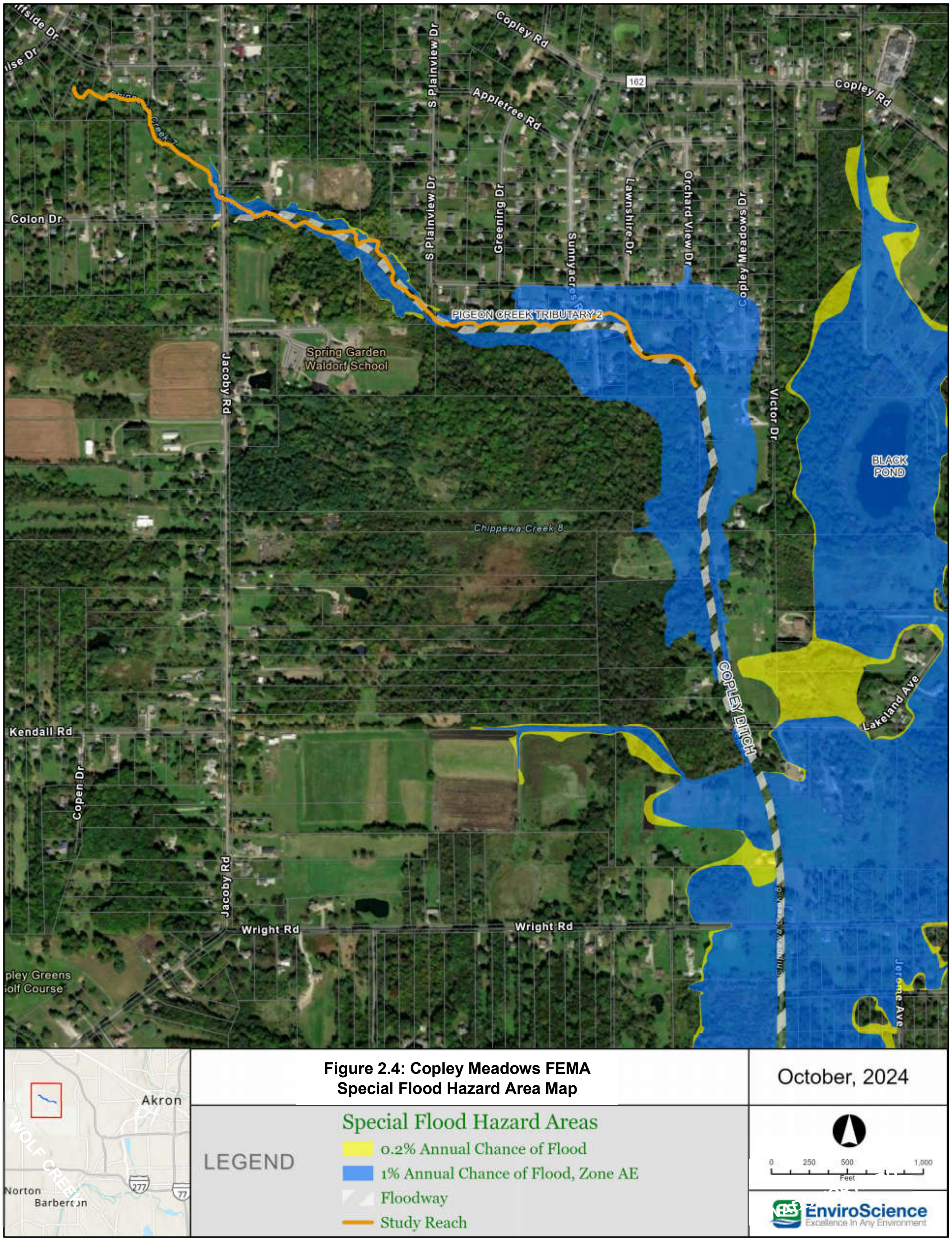


Figure 2.2: Sunnyacres Rd. Culvert, Upstream (4-ft x 8-ft Box)

Figure 2.3: Sunnyacres Rd. Culvert, Downstream (72” Rigid Concrete Pipe)

Figure 2.4: FEMA Special Flood Hazard Area Map



2.1.2 Web Soil Survey

A web soil survey was completed on the Natural Resources Conservation Service (NRCS) website (Appendix A) for the project areas to identify the existing soils. A large majority of the project areas were identified as Canfield silt loam and Ravenna silt loam, with the other prevalent soils including Luray Silt Loam, Sebring silt loam and Carlisle muck. For a full map and table of the existing soils, see Appendix A. Many of these soils which are found throughout the developed housing areas are not defined as being hydric soils, however soils identified near the historic stream alignment and existing wetlands are defined as very hydric soils, meaning they are saturated by water, resulting in anaerobic conditions. While this is beneficial for the goals of the project, it is important to keep in mind for the spoiling or reuse of the excavated materials.

2.1.3 Site Assessment

ES performed a site assessment of the Copley Meadows study area. The site assessment included walking the full length of the study reach and observing potential improvement locations. Observations included existing berms, culverts, low-lying wetland areas, and morphological indicators such as terraces or low benches, stream pattern, bankfull indicators, and streambed materials. These site walks enabled the ES team to identify potential flood-prone expansion areas, historic stream alignment remnants and existing wetland areas, construction access routes, channel improvement areas, and spoil locations. These proposed improvement areas were then translated into a Concept Plan drawing and presented to Summit County Engineer on July 1, 2024 for approval prior to proceeding with survey. Revisions to the conceptual designs discussed on the call were then implemented into the final Concept Plan and used as the guide for preliminary design (Appendix F). See Section 3 for preliminary design areas.

2.1.4 Wetland Delineation

ES performed a delineation of wetlands and other waters on October 17, 2024 throughout the Copley Meadows and Copley Ditch sites. Seven distinct vegetative communities were identified within the Copley Meadows project area, including three wetland community types. The surrounding properties consist of forested, agricultural, rural residential, and suburban residential land uses. Nine wetlands were identified within the Copley Meadows project area and account for approximately 12.409 acres of wetland on site. The onsite wetlands are comprised of palustrine forested (PFO), palustrine scrub-shrub (PSS), and palustrine emergent (PEM) vegetative communities. Seven streams were identified within the project area and account for approximately 5,132 LF of perennial stream, 301 LF of intermittent stream, and 75 LF of ephemeral stream on site. The complete delineation report and associated mapping can be found in Appendix I.

2.2 EXISTING DATA REVIEW

2.2.1 Studies

The Summit County Engineer provided ES with data previously collected and generated in and around the Copley Meadows project area. The original plans and documents including the Summit County Ditch Index, Reconstruction & Cleaning of Copley Ditch (County Ditch #38) Plans were provided. These plans helped the team understand the original shape, alignment, and easement widths for the petition ditch. The Copley Meadows/Sunnyacres Ditch Study, completed by CTI Engineers, Inc. (Appendix H) on September 2, 2016 provided similar insights that the ES team took away from the site assessment, identifying potentially undersized culverts, erosion and debris jam concerns, and overall ditch conditions. Additionally, the Jacoby Rd. Apartments Concept Plan was provided. This potential development was not considered for the initial preliminary design improvements. All existing data provided by Summit County Engineer is provided in Appendix H.

A Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan) for the Pigeon Creek Watershed was approved in April 2019 (Appendix H). The Copley Meadows study area is not within Critical Area 1 identified in the NPS-IS Plan. However, goals such as restoring morphology of 1,500-LF of petitioned ditches, stabilizing 1,500-LF of eroding ditch banks, and creating or restoring floodplain and wetland areas could be partially addressed through improvements throughout Copley Meadows.

2.2.2 Historic Maps

Direct evidence of the historic alignment and profile of PCT2, such as historic ditching plans or drainage studies, is not available. Review of historic mapping of the area indicates that, prior to the construction of Copley Ditch, this reach of PCT2 may have been a tributary to Black Pond. This potential historic alignment was depicted in the 1905 Akron, Ohio United States Geological Survey (USGS) Topographic Quadrangle Map (Figure 2.5). The accuracy of historical USGS mapping shows topographic data with 10-foot contours, and exact positioning of the stream/ditch may not have been accurate. The County provided Ditch Index map confirms this historic alignment and depicts the current ditch diverging from the historic alignment due west of Black Pond.

