COPLEY DITCH & BLACK POND OUTLET, STREAM RESTORATION AND BANKFULL WETLANDS

Preliminary Design Report
Copley Township, Summit Co., Oh

Prepared for:

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Project No.: 16215
Original Date: 5/5/2023
Revised Date: 8/2/2023

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Authorization for Release

The analyses, opinions, and conclusions in this document are based entirely on EnviroScience's unbiased, professional judgement. EnviroScience'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's internal Quality Assurance standards.

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EXECUTIVE SUMMARY

EnviroScience proposes to develop preliminary improvement plans for the Copley Ditch and the Black Pond Outlet projects, both located in Copley Township, Summit County, Ohio. The Copley Ditch project reach includes approximately 9,000 linear feet between Wealthy Drive at the upstream end and the Copley-Norton City limit at the downstream end. Black Pond Outlet is approximately 7,000 linear feet of ditch between Copley Road at the upstream end and Penelope Drive at the downstream end. Both Copley Ditch and Black Pond Outlet confluence with Pigeon Creek just south of the study limits.

The preliminary designs identify work areas where improvements could be implemented that would expand stormwater capacity, frequency of overbank flows in wetland/floodplain areas, improved habitat and stream functionality resulting in lower overall flood elevations and improved water quality. Proposed improvements include creation of two-stage ditch, removal of existing levees for better connectivity to the existing floodplains and wetlands, re-meandering sections of the ditch for ecological improvements, and installation of grade control riffle structures. The preliminary design also proposes work on the existing Panzner Wetland Wildlife Reserve including the creation of berms, level spreader trench and water control structures to better use the property as additional stormwater storage and treatment. The proposed design approach was focused on minimizing disturbance areas, both to reduce impacts to existing vegetation and surrounding wetlands, but also to limit easement acquisitions necessary to complete the work, and maintaining a feasible overall cost. Additionally, minimizing the earthwork and reusing material within the channel, reducing haul off, is a cost-efficient way to improve stream function. This low-impact approach focuses most of the work within the existing, overwide stream channels and their immediate banks.

The proposed conditions hydraulic model for Copley Ditch indicates proposed improvements at Work Areas 1 – 6 will provide additional storage by accessing floodplains, will increase hydraulic efficiency using two-stage ditches, and will attenuate peak flows for higher frequency events by diverting floodwater through Panzner Wetland property improvements. We recommend the two-stage ditch in Work Area 2, levee removals in Work Areas 2, 3, 4 and 5, alternating channels in Work Area 5, and all improvements at Work Area 6.

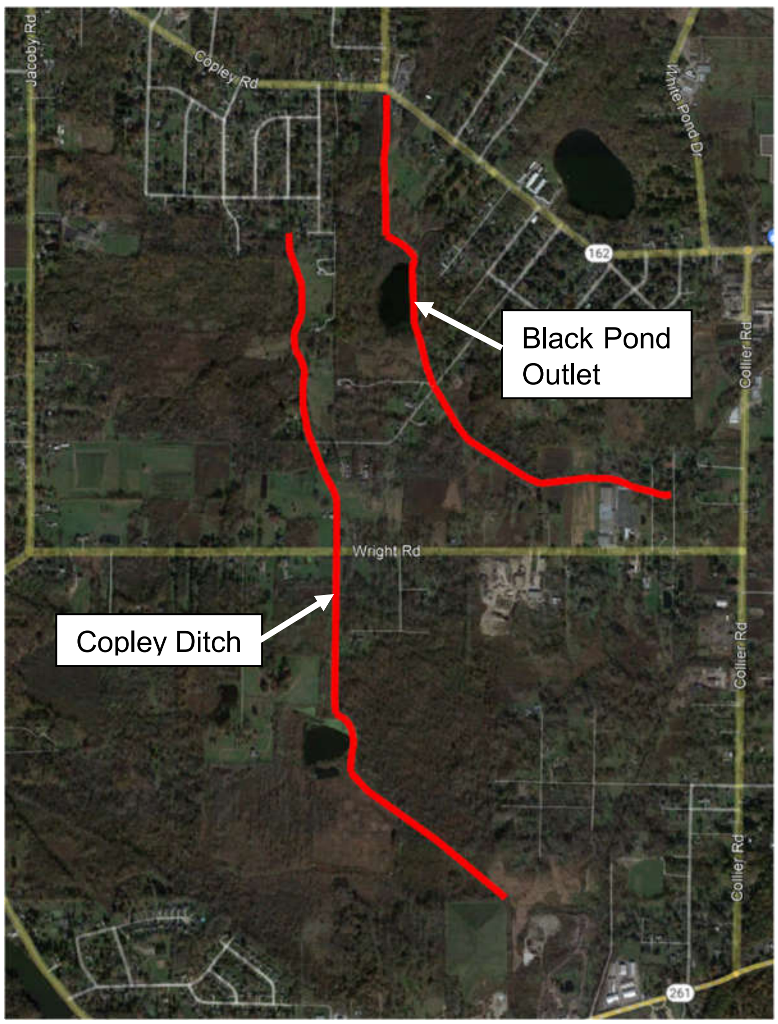
The proposed conditions model for Black Pond Outlet also indicates that the improvements proposed at Work Areas 1 – 8 will decrease water surface elevations. We recommend the riffle grade control in Work Area 1, two-stage ditch and culvert removal at Work Area 2, riffle grade control at Work Area 3, re-meandering and abandoning the existing ditch in Work Area 4, providing control structures to divert base flows in Work Area 5, levee removal and additional control structure(s) in Work Area 6, adding the two-stage ditch and levee removals in Work Area 7, and two-stage ditch in Work Area 8.

Based upon the preliminary designs generated as part of this study, cost estimates have been developed for each project. The costs include the anticipated construction cost as well as the final design, survey, permitting, and construction administration services that would be required to complete the projects. It is anticipated that these projects will not be released for bid until the year 2027, so an inflation factor has been added to both project totals to account for the projected cost increase. The estimated total project cost including a 20% contingency for Copley Ditch is $2,006,745. The estimated total project cost including a 20% contingency for Black Pond Outlet is $954,107.

1.0 INTRODUCTION

The Summit County Engineer (SCE) contracted EnviroScience to develop preliminary improvement plans for the Copley Ditch and the Black Pond Outlet projects, both located in Copley Township, Summit County, Ohio. The Copley Ditch project reach includes approximately 9,000 linear feet between Wealthy Drive at the upstream end and the Copley-Norton City limit at the downstream end. Black Pond Outlet is approximately 7,000 linear feet of ditch between Copley Road at the upstream end and Penelope Drive at the downstream end. Both Copley Ditch and Black Pond Outlet confluence with Pigeon Creek just south of the study limits. 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 Ditch & Black Pond Outlet 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 by creating 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 width to depth over 90% of the ditch's flow ranges. The ditch is created for large volume flow events, and during the long periods between these 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.

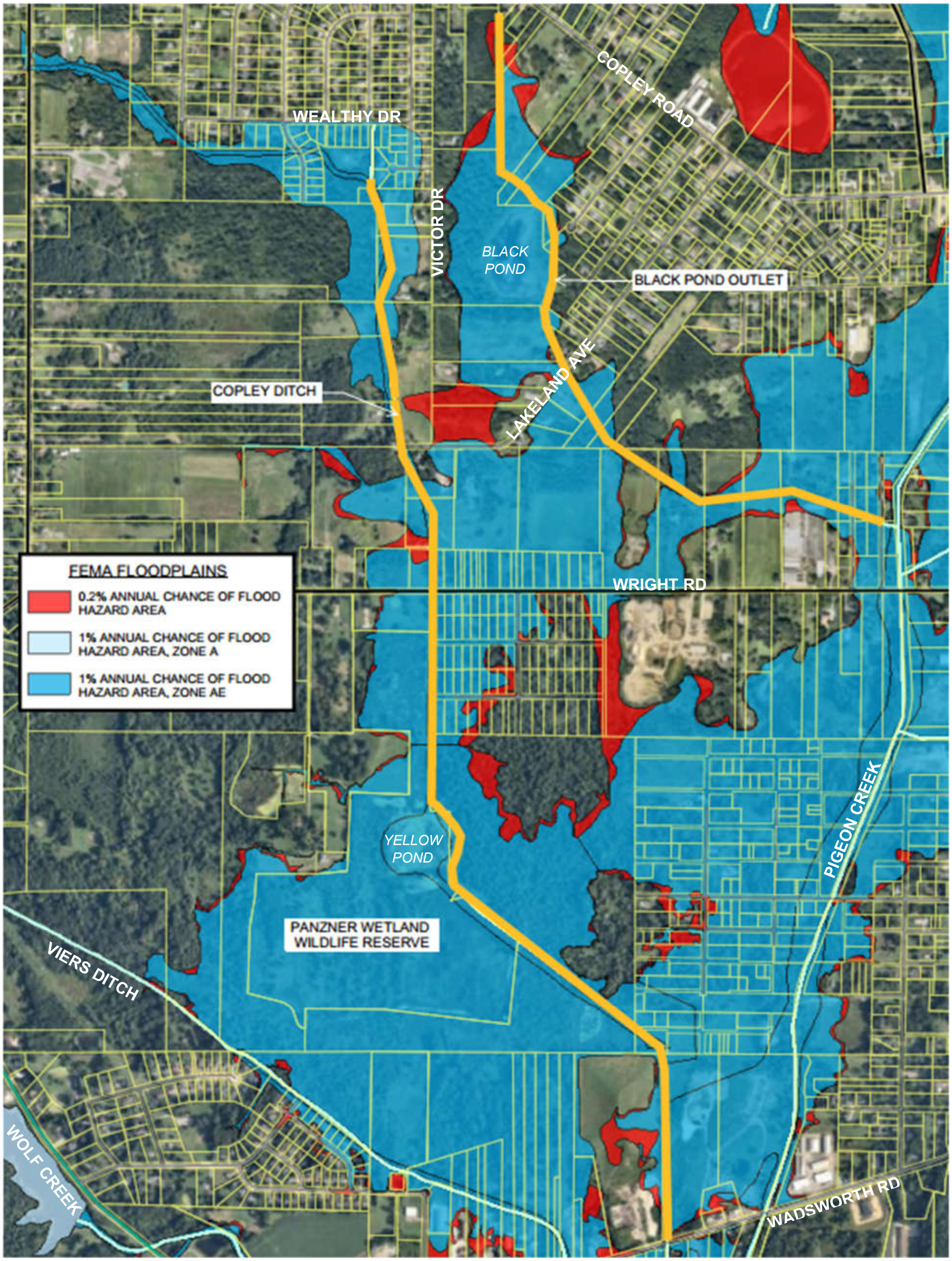
The Summit County Engineer has expressed interest in restoring the ditches to the original cross section design shown on the county ditch plans. The two-stage ditch concept is a design theory that recognizes the benefits of a smaller, hydraulically efficient channel to move both the water and sediment to stop the cycle of inevitable and costly channel maintenance. The two-stage ditch will improve the functionality of the stream, more efficiently moving sediment, thereby enhancing water quality. The second stage of the channel will be vegetated with native species which will both act to increase roughness and slow flows, while also providing a level of treatment for stormwater, again bettering the water quality through the reaches. Typically, the second stage in this approach is associated with bankfull water volumes, as this level is a naturally recurring storm interval that the stream functions for maintenance. These bankfull indicators become important elevations during design and preliminary design to understand the scale and change that may be necessary to accomplish the two-stage goal. In addition to the two-stage ditch design, EnviroScience will evaluate other flood storage improvements including bankfull floodprone area and wetland creation, installation of grade control structures, and removal of levees.

2.0 EXISTING CONDITIONS

2.1 EXISTING SITE AND DRAINAGE CONDITIONS

Copley Ditch and Black Pond Outlet are located within Pigeon Creek Watershed (HUC-12 05040001 01 02). The project areas are defined as a Zone AE FEMA Special Flood Hazard Area (SFHA) for an extensive footprint outside the channels. Copley Ditch is also a designated "Regulatory Floodway," subject to a "No Rise" condition for improvements.

Figure 2.1: FEMA Special Flood Hazard Area Map



A web soil survey was completed on the NRCS website for the project areas to identify the existing soils. A large majority of the project areas were identified as Carlisle muck, with the other prevalent soils including Luray silt loam, Damascus loam, and Olmsted Loam (in the more upland areas). For a full map and table of the existing soils, see Appendix A.1. These soils are all defined as being very hydric soils, meaning they are saturated by water, resulting in anaerobic conditions, which are necessary for wetlands. 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.

EnviroScience performed site assessments of both Copley Ditch and Black Pond Outlet. The site assessments included walking the full length of each area of study 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 EnviroScience team to identify potential floodplain expansion areas, bankfull wetland locations, construction access routes, channel improvement areas, and spoil locations. These proposed improvement areas were presented to Summit County Engineer for approval prior to proceeding with survey. See Section 3 for preliminary design areas.

An existing beaver dam was noted near the downstream end of Copley Ditch project area. The Summit County Engineer also mentioned that complaints had been received from nearby residents regarding this beaver dam and it causing inundation of their properties. During site walks, several residents mentioned this same beaver dam to EnviroScience staff as well. While wanting to make note of this obstruction for future maintenance concerns for the County, due to it being considered a temporary structure, the design team will not include the beaver dam in the following hydraulic analysis of the Copley Ditch reach. The Summit County Engineer is currently coordinating the removal of the beaver dam.

2.2 EXISTING DATA REVIEW

The Summit County Engineer provided EnviroScience with data previously collected and generated in and around the Copley Ditch and Black Pond Outlet watersheds. The original plans and documents including the Summit County Ditch Index, Reconstruction & Cleaning of Copley Ditch (County Ditch #38) Plans, and Black Pond Ditch #7 Plans were provided. These plans helped the team understand the original shape, alignment, and easement widths for both ditches. The Wolf Creek Rehabilitation Study and Conceptual Cost Estimate, completed by ms consultants, inc, in June 2015 provided insight into problem areas previously encountered in Copley Ditch and Black Pond Outlet, along with proposed solutions and associated costs. This aided the team in identifying the focus areas for potential design improvements. All existing data provided by Summit County Engineer is provided in Appendix J.

2.3 SURVEY DATA

Once EnviroScience completed the initial site assessment and received approval from Summit County Engineer on the conceptual improvement areas, a detailed survey was initiated. DLZ performed a survey of the identified potential improvement areas in December 2022. The elevation datum for the survey is NAVD88, and the horizontal datum is NAD83 Ohio State Plan, North Zone (US Foot). The data was collected using a combination of Trimble R12 GPS receivers, Trimble S3 Station, and senseFly eBee X mapping drone with the Aerial X Camera payload. Two separate flights were completed to provide background into the site and elevations needed for preliminary design planning. Data collected includes topography of the delineated work areas, property boundary pins (if encountered), and verification of culvert and road crossings through collection of inverts, bridge elevations, and culvert sizes along or near the subject ditch lines. 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. Supplemental GIS LIDAR contours and parcel data obtained from OGRIP (Ohio Geographically Referenced Information Program) was incorporated in the basemap. Orthomosaic aerial imagery was also developed from the drone flight.

