Three Forks of Beargrass Creek Ecosystem Restoration
Appendix A
Civil Engineering

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1. Introduction

The Three Forks of Beargrass Creek Feasibility Study is assessing ecosystem restoration work within the Beargrass Creek watershed, located in Jefferson County, Kentucky. The three forks of Beargrass Creek are the Muddy Fork, Middle Fork, and South Fork. The forks converge east of downtown Louisville, KY and outlet into the Ohio River. Beargrass Creek is an urban watershed, altered and constrained by past development. The recommended plan by the project delivery team consists of 12 different sites spread across all 3 forks of Beargrass Creek, chosen to optimize ecosystem restoration work performed under the project constraints. The sites cover a large area and vary in existing condition. The recommended plan proposes riparian, riverine, hydrologic, and connectivity-based work units. Most sites propose a combination of the work unit types to meet the restoration objective.

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

2. Surveying and Mapping

The horizontal coordinates used in development of the included civil plan sheets reference the Kentucky State Plane Coordinate System, North Zone. The horizontal datum is the North American Datum of 1983 (NAD83), units of U.S. survey feet. The vertical datum used is the North American Vertical Datum of 1988 (NAVD88), units of U.S. survey feet. Ground elevations used for utility impact determinations and conceptual earthwork quantities were obtained from Digital Elevation Models (DEM). The DEM used was developed using Light Detection and Ranging (LiDAR) by the state of Kentucky and was published in 2012. The resolution of the DEM is specified at 2 feet. The DEM was adequate for this phase of the project, but a full site survey will need to be performed for the design phase. The site survey should include a topographic survey, stream surveys, geotechnical exploration and classification, and utility mapping.

3. Right-of-Way, Real Estate

Feasibility level of right-of-way was developed for this study. Right-of-way need was determined for: the proposed project work, access for construction, construction staging and laydown, and access for maintenance after construction completion. An acquisition or easement type was set for each project element and the areas for each type was totaled. More information on the real estate instruments used, right-of-way areas, and real estate costs for this project can be found outside of this appendix in other portions of the report. The right-of-way limits are displayed on the civil plan sheets, found at the end of this appendix.

The right-of-way limits were set based on an offset buffer the project work unit boundaries. Project work units include the P, H, R, and C types. For the Planting (P) work units and the Hydrologic (H) work units, the right-of-way was offset 20 feet beyond the edge of the work unit boundary. For the Riverine (R) work units, the right-of-way was offset 20 feet beyond the

maximum preliminary cross section design extents. The preliminary cross section designs varied across the project. Most of the Connectivity (C) features are located along the Riverine work units, and do not need separate right-of-way delineation. There are a few standalone Connectivity features where the right-of-way was offset 20 feet beyond the edge of the estimated feature size. Most of the project sites contain multiple work unit types that share work boundaries. The right-of-way boundaries were set to combine and encompass the outermost right-of-way offset buffer at the site level. For all the work unit types, the proposed right-of-way offset will be a buffer that only needs to persist as a temporary work area easement for the length of the construction. The actual footprint of the work units will be acquired under a separate real estate instrument. That information can be found within the real estate report.

Right-of-way limits were also set for supporting project features where proposed work does not directly happen. These supporting features include the access roads, staging and construction laydown areas. Many work unit access points come directly off public roads, which do not require any kind of right-of-way. Other access points use existing private roads or parking lots to reach work units. For existing roads, the right-of-way limits are set to the edges of the road width, assuming that the only need is access. There are no planned improvements to existing roadways that would require a larger right-of-way such as widening or drainage improvements. The existing road widths vary; the right-of-way was measured and set based on aerial imagery. There are some instances where new access road is proposed to be constructed. Right-of-way for the new construction includes space for the travel way, shoulders, drainage, and cut and fill match points. The limits also include additional required buffer beyond the cut and fill match. More information on the new access roads can be found in Section 5.

The right-of-way obtained for the project work units will need to persist for as long as the projected lifecycle of each element. The right-of-way obtained for the access, staging, laydown, and buffers will need to persist through the construction phase. The right-of-way obtained for some of the access will need to persist through the Adaptive Management phase or longer, dependent on long-term maintenance needs. The right-of-way limits and easements shown on the plan sheets will be further refined during the design phase with the completion of a full site survey.

4. Water Control Plan, Erosion and Sediment Control

Construction of the project work units are organized around the three forks of Beargrass Creek. Much of the proposed work will take place in or adjacent to the creeks. The riverine (R) work units alter the creek cross section and involve in-channel construction. The connectivity (C) work units install or remove features in the creek channel. The hydrologic (H) and planting (P) work units are located adjacent to the creek channel.