Figure 2.5: 1905 USGS Quadrangle Topographic Map

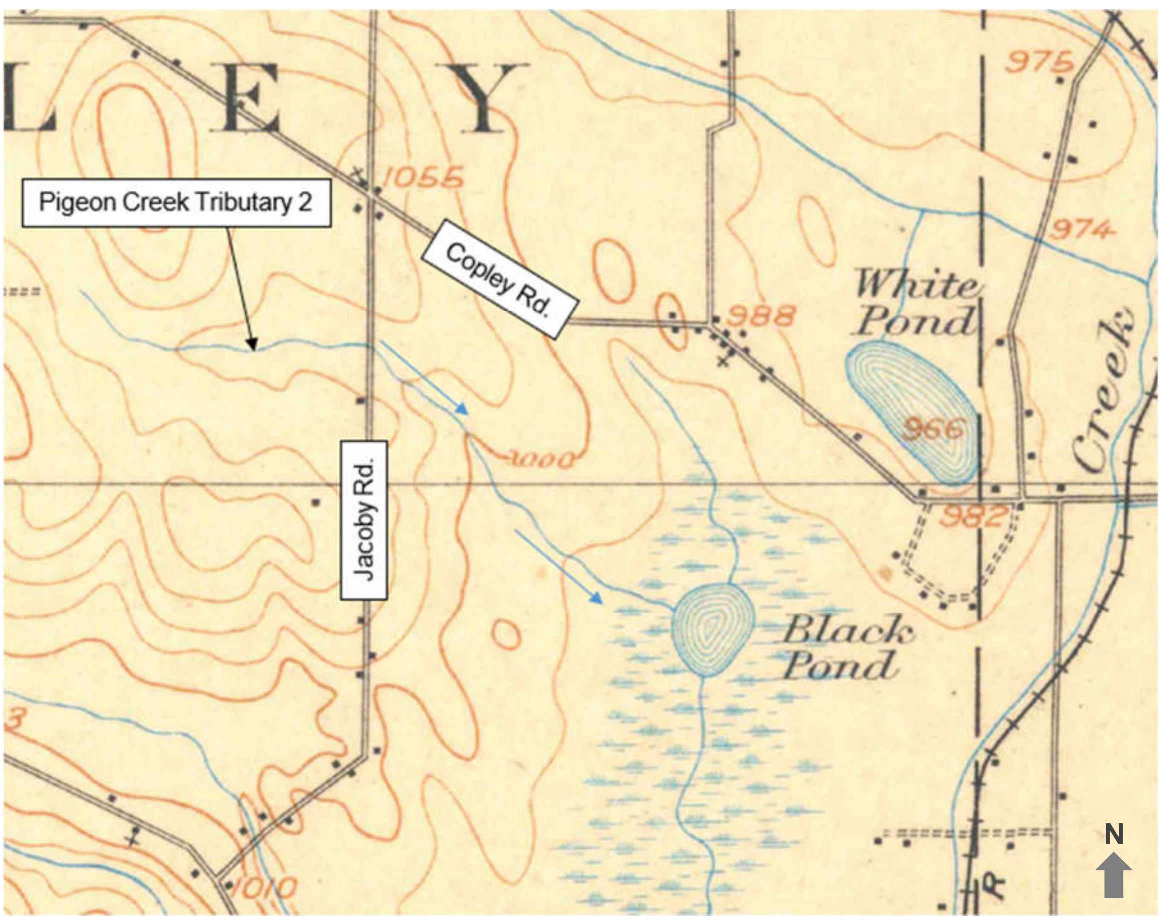


Figure 2.5 shows the historic alignment diverging from the current ditch location starting at the corner of S. Plainview Dr. and Wealthy Dr. The alignment continued at the same southeast angle through what is now existing wetland areas. The possible remnants of this old channel's belt width can be seen in Geographic Information System (GIS) contour data. During the site assessment walk, the team noted that some existing wetland depressional areas seemed to be from an abandoned channel based on their shape

and orientation within the open floodplain valley. This information is valuable to the design team as this reinforces the viability of the conceptual design of rerouting the stream channel through this area again.

2.3 DATA COLLECTION

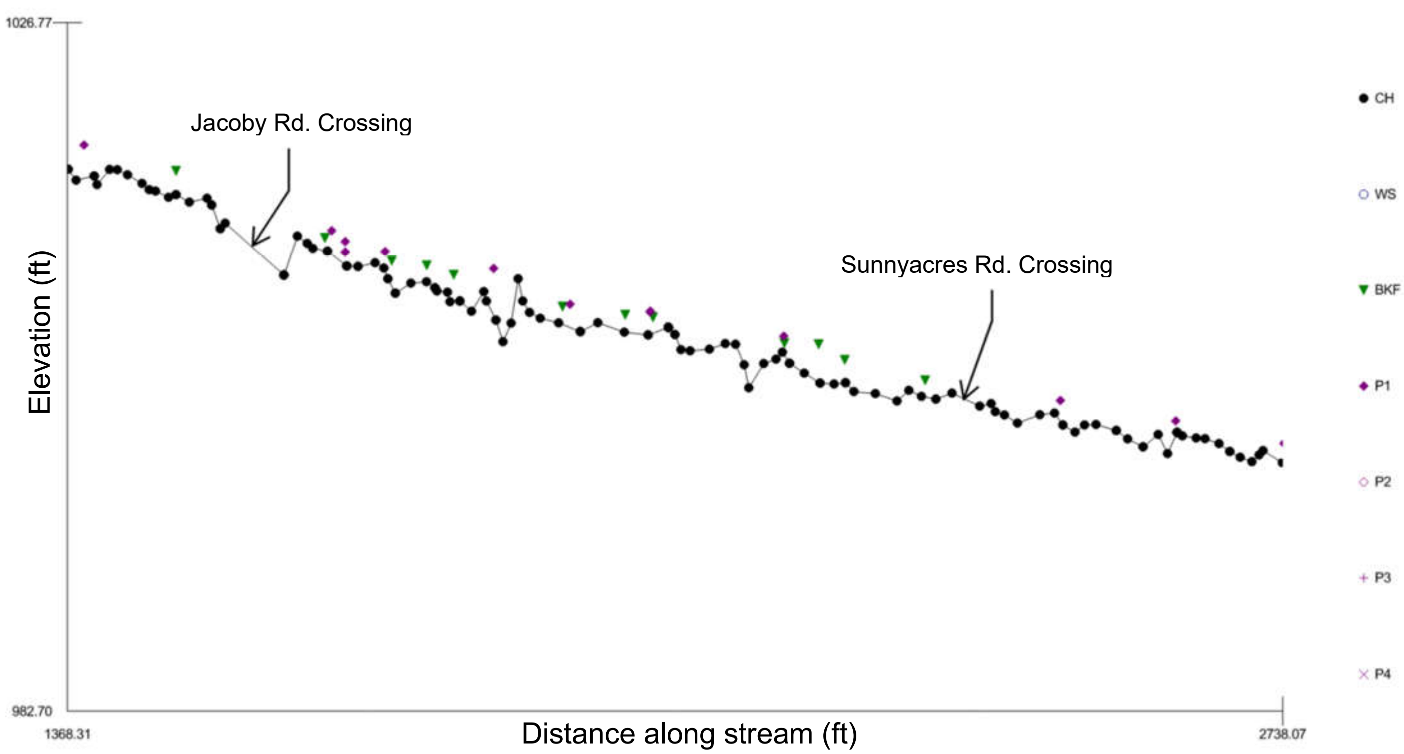
2.3.1 Survey

Once ES completed the initial site assessment and received approval from the Summit County Engineer on the conceptual improvement areas, a detailed survey was initiated. GPD Group performed a topographical survey of the study reach in July 2024. The elevation datum for the survey is North American Vertical Datum of 1988 (NAVD88), and the horizontal datum is North American Datum of 1983 (NAD83) Ohio State Plane, North Zone (US Foot). Data collected includes verification of culvert and road crossings through collection of inverts, road elevations, and culvert sizing information. Topographic survey sections were taken at 50-ft intervals and at significant changes in ditch direction. Property boundary pins found during the survey were collected. Ohio Utilities Protection Service (OUPS) coordination was completed, and the available utility data was included in the survey data. Once all the data was obtained in the field, it was processed and imported to AutoCAD Civil 3D to generate a basemap for the project.

2.3.2 Geomorphology

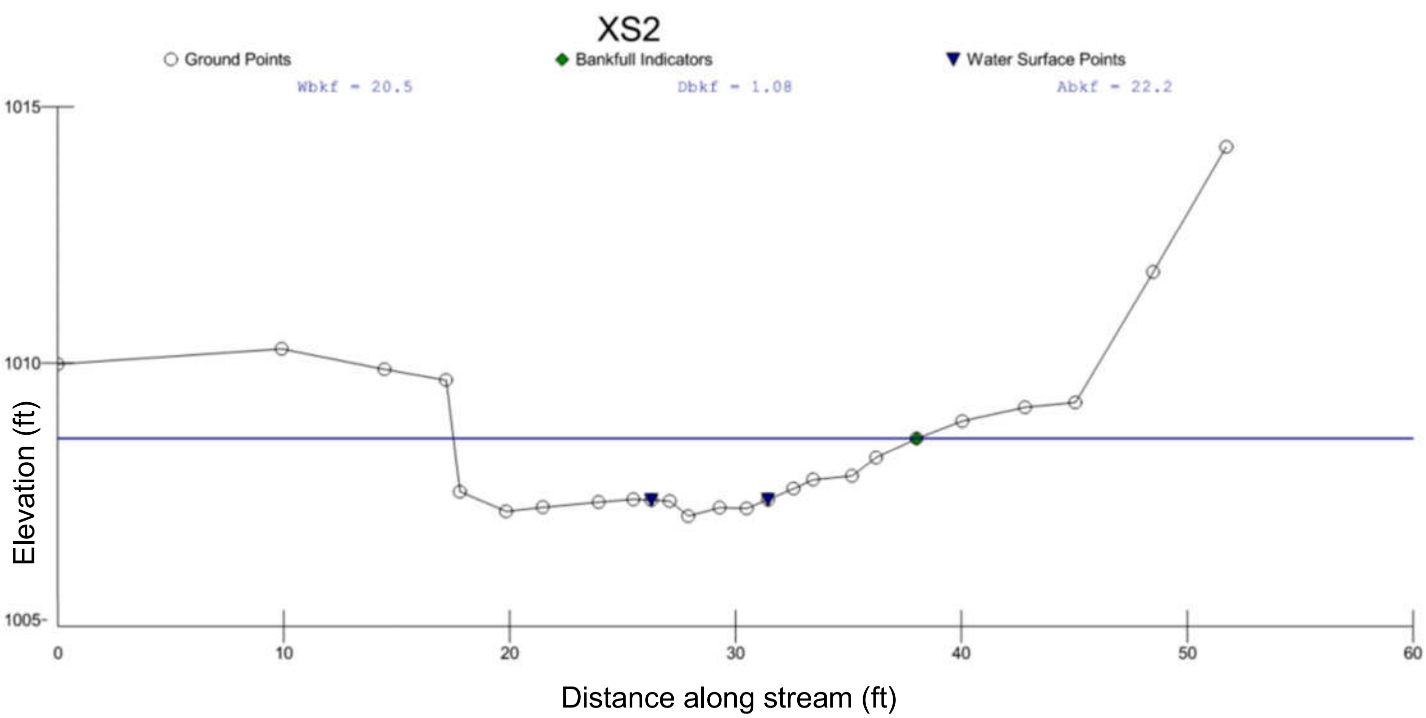
ES supplemented the GPD survey with specific geomorphology data, including thalweg profile data and bankfull indicators. Thalweg profile data comprises geomorphological features such as riffles, pools, runs, and glides, and helps the design team better understand the current patterns and slope throughout the reach. Bankfull indicators highlight the incipient point for a naturally formed stream channel. These features help identify potential elevations for flood-prone area expansions or two-stage ditch tiers. Using this data, a profile was generated in Rivermorph and is shown in Figure 2.6 below. The slope in this profile was 1.04%.