2.4 PANZNER WETLAND WILDLIFE RESERVE

Located along a roughly 3,200 LF section of Copley Ditch's western bank between Wright Rd. and Wadsworth Rd. is the Panzner Wetland Wildlife Reserve (PWWR). A schematic of the property can be found in Appendix H.1. This nearly 105-acre property contains high quality, Category 3 wetlands, owned and maintained by the University of Akron (U of A). The land is an authorized site for compensatory mitigation and currently operates as a field station for U of A. EnviroScience coordinated several conversations with Lara Roketenetz, Ph. D. and Randall Mitchell, Ph. D. of the University of Akron, as well as Steve Panzner, the former landowner who is still heavily invested in the success of the PWWR. The design team wanted to facilitate this dialogue with the PWWR not only to glean any information or understanding they had of the watershed and flow regimes seen along Copley Ditch over the years, but also to gage their interest in using the property as part of the restoration and stormwater management efforts.

Figure 2.2: Panzner Wetland Schematic

Yellow Pond lies adjacent to Copley Ditch and is largely an open water pond with a berm along the eastern boundary with Copley Ditch. In the southeast corner of the pond is a small opening/breach that serves as the hydrologic connection between the wetlands and Copley Ditch. Currently there is no control structure nor means of adjusting water level. A small secondary pond just south of Yellow Pond has a similar small breach to allow connection to Yellow Pond. The mitigation wetlands lie to the south of this secondary pond and are also separated from Copley Ditch via berms. The mitigation wetlands are also separated from additional lands by a subtle grade change to higher ground. The western old field has good potential to be used for additional flood storage / wetland creation. The southern boundary of the Panzner property is characterized by an excavated swale/ditch that conveys water around the perimeter of the wetland and eventually back to the secondary pond in the north. South of the Panzner property lies several large parcels that have good potential for flood storage and/or wetland development.

To fully utilize the additional lands west of the mitigation area, earthwork involving both ditches is necessary in order to deliver hydrology to the western field along with embankments/berms to contain/control water in defined cells. The intent would be to keep the mitigation wetlands separate from the additional stormwater areas. The control of stormwater could continue to the parcels south of Panzner properties given additional earthwork to conceptually create a network of stormwater wetland cells.

The separation of the stormwater project from the mitigation wetlands is recommended due to concerns of invasive species by U of A. Currently, the mitigation wetlands are high quality with relatively low occurrence of invasives species. This has been accomplished through significant effort and resources by Panzner and U of A. Their annual budgets to control invasives are very small.

The invasive issue was clearly explained to EnviroScience as their biggest concern with respect to allowing more water into the site. The fear is that drastic changes to the flows and water elevations on the property will greatly increase the re-introduction of invasive species to the property. They also have concerns about future developments proposed in the West Akron and Copley areas to increase the amount and frequency of stormwater. Their concern regarding changes in water surface elevation was due not only to the sensitivity of the current site hydrology, but the fact that there is currently no defined inlet nor outlet controlling the wetland to maintain a consistent elevation if flows were altered. Therefore, invasive species would prove extremely detrimental to the PWWR, both in the substantial cost to treat and eliminate them once on the site and due to the Category 3 designation they are striving to maintain. While the PWWR highlighted the potential need for a long-term maintenance plan for invasive species control it is understood that the funding and resources needed for that effort is not currently available. At a minimum the project should have a target to include a single year effort during construction to mitigate the spread of invasives during earthwork and material hauling. Their final concern involves future developments, including those at White Pond, Jacoby Road and in the Knox Blvd area of Copley Township, and is a similar motivation for SCE completing these improvements to Copley Ditch. Overall, the PWWR representatives were open to being part of the proposed improvements as long as there are no negative impacts to the wetland.

With these concerns stated, the Panzner and U of A representatives agreed that there was good potential for additional water storage on lands to the west and south of the mitigation wetlands. They were also open to the idea of one or more water control structures. Ultimately, we believe they would be receptive to a project if the invasive species needs were addressed adequately, and they were included as a stakeholder in plan review process.

3.0 EXISTING CONDITIONS MODELS

To determine the hydraulic feasibility of the ditch restoration and bankfull wetland concept designs, EnviroScience developed existing conditions models for Copley Ditch and Black Pond Outlet. 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

The project sites are within a FEMA SFHA AE, with the main channel of Copley Ditch within a Regulatory Floodway according to the Flood Insurance Rate Map (FIRM Panel 39153C0178F, Panel 178 of 285, effective April 19, 2016). See Appendix C.1 for the FIRM. In order to evaluate potential impacts to the regulatory floodplain and floodway, the current effective model for the project area was requested from FEMA Engineering Library. When FEMA looked for a hydraulic model, they did not find the model itself but did find the results from the model. EnviroScience received HEC-2 printouts (summary tables only) from microfiche that was scanned to PDF (Appendix C.2). This HEC-2 printouts were available for cross sections A through G of the FIRM panel for Copley Ditch only. FEMA Engineering Library was unable to locate any associated maps. The data were never converted to 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. Black Pond Outlet has not been modeled/studied to date.

According to the HEC-2 printouts, The original HEC-2 hydraulic model for Copley Ditch, named Pigeon Creek Tributary 2, was developed by Polytech Inc., released in November 1976, and last updated in August 1977. The model consisted of seven (7) cross sections along Copley Ditch 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.2). 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: Copley Ditch, 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)
A	966.04	968.9	-2.9
B	966.86	968.9	-2.0
C	971.20	970.6	0.6
D	973.34	972.7	0.6
E	995.53	994.9	0.6
F	1019.40	1018.8	0.6
G	1024.35	1023.8	0.6

Ignoring Cross Sections A and B, which are located along a tributary to the main channel of Copley Ditch, the difference between the HEC-2 computed elevations and FIRM WSELs is consistently 0.6-ft. It is assumed that 0.6-ft represents a vertical datum conversion from NGVD to 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 Copley Ditch shown on the FIRM were taken from the HEC-2 with no other models or studies considered. The FIRM for Black Pond Outlet does not show any evidence that it was ever modeled, such as cross sections or WSELs. We surmise that the delineation of flood hazards shown on the FIRM for Black Pond Outlet are based on the same profile as Copley Ditch. Copley Ditch in turn appears to be based on the same profile as Pigeon Creek. As the effective hydraulic models are unavailable for Copley Ditch and Black Pond Outlet, it was necessary to develop alternative hydraulic models in attempt to reproduce the FIS profiles.

In terms of flow rates, FEMA Engineering Library was unable to locate any separate hydrologic studies for the project areas. The annual peak streamflows 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 Copley Ditch. The flow used to develop the HEC-2 profile for the 100-yr event is shown in Table 3.1 and 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 Copley Ditch and Black Pond Outlet 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. EnviroScience therefore computed flows using the best available data in HEC-HMS using the procedures documented in Section 3.2.

3.2 EXISTING CONDITIONS HYDROLOGIC MODEL

In the absence of reliable flow values, EnviroScience performed rainfall-runoff modeling to develop flows based on current information. The EnviroScience (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 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 watersheds for Copley Ditch and Black Pond Outlet. Flow direction was determined using the eight direction pour point model (Jenson 1988, Qin 2007). The Wadsworth Rd bridge (41.057453°, -81.598628°) was used as the basin outlet for Copley Ditch. The Penelope Dr bridge (41.075184°, -81.591561°) was used as the basin outlet for Black Pond Outlet. The drainage areas for Copley Ditch and Black Pond Outlet are 1.66 and 0.52 square miles, respectively (see Figure 3.1 and 3.2).

3.2.2 Land Use and Hydrologic Condition

Satellite imagery, Summit County tax parcel shapefiles, zoning data and C-CAP Derived Land Cover – BETA 10m 2017 (CCAP) 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 Herbaceous, Upland Forest, Developed (Residential/Commercial/Industrial), Scrub/Shrub Wetland and Forested Wetland.

NRCS Soil Survey data were used to determine the Hydrologic Soil Groups (HSG) for the drainage basins. Twenty-eight different soils were identified, largely consisting of Carlisle muck. For a full map and table of the existing soils, see Appendix A.1. 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.2).

3.2.3 Basin Model Setup

Subbasins were delineated using drainage areas approximating those of the 14-digit Hydrologic Units (HUC-14). Copley Ditch consists of eleven (11) subbasins, seven (7) reaches, and one (1) sink. Black Pond Outlet consists of three (3) subbasins, one (1) reach 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. HMS basin schematics for Copley Ditch and Black Pond Outlet are provided in Figures 3.1 and 3.2. The subbasin parameters used for modeling are summarized in Tables 3.2 and 3.3.

It should be noted that K.E. McCartney & Associates (KEM) performed an independent review of the models on June 6, 2023 and found the assumptions within the basin model setups 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. EnviroScience 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 basins. 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. EnviroScience 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 – Copley Ditch

COPLEY DITCH						
Subbasin ID	**Area (ac)**	**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	82.26	73.9	5,429	0.0163	0.04938	23.9
Subbasin-7	131.5	69.3	6,172	0.02463	0.07547	24.3
Subbasin-16	14.3	65.2	1,538	0.01504	0.07828	8.7
Subbasin-8	185.8	58.1	6,959	0.01252	0.06758	37.7
Subbasin-17	10.7	57.5	1,936	0.01193	0.14068	9.6
Subbasin-9	106.7	55.8	4,297	0.00428	0.05836	29.3
Subbasin-19	123.8	60.7	7,186	0.00212	0.06675	36.5
Total	1062.36					

Figure 3.1: HEC-HMS Basin Schematic for Copley Ditch

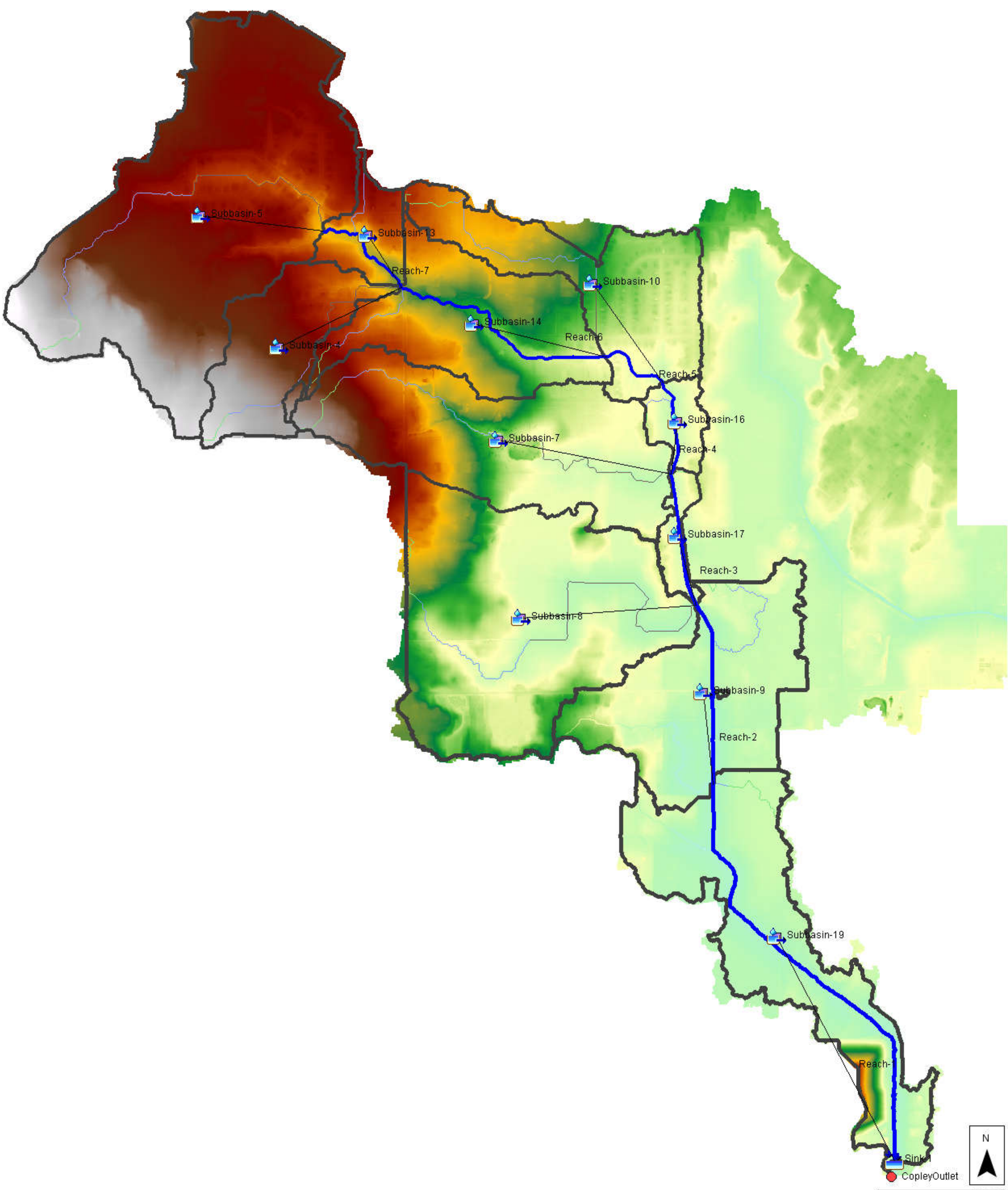
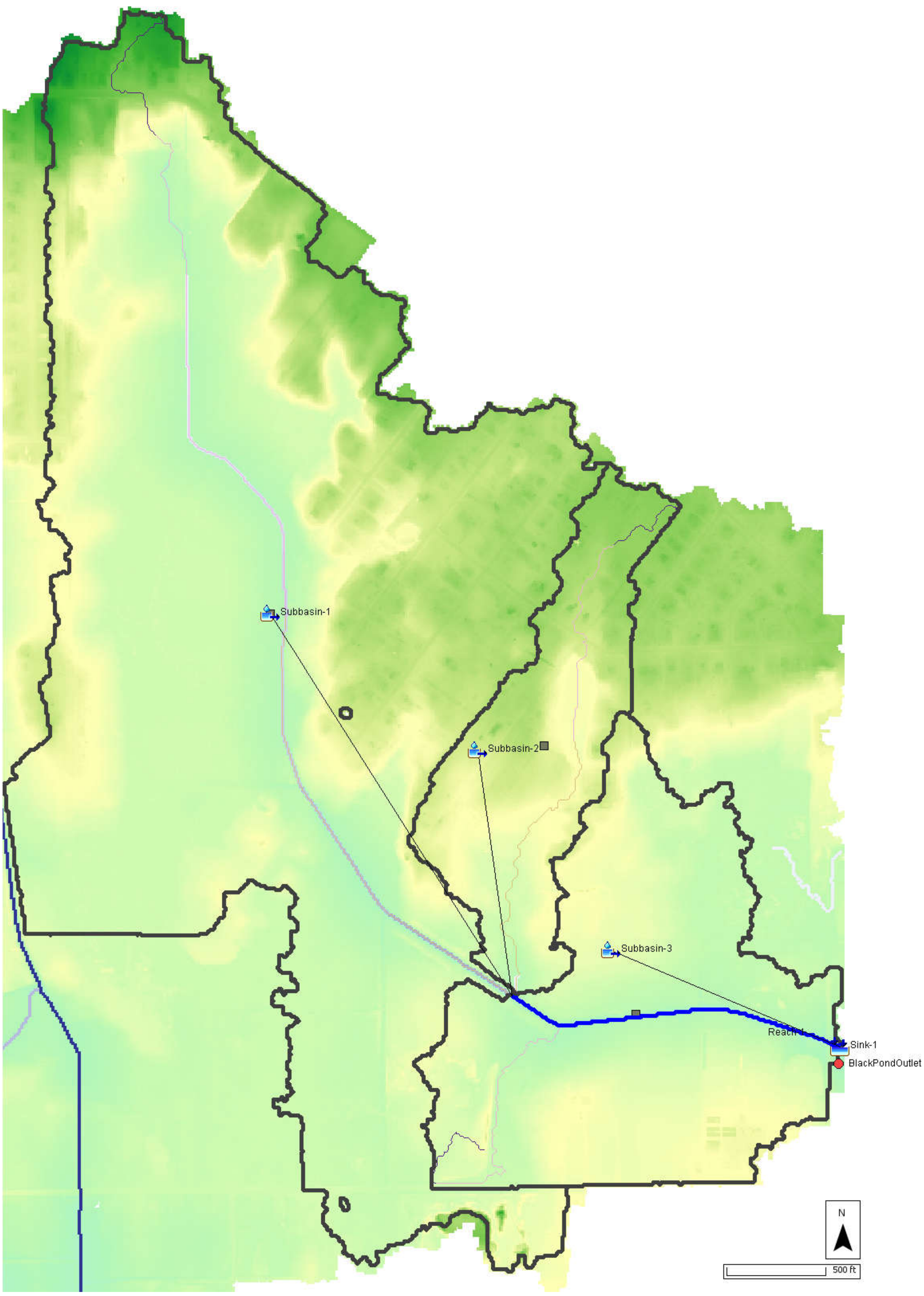