The in-channel work means the design and construction will need to pay close attention to issues of water diversion, water quality, and erosion control. Temporary water diversion may be necessary to install or remove certain connectivity features, connect relocated riverine features, or protect hydrologic work units from being inundated during construction. Water quality, erosion control, and sediment control will be addressed through a Kentucky Pollutant Discharge Elimination System (KPDES) permit and a Stormwater Pollution Prevention Plan (SWPPP).

Stream channel excavation creates a much higher erosion and sediment discharge risk than the typical construction project. The design and implementation of the erosion control will be a major component of this project.

5. Access Roads

Due to the urban nature of the project, most work units on the project can be accessed by existing public or private roads. There are only a few work units that will require newly constructed access roads to complete the proposed work. New access roads will be built as temporary, one-way haul routes with gravel surfacing. Minimum criteria will be met for travel way width and turnout spacing for passing. The access roads are only planned as use for the project and would not be needed after the construction and maintenance phases. A review of the existing topography was performed to ensure that the access roads were not proposed on overly steep grades. Engineering Manual (EM) 385-1-1 requires access roads to have a maximum grade of 10%, or up to 12% allowable for distances of 400 feet or less. Lengths for new access roads on the project are described in the Site-Specific Discussion, Section 8.

6. Work Unit Laydown and Staging

Laydown and staging areas for the sites was determined based on the work units present. Different assumptions were made for the riverine, riparian, hydrologic, and connectivity units. The urban nature of the project means that space availability for laydown is low. Project planning sought to maximize area used for ecosystem restoration, reducing the amount of easily accessible land for other uses. Generally, the proposed project work units are bounded by public roads, residential and commercial development, cemeteries, public schools, hospitals, and other development. Laydown areas for the work units were selected based on the assumptions listed in the following paragraphs. Project conditions did not always match the assumptions made, and laydown areas were fit in where there was space available. When possible, the proposed laydown areas are delineated to exceed the assumptions. Before right-of-way acquisition during the design phase of the project, the laydown areas will be further refined.

The riverine work units will have the most intensive construction effort on the project. They involve re-grading the channel cross-section to improve the stream health. Generally, the R2 and R4 units will widen, lower, or relocate the creek channel, or a combination of the three. The units will involve large quantities of earthwork, with a net excess of material. The laydown space will need to accommodate material stockpiles of soil and rocks that is being excavated from the channel cross-section. When there is an excess of material for the riverine unit, the stockpiles will need to be removed using haul vehicles. The laydown space would also need to accommodate equipment storage including tracked equipment and haul vehicles. It is assumed that there will be an access and laydown point needed every ¼ mile along each riverine stream unit. Between laydown areas, tracked equipment will travel along the stream banks to reach all points on the riverine units. It is assumed that the minimum size of each riverine laydown area needed is ¼ acre. Where distance between laydown areas is greater than ¼ mile or the laydown area is combined with laydown for other work unit types, the total area will be increased. Laydown areas were selected to minimize overlap with other planned work units, only doing so where needed. Overlapping areas are discussed in the site-specific discussions in section 8.

Laydown areas were selected to minimize clearing and grubbing work and utilize open space or existing disturbed areas whenever possible.

The planting work units will have a smaller laydown area need than the riverine units. In planting areas, the primary activities are planting and invasive species removal. Earth movement will be minimal, and no import or export of material is anticipated. Clearing and grubbing needs will vary across planting units, and in some cases cleared materials will need to be stockpiled and exported. The laydown areas for planting work units will need to accommodate delivery and stockpiling of planting material and small equipment storage. The equipment needs for planting units are pickup trucks, trailers, OHVs, and smaller size digging equipment. Plant stockpiles need less space than earthwork stockpiles, so a minimum laydown area size of 1/8 acre is assumed. Due to the increased mobility of the equipment used in tree planting, the spacing of laydown areas can be increased. It is assumed that one access point and laydown would be needed for each continuous planting unit. When units are separated by large public roads or other developed features, laydown areas were planned on each side. In many cases, the planting laydown is combined with the riverine laydown areas.