Figure 2.6: Representative Profile Based on Morphological Data Collection



ES also collected particle data and cross-sectional data to help characterize bedload and estimate the channel forming (bankfull) discharge of the stream. Stable cross-sectional data is difficult to collect within the project reach as it is still actively adjusting due to historic vertical and horizontal changes from ditching. Two cross sections were measured in the field and detailed discharge estimation will be completed as part of subsequent design phases. One of these cross-sections was used as a representative cross-section and is shown in Figure 2.7 below. Based on this cross-section, the bankfull area should be 22.2 square feet. However, a bankfull area of 16 square feet was used due to observed incision and the desired connection to floodplain storage.

Figure 2.7: Representative Existing Conditions Cross-section



The particle data suggests that the bedload contains principally gravel to sand-sized particles. A pebble count and bar sample analysis were performed. Based on the pebble count, the representative particle size (D84) was 60mm (2.36 inches). Based on the bar sample, the representative particle size (D84) was 40 mm (1.57 inches). The largest particle recorded within the bar sample was 105 mm (4.13 inches). The samples were dominated by gravel sized particles, with coarse grained sand as the second most dominant.

3.0 EXISTING CONDITIONS MODELS

To determine the hydraulic feasibility of the concept designs, ES developed existing conditions models for the Copley Meadows study reach. Hydraulic feasibility is established when the proposed designs lead to an expansion of the existing floodplains without causing an increase to the 100-year regulatory flood levels (no-rise requirement). The procedures used to develop the existing conditions models are documented in the following sections.

3.1 PREVIOUSLY DEVELOPED MODELS AND BASE DATA

As mentioned in section 2.1.1, the project area is mostly defined as a FEMA SFHA AE with the main channel itself designated "Regulatory Floodway," according to the Flood Insurance Rate Map (FIRM Panel 39153C0178F, Panel 178 of 285, effective April 19, 2016). See Appendix C for the FIRM. The upstream FEMA Limit of Study is approximately 60 feet west of Jacoby Rd., with the section of PCT2 west of Jacoby Rd. not being mapped.

To evaluate potential impacts to the regulatory floodplain and floodway, the current effective model for the project area was requested from FEMA Engineering Library. However, when FEMA looked for a hydraulic model, they did not find the model itself but did find the results from the model. ES received Hydraulic Engineering Center (HEC-2) printouts (summary tables only) from microfiche that was scanned to PDF (Appendix C). These HEC-2 printouts were available for cross sections E through G of the FIRM panel for PCT2. FEMA Engineering Library was unable to locate any associated maps. The data were never converted to Hydraulic Engineering Center-River Analysis System (HEC-RAS) and were not found in electronic format. In summary, the current effective model was never archived by FEMA and likely no longer exists; only summary tables with water surface elevations (WSEL) and corresponding flow rates could be gleaned from the HEC-2 printouts.

According to the HEC-2 printouts, the original HEC-2 hydraulic model for PCT2, was developed by Polytech Inc., released in November 1976, and last updated in August 1977. The model consisted of three (3) cross sections along the Copley Meadows reach with WSELs computed for the 10-yr, 50-yr, 100-yr and 500-yr flows. Again, the actual model is no longer available but the WSELs and flow rates were recorded in the HEC-2 printouts (Appendix C). The computed WSELs using the HEC-2 data for the 100-yr event (340 cfs) were compared to those published in the FIRM Panel, provided in Table 3.1 below:

Table 3.1: Ex. Water Surface Elevations (WSEL) for 100-yr Event, HEC-2 vs FIRM

Cross Section	HEC-2 WSEL (ft) (NGVD)	FIRM WSEL (ft) (NAVD88)	Difference HEC-2 - FIRM (ft)
E	995.53	994.9	0.6
F	1019.40	1018.8	0.6
G	1024.35	1023.8	0.6

The difference between the HEC-2 computed elevations and FIRM WSELs is consistently 0.6 ft through these three cross-sections. It is assumed that 0.6 ft represents a vertical datum conversion from National Geodetic Vertical Datum (NGVD) to North American Vertical Datum (NAVD). It is reasonable to conclude that the HEC-2 model is the same model used in the determination of the current effective Flood Insurance Study (FIS) and FIRM. Based on the available data, we believe that WSELs for PCT2 shown on the FIRM were taken from the HEC-2 with no other models or studies considered. As discussed in Section 2, our team observed that the profile for PCT2 incorrectly shows a crossing at S. Plainview Dr. and not at Sunnyacres Rd. The existing culverts under Sunnyacres Rd. have been in place since approximately 1972, according to the Copley Meadows No.1 plans, and should therefore have been captured in the 1979 initial study of Summit County's unincorporated areas. Additionally, it does not appear that a road or culvert was ever in place at S. Plainview Dr. after review of historic aerials. Due to these discrepancies, it is clear that the FIS profile is not reproducible using current standards for hydraulic modeling; it was necessary to develop an alternative hydraulic model.

In terms of flow rates, FEMA Engineering Library was unable to locate any separate hydrologic studies for the project area. The annual peak stream flows with annual exceedance probabilities of 0.1, 0.02, 0.01, and 0.002 (equivalent to recurrence intervals 10-, 50-, 100-, and 500-years, respectively) were included in the HEC-2 printouts for PCT2. These flows are summarized in Table 3.4. The flow used to develop the HEC-2 profile for the 100-yr event was reported as 340 cfs, per the HEC-2 printouts. Unfortunately, the basin parameters used to calculate these flows (subbasin area, curve number, time of concentration, etc.) are not available, so we are unable to directly inspect them for reasonableness.

USGS StreamStats automatically computes flows for PCT2 following guidance outlined in Bulletin 17C, developed by the Advisory Committee on Water Information (Koltun 2019). Flows for HEC-2 and StreamStats are similar in magnitude; however, it should be noted that the HEC-2 flows were computed at least 45 years ago. Several revisions to precipitation frequency estimates, combined with the impacts of urbanization, lower our confidence in the validity of the existing sources. ES, therefore, computed flows using the best available data in Hydraulic Engineering Center-Hydraulic Modeling System (HEC-HMS) using the procedures documented in Section 3.2.

3.2 EXISTING CONDITIONS HYDROLOGIC MODEL

In the absence of reliable flow values, ES performed rainfall-runoff modeling to develop flows based on current information. The ES existing conditions hydrologic model was developed using the Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) within ArcGIS. Copley Ditch and Black Pond Outlet were modeled separately to compute peak flows with annual exceedance probabilities of 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, and 0.002 (equivalent to recurrence intervals of 2-, 5-, 10-, 25-, 50-, 100-, and 500-years, respectively).

3.2.1 Drainage Area Determination

The 2019 Ohio Statewide Imagery Program (OSIP) III LiDAR data were obtained from Ohio Geographically Referenced Information Program (OGRIP). Point cloud data (LAS) were converted to a digital elevation model (DEM) with 1.0-ft resolution. HEC-GeoHMS was used to delineate the watershed for Copley Meadows. Flow direction was determined using the eight direction pour point model (Jenson 1988, Qin 2007). The confluence with Copley Ditch (41.083624°, -81.608283°) was used as the basin outlet. The drainage area for Copley Meadows is 490 acres, or 0.77 square miles (see Figure 3.1).

3.2.2 Land Use and Hydrologic Condition

Satellite imagery, Summit County tax parcel shapefiles, zoning data and Costal Change Analysis Program Derived Land Cover – BETA 10m 2017 (C-CAP) were used to determine existing land use classification for properties within the drainage basins. Field surveys and Google Street View were used to verify the accuracy of the data. The primary land cover types, in order of total area, include Upland Forest, Upland Herbaceous, Developed (Residential/Commercial/Industrial), Scrub/Shrub, Barren Land, and Open Water.