Table 3.3: Subbasin Parameters – Black Pond Outlet

BLACK POND OUTLET						
Subbasin ID	**Area (ac)**	**CN**	**Longest Flowpath (ft)**	**Longest Flowpath Slope (ft/ft)**	**Basin Slope (ft/ft)**	**Lag Time (min)**
Subbasin-1	230.4	56.6	6,295	0.00725	0.05473	25.3
Subbasin-2	33.9	45.2	3,425	0.00933	0.03756	53.7
Subbasin-3	66.9	67.5	3,565	0.00710	0.05566	22.6
Total	331.2					

Figure 3.2: HEC-HMS Basin Schematic for Black Pond Outlet



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 NOAA Atlas 14, Volume 2, Version 3 for Akron, Ohio, Station ID 33-0059 (Appendix A.3). Precipitation depths are summarized in Table 3.4.

Table 3.4: Precipitation Depths, NOAA Atlas 14

BLACK POND OUTLET								
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 hydraulic models and proposed conditions hydraulic models. The flow values calculated by EnviroScience (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 3.5.

Table 3.5: Flood Frequency Estimates for 100-yr Event, HEC-2 vs StreamStats vs HEC-HMS

Recurrence Interval (yr)	COPLEY DITCH			BLACK POND OUTLET	
	HEC-2 (cfs)	StreamStats (cfs)	HEC-HMS (cfs)	StreamStats (cfs)	HEC-HMS (cfs)
2	n/a	112	165	24.6	14.4
5	n/a	168	495	36.5	38.5
10	181	206	580	44.8	67.8
25	n/a	256	652	55.7	122.7
50	289	294	701	64.1	176.0
100	340	333	707	72.6	238.3
500	513	423	752	93.3	417.4

3.3 EXISTING CONDITIONS HYDRAULIC MODEL

Copley Ditch and Black Pond Outlet both exhibit complex overland flow patterns for larger flooding events. South of Lakeland Avenue, the two regulatory floodplains converge, which is further complicated by potential backwater effects from the confluence of Black Pond Outlet and Pigeon Creek, just north of Wright Rd. Further, Copley Ditch is diverted around Yellow Pond and the Panzner Wetland Preserve during low flow events yet can flow in and out of these bermed areas in both directions depending on the river stage. One-dimensional (1D) hydraulic models have limitations in modeling complex flooding scenarios such as these. The objective of this task is therefore to provide an alternative model to the current effective model (unavailable- not supplied by FEMA Engineering Library) to re-evaluate and map flood inundation and depth using the revised hydrology of Section 3.2, the most recent topographic data (OGRIP 2019) and a 1D/2D modeling approach to better simulate these flow patterns using the latest version of HEC-RAS (6.3.1).

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. The 1D portion of the Copley Ditch model begins just south of the intersection at Copley Rd and Copley Meadows Dr. 2D flow areas are provided on the left and right overbanks of the main channel just south of Lakeland Ave. The Copley Ditch model terminates just downstream of the Wadsworth Rd bridge and just upstream of the Pigeon Creek confluence. The Black Pond Outlet 1D model begins just downstream of Copley Rd with 2D flow areas provided on the left and right overbanks downstream of Lakeland Ave. The model terminates just downstream of Penelope Rd. bridge and just upstream of the Pigeon Creek confluence. 2D flow areas are connected to the 1D cross sections using lateral weirs. The 2D areas are better suited for simulating shallow overbank flow as well as capturing depression storage and complex interactions between the two floodplains, especially in the vicinity of Panzner Wetland Preserve. Figures 3.2 and 3.3 show the 1D HEC-RAS model schematics.

Figure 3.3: HEC-RAS Schematic for Copley Ditch

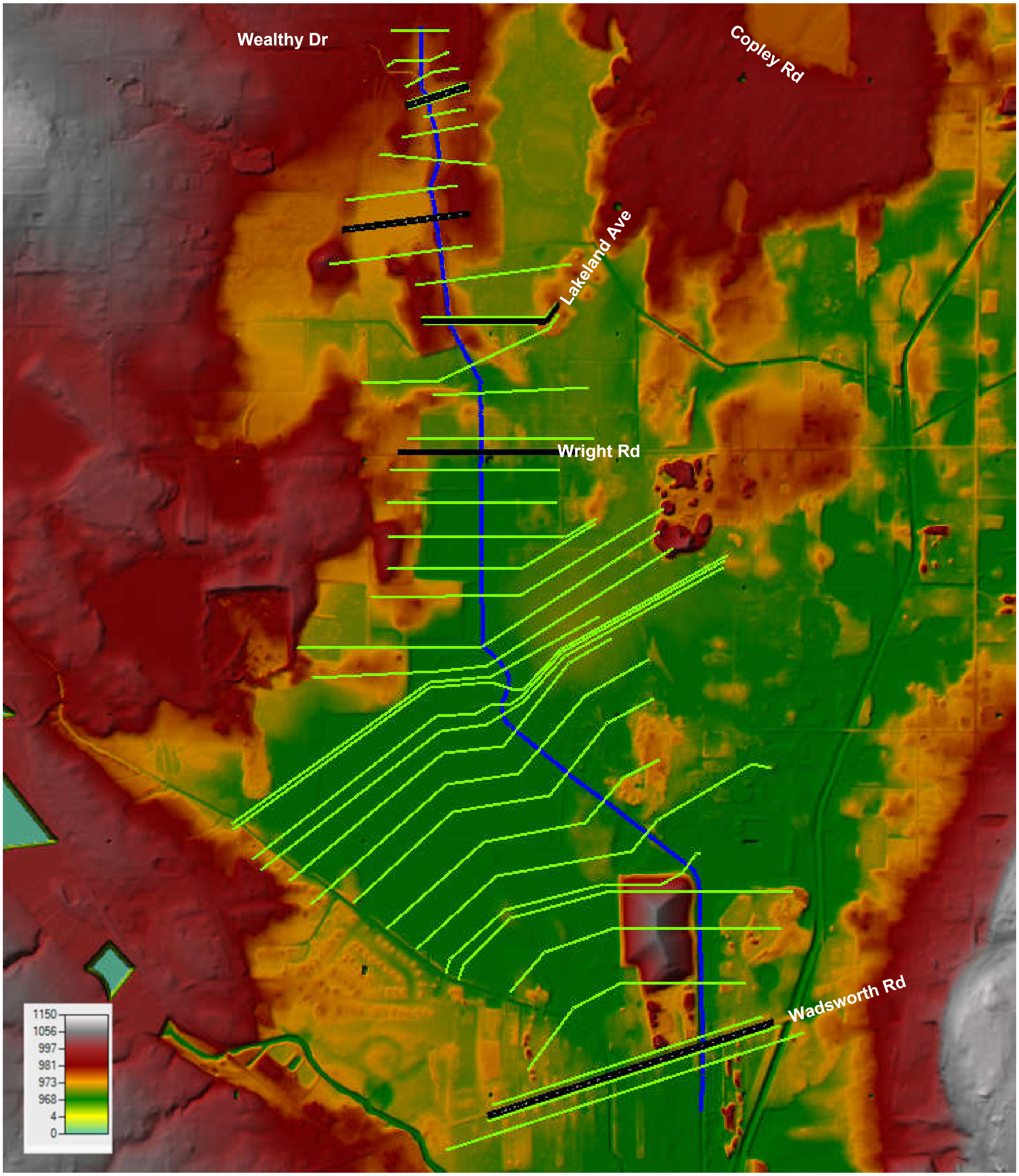
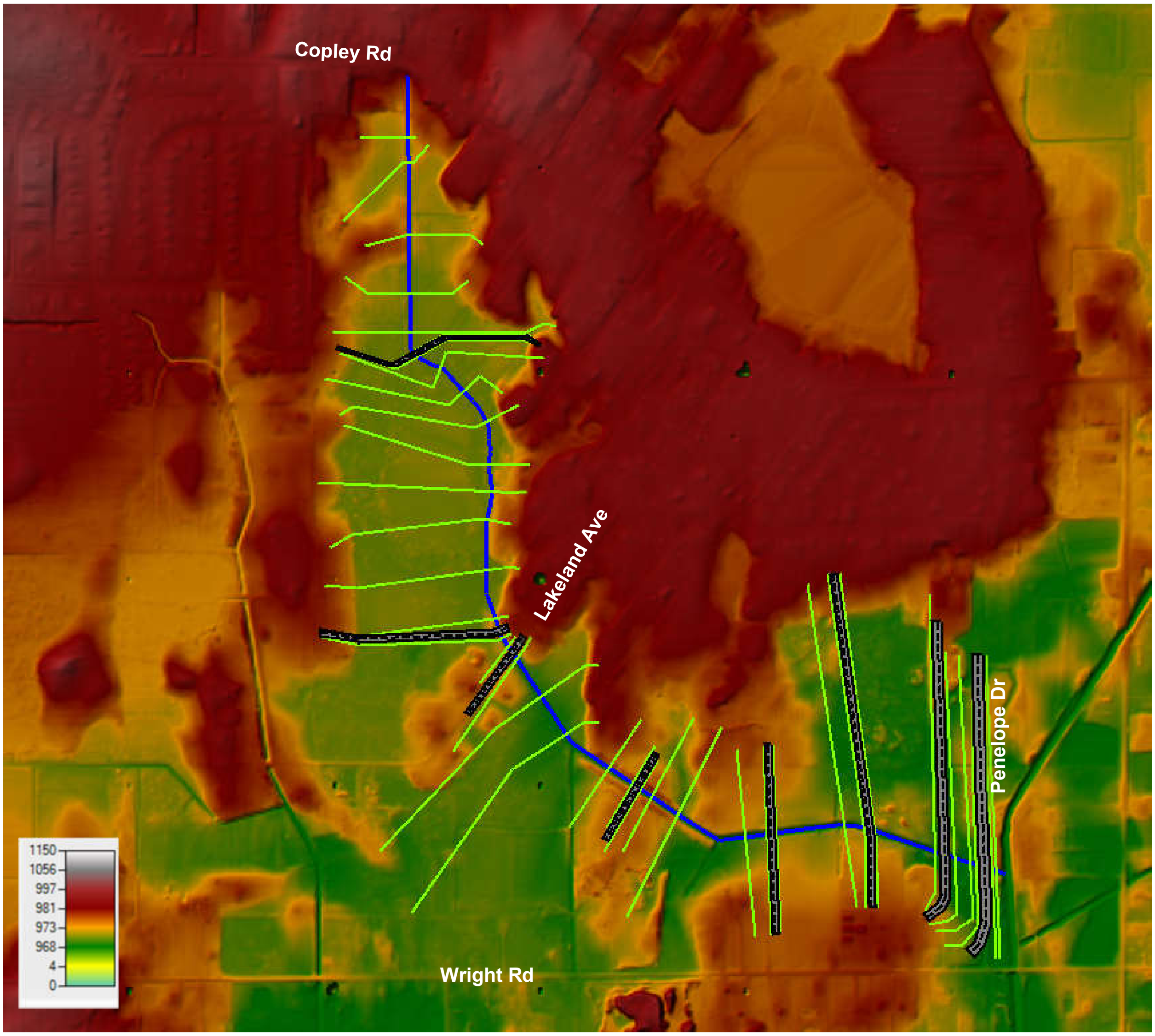


Figure 3.4: HEC-RAS Schematic for Black Pond Outlet



3.3.2 1D Model Geometry

Cross sections were extracted from the 2019 LiDAR. In general, cross sections are spaced approximately every 200 feet, upstream and downstream of all bridge/culvert crossings, with additional cross sections provided in the proposed improvement areas. Where possible, cross sections were also drawn to coincide with the current FIRM. The exceptions are Cross Sections E, F and G which are tributary to the main channel and not practical for modeling and not used in this model; much of this tributary is underground in a stormwater sewer with relatively small flows originating from the headwater subbasin. Several FIRM cross sections were adjusted to correctly align with the main channel and cover the entire width of the floodplain.

Copley Ditch has four (4) bridge/culvert crossings and Black Pond Outlet has six (6) bridge/culvert crossings. Stationing, top of deck, culvert lengths, pipe inverts, construction materials and geometry were obtained from field survey data.