The hydrologic work units will have a construction effort like the riverine work units. The hydrologic units will generally regrade the existing ground to increase the water storage potential. These units will generally involve large quantities of earthwork, but it is assumed that the design will balance the earthwork and keep off-haul to a minimum. Therefore, the laydown needs generally match that of the riverine work units in terms of type of equipment use. The hydrologic work units are more efficiently organized than the riverine units. They are contained work areas instead of the long linear work areas of the riverine. It is assumed that each hydrologic unit will need its own access point and laydown. It is assumed that the minimum laydown size needed is ¼ acre. Where hydrologic units are adjacent to other work units, laydown areas have been combined.

The connectivity work units are smaller, single location features scattered through some of the sites. Most of the connectivity features are tied to a corresponding riverine work unit. There are only a few locations where connectivity features are standalone. Those standalone areas were evaluated on whether they would need their own supporting laydown area. Most of the proposed connectivity construction is constructing riffles, with an impact no wider than the existing channel. The standalone features were also located along an existing low-volume public roadway. It was determined that with the small construction scope and the proximity to the roadway, a supporting laydown area will not be needed for those features.

The laydown areas for all sites can be viewed on the civil plan sheets, included with this appendix.

7. Quantity Estimation

Due to the size of the project and the associated cost, a topographical survey was not completed for the project area during this feasibility study. Without a site survey, the design development, assumptions, and quantities relied on existing available information. The primary information sources used were publicly available LiDAR DEMs and aerial imagery. Based on the available

information and the goals of the project, assumptions were made to develop a preliminary design for the purpose of selecting a recommended plan and developing a baseline cost estimate. The assumptions for design and cost were developed jointly between planning, civil engineering, hydraulics engineering, cost engineering, and non-federal sponsor engineers.

7.1. Demolition

Demolition quantities were measured at each site based on available aerial imagery. Overall, there is not much demolition proposed with the project. Most sites and work units are in open areas, existing forested areas, parks, or water storage basins. Only some sites have some minor demolition of miscellaneous items or abandoned surfaces like or gravel areas or concrete blocks. Trails and other features in parks will be designated to remain unless they specifically need to be altered to accommodate the design. Notable demolition items are included in the paragraphs below.

At site X2, the southwest portion of the site has a proposed H2 and planting unit that is adjacent to the current Louisville Metropolitan Police Department (LMDP) vehicle impound lot. The H2 boundary is along the edge of the lot. The H2 work unit will not directly impact the impound lot and there will be no demolition of any of the features. There are miscellaneous gravel and debris patches within the H2 that will be removed.

At site X22, the work area is the most urban of all sites, and each work unit is surrounded by roads, buildings, and other paved surfaces. Within the work areas there is approximately 3,850 square feet of miscellaneous abandoned concrete surface and 13,550 square feet of miscellaneous abandoned gravel surface to be demolished. Within the work areas, there are also existing facilities and supporting features that are to remain. Facilities to be protected will be fully delineated during the design phase. The southernmost work area of site X22, near the border of site X29, overlaps approximately 65,850 square feet of existing, in-use, asphalt surface parking lot. For this study, it was assumed that the lot would be demolished to allow the proposed work.

At site X38, there is an existing walking trail that parallels the stream channel. South of the stream channel and the walking trail, there are H2 units proposed to be constructed. Where these H2 units connect to the stream channel, they impact the existing trail. Because the H2 units will change the grading (see section 7.2) the walking trail will not be able to maintain its original alignment and profile. Approximately 6,300 square feet of asphalt walking trail is assumed to be demolished. The trail will be rerouted, either vertically or horizontally. Proposed recreation features are discussed more in depth elsewhere in this feasibility study report.

7.2. Hydrologic (H) Work Units

The Hydrologic Resurgence Via Basins/Swales alternatives (H2) reshapes the existing ground by grading the terrain in a way which would frequently be recharged by the stream. This alternative would increase storage along the stream. The change in storage ranges from insignificant to large enough to act as a reservoir during high water events. Some of the H2 areas identified in this project are existing storage basins maintained by the Louisville Metropolitan Sewer District.

These basins are located adjacent to Beargrass Creek and have been designed as storage to reduce flood risk. Improvements to the existing basins cannot reduce the available water storage capacity.