NRCS Soil Survey data were used to determine the Hydrologic Soil Groups (HSG) for the drainage basins. Nineteen different soils were identified, largely consisting of Carlisle muck and Ravenna silt loam. For a full map and table of the existing soils, see Appendix A. In general, the soils are very hydric / poorly drained which increases the stormwater runoff coefficient. The land use and Hydrologic Soil classifications were combined to develop 24-hour SCS Curve Number (CN) data for each subbasin using zonal statistics in GIS. Guidance from TR-55 Urban Hydrology for Small Watersheds (NRCS 1986) and HMS Technical Reference Manual (HEC 2000) were used to develop a CN conversion table. This information was applied to create a gridded CN dataset in GIS (Appendix A).

3.2.3 Basin Model Setup

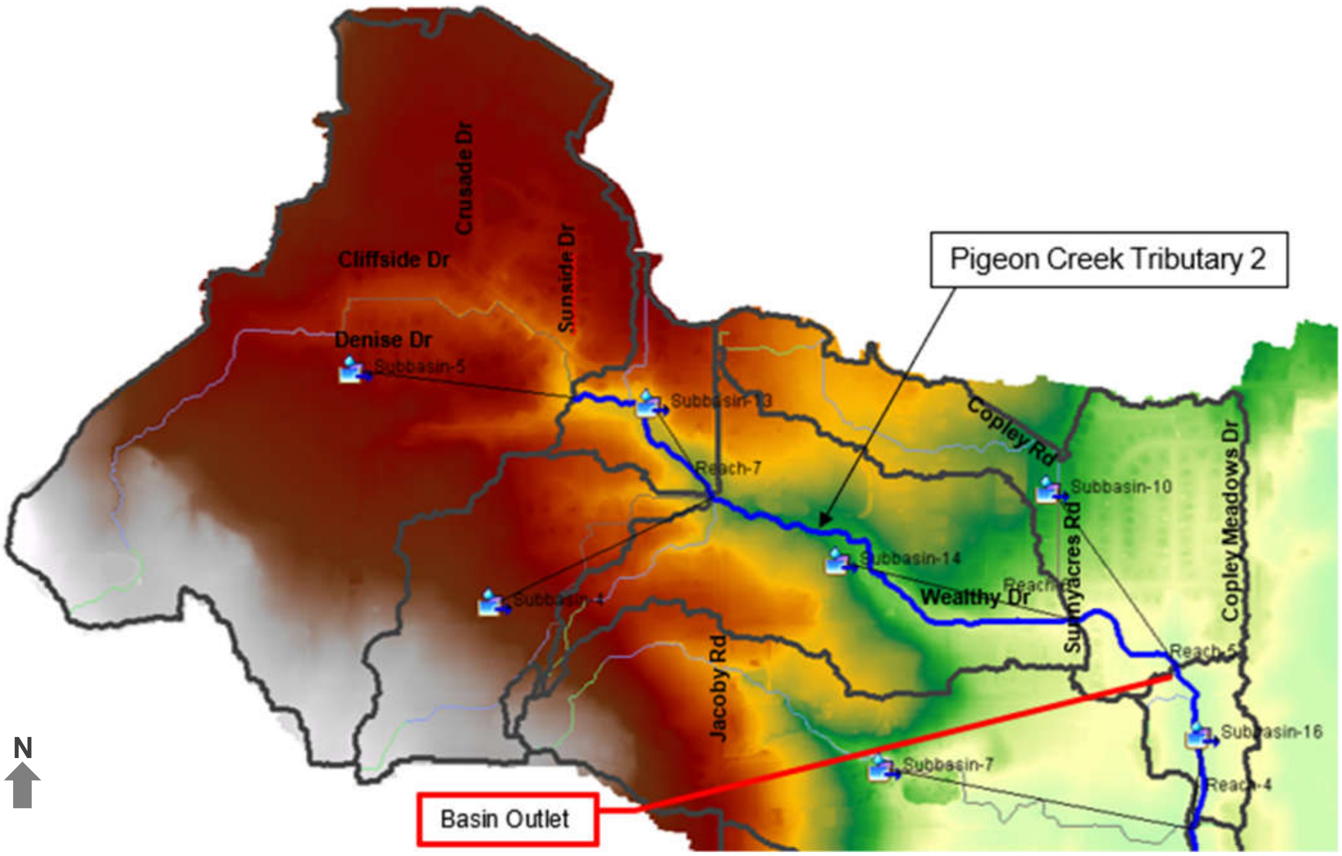
Subbasins were delineated using drainage areas approximating those of the 14-digit Hydrologic Units (HUC-14). The Copley Meadows study area consists of six (6) subbasins, three (3) reaches, and one (1) sink. The SCS Curve Number Method and SCS Unit Hydrograph Method are used for loss and transform, respectively. Time of concentration was determined using the SCS Watershed Lag Method with dimensional attributes, such as longest flow path and basin slope, determined from flow direction and flow accumulation models. The Muskingum method was used for reach routing. The HMS basin schematic is provided in Figure 3.1. The subbasin parameters used for modeling are summarized in Table 3.2.

It should be noted that K.E. McCartney & Associates (KEM) performed an independent review of the full Copley Ditch model, which includes Copley Meadows, on June 6, 2023. KEM found the assumptions within the basin model setup to be reasonable with the exception of lag times and curve numbers. KEM reported higher lag times which would result in lower peak flow rates (Appendix B). ES re-calculated the lag times using the SCS method which resulted in the same values. It's unclear what method KEM used to perform independent verification, however, results can vary depending on the method. It is our conclusion that the lag times are realistic for the study basin. With respect to curve numbers, KEM suggested that the CN values less than or equal to 60 would be indicative of Type A and B soils, which is inconsistent with very hydric / poorly drained soils. ES confirmed the presence of Type A and B soils for these areas and determined the CN values to be reasonable.

Table 3.2: Subbasin Parameters

Subbasin ID	Area (acres)	CN	Longest Flowpath (ft)	Longest Flowpath Slope (ft/ft)	Basin Slope (ft/ft)	Lag Time (min)
Subbasin-5	240.1	74.0	6,103	0.01787	0.05535	24.7
Subbasin-4	55.7	73.4	3,914	0.03109	0.04796	18.9
Subbasin-13	21.8	74.6	2,149	0.02703	0.09747	7.9
Subbasin-14	89.7	73.9	5,190	0.02491	0.08375	17.7
Subbasin-10	82.3	73.9	5,429	0.0163	0.04938	23.9
Total	489.6					

Figure 3.1: HEC-HMS Basin Schematic



3.2.4 Meteorologic Model

Precipitation depths were used as meteorological input in HEC-HMS to develop frequency storms. Depths were obtained for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year 24-hr events from National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3 for Akron, Ohio, Station ID 33-0059 (Appendix A). Precipitation depths are summarized in Table 3.3.

Table 3.3: Precipitation Depths, NOAA Atlas 14

COPLEY MEADOWS (PIGEON CREEK TRIBUTARY 2)								
Duration	**1-yr Depth (in)**	**2-yr Depth (in)**	**5-yr Depth (in)**	**10-yr Depth (in)**	**25-yr Depth (in)**	**50-yr Depth (in)**	**100-yr Depth (in)**	**500-yr Depth (in)**
5 Minutes	0.323	0.386	0.466	0.528	0.607	0.667	0.726	0.863
15 Minutes	0.615	0.737	0.89	1.00	1.15	1.25	1.36	1.58
1 Hour	0.994	1.21	1.53	1.77	2.10	2.36	2.62	3.25
2 Hours	1.16	1.41	1.79	2.09	2.52	2.87	3.23	4.15
3 Hours	1.24	1.50	1.90	2.23	2.69	3.07	3.47	4.50
6 Hours	1.49	1.79	2.26	2.64	3.20	3.66	4.15	5.47
12 Hours	1.74	2.09	2.61	3.04	3.67	4.21	4.78	6.33
1 Day	2.05	2.45	3.03	3.51	4.22	4.81	5.44	7.13

3.2.5 Hydrologic Modeling Results

The hydrologic modeling results include the final flow values that serve as input for both the existing conditions and proposed conditions hydraulic models. The flow values calculated by ES (HEC-HMS) are considerably higher than the HEC-2 values taken from the 1976 printouts and the StreamStats values. There are several variables which affect the peak flows including watershed size, watershed slope, soil types, land use, etc. Given that these variables were meticulously calculated and verified, we believe the most-up-to-date and realistic values are included in the analysis. The HEC-HMS flows were therefore used in subsequent analyses due to greater currency and accuracy of hydrologic variables. Comparative flow values are provided in Table 3.4.