Manning's n values were associated with each gridded land cover type as described in Section 3.2.2. For overbank areas, Manning's n values were automatically extracted from the grid. For the main channel, n values were manually assigned. All n values were taken from RAS Technical Reference Manual (HEC, 2012). A high-resolution orthomosaic obtained using an unmanned aerial vehicle (UAV) was used for visual inspection.

3.3.3 2D Model Geometry

A 2D computational mesh with an average cell size of 100-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 berms and weirs at Panzner Wetland Preserve. Manning's n values were assigned to the 2D mesh using the land use grid discussed in previous sections. 2D flow areas were connected to 1D cross sections using lateral weirs. The lateral weirs were delineated along high grounds where the floodplain is not well-defined.

3.3.4 Hydraulic Modeling Results

Visual indicators in the field and aerial imagery suggest that the floodplain is being accessed often. An iterative approach was used to estimate the physical bankfull flow by gradually increasing steady state flow in the 1D model and determining the point at which water began to enter the floodplain. For Copley Ditch, this was determined to be approximately 80 cubic feet per second (cfs). This flow rate is approximately equal to a 1.4-yr event. For Black Pond Outlet, the physical bankfull flow was approximated as 20 cfs, or the equivalent of a 1.8-year event.

It should be noted that Copley Ditch and Black Pond Outlet become hydraulically connected for large flood events. This is due to the relatively flat and expansive floodplain shared by the two ditches. Black Pond Outlet (Black Pond XS 16) controls the water surface elevation (WSEL) just upstream of Lakeland Avenue for the 25-yr (971.55'), 50-yr (971.65'), 100-yr (971.75) and 500-yr (972.52') events. Copley Ditch (Copley XS 16) controls the WSEL just upstream of Wright Road for the 100-yr (975.80') and 500-yr (also 975.80') events. This implies that Copley Ditch and Black Pond Outlet must be jointly modeled for the 25-yr event and up.

Copley Ditch becomes hydraulically connected to Viers Ditch at Cross Section 37 for events greater than the 10-yr (> 580 cfs). For the 100-yr event, Copley Ditch creates a backwater effect on Viers Ditch which is effective from Wadsworth Road to approximately the cul-de-sac at Oakmont Drive. This backwater effect is relatively minor and extends less than 1,500 feet.

The hydraulic model output for the 100-yr events for Copley Ditch and Black Pond Outlet is provided in Table 3.6 and Table 3.7, respectively. Note, "Floodplain Activated" refers to the water surface elevation (WSEL) exceeding the height of the channel bank(s) in which the floodplain is accessed. The associated flood inundation maps for the 100-year events for Copley Ditch and Black Pond Outlet are shown in Figure 3.5. This inundation map can also be found in the Appendices. For culverts and bridges, the smallest event that causes overtopping is shown in parentheses in the third column, e.g., the culvert at Station 11159.25 overtops during the 2-yr event and up.

Table 3.6: HEC-RAS Existing 100-yr Hydraulic Results for Copley Ditch

Cross Section ID	Station	100-yr			Floodplain Activated	
		Flow (cfs)	Velocity (ft/s)	WSEL (ft)	Left WSEL (ft) / #-yr	Right WSEL (ft) / #-yr
0	11842.91	165	2.16	978.31		977.59 / 10
1	11557.42	495	2.29	978.15	977.08 / 2	977.08 / 2

Cross Section ID	Station	100-yr			Floodplain Activated	
		Flow	Velocity	WSEL	Left	Right
		(cfs)	(ft/s)	(ft)	WSEL (ft) / #-yr	WSEL (ft) / #-yr
2	11375.12	495	4.48	977.80	976.34 / 1	
3	11193.45	495	1.59	977.78	976.33 / 1	
C1	11159.25	Culvert (2)				
4	11125.04	495	2.20	977.60		976.81 / 10
5	10989.36	495	2.15	977.52	975.98 / 1	975.98 / 1
6	10825.25	495	3.10	977.31	976.05 / 2	977.01 / 25
7	10539.61	528	3.19	976.86		976.86 / 100
8	10235.37	528	5.20	975.71		
9	9966.212	528	0.34	975.97		975.91 / 25
C2	9942.85	Culvert (25)				975.91 / 25
10	9919.487	528	0.41	975.96		975.96 / 100
11	9620.383	528	4.71	975.56		
12	9309.469	528	0.10	975.80	975.80 / 100	
13	8950.587	528	0.19	975.80	975.80 / 100	
C3	8915.84	Culvert (100)				
14	8883.374	528	0.88	971.77	969.85 / 2	
15	8420.53	626	0.52	971.75		968.76 / 2
16	8105.1	626	0.43	971.75	968.72 / 5	968.72 / 5
17	7646.753	626	0.39	971.38	975.46 / 100	975.46 / 100
C4	7515	Culvert (50)				
18	7345.123	626	3.79	968.03	968.01 / 50	968.01 / 50
19	7015.666	626	0.78	968.04	966.62 / 10	968.04 / 100
20	6683.573	626	0.58	968.02	965.76 / <1	966.61 / 10
21	6377.105	626	0.65	968.00	967.59 / 50	967.59 / 50
22	6104.842	626	4.30	967.68	968.54 / 500	968.54 / 500
23	5611.648	701	0.34	967.84	965.88 / 5	965.88 / 5
24	5411.232	701	0.32	967.83	965.88 / 5	965.88 / 5
25	5290.373	701	0.21	967.83	966.02 / 10	966.02 / 10
26	5094.838	701	0.30	967.83	965.49 / <1	965.49 / <1
27	4918.717	701	0.15	967.83	966.02 / 10	965.86 / 5
28	4820.195	701	0.17	967.83	965.47 / <1	965.88 / 2
29	4615.68	701	0.19	967.83	965.88 / 2	966.01 / 10
30	4314.558	701	0.19	967.83	965.44 / <1	965.88 / 2
31	3948.158	701	0.17	967.83	965.40 / <1	965.40 / <1
32	3499.253	701	0.20	967.82	965.98 / 10	965.17 / <1
33	2973.41	701	0.28	967.82	967.39 / 50	966.75 / 25
34	2456.788	701	0.50	967.81	964.53 / <1	966.73 / 25
35	2154.998	701	0.20	967.81	965.72 / 10	965.28 / 5
36	1798.854	701	0.51	967.80	964.33 / <1	964.33 / <1
37	1257.217	701	0.57	967.78	966.67 / 25	965.51 / 10
38	740.1591	707	2.79	967.59	968.16 / 500	968.16 / 500
C5	645.66	Bridge (>500)				
39	586.1381	707	3.23	967.32	966.95 / 50	966.95 / 50
40	436.3133	752	3.49	967.14	966.76 / 50	966.76 / 50

Table 3.7: HEC-RAS Existing 100-yr Hydraulic Results for Black Pond Outlet

Cross Section ID	Station	100-yr Flow (cfs)	Velocity (ft/s)	WSEL (ft)	Floodplain Activated Left WSEL (ft) / #-yr	Right WSEL (ft) / #-yr
0	6896.33	161.00	0.42	975.80	975.81 / 100	972.78 / 25
1	6745.78	161.00	0.18	975.80	975.81 / 100	972.76 / 25
2	6302.44	161.00	0.18	975.80	972.63 / 50	975.81 / 100
3	5952.11	161.00	0.11	975.80	970.43 / <1	972.68 / 50
4	5716.81	161.00	0.06	975.80	972.68 / 50	970.82 / 10
5	5595.92	161.00	0.03	975.80	970.82 / 10	970.82 / 10
C6	5578	Culvert (<1)				
6	5554.15	161.00	0.02	975.80	970.43 / <1	970.43 / <1
7	5397.20	161.00	0.02	975.80	970.43 / <1	970.82 / 10
8	5194.21	161.00	0.01	975.80	970.43 / <1	970.43 / <1
9	4957.75	161.00	0.02	975.80		970.82 / 10
10	4696.65	161.00	0.02	975.80	972.68 / 50	972.68 / 50
11	4530.5	161.00	0.03	975.80	972.68 / 10	972.68 / 10
12	4357.87	161.00	0.05	975.80	972.68 / 25	970.80 / 10
13	4051.60	161.00	0.06	975.80		970.77 /10
14	3746.68	161.00	0.06	975.80		970.73 / 10
15	3678.25	161.00	0.06	975.80		972.67 / 50
C7	3648.44	Culvert (25)				
16	3618.63	161.00	0.07	975.80		969.83 / 10
17	3561.98	161.00	0.81	972.66		972.64 / 100
C8	3518.4	Culvert (25)				
18	3463.40	161.00	0.88	971.75		
19	3196.99	161.00	0.29	971.75	969.22 / 10	969.22 / 10
20	2920.26	161.00	0.08	971.75	971.55 / 25	971.55 / 25
21	2584.8	161.00	1.38	971.71		
22	2409.91	161.00	1.32	971.67		
23	2352.96	161.00	1.49	971.64		
24	2272.88	161.00	1.14	971.63		
25	2079.64	167.00	0.79	971.60		
26	1624.83	167.00	0.64	971.57		971.51 / 25
27	1494.38	167.00	0.93	971.56		971.49 / 25
C9	1465.5	Culvert (25)				
28	1436.66	167.00	1.07	971.24		
29	1019.18	167.00	0.95	971.20		
30	901.73	167.00	0.11	971.21	971.21 / 100	
C10	865.63	Culvert (25)				
31	829.53	167.00	1.09	969.42		
32	448.85	167.00	0.27	969.42	969.42 / 50	969.42 / 50
C11	385.88	Culvert (100)				
33	322.89	212.00	0.53	968.38		967.69 / 25
34	224.98	212.00	0.89	968.37		967.68 / 25
35	181.40	212.00	10.44	966.50		967.64 / 50
C12	130.28	Culvert (100)				
36	79.149	212.00	4.86	966.59		967.78 / 100
37	54.544	212.00	7.45	965.78		967.73 / 100

3.3.5 FIRM Comparison

There are five cross sections shared by the FIRM and HEC-RAS model. Four of these cross sections correspond to the HEC-2 model while the fifth cross section comes from a separate study for Pigeon Creek. Table 3.8 provides a comparison of the 100-yr water surface elevations (WSEL) for existing conditions. The HEC-RAS water surface profile is more varied and steeper on average while the FIRM profile is relatively flat.

Table 3.8: Comparison of Water Surface Elevations (WSEL) for 100-yr Event, HEC-2 vs HEC-RAS

Cross Section ID FIRM / RAS	FIRM WSEL (ft)	HEC-RAS WSEL (ft)	Difference RAS - FIRM (ft)
Trib_D / 13	972.7	975.80	3.10
Trib_C / 17	970.6	971.64	1.04
Trib_B / 19	968.9	967.97	-0.93
Trib_A / 34	968.9	967.84	-1.06
Pigeon_D / 38	968.9	967.31	-1.59

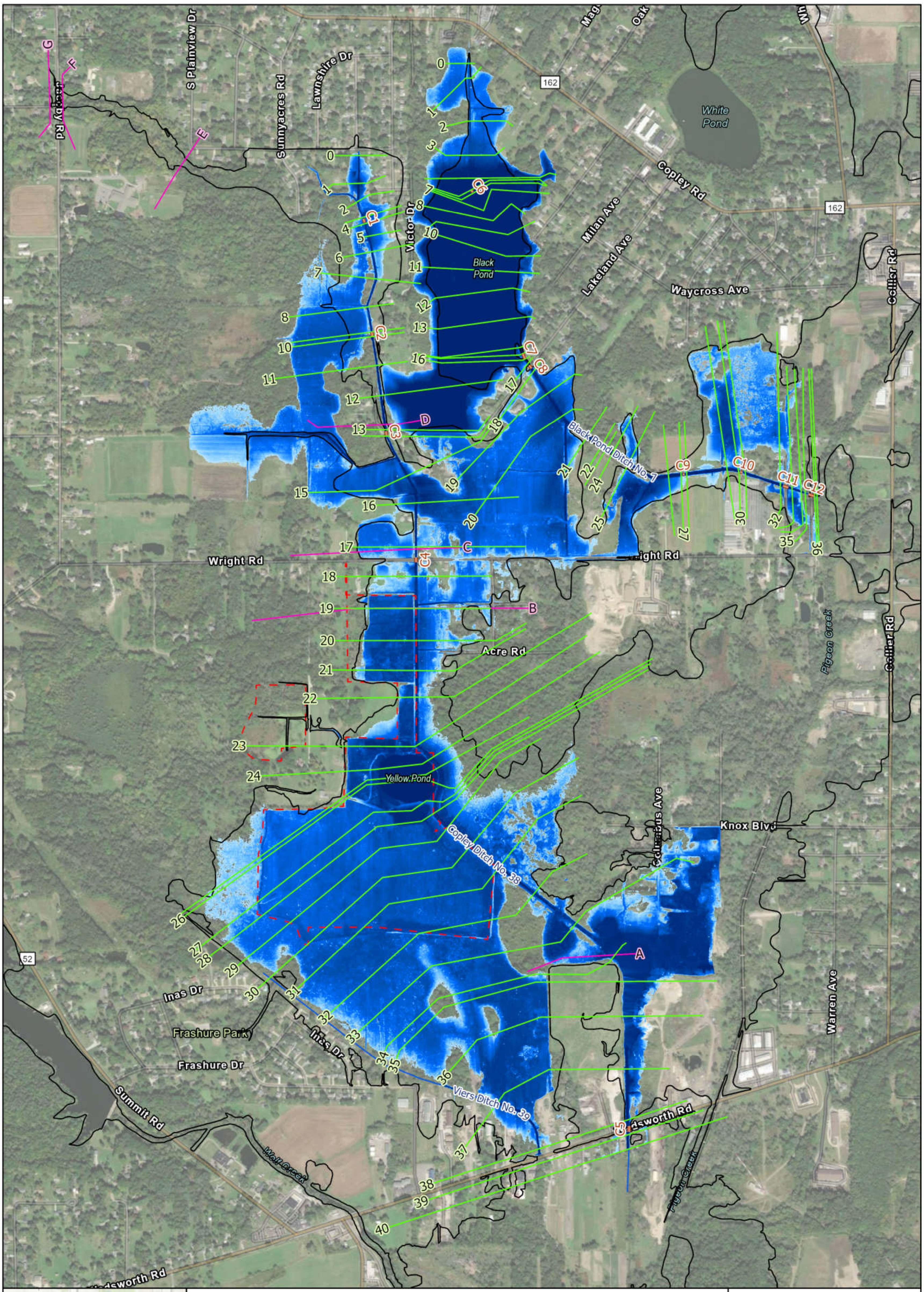
For reasons discussed in Section 3.1, the validity of the FIRM profile, which was developed in 1976 using smaller flows, is considered problematic. Questions surround the geometry used in the HEC-2 analysis. Again, the HEC-2 records which the FIRM is based on are not accompanied by a model and therefore cannot be inspected. The next best records for comparison are the *Summit County Department of Highways, Reconstruction & Cleaning of Copley Ditch (No 38)* plans (Plans) which contain channel slopes and typical cross sections. The Plans are dated July 1974 which is contemporaneous with the HEC-2 data. In an attempt to validate the Plans—and by extension the HEC-2 model—DLZ surveyed the five cross sections shared by the FIRM and HEC-RAS model in April 2023. In general, the present-day channel does not align with the drawings. The channel widths also vary by as much as 100%. Discrepancies between the channel dimensions and alignment can yield significantly different results.

Lastly, we compared the five bridges/culverts from the HEC-RAS model to the Plans. Table 3.9 provides a description of each culvert followed by the minimum channel elevation associated with that cross section. The first two culverts, C1 and C2, which consist of earthen crossings with 72" corrugated metal pipes (CMP) are not displayed on the Plans. It's unclear if these crossings were installed after the development of the HEC-2 model and if they were included in the model itself. We surmise that the differences in WSEL at *Trib_D/13* and *Trib_C/17* can be explained by the backwater effects created by the 72" CMPs which overtop for the 2- and 25-yr events, respectively. The undersized culverts have the effect of raising the WSELs in the HEC-RAS model which we assume is not reflected in the original HEC-2 model. Downstream of Lakeland Avenue, the HEC-RAS model reflects a typical water surface profile which more or less follows the slope of the main channel. On the other hand, WSELs between Lakeland Avenue and Wadsworth Bridge in the FIRM are completely flat. For cross section *Pigeon_D*, the WSEL is presumably controlled by Pigeon Creek with the flat water surface extending over 8,000 LF upstream. This profile would be reasonable for a large waterbody such as a lake or reservoir, but is unrealistic for a ditch.

In conclusion, we believe that the FIRM is unreliable for Copley Ditch and Black Pond Outlet and the HEC-RAS model is a better representation of the flooding potential based on updated hydrology.

Table 3.9: Comparison of Bridge/Culvert Crossings in 1974 Plans vs HEC-RAS

Culvert ID	Culvert Description	STA Plans	MIN CHAN ELEV. (ft) PLANS	MIN CHAN ELEV. (ft) HEC-RAS	Difference RAS - FIRM (ft)	Comments
C1 – Earthen Crossing	CMP 72"	126+43	972.80	971.40	-1.40	Not shown in Plans / Overtops at 2-yr
C2 – Earthen Crossing	CMP 72"	114+27	969.97	967.90	-2.07	Not shown in Plans / Overtops at 25-yr
C3 – Lakeland Ave	CMP 6.5' x 9.0'	104+00	967.67	966.26	-1.41	Overtops at 100-yr
C4 – Wright Rd	Conc. Box 7' x 10'	90+00	965.85	962.55	-3.30	Overtops at 50-yr
C5 – Wadsworth Rd	Conc. Slab 20' Span w/Piers	21+50	962.69	960.52	-2.17	Overtops > 500-yr



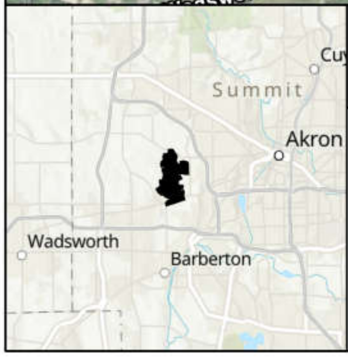


Figure 3.5: Copley Ditch and Black Pond Outlet Existing Conditions – 100-yr

JULY, 2023

Cross Section - ES
Cross Section - FIRM
Ditch
Bridge/Culvert
U of A/Panzner
FIRM 100-yr Floodplain
HEC-RAS Depth (ft)
10.0
0.0

0 400 800 1,600
Feet

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4.0 PRELIMINARY DESIGN

The following sections explain our preliminary approach to providing stormwater storage solutions as well as improving the ecological functions of the existing Copley Ditch and Black Pond Outlet Systems. The preliminary designs below are based upon the preliminary survey and data we have collected at this point and may evolve with additional future design.

4.1 COPLEY DITCH: PROJECT SCOPE

The preliminary improvements to Copley Ditch are grouped into six main work areas. These areas have a combination of two-stage ditch creation, riffle grade control structure installation, and removal of levees. Additionally, on the Panzner Wetland property, berms and ditch plugs will be installed to further inundate the property and use it for additional stormwater storage and treatment. Brief explanations for the selected improvement locations and types are provided below. See Appendix D for the 60% Preliminary Design Plans.

A summary of the six work areas follows:

- **Work Area 1**: 185 LF Two-Stage Ditch (filling overwide channel)
- **Work Area 2**: 661 LF Two-Stage Ditch (excavation of ditch and floodprone bench); 6,930 SF (0.16 AC) Levee Removal (72 LF)
- **Work Area 3:** 7,140 SF Levee Removal (330 LF); Riffle Grade Control installed in Existing Channel
- **Work Area 4:** 56,823 SF (1.30 AC) Levee Removal (290 LF) and Floodprone Area Expansion
- **Work Area 5:** 9,984 SF (0.23 AC) Levee Removal (145 LF); Alternating Channel Fill to create Meanders (using material excavated from levees)
- **Work Area 6:** Outlet Control Structure Installation on Yellow Pond; 5301 LF of Berm Creation including 3 Berm Outlets with Agri Drain structures; 1225 LF Level Spreader; 3 Ditch Plug locations within PWWR; 143,638 SF (3.30 AC) Depressional Wetland excavation to generate berm material
    - Two-Stage Ditch had previously been proposed in this area and was incorporated in the modeling, however due to constructability and access concerns in this wetland area, this has been eliminated from the design plans.

4.1.1 Ditch and Floodplain Improvements

EnviroScience evaluated the Copley Ditch corridor and found several opportunities for accessing existing low-lying floodprone and wetland areas, along with locations to implement two-stage ditch designs. The design team provided concept maps of these proposed improvement areas to SCE for review, and received feedback which has been incorporated into the preliminary design plans. The original concept plans can be found in Appendix G.

A majority of these floodprone area expansions are possible through removal of berms to allow the flows to access the already flat low-lying topography along the Ditch. While the wider floodplain is utilized during large storm events and is part of the designated FEMA floodplains, it is important to differentiate that these proposed improvements are designed to become utilized during the lower, more frequent storm events. This is altering the original management approach for this area from directing the water off the landscape quickly to the opposite approach of increasing detention and time of concentration.

Besides the levee breaches, we have proposed riffle control structures at key locations to help raise the base and flood water levels. Re-meandering the channel in some locations is more feasible than others given the relationship of the adjacent ground (i.e. floodplain) to the ditch alignment. Previous channelization often disregards original valley topography and simply excavates through higher elevations to achieve the straight ditch geometry. Consequently, these reaches would have more earthwork volumes to meet a similar outcome to other areas making them less cost effective. We understand the comments from SCE regarding the desire for more re-meandering and will scrutinize that potential more closely in the next design phase. There are six levee removal areas identified along Copley Ditch, including an excavation area that incorporates wetland depressions for additional capacity, and habitat variation. There is one riffle grade control proposed in this reach which is intended to raise water elevations so that existing floodprone areas will be more frequently activated. These existing floodprone areas that would be inundated are likely undevelopable due to their current low-lying, saturated soil state, so this expanded flood area should not be seen as detrimental to potential growth or development of the community.

One of the big questions posed by SCE on the concept maps was if all of Copley Ditch could be reworked into a two-stage ditch. A two-stage ditch is an alternative that can occur in the higher bank areas where re-meandering may not be as feasible. The creation of a two-stage ditch also has to be carefully implemented due to FEMA floodway designation. Changing the shape of the existing cross section will affect the model. Balancing the cut and fill material will not only be important but it is anticipated that a haul off or spoiling of material outside of the floodway will be necessary to meet the “no-rise” condition. Therefore, a two-stage ditch creation or floodprone bench creation may be most cost-effective and help the model near areas with “good” construction access. Approximately 850 LF of a two-stage ditch is proposed along Copley Ditch. Most of this two-stage ditch creation involves filling of the overwide channel, however one area includes the excavation of a bankfull bench, a floodprone area that will see regular inundation at low interval storms.

The Panzner mitigation wetlands, now managed by U of A, is one of the most significant areas of potential to expand stormwater management. If the invasive species concerns can be navigated and potential parcels to the south of the Panzner property can be acquired by purchase or easement, the proposed combination of parcels could total 173 acres of stormwater management potential. Approximately 5,500 LF of berms are proposed on or adjacent to the Panzner property. The installation of the berms in tandem with several ditch plugs and a rock control structure at the downstream end of Yellow Pond are intended to create different cells within the property to retain more water, essentially using the existing wetlands for additional stormwater storage and treatment. Materials excavated in other areas of Copley Ditch could be hauled to this area to create the berms, however care would need to be taken to ensure no introduction of invasive seed banks that may be present within the excavated materials. For these reasons, we have proposed excavating wetland depressions within the Panzner property, nearby the proposed berms, so that materials do not need to be handled multiple times.

4.1.2 Property Acquisition and Easements

The proposed work areas for Copley Ditch spans twenty privately owned properties. The limits of the proposed inundation or storage areas are what the floodplain expansions detail, while smaller levee removal areas will be identified where earthwork is proposed. 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 Ditch Improvements.

4.1.3 Access and Staging

The current preliminary plan assumes spoiling materials on-site within the overwide/abandoned ditch alignment, or nearby on adjacent properties. This strategy, while saving the construction cost of hauling materials off-site, does generate additional easement areas. At this stage of planning, we should consider haul off of material to assist with floodway modeling to determine the most cost-effective approach. Temporary easement areas will be required for the construction access routes. Additional considerations for spoiling material includes the potential need for a separate Stormwater Pollution Prevention Plan (SWPPP) and NOI if spoiled off site, and possible soil testing for material to be hauled off site or placed on different properties. Anticipated access routes are shown on the 60% Design Plans in Appendix D.

4.1.4 Preliminary Cost Estimate

Cost information from the previously completed Wolf Creek Study was used to guide EnviroScience's design to keep the scope of work in-line with projected construction budgets. Quantities were generated based off the preliminary survey data collected in comparison with the proposed grades for the ditch improvement features.

The table below provides the costs for major components of the proposed Copley Ditch Improvements. A detailed, itemized cost estimate will be provided in the next phase of the study. A one-year invasive species treatment is included in the construction total, as this is a typical process for stream restoration work. We also feel it is recommended to include an estimate for multiple years of post-construction invasive management given their concerns coupled with the shear size and potential for improvement in those areas. A detailed, itemized cost estimate is provided in Appendix I.

Table 4.1 Copley Ditch Preliminary Cost Estimate

Item	Cost
Construction Total (Including 20% Contingency)	$1,181,829
Final Engineering & Survey	$118,183
Construction Administration & Inspection	$177,275
Permitting & Regulatory	$45,000
Pre-construction Treatment of Panzner Work Area (~115 Acres)	$35,000
Post-Construction Treatment of Panzner Work Area (2 Years)	$75,000
Post Construction Treatment of Other Work Areas (1 Year) Excludes ~115 Acres of Panzner Area assumed above	$40,000
Preliminary Project Cost Estimate	**$1,672,287**
Projected 2027 Preliminary Project Cost Estimate	**$2,006,745**

4.2 BLACK POND OUTLET: PROJECT SCOPE

The preliminary improvements to Black Pond Outlet are grouped into eight main work areas. These areas have a combination of floodplain expansions, two-stage ditch creation, stream restoration and meandering, control structure installation, and removal of levies. Brief explanations for the selected improvement locations and types are provided below. See Appendix D for the 60% Design Plans.

A summary of the eight work areas follows:

- **Work Area 1**: Riffle Grade Control installed in Existing Channel
- **Work Area 2**: 770 LF Two-Stage Ditch (fill of overwide channel)
- **Work Area 3**: Riffle Grade Control installed in Existing Channel
- **Work Area 4**: 980 LF of Re-Meandered Two-Stage Ditch and Abandon/Fill of 835 LF Ex. Channel
- **Work Area 5**: Control Structure installed at inlet of Black Pond to divert flow to channel
- **Work Area 6**: Outlet Control Structure Installation on Black Pond; 9381 SF (0.22 AC) of Levee Removal/Floodprone Area Expansion (160 LF)
- **Work Area 7**: 1425 LF Two-Stage Ditch (fill of overwide channel); 15,035 SF (0.35 AC) Levee Removal (295 LF)
- **Work Area 8**: 900 LF Two-Stage Ditch (excavation and fill in channel)

4.2.1 Ditch and Floodplain Improvements

The Black Pond Outlet project is a smaller watershed but has multiple opportunities grouped into 8 work areas. In some respects, the proposed opportunities and reasoning are similar to those stated above with Copley Ditch. We believe one of the more significant areas proposed on Black Pond is associated with Black Pond itself. Currently the base flow and flood flow of the ditch enter the pond in an uncontrolled manner. There is a bypass ditch alignment that could be easily re-activated such that base flow no longer enters Black Pond. Water control structures installed at both the inlet and outlet could convert this pond to a ~7.0 acre stormwater management area. Re-activation of the bypass ditch is not explicitly modeled or shown in the plans; further study will be required before a final design volume and overall feasibility (i.e. freeboard, elevations) can be determined. Upstream of Black Pond, there are also low-lying areas that could be better utilized through a combination of re-meandering channel, levee removal and/or riffle grade control structures. Moving downstream in the watershed Floodplain Expansion Area 3, we will have to evaluate this more closely. Here the adjacent topographic elevations are much higher than the ditch, creating some larger earthwork volumes if excavation, two-stage or re-meandering would be proposed.

4.2.2 Property Acquisition and Easements

The proposed work areas for Black Pond Outlet stretch across nineteen privately owned properties. It is important to note that while floodplain expansion may be shown on a property, that does not necessarily indicate that any earthwork is proposed in that area. The basis of EnviroScience's approach was to use the existing topography as much as possible to limit earthwork disturbance, and some of these expansion areas involve minor grading and removal of levies to access these existing low-lying storage areas.

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 Black Pond Outlet improvements.

4.2.3 Access and Staging

The current design plan assumes spoiling materials on-site, or nearby on adjacent properties. This strategy, while saving the construction cost of hauling materials off-site, does generate additional easement areas. Temporary easement areas will be required for the construction access routes. Additional considerations for spoiling material are the potential need for a separate Stormwater Pollution

Prevention Plan (SWPPP) and 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

Cost information from the previously completed Wolf Creek Study was used to guide EnviroScience's design to keep the scope of work in-line with projected construction budgets. Quantities were generated based off of the preliminary survey data collected in comparison with the proposed grades for the ditch improvement features.