Table 3.4: Comparison of Calculated Peak Discharges, HEC-2 vs StreamStats vs HEC-HMS

Recurrence Interval (yr)	**Pigeon Creek Tributary 2**		
	HEC-2 (cfs)	**StreamStats (cfs)**	**HEC-HMS (cfs)**
2	n/a	59	92
5	n/a	100	161
10	181	131	224
25	n/a	175	322
50	289	209	406
100	340	245	495
500	513	332	732

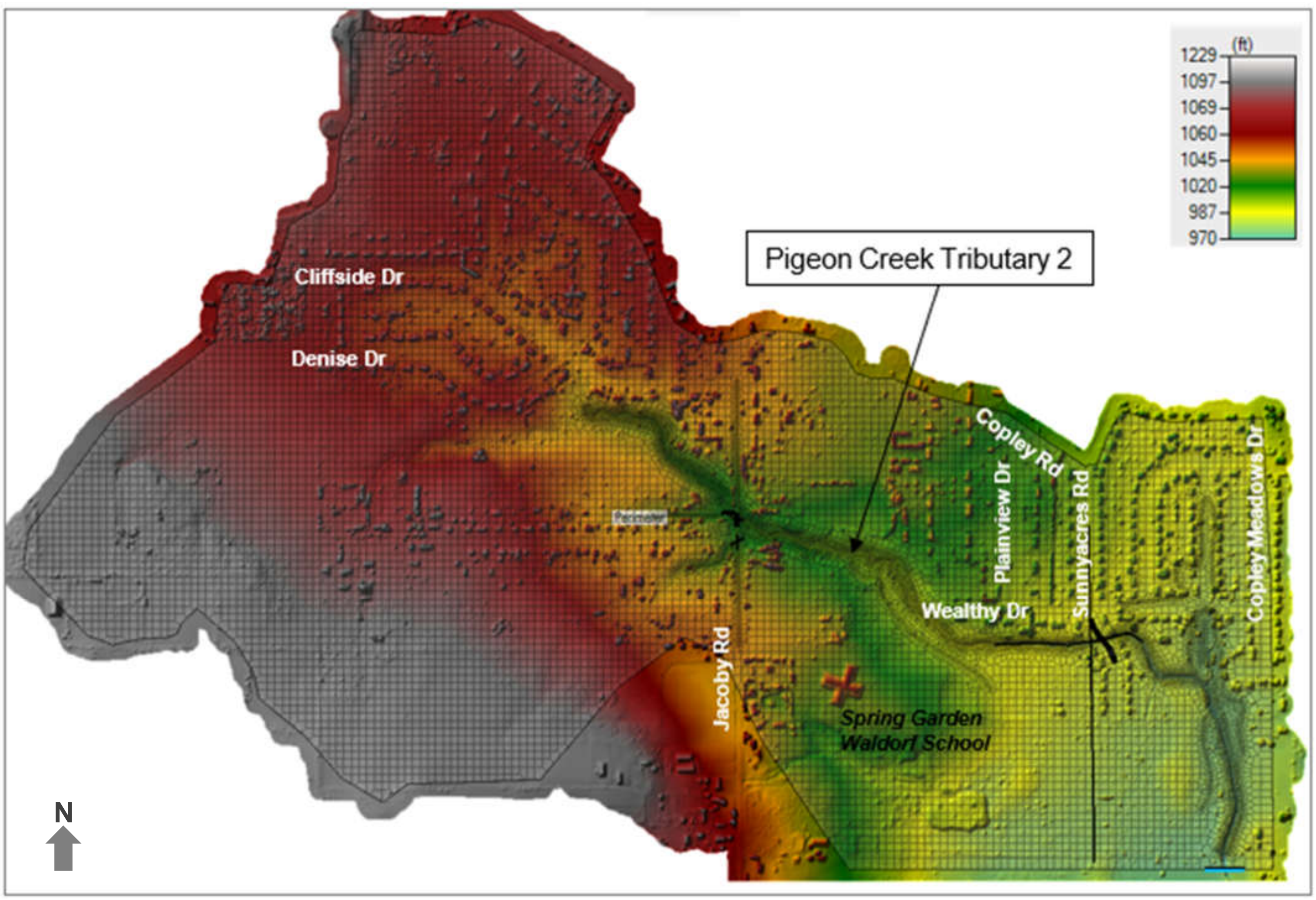
3.3 EXISTING CONDITIONS HYDRAULIC MODEL

Copley Meadows is a tributary to Copley Ditch. Its five subbasins represent the headwaters of the larger Copley Ditch / Black Pond Outlet watershed. The study reach (PCT2) is approximately 5,270 LF. The upstream end of the study area is approximately 1,440 LF west of Jacoby Rd. The downstream limit is the confluence point with the Copley Ditch reach, situated just west of the Titan Rd. cul-de-sac. This area has seen frequent flooding, particularly along Sunnyacres Rd., south of Wealthy Dr. To date, the cause(s) for nuisance flooding for residences in this area is unknown. For the purpose of identifying these sources, ES determined that a two-dimensional (2D), Rain-on-Grid model would be most helpful. In this approach, a specified hyetograph (design storm) is applied uniformly throughout the entire watershed. The modeled rainfall typically follows the path of least resistance to a storage area or to the basin outlet. By following these flow paths, we can then determine if residences are being inundated by channel bank overtopping and/or flash flooding.

3.3.1 Terrain and Modelling Domain

The 2019 OSIP III LiDAR data were obtained from OGRIP. Point cloud data (LAS) were converted to a digital elevation model (DEM) with 1.0-ft resolution. Structures, including homes and buildings, were preserved in the final terrain model (Figure 3.2).

Figure 3.2: HEC-RAS Schematic for Copley Meadows



3.3.2 2D Model Geometry

A 2-dimensional (2D) computational mesh with an average cell size of 50-sf was developed for the more expansive floodplains. Breaklines and refinement regions were added to increase the modelling precision of smaller flow areas such as the channel centerline, ditches, and swales. These cell sizes ranged from 1- to 10-sf. Manning's n values and curve numbers (CN) were assigned to the 2D mesh using the land use and soils grid discussed in Section 3.2.2. The model includes three major roadway crossings, including (1) the residential driveway at 1668 Jacoby Rd., (2) Jacoby Rd., and (3) Sunnyacres Rd. These crossings were modeled as 2D connections using culverts and weir flow for overtopping. These culverts were input into the model with invert coordinates based on survey provided by GPD. Roughness values and entrance/exit loss coefficients were entered based on typical values for the pipe materials and inlet/outlet geometries as surveyed by GPD.

Much consideration was given to modeling the culverts under Sunnyacres Rd. Drawings from 1972 show 83 LF of two (2) 48" RCPs crossing under Sunnyacres Rd., followed by a junction chamber with a 30˚ deflection, followed by 134 LF of one (1) 72" RCP with a 30˚ bend. The GPD survey indicates that the dual 48" culverts were replaced with a 4' × 8' box culvert. Based on conversations with the County, we believe the box culvert discharges into the junction chamber before discharging into the 72" RCP. This culvert configuration is difficult to represent in a hydraulic model. EnviroScience performed multiple iterations using different simplifying assumptions to model the culverts. All iterations used actual survey coordinates for the inverts and bends. Some iterations included, (1) 217 LF of 4' × 8' box culvert, (2) 217 LF of 72" RCP, and (3) 83 LF of 4' × 8' box which daylights before immediately discharging into 134 LF of 72" RCP. In all iterations, the culvert capacity was primarily restricted by the channel downstream, *i.e.*, the culvert system is outlet controlled. The final existing conditions model uses the 4' × 8' box throughout. With very minor differences between iterations, the box configuration allowed for more accurate modeling of inlet behavior, which was of interest during the alternatives analysis described in Section 4.1.

3.3.3 Hydraulic Modeling Results

Visual indicators in the field, including standing water, leaf and debris lines or stain lines from high flows, and bent or knocked down vegetation, along with aerial imagery suggest that the floodplain is being accessed often. An iterative approach was used to estimate the physical bankfull flow by gradually increasing flow in the model and determining the point at which water began to enter the floodplain. This was determined to be approximately 75 cubic feet per second (cfs). This flow rate is approximately equal to a 1.8% chance annual flood. It should be noted that the 10-yr storm is the design storm event for the Sunnyacres culvert. Upon review of our model, the Sunnyacres culvert capacity was incapable of passing the 10-yr storm volume and flow surpassing this level begins to threaten the structures in the vicinity of the culvert. The hydraulic modeling that supported the design process is summarized below in Section 4.1.

The hydraulic model output for the 100-yr event is provided in Table 3.5. "Floodplain Activated" refers to the WSEL exceeding the height of the channel bank in which the floodplain is accessed. The associated flood inundation map for the 100-year event is shown in Figure 3.3.

Table 3.5: HEC-RAS Existing 100-yr Hydraulic Results

Cross Section ID	100-yr			Floodplain Activated	
	Flow	Max Velocity	WSEL[1]	Left WSEL[1] (ft) / #-yr	Right WSEL[1] (ft) / #-yr
	(cfs)	(ft/s)	(ft)		
G	530	3.35	1023.35	1023.77 / 500-yr	1022.58 / 10-yr
F	592	2.90	1018.22	1017.84 / 25-yr	1016.79 / 10-yr
E	584	2.89	996.03	995.19 / 25-yr	992.85 / 2-yr
Sunnyacres	639	2.91	984.03	984.62 / 100	983.92 / 10-yr

[1] All elevations provided in NAVD 88

3.3.4 FIRM Comparison

The FIRM model has three cross sections. The HEC-RAS model developed by ES was evaluated at these cross sections. Table 3.6 provides a comparison of the 100-yr WSEL for existing conditions.

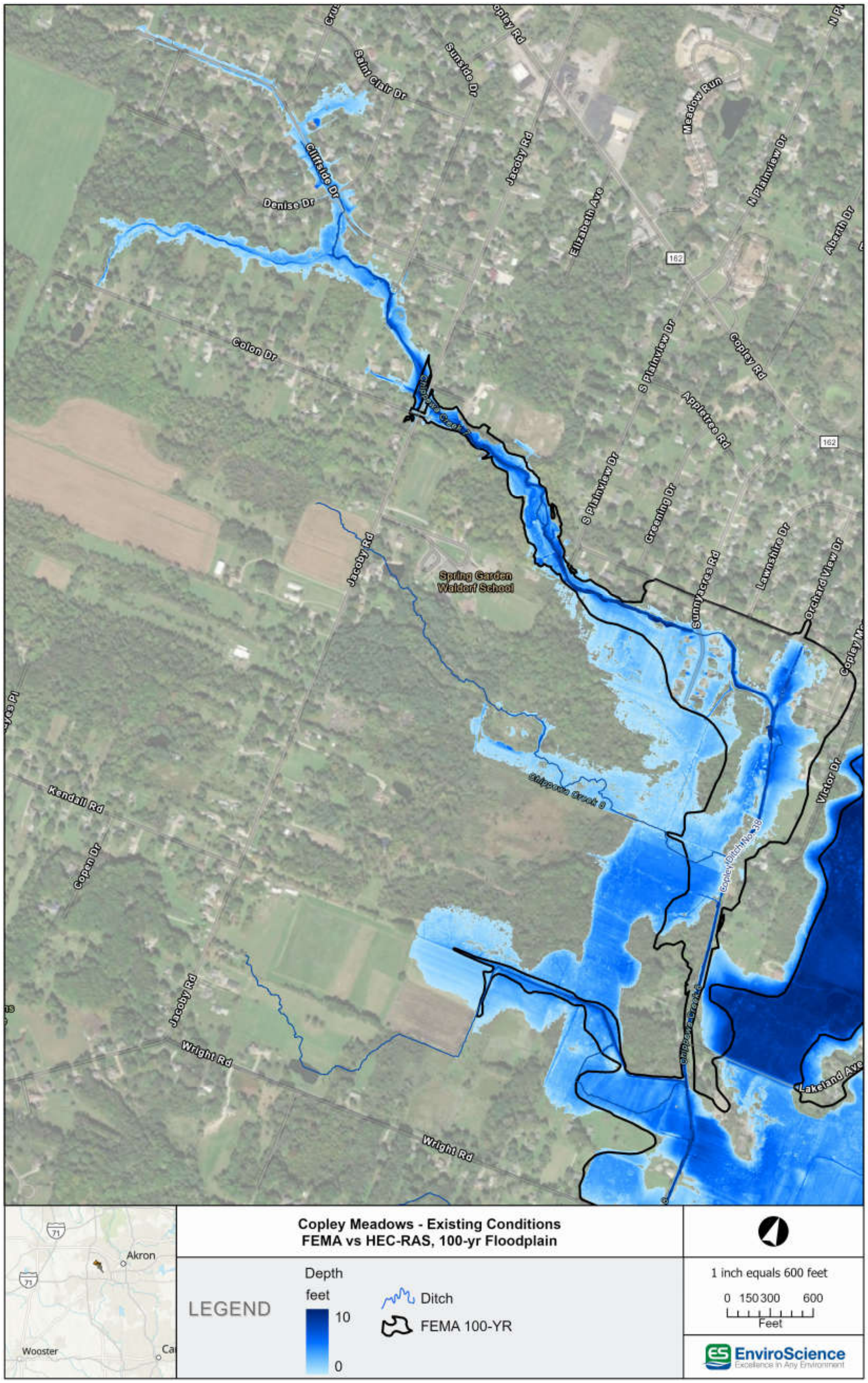
Table 3.6: Comparison of WSEL for 100-yr Event, HEC-2 vs HEC-RAS

Cross Section ID FIRM / RAS	FIRM WSEL[1] (ft)	HEC-RAS WSEL[1] (ft)	Difference RAS - FIRM (ft)
Trib_2 / E	994.9	996	1.1
Trib_2 / F	1018.8	1018.2	-0.6
Trib_2 / G	1023.8	1023.4	-0.4

[1] All elevations provided in NAVD 88

For reasons discussed in Section 3.1, the validity of the FIRM profile, which was developed in 1976 using smaller flows, is considered problematic. Questions surround the geometry used in the HEC-2 analysis. Again, the HEC-2 records which the FIRM is based on are not accompanied by a model and therefore cannot be inspected. In conclusion, we believe that the FIRM is unreliable for Copley Meadows and the HEC-RAS model is a better representation of the flooding potential based on updated hydrology, and rain-on-grid approach that can be used to distinguish flash flooding issues from overbank flows.

Figure 3.3: Existing Conditions - HEC-RAS vs FEMA – 100-yr event



4.0 PRELIMINARY DESIGN

The following sections detail our approach to increasing stormwater storage and reducing peak flow in addition to improving the ecological functions of the Copley Meadows reach of PCT2. The hydraulic model developed during the 30% design stage was expanded to provide a more detailed analysis of conceptual alternatives. Alternatives were based on 30% design feedback from SCE following the conceptual design review meeting.

4.1 ALTERNATIVES ANALYSIS

The hydraulic model developed for Copley Meadows was used to evaluate the feasibility of several conceptual design alternatives. All alternatives were primarily assessed based on their effects on the 10-year flooding of Sunnyacres Rd. and the houses along that road. These alternatives included one or more iterations or combinations of the following:

- **Diversion Channel**: Several diversion channels were modeled, with differing tie-in points, channel geometries and with or without complementary berms.
- **Sunnyacres Rd. Culvert Improvements**: Increases in either the rise or span of the 4' x 8' box culvert at Sunnyacres Rd. were modeled.
- **Ditch Improvements**: Variations of a two-stage ditch were modeled with varying slopes and storage volumes.

The following summarizes the sequence of alternatives that were analyzed. Each alternative described has a corresponding plan and profile across Sunnyacres Rd. attached in Appendix B:

1. **Expanded Culvert** (Figures B.6.a-b): Sunnyacres Rd. Culvert was modeled as a 4' x 12' box culvert instead of a 4' x 8' culvert. Flow conveyance increased less than would be expected for an inlet-controlled culvert, and problematic flooding around Sunnyacres Rd. persisted. Despite a 50% increase in cross-sectional area, the culvert's conveyance only improved from 211 cfs to 249 cfs. This would also cause the culvert to be classified as a bridge, resulting in increased maintenance and inspection requirements.
2. **Diversion Channel – Version 1** (Figures B.7.a-b): A meandering diversion channel was added between where the existing ditch turns towards Sunnyacres Rd. and the house near the end of Victor Dr. The channel used 12 ft bottom width and 3:1 side slopes. A small rise in the main channel bottom downstream of the diversion was also added in order to help divert flow, together with a small berm around the back of the houses on Sunnyacres Rd. The road no longer overtopped, but some flooding remained around 1590 Sunnyacres Rd. Additionally, this alternative would involve relatively significant excavation, haul-off and wetland impacts.
3. **Two-stage Ditch – Version 1** (Figures B.8.a-b): A two-stage ditch was added between where the existing ditch turns towards Sunnyacres Rd. and the inlet of Sunnyacres Rd. Culvert. Although the peak stage decreased in the two-stage ditch upstream of the culvert, there was not an improvement in stage at the inlet. It appeared that the amount of storage created was insufficient to attenuate the 10-year flood.
4. **Two-stage Ditch – Version 2** (Figures B.9.a-b): The previous two-stage ditch was steepened upstream of the culvert inlet and flattened nearer to the inlet. The second stage was also expanded in the area near the inlet. The aim of these modifications were to allow flow to back up at the culvert

inlet and increase the headwater above the crown of the pipe, helping to force water into the culvert. A small stage improvement (~0.04 ft) was noted near the road, but the flooding problem persisted. It was suspected that the limited space between the culvert crown and the top of the bank was preventing sufficient headwater buildup.

5. **Two-stage Ditch – Version 2 and Taller Culvert** (Figures B.10.a-b): The culvert's rise was increased so as to be a 6' x 8' culvert, and the modified two-stage ditch was run together with it. Increasing the culvert's height would be a challenge due to the limited space between the crown of the culvert and the road, but the effects of less restriction on the culvert inlet were of interest. Again, the 6' x 8' culvert underperformed the expectation of an inlet-controlled culvert, conveying a peak of about 246 cfs compared to the existing 4' x 8' culvert's 211 cfs.

6. **Two-stage Ditch – Version 3** (Figures B.11.a-b): The previous two-stage ditch was modified to include additional storage near the culvert inlet, which would involve removing the house at 1590 Sunnyacres Rd. The culvert under the road was again a 4' x 8' box culvert as in the existing conditions model. The model showed a decrease in peak stage of about 0.06 ft at the road, which was again insufficient to prevent significant flooding around Sunnyacres Rd.

7. **Culvert as a Trench** (Figures B.12.a-c): A limitation of HEC-RAS is that it can't provide a water surface profile within a culvert. The modeled underperformance of the culvert suggested that the culvert was under outlet control, likely due to a combination of factors such as the flatness of the downstream reach and the series of unnatural sharp bends downstream of the culvert. Scenarios were run that replaced the culvert with an 8-foot-wide trench with the Manning's roughness of a concrete pipe. This allowed the observation of a continuous water surface profile and control over downstream boundary conditions. Allowing the trench to discharge freely to a 0.4% slope resulted in a significant decrease in water surface elevation near the culvert outlet from about 982.3 to 979.3 ft. 1590 Sunnyacres Rd. and the road no longer flooded in this scenario. Running this scenario together with Version 3 of the two-stage ditch further improved the stage near the outlet to about 979.1 ft. Although unrealistic, this scenario provided another suggestion that the culvert was outlet controlled, suggesting that any improvement to the culvert would be limited by downstream conditions. Given this and the limited room within the existing easement to add useful storage volume, a diversion channel became the primary design option considered.