The table below provides the costs of major components of the proposed Black Pond Outlet Improvements. A one-year invasive species treatment is included in the construction total, as this is a typical process for stream restoration work. A detailed, itemized cost estimate is provided in Appendix I.

Table 4.2 Black Pond Outlet Preliminary Cost Estimate

Item	Cost
Construction Total (Including 20% Contingency)	$598,494
Final Engineering & Survey	$71,820
Construction Administration & Inspection	$89,775
Permitting & Regulatory	$35,000
Preliminary Project Cost Estimate	**$795,089**
Projected 2027 Preliminary Project Cost Estimate	**$954,107**

5.0 PROPOSED CONDITIONS HYDRAULIC MODEL

The following sections provide summaries and discussions of the proposed conditions hydraulic models. Each proposed conditions model includes one or more components from the preliminary design as discussed in Section 4. In general, proposed conditions models are grouped into work areas. These work areas may consist of any combination of improvement strategies. These different strategies are modeled in isolation in order to evaluate the efficacy of the different improvement types. In this way, we can perform cost-benefit analysis to determine the desired project components. For instance, *Work Area A* may consist of *Improvement A* and *Improvement B* with 90% of the flood benefits from *Improvement A* but 90% of the cost from *Improvement B*. In this hypothetical case, it would be desirable to eliminate *Improvement B* from *Work Area A.* For final design, it is recommended that all desired improvements be included in a single proposed conditions model. Detailed tables are provided showing the change in water surface elevation (ΔWSEL) for all proposed improvements. It should be noted that in general, the impacts of the improvements are localized, i.e., two-stage ditch creation reduces the flooding potential for adjacent properties but has no effect further downstream at Wadsworth Bridge. For convenience, Tables 5.1.1 through 5.2.3 display the ΔWSEL only for the cross sections that have a change of at least ± 0.01-ft. For example, in Table 5.1.1, the two-stage ditch affects cross sections 0 – 8 only.

5.1 COPLEY DITCH: PROJECT SCOPE

The preliminary improvements to Copley Ditch are grouped into six main work areas. These areas have a combination of two-stage ditch creation, riffle grade control structure installation, and removal of levees. Additionally, on the Panzner Wetland property, berms and ditch plugs will be installed to further inundate the property and use it for additional stormwater storage and treatment. Brief explanations for the selected improvement locations and types are provided below along with their impacts on the proposed hydraulic model.

5.1.1 Two-Stage Ditch

The proposed conditions model for Copley Ditch contains two (2) two-stage ditch sections. The two-stage ditches were modeled together due to their proximity to each other. The construction of the two-stage ditch in Work Area 2 also assumes the levee removals as indicated on C-01. The improvements result in a significant reduction in water surface elevations (WSEs) extending from STA 151+00 to 166+00. There is a slight increase in WSEL at STA 169+00 as the two-stage ditch transitions back to the natural channel. We anticipate, however, that this increase could be reduced or eliminated through more detailed design.

Table 5.1: Copley Ditch – Two-stage Ditch, Existing vs Proposed

ΔWSEL (PROPOSED - EXISTING), FT

XS ID	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
0	-0.08	-0.07	-0.07	-0.09	-0.12	-0.11	-0.09	-0.22
1	-0.08	-0.07	-0.08	-0.09	-0.13	-0.13	-0.11	-0.28
2	-0.07	-0.07	-0.06	-0.07	-0.11	-0.1	-0.08	-0.38
3	-0.06	-0.06	-0.05	-0.05	-0.08	-0.07	-0.03	-0.3
4	-0.06	-0.16	-0.38	-0.57	-0.72	-0.77	-0.63	-0.66
5	-0.06	-0.17	-0.42	-0.66	-0.87	-0.92	-0.79	-0.79
6	-0.04	-0.12	-0.34	-0.56	-0.86	-0.97	-0.83	-0.88
7	-0.01	-0.04	-0.13	-0.24	-0.48	-0.55	-0.79	-1.15
8		0.01	0.01	0.03	0.06	0.1	0.16	0.45

5.1.2 Levee Removal

There are several opportunities for accessing existing low-lying floodprone and wetland areas through levee removal and excavation. The levee removals for Work Areas 3 and 5 were modeled together with significant decreases in WSEs between STA 192+00 and STA 205+00.

Table 5.2: Copley Ditch – Levee Removals, Existing vs Proposed

ΔWSEL (PROPOSED - EXISTING), FT

XS ID	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
17	-0.50	-0.63	-0.55	-0.43	-0.03			
18	-0.25	-0.37	-0.51	-0.44	-0.44	-0.34		
19	-0.17	-0.27	-0.41	-0.09	0.02	0.02	-0.01	-0.01
20	-0.13	-0.23	-0.35	-0.12	0.00	-0.01	-0.01	
21	-0.08	-0.15	-0.30					

5.1.3 Panzner Wetland Expansion

The Panzner Wetland property improvements, or Work Area 6, include berms, ditch plugs and outlet structures modeled separately from the other work areas. Taken together, these improvements result in a decrease in WSEL between STA 207+30 through the end of the study area at Wadsworth Bridge.

There was no change in WSEL for the 50-, 100- and 500-yr events. At these flooding stages, WSELs exceed the height of the proposed berms, netting no increase in floodwater storage. It should be noted that the following results pertain to Option B which provides 20 acres of additional storage over Option A. This represents the maximum expected potential flood benefit from the Panzner expansion project. The primary disadvantage of Option B, however, is that eleven (11) additional parcels would need to be acquired to support the project.

Table 5.3: Copley Ditch – Panzner Wetland Improvements, Existing vs Proposed

	ΔWSEL (PROPOSED - EXISTING), FT							
XS ID	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**500-yr**
22	-0.34	-0.6	-0.27	-0.16	-0.22			
23	-0.38	-0.75	-0.44	-0.26	-0.22			
24	-0.38	-0.76	-0.44	-0.28	-0.22			
25	-0.38	-0.76	-0.45	-0.27	-0.22			
26	-0.39	-0.76	-0.45	-0.28	-0.23			
27	-0.39	-0.75	-0.44	-0.28	-0.22			
28	-0.37	-0.75	-0.36	-0.27	-0.22			
29	-0.36	-0.76	-0.29	-0.28	-0.22			
30	-0.35	-0.78	-0.21	-0.29	-0.22			
31	-0.33	-0.79	0.67	-0.3	-0.23			
32	-0.11	-0.71	0.48	-0.31	-0.22			
33	-0.11	-0.3	-0.21	-0.19	-0.23			
34	-0.11	-0.29	-0.16	-0.18	-0.23			
35	-0.11	-0.27	-0.17	-0.19	-0.24			
36	-0.09	-0.26	-0.2	-0.21	-0.25			
37	-0.16	-0.54	-0.38	-0.29	-0.25			
38	-0.19	-0.63	-0.45	-0.36	-0.28			
39	-0.2	-0.63	-0.46	-0.37	-0.31			
40	-0.2	-0.62	-0.45	-0.37	-0.29			

5.1.4 Copley Ditch Recommendations

The proposed conditions model indicates that the improvements proposed at Work Areas 1 – 6 will provide additional storage by accessing existing and created floodprone areas, will increase hydraulic efficiency through the use of two-stage ditches, and will attenuate peak flows for higher frequency events by diverting floodwater through Panzner Wetland property improvements. We therefore recommend the two-stage ditch in Work Area 2, levee removals in Work Areas 2, 3, 4 and 5, alternating channels in Work Area 6, and all improvements at Work Area 6.

5.2 BLACK POND OUTLET: PROJECT SCOPE

The preliminary improvements to Black Pond Outlet are grouped into eight main work areas. These areas have a combination of two-stage ditch creation, riffle grade control structure installation, channel meandering, and removal of levees. Brief explanations for the selected improvement locations and types are provided below, along with their impacts on the proposed hydraulic model.

5.2.1 Grade Control

Riffle grade control for Areas 1 and 3 were modeled together due to their similar function and proximity. Taken together, the controls provide a decrease in WSELs for higher frequency events with no effect on 100- and 500-yr flows. The decrease in WSEs, however, is followed by a slight jump in WSEL. These impacts are noted from STA 6+10 to 10+60.

Table 5.4: Black Pond Outlet – Riffle Grade Control, Existing vs Proposed

	ΔWSEL (PROPOSED - EXISTING), FT							
XS ID	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**500-yr**
0		0.06	-0.02	-0.13	-0.01	-0.02		
1	-0.04	-0.13	-0.29	-0.34	-0.01	-0.02		
2		0	0.01	0.11	0.01	0.02		

5.2.2 Two-stage Ditch and Levee Removals

The proposed conditions model for Black Pond Outlet contains three (3) two-stage ditch sections. The two-stage ditch at Work Area 2 was modeled separately while two-stage ditches for Work Areas 7 and 8 were modeled together due to their proximity to each other. Areas 7 and 8 also assume levee removals.

Table 5.5: Black Pond Outlet – Two-stage Ditch Work Areas 7 & 8, Existing vs Proposed

	ΔWSEL (PROPOSED - EXISTING), FT							
XS ID	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**500-yr**
18	-1.22	-1.05	-0.67	-0.23	-0.01	-0.01	-0.04	-0.1
19	-1.2	-1.03	-0.63	-0.2	-0.01	-0.01	-0.04	-0.11
20	-1.2	-1.02	-0.61	-0.19	-0.01	-0.01	-0.04	-0.11
21	-1.19	-0.98	-0.51	-0.12	-0.01		-0.03	-0.09
22	-1.07	-0.74	-0.17	-0.02		0.02		-0.01
23	-0.37	-0.12	0.04	0.01		0.02		-0.02
24	-0.29	-0.26	0.03	0.01	0.01	0.03	0.01	-0.01
25	-0.29	-0.26	0.01	-0.01		0.01	-0.01	-0.05
26	-0.3	-0.29	-0.01	-0.02		0.02	-0.01	-0.05
27	-0.64	-0.35		-0.02		0.02	-0.01	-0.05
28	-1.2	-0.85	-0.29	-0.09	-0.03	-0.01	-0.02	-0.08
29	-0.45	-0.21	-0.04	-0.02	-0.02			-0.02
30	-0.59	-0.19	-0.01	-0.01	-0.01			
31	-0.48	-0.12	-0.04	-0.02	-0.01			-0.01
32	-1.22	-1.05	-0.67	-0.23	-0.01	-0.01	-0.04	-0.1

The improvements at Work Areas 7 and 8 lead to significant decreases in WSELs extending from STA 39+00 to STA 70+00.

In addition to the two-stage ditch at Work Area 2, this model also assumes re-meandering and abandoning the existing ditch, culvert removal, riffle grade control and control structures to divert base flows as indicated on C-06 (Work Areas 3, 4, 5, 6). These improvements result in a significant reduction in water surface elevations (WSEs) extending from STA 10+60 to 66+20. It should be noted that when modeling channel re-meandering separately, there is no net reduction in WSEL; re-meandering is therefore not recommended at Work Area 2.

Table 5.6: Black Pond Outlet – Two-stage Ditch Work Area 2, Existing vs Proposed Conditions

	ΔWSEL (PROPOSED - EXISTING), FT							
XS ID	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**500-yr**
2	-0.02	-0.07	0.32	0.77	-0.8	-0.52	0	-0.01
3	0	-0.01	0	-0.01	-1.2	-0.97	0	0
4	0	-0.01	0	0	-1.21	-0.97	0	0
5	0	-0.01	0	0	-1.21	-0.97	0	0
6	0	-0.01	0	0	-1.21	-0.97	0	0
7	0	-0.01	0	0	-1.21	-0.97	0	0
8	0	-0.01	0	0	-1.21	-0.97	0	0
9	0	0	0	0	-1.21	-0.97	0	0
10	0	0	0	0	-1.21	-0.97	0	0
11	0	0	0	0	-1.21	-0.97	0	0
12	0	0	0	0	-1.21	-0.98	0	0
13	0	0	0	0	-1.22	-0.97	0	0
14	0	0	0	0	-1.23	-0.98	0	0
15	0	0	0	0	-1.23	-0.99	0	0
16	0	0	0	0	-1.23	-0.99	0	0
17	0	0	0	0	-1.25	-1.02	-0.93	-0.15
18	0	0	0	0	-0.4	-0.17	-0.17	-0.08
19	0	0	0	0	-0.4	-0.17	-0.17	-0.09
20	0	0	0	0	-0.4	-0.17	-0.17	-0.09
21	0	0	0	0	-0.4	-0.17	-0.17	-0.1
22	0	0	0	0	-0.42	-0.18	-0.18	-0.11
23	0	0	0	0	-0.42	-0.18	-0.18	-0.12
24	0	0	0	0	-0.42	-0.18	-0.18	-0.13
25	0	0	0	0	-0.42	-0.19	-0.19	-0.13
26	0	0	0	0	-0.43	-0.19	-0.2	-0.14
27	0	0	0	0	-0.43	-0.19	-0.21	-0.15
28	0	0	0	0	-0.74	-1.66	-1.68	-1.83
29	0	0	0	0	-0.71	-1.63	-1.63	-1.59

5.2.3 Black Pond Outlet Recommendations

The proposed conditions model indicates that the improvements proposed at Work Areas 1 – 8 will provide additional storage by accessing floodplains, will increase hydraulic efficiency through the use of two-stage ditches, and will decrease the energy grade line by meandering the channel. Removal of the culvert between Work Areas 3 and 4 provides the greatest overall benefit by eliminating a choke point. We therefore recommend the riffle grade control in Work Area 1, two-stage ditch and culvert removal at Work Area 2, riffle grade control at Work Area 3, re-meandering and abandoning the existing ditch in Work Area 4, providing control structures to divert base flows in Work Area 5, levee removal and additional control structure(s) in Work Area 6, adding the two-stage ditch and levee removals in Work Area 7, and two-stage ditch in Work Area 8.

6.0 PERMITS AND REGULATORY COMPLIANCE

Regulatory permitting requirements for wetlands, floodplain, USACE, and Ohio EPA have been evaluated and summarized below:

1. FEMA: The entirety of the Copley Ditch and Black Pond Outlet study areas are within FEMA designated Zone AE, with the main channel of Copley Ditch 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 both Copley Ditch and Black Pond Outlet will require a Special Flood Hazard Development Permit from the County's Floodplain Administrator. This permit will require a hydraulic analysis (HEC-RAS) of each corridor. For Copley Ditch, which is within the floodway, the analysis will need to show a No-Rise scenario. The Black Pond Outlet analysis has an allowable tolerance of 1-foot of rise since it is in Zone AE without a floodway.