8. **Diversion Channel – Version 2** (Figures B.13.a-b): A diversion channel was modeled which tied into the ditch between 2598 and 2576 Wealthy Dr. about two feet below the top of bank, continuing south into the wetland at the same elevation until meeting grade. A berm was also put behind the houses on Sunnyacres Rd. This alternative was intended to have less wetland impact than Version 1 of the diversion channel while also targeting peak flood attenuation by only beginning to divert water when the water begins to approach the top of the bank. This helps to maximize the effectiveness of additional floodplain storage accessed by the diversion. The peak stage near the road decreased by about 0.19 ft relative to existing conditions, which improved but did not prevent flooding around Sunnyacres Rd.

9. **Diversion Channel – Version 3** (Figures B.14.a-b): A two-stage ditch with additional storage near the Sunnyacres Rd. Culvert inlet, similar to Two-stage Ditch – Version 2, was coupled with a diversion channel that tied into the second stage of the modified ditch near the inlet and curved behind the end of Sunnyacres Rd. before emptying into the floodplain where it met grade. The bottom of the channel was set about 4 ft below the top of the bank near the ditch tie-in. The diversion channel was modeled with a 40-ft bottom width, 4:1 side slopes and a 0.2% channel bottom slope.

The intent behind this alternative was to use the underperforming culvert to act as a chokepoint, helping to divert water into the side channel once the flood had risen at least three feet above the bottom of the main ditch. In terms of excavation volume and wetland impacts, this alternative would be between Diversion Channel Versions 1 and 2. This alternative prevented overtopping of Sunnyacres Rd. for the 10-year flood and reduced flooding around 1590 Sunnyacres Rd.

10. **Diversion Channel – Version 4** (Figures B.15.a-b): This alternative is nearly identical to Diversion Channel Versions 3, with the key difference being a change in the two-stage modification to the existing ditch. It was noted that although the additional storage provided by the second channel stage provided benefits to water surface elevations upstream of the culvert, this was not the key area for flooding impacts. Channel widening in this area would increase construction costs through greater excavation and easement acquisitions without providing a significant reduction in flooding at the houses around Sunnyacres Rd. Version 4 of the diversion channel is otherwise identical to Version 3, with the same diversion channel layout and geometry and the same tie-ins excluding the extents of the main channel's second stage. Version 4 also prevented overtopping of Sunnyacres Rd. for the 10-year flood and reduced flooding around 1590 Sunnyacres Rd. Due to the width and mild slope of the diversion channel, peak side channel velocities in the 10-year flood remained below 2 ft/s, which would help to reduce scouring erosion. Due to attenuation resulting from the increase in available storage volume, the downstream ditch also saw a decrease in peak flood stage of about 0.27 ft at 1,000 ft downstream of the culvert outlet. Compared to alternatives that might increase culvert conveyance by decreasing flooding upstream and worsening flooding downstream, this is also an advantage of the diversion channel. Given the effectiveness of this alternative and the balance between minimizing wetland impacts, avoiding an expensive culvert replacement and avoiding the demolition of the house at 1590 Sunnyacres Rd., it is the preferred alternative.

4.2 IMPROVEMENT RECOMMENDATIONS

Brief explanations for the selected improvement areas and types are provided below. As the design and data analysis continues to evolve, the design team is open to discussions about additional improvement areas or modifications to proposed improvements to better meet project goals. Please consider the designs preliminary and subject to comment / revision through the value engineering process. See Appendix D for the 60% Preliminary Design Plans. Figure 4.1 provides a map of the improvement area locations.

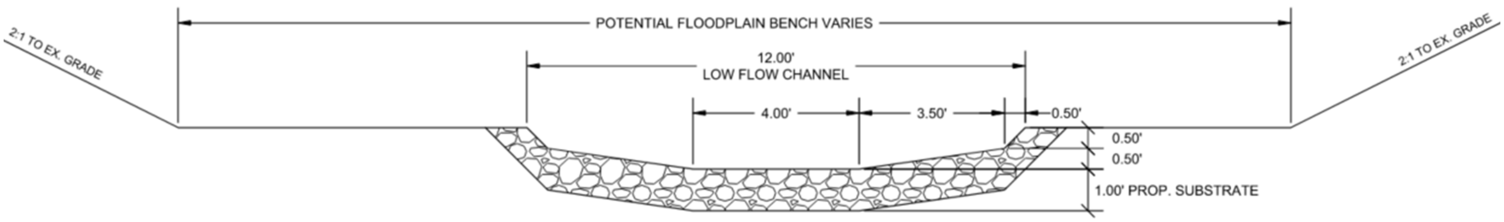
A summary of the locations and extents of work is as follows:

- **Improvement Area 1, Ex. Sta. 15+00 – 15+75**: Riffle installation at downstream end of Jacoby Rd. culvert
    - Current culvert outlets into a pool, with a significant drop from end of pipe to streambed
    - Installation of the riffle will more gradually transition this grade change, and allow for fish passage, while also protecting from further scour
        - 40-LF riffle incorporating existing rip-rap in the channel
        - Leave 15-LF pool at downstream end of riffle

- **Improvement Area 2, Ex. Sta. 29+00 – 30+00**: Increased floodwater storage through Flood-prone Area Expansion
    - Directly West of the intersection of Plainview Dr. and Wealthy Dr.
        - Approximately 0.12 acres
        - Removal of dredged/bermed material along right stream bank

- **Improvement Area 3, Ex. Sta. 34+50 – 43+50:** Stabilize existing ditch, increase in-line floodwater storage, and increase overall conveyance capacity of the existing ditch through Two-Stage Ditch Construction
  - Re-grade existing ditch between the departure point of the re-established historic channel and Sunnyacres Rd. to stabilize bank slopes
    - Approximately 947 LF two-stage ditch construction
    - Includes re-establishment of riffle-pool complexes within a low-flow channel

Figure 4.2: Proposed Two-Stage Ditch Typical Cross-Section



  - Construct a low-flow channel to maintain sediment transport along this reach of the ditch
  - Construct an expanded second stage to provide additional storage volume
    - Second stage connects to wetland diversion swale
  - Stabilization of left bank through grading and rock placement (bank stabilization rock)

- **Improvement Area 4, Ex. Sta. 42+00 – 42+50:** Increased flow conveyance through construction of a Wetland Diversion Swale
  - Approximately 735 LF of new vegetated swale construction
  - 40-ft wide swale to help divert high flows away from Sunnyacres Rd.

4.2.1 Ditch and Floodplain Improvements

ES evaluated three locations along PCT2 (which together constitute Improvement Area 1) for potential floodwater storage opportunities and conveyance improvement options. Initially, three areas were identified as potential floodwater storage areas, however after further analysis, only one area will remain. The locations eliminated were upstream of Jacoby Rd. and did not significantly contribute to reduction in flows that reduced flooding. Additionally, the design team determined that no significant flood issues were present at the Jacoby Rd. crossing that required the costs associated with those floodplain expansions.

Improvement Area 1 consists of the installation of a riffle to provide a transition from the outlet of the Jacoby Rd. culvert to the streambed. This currently is a drop of over 5-ft into a plunge pool. This creates a fish passage barrier while also creating significant scour and erosion. Evidence of previous erosion prevention measures are apparent as rip-rap has been placed in the channel. However, this did not improve the fish passage issue at the culvert. Our design involves installation of a riffle at the outlet with a small pool at the downstream end to transition into the existing streambed and slope.

The location proposed for Improvement Area 2 is located directly west of the intersection of Plainview Dr. and Wealthy Dr. This area currently appears to have dredged or otherwise spoiled materials located along existing low-lying areas in which excavation at or near the bankfull elevation of the stream will provide additional detention of stormwater during high flow events. It is likely that these low-lying areas will support hydrophytic vegetation. Establishment of dense vegetation is desirable in these areas to increase floodplain roughness and further enhance the detention action of these flood-prone storage areas. However, to complete this improvement of 0.12 acre of floodplain, approximately 70 trees would need to be removed for access and earthwork. Additionally, all materials will need to be hauled off site for spoiling. This may not be desirable from the standpoint of cost for clearing and replanting. The design team will further scrutinize this area prior to final design to determine if the benefits outweigh the costs.

Improvement Area 3 is a proposed restoration of the existing ditch between Plainview Dr. and Sunnyacres Rd. including stabilization of the banks through grading and placement of rock, two-stage ditch creation including a floodplain bench and low-flow channel, and re-establishment of riffle-pool complexes. These features serve to improve conveyance, stability, and storage capacity of the system. Construction of the two-stage ditch within the existing ditch footprint or with target excavation along the southern bank. The bottom of the ditch will be graded to form a low-flow channel to convey smaller flood flows, local discharges from household drainage systems, and promote transport of sediment. The regrading will include improved geometry, providing meanders to aid in the dissipation of energy through the system. This feature will require a net cut of material, with excess material exported off-site. Stabilization along the left bank will include placement of rock along the slope and trenched into the toe of the slope. This rock will also provide outlet protection for existing pipes and drains currently causing erosion and scour along the bank.