2. Section 401/404 Permits: A pre-application meeting was held with Chantelle Carroll of the USACE Buffalo District on April 25, 2023 at 1:00pm. Upon completion of the pre-application meeting, EnviroScience requested that Ms. Carroll provide separate project numbers (LRB numbers) for Copley Ditch and for Black Pond Outlet. This will allow Summit County Engineer to either submit these permits separately or jointly, depending on the excepted project timelines. The information that follows is a summary of that pre-application meeting and our additional permit research.

   USACE and Ohio EPA only regulate instances where either fill is being placed into a wetland or below the ordinary high-water mark (OHWM) of a stream or, in the instance of Ohio EPA, where an existing stream or wetland habitat type is being altered or degraded. The project areas are located within a "white-eligible" watershed for coverage under the blanket Ohio EPA Water Quality Certification for Nationwide Permits. Therefore, the project can operate under the Nationwide 27 (NWP 27) with the WQC attached. No permitting through the Ohio EPA (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.

   The permit does stipulate that 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 at the same time as the NWP 27 application because the application should include the waiver. This essentially streamlines the process of requesting the waiver as ODNR would approve the request and USACE would approve the NWP 27 with the waiver attached, avoiding having to re-verify the NWP to include the waiver after the fact.

Given the high-quality wetlands within the PWWR, we would suggest as part of the permitting process for this project to complete a consultation with Ohio Division of Natural Resources (ODNR) for Threatened and Endangered species (T & E) and with US Fish and Wildlife Service (USFWS) for bats. Additionally, a full environmental review from ODNR along with 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. A final permitting consideration is that post-construction monitoring may be required to be completed to satisfy the permit conditions through USACE. Since the sites are less than 5 sq. miles of drainage area a mussel survey will not be necessary.

3. 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 Notice of Intent (NOI) will need to be submitted prior to construction. Potential challenges for SWPPP and NOI permits are the ownership of the properties. SCE may need to consider specific language for their easement acquisitions to allow the entire project area to be considered one area.

7.0 HABITAT IMPROVEMENTS

As channelized ditches both Copley Ditch and Black Pond share many of the same characteristics with respect to degraded habitat. Channelization and ditching create a foundation for impaired habitat in which many especially low gradient streams can not recover from naturally. The loss of meandering geometry, overwide channel dimension, lack of velocity variability, destruction of riparian corridor, spoil levees etc. all work negatively against stream function with respect to providing habitat for riverine biology and wildlife. While this scope of work did not directly investigate the habitat quality of each reach, in our experience these areas would fall into the range of 35-55 with respect to the Qualitative Habitat Evaluation Index (QHEI). The typical target for attainment of Warm Water Habitat standards is a target of 60. These streams would be considered impaired in terms of habitat quality.

The proposed designs aim to reverse some or all of those attributes in the various work areas. Central to many of these improvements is modification to the channel dimension to eliminate the overwide condition and replace it with an appropriately sized channel dimension. This can occur in both the two-stage ditch configuration or new re-meandered channel but what occurs is improved sediment transport competency and hydraulic efficiency. The fine sediments and silt currently choking the channel and filling in the overwide condition will be either transported downstream or deposited in the floodplain as normally occurs in natural systems. The channel shape and its influence on the hydraulics and sediment regime in the channel is paramount to creating a habitat foundation for biology and wildlife. Often this fundamental change can have a cascading positive effect to create the riffle-pool complexes, variable flow regimes and in-stream habitat that are captured by the metrics of the QHEI. This along with improvements to the riparian corridor by removing invasive species to be replaced by a more diverse native species assemblage will promote woody overhanging vegetation, varying organic inputs for macroinvertebrate communities, increased streambank stability, root mats and root wads.

In summary, the fundamental shifts in channel geometry, elimination of the overwide condition, creating more frequent overbank accessibility, removal of invasive species and improving the native species throughout the corridor will have a positive effect on habitat and function for both Copley Ditch and Black Pond Outlet.

8.0 CONCLUSIONS

Based upon the preliminary data gathered and initial designs, estimates, and models the following conclusions regarding feasibility, project benefits, and general recommendations are provided for both Copley Ditch and Black Pond Outlet.

Immediate benefits of the proposed improvements include additional stormwater capacity for lower frequency storms, improved water quality through natural filtration and settling within the floodprone and wetland areas, and improved stream function, meaning better sediment transport which will help alleviate sediment buildup. 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 at Wadsworth Bridge. No significant reduction of flows were obtained at the downstream limit of the study area, however the enhancements should help lessen the strain on properties along the improvement areas during more frequent storm events.

The design team focused the improvements within the existing channel and immediate banks as much as possible to help minimize disturbance and thereby reducing excess costs for clearing, excavation, and easements as much as possible. The proposed improvements also attempted to balance earthwork as much as possible within the smaller work areas, or at a minimum within the overall Copley Ditch and Black Pond Outlet projects. Additionally, the proposed improvements are designed to be low maintenance, with no structures or features that should require routine cleaning or upkeep. The two-stage ditch and corresponding expanded floodprone benches will include native seeding and plantings, and once these are established, they will not require regular mowing or maintenance. The County can select specific species in the final design based on growing height and appearance to best suit their and the residents' preferences. The design team believes that the costs of these improvements are in line with the benefits that will be seen by the County and its residents.

However, one important point must be understood regarding this approach to these drainageway improvements. It must be clearly communicated to the community, especially adjacent property owners, that while these improvements have an overall benefit for the functionality of the ditches, it may mean seeing more inundation during low frequency storm events. As we have frequently pointed out, a large focus of this design was to leverage the existing low-lying areas to use as additional capacity, storage, and treatment, so this means more water will be spread out over adjacent floodplains, which can be concerning to some residents who are, understandably, hesitant to want water on their properties. Public outreach and meetings to address these concerns and educate the public about how these waterways should function will be a critical piece to the success of the project.

It is the design team's recommendation that prior to moving into construction additional survey and detailed design be completed. The survey scope was limited in this phase of design. Survey data was only collected in areas that were selected for improvements to understand general slopes, grades, and general features of the sites. To generate a more complete, comprehensive design, detailed topographical and morphological survey would be required to better understand the project reaches. Detailed morphological data would be critical to finalizing the proposed thalweg elevations for the two-stage ditch and re-meandered reaches. This information is also crucial for generating accurate quantities and tie in points for the proposed in-stream features. It may also be important to complete geotechnical investigations of the materials being used for creating berms or fill within the channel to ensure they are of adequate quality for these uses.

Finally, long-term invasive species management is an important aspect of this design. The use of the Panzner Wetland property may hinge on the ability to implement a long-term invasive management plan. However, the feasibility of successfully executing a long-term treatment plan is not simple as both the funds and staff resources are not currently available to Summit County Engineer. Ongoing coordination between the PWWR and Summit County Engineer will be necessary to move forward with the designs as presented. Overall, long term maintenance for the project would be primarily focused on vegetation management, both for native and non-native, or invasive, species.

9.0 REFERENCES

Koltun, G.F., 2019, Flood-frequency estimates for Ohio stream gages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019–5018, 25 p., https://doi.org/10.3133/sir20195018.

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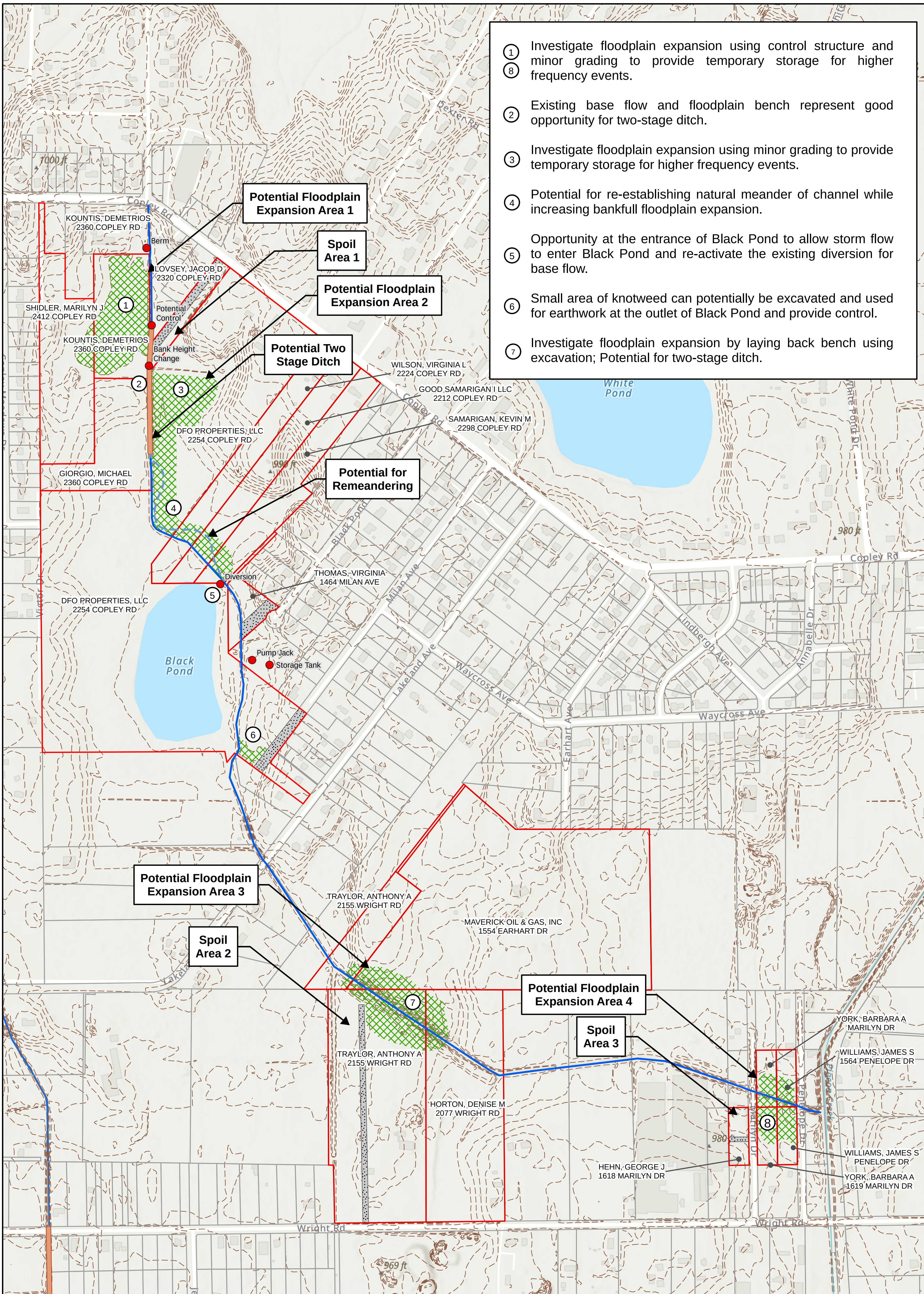

Figure 2. Black Pond Outlet - Initial Site Evaluation Priority Areas of Study for Potential Enhancements

October, 2022

LEGEND

- Existing Feature
- Waterbody
- Parcel
- Adjacent Parcel
- Black Pond Ditch
- Contour
- Floodplain Expansion
- Two Stage Ditch
- meander
- Access Road

0 200 400 800 Feet

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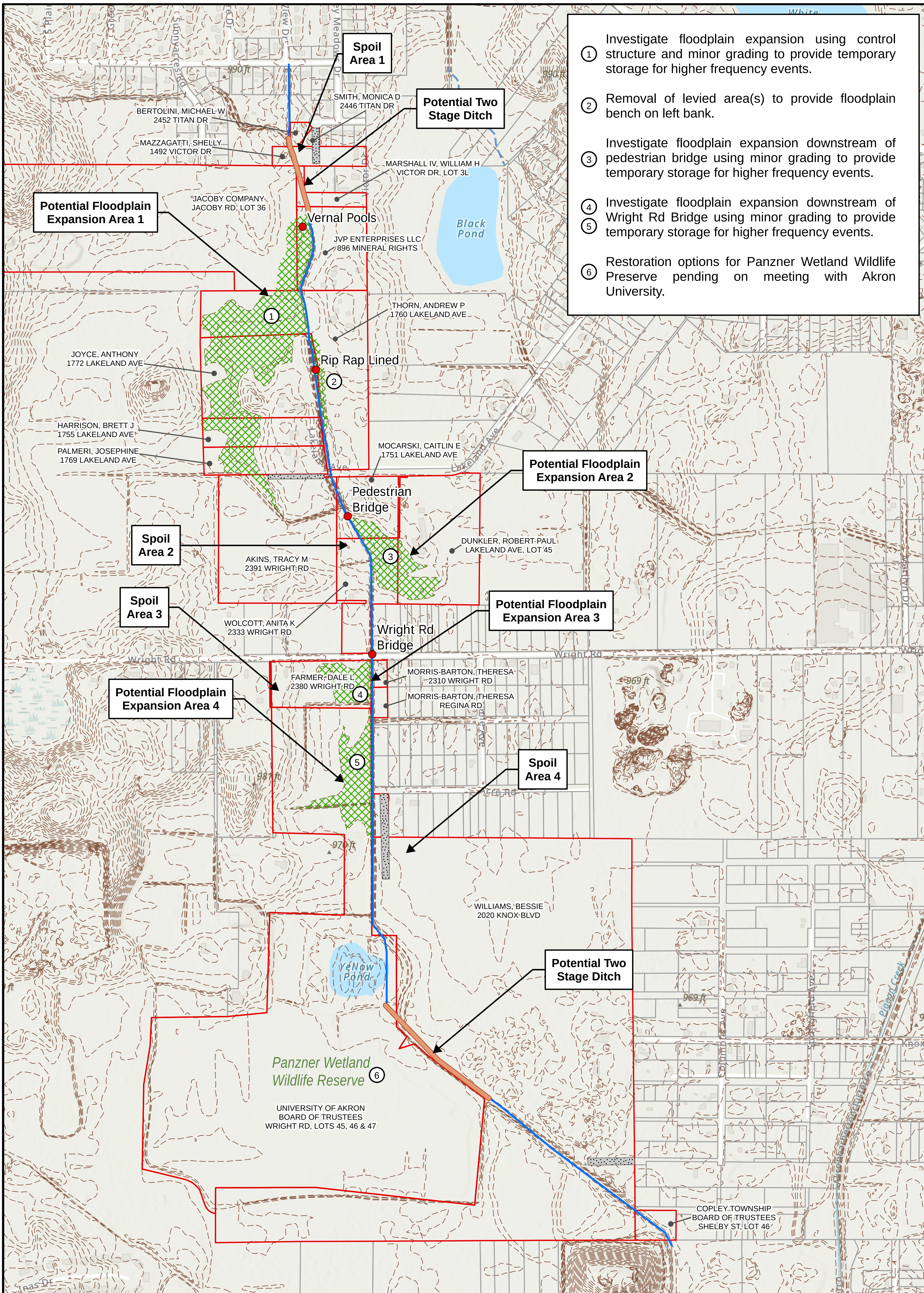
Date: 10/21/2022

Basemap courtesy of Esri.



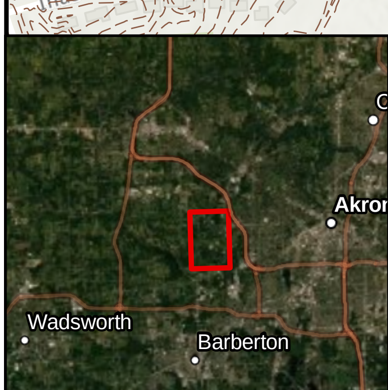


Figure 1. Copley Ditch - Initial Site Evaluation
Priority Areas of Study for Potential Enhancements

October, 2022

LEGEND

- Existing Feature
- Waterbody
- Parcel
- Adjacent Parcel
- Copley Ditch
- Contour
- Floodplain Expansion
- Two Stage Ditch
- meander
- Access Road

0 250 500 1,000 Feet

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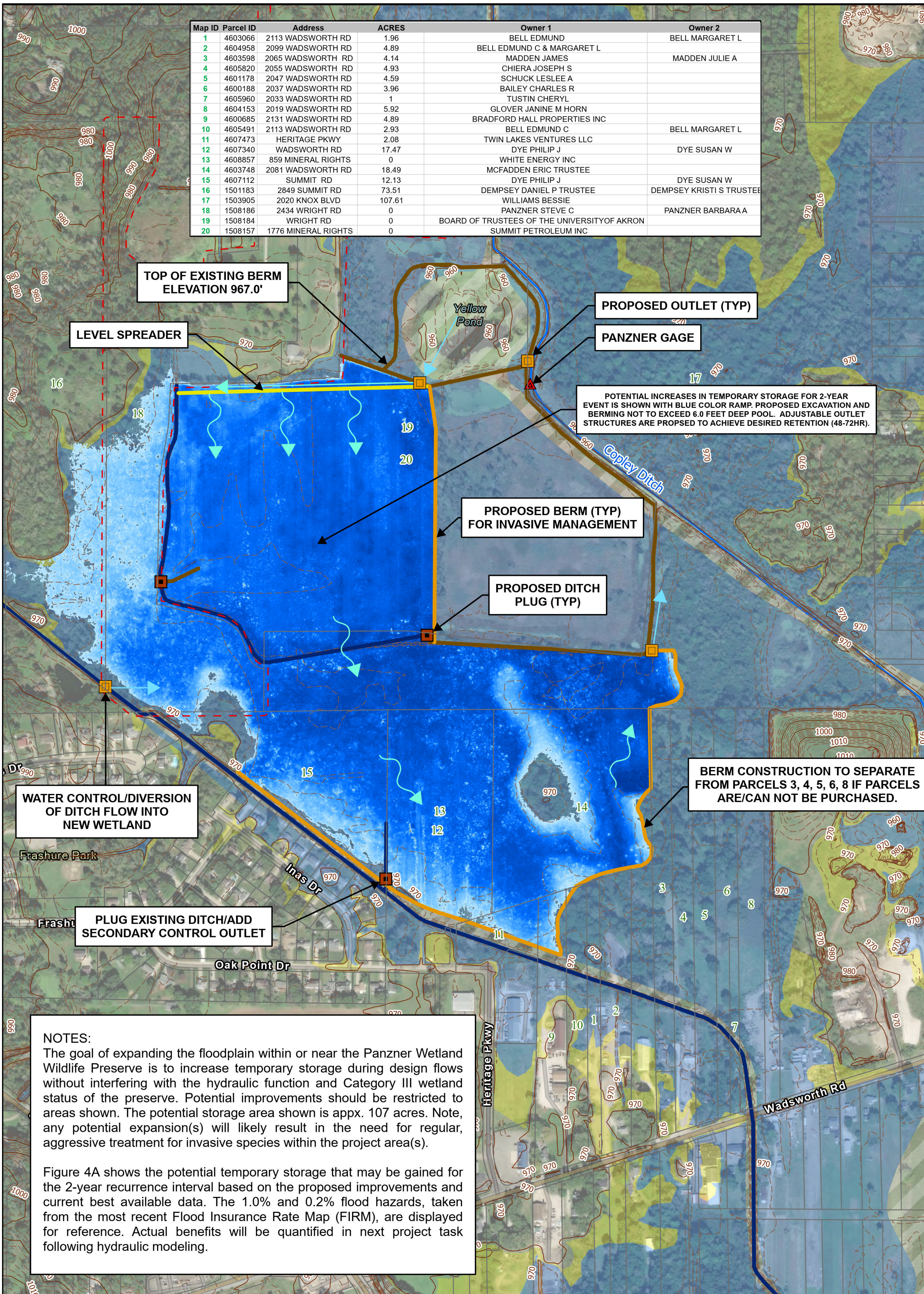
Date: 10/21/2022

Basemap courtesy of Esri.

Map ID	Parcel ID	Address	ACRES	Owner 1	Owner 2
1	4603066	2113 WADSWORTH RD	1.96	BELL EDMUND	BELL MARGARET L
2	4604958	2099 WADSWORTH RD	4.89	BELL EDMUND C & MARGARET L	
3	4603598	2065 WADSWORTH RD	4.14	MADDEN JAMES	MADDEN JULIE A
4	4605820	2055 WADSWORTH RD	4.93	CHIERA JOSEPH S	
5	4601178	2047 WADSWORTH RD	4.59	SCHUCK LESLEE A	
6	4600188	2037 WADSWORTH RD	3.96	BAILEY CHARLES R	
7	4605960	2033 WADSWORTH RD	1	TUSTIN CHERYL	
8	4604153	2019 WADSWORTH RD	5.92	GLOVER JANINE M HORN	
9	4600685	2131 WADSWORTH RD	4.89	BRADFORD HALL PROPERTIES INC	
10	4605491	2113 WADSWORTH RD	2.93	BELL EDMUND C	BELL MARGARET L
11	4607473	HERITAGE PKWY	2.08	TWIN LAKES VENTURES LLC	
12	4607340	WADSWORTH RD	17.47	DYE PHILIP J	DYE SUSAN W
13	4608857	859 MINERAL RIGHTS	0	WHITE ENERGY INC	
14	4603748	2081 WADSWORTH RD	18.49	MCFADDEN ERIC TRUSTEE	
15	4607112	SUMMIT RD	12.13	DYE PHILIP J	DYE SUSAN W
16	1501183	2849 SUMMIT RD	73.51	DEMPSEY DANIEL P TRUSTEE	DEMPSEY KRISTI S TRUSTEE
17	1503905	2020 KNOX BLVD	107.61	WILLIAMS BESSIE	
18	1508186	2434 WRIGHT RD	0	PANZNER STEVE C	PANZNER BARBARA A
19	1508184	WRIGHT RD	0	BOARD OF TRUSTEES OF THE UNIVERSITYOF AKRON	
20	1508157	1776 MINERAL RIGHTS	0	SUMMIT PETROLEUM INC	



NOTES:
The goal of expanding the floodplain within or near the Panzner Wetland Wildlife Preserve is to increase temporary storage during design flows without interfering with the hydraulic function and Category III wetland status of the preserve. Potential improvements should be restricted to areas shown. The potential storage area shown is appx. 107 acres. Note, any potential expansion(s) will likely result in the need for regular, aggressive treatment for invasive species within the project area(s).

Figure 4A shows the potential temporary storage that may be gained for the 2-year recurrence interval based on the proposed improvements and current best available data. The 1.0% and 0.2% flood hazards, taken from the most recent Flood Insurance Rate Map (FIRM), are displayed for reference. Actual benefits will be quantified in next project task following hydraulic modeling.

Figure 4A. Panzner Wetland Wildlife Preserve Potential Floodplain Expansion Option A

FEBRUARY, 2023

- Berm (Existing)
- Berm (Proposed)
- Ditch/Trench (Existing)
- Level Spreader (Proposed)
- Outlet
- Plug
- Panzner Property Limits (offset for clarity)
- Parcel
- Flood Hazards
  - 500-Year
  - 100-Year (AE)
  - Floodway
- Contour
- POTENTIAL STORAGE DEPTH (FT): 0.0 – 6.0

0 150 300 600 Feet

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Date: 2/6/2023

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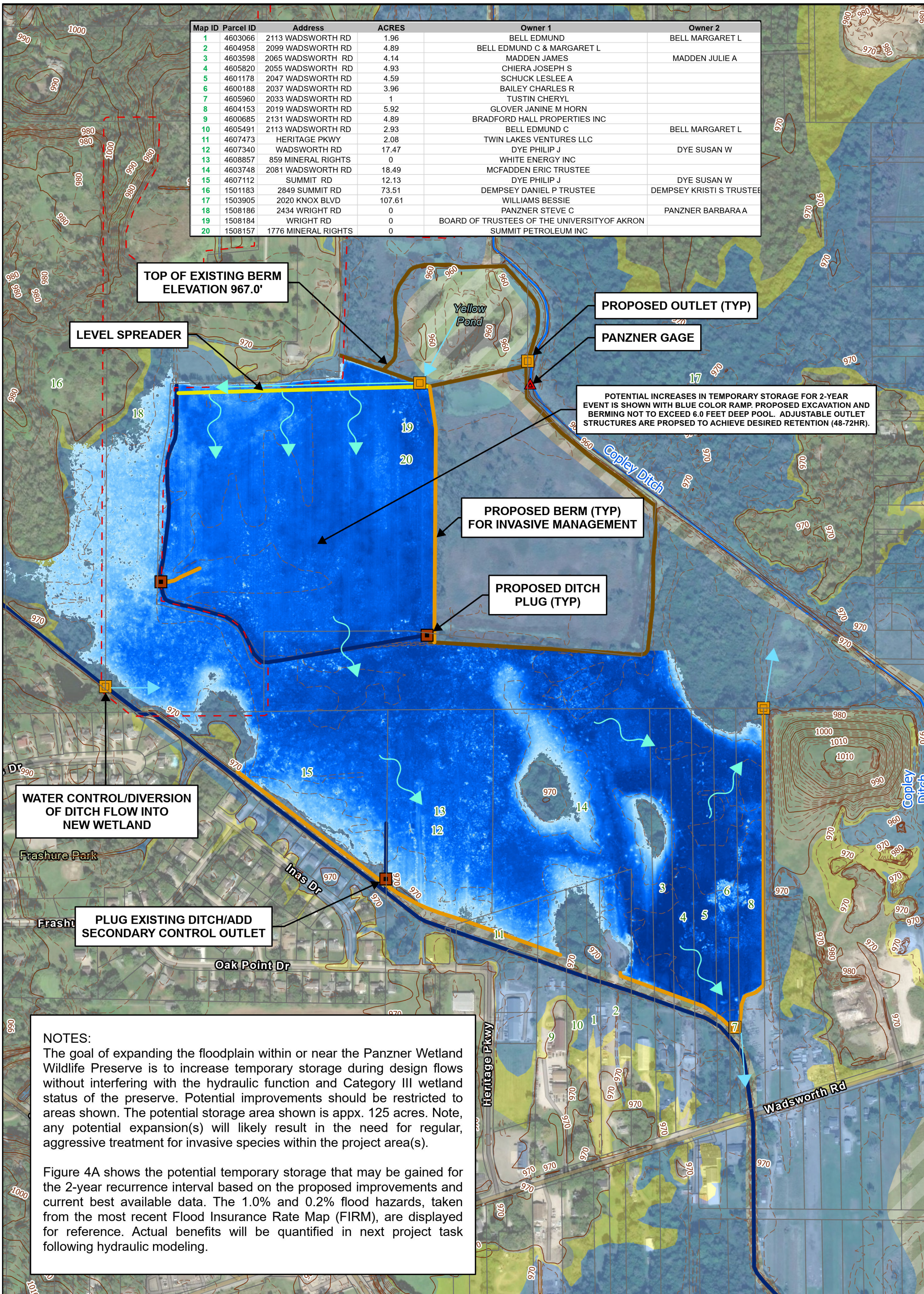

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6	4600188	2037 WADSWORTH RD	3.96	BAILEY CHARLES R	
7	4605960	2033 WADSWORTH RD	1	TUSTIN CHERYL	
8	4604153	2019 WADSWORTH RD	5.92	GLOVER JANINE M HORN	
9	4600685	2131 WADSWORTH RD	4.89	BRADFORD HALL PROPERTIES INC	
10	4605491	2113 WADSWORTH RD	2.93	BELL EDMUND C	BELL MARGARET L
11	4607473	HERITAGE PKWY	2.08	TWIN LAKES VENTURES LLC	
12	4607340	WADSWORTH RD	17.47	DYE PHILIP J	DYE SUSAN W
13	4608857	859 MINERAL RIGHTS	0	WHITE ENERGY INC	
14	4603748	2081 WADSWORTH RD	18.49	MCFADDEN ERIC TRUSTEE	
15	4607112	SUMMIT RD	12.13	DYE PHILIP J	DYE SUSAN W
16	1501183	2849 SUMMIT RD	73.51	DEMPSEY DANIEL P TRUSTEE	DEMPSEY KRISTI S TRUSTEE
17	1503905	2020 KNOX BLVD	107.61	WILLIAMS BESSIE	
18	1508186	2434 WRIGHT RD	0	PANZNER STEVE C	PANZNER BARBARA A
19	1508184	WRIGHT RD	0	BOARD OF TRUSTEES OF THE UNIVERSITYOF AKRON	
20	1508157	1776 MINERAL RIGHTS	0	SUMMIT PETROLEUM INC	

NOTES:

The goal of expanding the floodplain within or near the Panzner Wetland Wildlife Preserve is to increase temporary storage during design flows without interfering with the hydraulic function and Category III wetland status of the preserve. Potential improvements should be restricted to areas shown. The potential storage area shown is appx. 125 acres. Note, any potential expansion(s) will likely result in the need for regular, aggressive treatment for invasive species within the project area(s).

Figure 4A shows the potential temporary storage that may be gained for the 2-year recurrence interval based on the proposed improvements and current best available data. The 1.0% and 0.2% flood hazards, taken from the most recent Flood Insurance Rate Map (FIRM), are displayed for reference. Actual benefits will be quantified in next project task following hydraulic modeling.

Figure 4B. Panzner Wetland Wildlife Preserve Potential Floodplain Expansion Option B

FEBRUARY, 2023

- Berm (Existing)
- Berm (Proposed)
- Ditch/Trench (Existing)
- Level Spreader (Proposed)
- Outlet
- Plug
- Panzner Property Limits (offset for clarity)
- Parcel
- Flood Hazards
  - 500-Year
  - 100-Year (AE)
  - Floodway
- Contour
- POTENTIAL STORAGE DEPTH (FT)
  - 0.0
  - 6.0

0 150 300 600 Feet

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