Improvement Area 4 will increase the flow conveyance around the Sunnyacres Rd. culvert through a wetland diversion swale. This can decrease the conveyance need for the culvert, avoiding the need for upsizing. This design coincides with the Improvement Area 3 features, by tying into a floodplain bench, and re-routing those flows to the south and then east around the Sunnyacres Rd. properties, with flows eventually outlet into the existing wetlands. This feature will require a net cut of material, with some excess material used to build a berm along the eastern property line. Additional spoils will need to be exported off-site.

4.2.2 Property Acquisition and Easements

The proposed work areas for Copley Meadows spans 17 privately owned properties. See Appendix E for a map of the easement areas and a table providing the list of properties and corresponding easement areas required based on the proposed Copley Meadows Area Improvements.

4.2.3 Access and Staging

The current preliminary plan assumes export of excavated material. Based on the current designs and modeling, spoiling of material west of the Sunnyside Rd. properties, east of the wetland diversion swale, is possible, but cannot hold all excavated materials. Future design refinement may identify potential spoil areas, but current information indicates that much of the surrounding area is wetland and spoiling will create permitting issues. Temporary easement areas will be required for the construction access routes. Additional considerations for spoiling material include the potential need for a separate Stormwater Pollution Prevention Plan (SWPPP) and Notice of Intent (NOI) if spoiled off site, and possible soil testing for material to be hauled off site or placed on different properties.

4.2.4 Preliminary Cost Estimate

ES generated quantities based off the survey data collected in comparison with the proposed grades for the improvement features. Table 4.1 below provides the costs for major components of the proposed Copley Meadows Improvements. A detailed, itemized cost estimate is provided in Appendix G.

Table 4.1 Preliminary Cost Estimate Summary

Item	Cost
General Conditions/Mobilization	$ 62,500.00
Clearing & Demolition	$ 120,750.00
Earthwork	$ 480,251.00
Rock Import	$ 94,015.00
Sediment & Erosion Control	$ 60,104.00
Planting, Seeding, and Habitat Improvement	$ 78,750.00
Invasives Management	$ 10,000.00
As-Built Survey	$ 15,000.00
Construction Sub-Total	**$ 921,370.00**
Construction Total (with 20% Design Contingency)	**$1,105,644.00**
Projected 2027 Construction Total (20% Inflation Factor)	**$1,326,773.00**

5.0 PROPOSED CONDITIONS HYDRAULIC MODEL

As described in Section 4.1, the hydraulic model developed for existing conditions was used to support an alternatives analysis which was used to determine the recommended alternative, version 4 of the diversion channel scenario. The proposed hydraulic model predicted that Sunnyacres Rd. would no longer overtop during the 10-year flood, reducing the maximum flood depth from roughly 0.52 ft in the existing conditions model to 0.00 ft. Due to attenuation resulting from the increase in available storage volume, the downstream ditch also saw a decrease in peak flood stage of about 0.27 ft approximately 1,000 ft downstream of the culvert outlet. The maximum flood depth immediately behind 1590 Sunnyacres Rd. was reduced from 0.31 ft to 0.00 ft. Maximum discharge in the Sunnyacres Rd. Culvert was reduced from 211 cfs to 167 cfs. Maximum discharge at the downstream boundary condition of the model near 1572 Victor Dr. increased from 252 to 269 cfs due to improved overall conveyance.

6.0 PERMITS AND REGULATORY COMPLIANCE

Regulatory permitting requirements for impacts to streams and wetlands will require notification to USACE and/or Ohio EPA. If impacts to wetlands and/or streams will occur, further federal and state agency coordination will be required, and results will be included with all permit applications. Local coordination is required for projects located within a known floodplain. This project has been evaluated and potential permitting and coordination is summarized below:

1. Section 401/404 Permits: A pre-application meeting was held with Lenza Paul of the USACE Huntington District on October 9, 2024. The Copley Meadows project was assigned file number LRH-2024-00826. The purpose of this pre-application meeting was to determine the potential permits required to complete proposed project activities. Final permitting needs can only be determined once aquatic resource quality has been evaluated and total impact amounts are

calculated. The information that follows is a summary of our current permit research and assumptions based on our conversation with the USACE.

USACE and Ohio EPA regulate the placement of fill within a wetland or below the ordinary high-water mark (OHWM) of a stream. Additionally, Ohio EPA regulates projects where an existing stream or wetland habitat type is being altered or degraded. The project areas are located within an area that is eligible (unshaded/white) for coverage under the blanket Ohio EPA Water Quality Certification (WQC) for Nationwide Permits (NWPs). Therefore, the proposed project will likely be permitted under the NWP #27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities) with the WQC attached. No permitting through the Ohio EPA (Individual 401 or Director's Authorization) is anticipated for this project. The permit does require the use of bioengineering incorporated into any bank stabilization practices, but bioengineering does not need to be used throughout the entire reach of the project area. There are no thresholds for wetland impacts provided the project demonstrates ecological uplift of the stream and the habitat it provides, including access to the floodplain. Impacted wetlands will need to be replaced within the project area at a 1:1 ratio. Also, during field review, if any wetlands on site are assessed as a Category 3 wetland using the Ohio Rapid Assessment Method (ORAM), an Individual 401 permit from OEPA may be required.

The permit does stipulate that in-stream work should not be performed during the in-water work restriction period of March 15 through June 30. Otherwise, an in-water work waiver would need to be obtained from ODNR to work within that timeframe. Should Summit County Engineer believe that work may need to take place during this time period, the best practice would be to submit the waiver request to ODNR prior to or concurrently with submission of the NWP application to USACE. ODNR will approve the waiver request, and USACE will include the waiver within the issued permit. This streamlines the process of requesting the waiver for ODNR approval prior to USACE permit approval and avoids re-verification and re-issuance of the NWP to include the waiver after the fact. A final permitting consideration is that post-construction monitoring is typically required to be completed to satisfy the permit conditions of the NWP #27 through USACE.

2. Federal and State Agency Coordination: Given the existing wetlands located throughout the study area, we would suggest both federal and state agency coordination for threatened and endangered species (T & E) as part of the permitting process. An Endangered Species Act consultation request can be sent to U.S. Fish and Wildlife Service for comments on Federally T & E species, specifically bat species. A full Environmental Review request can be submitted to Ohio Department of Natural Resources (ODNR) for state T & E species. Additionally, coordination with Ohio Historical Preservation Office (OHPO) may be necessary. Coordination responses can be included with the NWP application and can streamline USACE's own coordination with these agencies. The onsite stream has a drainage area less than 5 square miles; therefore, a mussel survey will not be necessary.

3. FEMA: The majority of the Copley Meadows study area of PCT2 is within FEMA designated Zone AE, with the main channel also within the floodway. The designation of Zone AE means that the area is subject to inundation of the 100-year storm, and the base flood elevation (BFE) has been identified. The floodway then designates this as an area that must be kept free of encroachment so that no rise in the BFE occurs. Therefore, work proposed along Copley Meadows will require a Special Flood Hazard Development Permit from the County's Floodplain Administrator. This permit

will require a hydraulic analysis (HEC-RAS) of the corridor, which will need to show a No-Rise scenario.

4. Ohio EPA NPDES: A Stormwater Pollution Prevention Plan (SWPPP) will need to be created for the project. Erosion and sediment discharge must be controlled throughout the construction process in accordance with the Ohio EPA construction general permit and local erosion and sediment control regulations. A NOI will need to be submitted prior to construction. Potential challenges for SWPPP and NOI permits are the ownership of the properties. Summit County Engineers may need to consider specific language for their easement acquisitions to allow the entire project area to be considered one area.

7.0 CONCLUSIONS

Based upon the data gathered and 60% designs, estimates, and models the following conclusions regarding feasibility, project benefits, and general recommendations are provided for PCT2.

The principal source of flooding identified at this stage of analysis is overtopping of the culvert under Sunnyacres Rd. and routing of flow south. The existence of lower-level garages at several homes makes them susceptible to floodwater intrusion in this scenario. The design effectiveness for flood storage improvements is an iterative process which must be supported by accurate modeling. The lack of an existing FEMA model caused some additional effort and due diligence to ensure an up to date and accurate model of the existing conditions. However, the design team feels at this juncture the model provides the best representation of current water routing and timing.

Immediate benefits of the proposed improvements include additional stormwater conveyance capacity for lower frequency storms and improved water quality through natural filtration and settling within the flood-prone and wetland areas. The overall impacts of the improvements are mostly localized (*i.e.*, two-stage ditch creation reduces the flooding potential for adjacent properties) but has no effect further downstream past Sunnyacres Rd. Combination of the two-stage ditch and the wetland diversion swale have eliminated overtopping of Sunnyacres Rd. during the 10-yr storm, which was a primary goal of the design team entering the 60% design iteration.

The installation of the fish passage riffle along with the flood-prone area expansion west of Plainview Dr. provides benefits to stream function and habitat but has little to no impact on stormwater capacity. While the work associated with the fish passage riffle has minimal impacts, the flood-prone excavation would result in significant tree removal and additional material haul off. For these reasons, the design team would like to discuss the potential removal of one or both of these improvement areas to reduce the over cost and impact of the project.

Our recommendation is to move forward into the final design with Improvement Areas 3 and 4 included in the 60% design.

8.0 REFERENCES

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