The proposed improvements in the H2 areas are grading and planting. To facilitate grading, existing vegetation will need to be cleared and grubbed from each area. Many of the H2 units are partially forested or vegetated. The existing basins are mowed grass and do not require any clearing. Existing vegetated areas were measured from aerial imagery and tabulated for each site. It is assumed that all vegetation within the H2 boundary will need to be cleared. After clearing operations, the H2 units would be mass graded to reshape the existing ground to achieve the water storage objective. It is assumed that grading operations would cut 1.5 feet into the existing ground on average across the work unit. It is assumed that the grading would extend across the entire area of the H2 unit. It is assumed that the earthwork will be re-used on site to balance the cut and fill so there won't be mass off-haul. Because the earthwork will be balanced, there will not be opportunity to lower the entire H2 area as a whole. Instead, the design will be to reshape the areas to maximize water retainage during high water events. After grading operations, the H2 unit would be planted with a designated plant community at a certain density. The planting communities are planned at all H2 sites, including the existing storage basins. At those basins, where new plants and roots exist in the ground, they occupy space that was previously only soil. To maintain the existing available water storage capacity, new plant volume would be offset by removing earth from the site.

Using these assumptions, quantities were developed to support the cost estimate. The table below includes clearing and earthwork quantities for H2 work units at each site.

H2 Quantities			
Site	*Sum of H2 work units size (acres)*	*Clearing (acres)*	*Earthwork (cubic yards)*
X2	38.0	20.2	91,853
X19	11.6	-	28,070
X22	6.4	-	15,493
X33	3.1	1.1	7,576
X35	7.0	5.3	17,029
X38	5.6	3.3	13,653
Total	71.8	29.9	173,673

7.3. Riverine (R) Work Units

The Instream Habitat and Floodplain Connectivity work unit (R2) is in the creek channel and maintains the current horizontal alignment while grading the banks to reconnect the floodplain. This work unit is modeled on the existing channel alignment with a designed channel cross section. The Sculpted Riverine Establishment work unit (R4) returns riverine habitat to a more natural state using engineering processes rather than natural processes. A new stream horizontal alignment is constructed to mimic a meandering channel and the banks would be graded for floodplain connectivity. This work unit is modeled as a new channel alignment with a designed channel cross section. Generally, the R4 work unit will result in meandering that creates a longer

stream length, flatter stream slope, and shallower, wider channel shapes than the existing condition. Both R2 and R4 work units would involve extensive grading in and adjacent to the stream channel. The following paragraphs contain assumptions for developing the cross sections used to estimate grading quantities.

Bankfull Dimensions of the existing channel (depth, width, etc.) – These values were obtained from Stream Stats, which bases its calculations on the Outer Bluegrass Regional curves developed by Brockman & Workman, et al. These values were found to be typically low, meaning that bankfull may in fact be a little higher resulting in a larger cross-sectional depth. Using these curves provides a conservative earth work value and is an approximation for planning purposes. Actual bankfull depth should be determined in design by developing site curves specific to the watershed and based on bankfull features identified in the reaches during field investigations.

Side slopes – R2 scenario: Floodplain bench slopes were set to 20H:1V out from bankfull and then tied into the existing grade at 4H:1V. Some sites required adjustments to the slope to be able to tie back in at steeper slopes due to other constraints. R4 scenario: Utilized bank slopes no greater than 2.5H:1V, floodplain bench slopes of 20H:1V, and tie into existing grade at 4H:1V. As with R2, some sites required adjustments due to site constraints.

Floodplain bench (R2 scenario and in many cases R4 due to incision) – Bench width was approximated at 75% of the channel width on banks where the alternative measure was applicable. At many sites, providing a floodplain bench was only feasible on one bank, and the side often alternated banks along the site. Cross-sections were placed in strategic locations to capture these changes. The slope across the floodplain bench varied from site to site to fit existing conditions, but when possible was less than or equal to 20H:1V.

Depth of Cut – was determined based on a comparison of existing ground elevation at the edge of the stream bank and the bankfull depth.

Profile – No profile changes were proposed except the thalweg associated with the cross-section. At most of the sites, there is not enough stream length and grade to raise the stream profile. Cross-section thalweg elevation was set at the existing bed elevation and built up to existing grade using the side slope assumptions stated above.

Using the above assumptions, cross sections were developed for the R2 and R4 work units at each site. The cross sections were then connected along the alignment to create a continuous design surface for the length of the work unit. Using CAD software, the difference between the existing surface and the proposed surface was analyzed to develop a cut and fill volume quantity. The volume indicates the amount of earthwork required to construct the R2 and R4 units at each site.

R2 and R4 Quantities		
Site	*Work Unit Type*	*Earthwork (cubic yards)*
X2	R2	10,826
X10	R2	54,295
X20	R2	2,386
X21	R2	26,491
X29	R4	247,863
X30	R4	175,529
X34	R2	141,512
X35	R2	56,351
X38	R2	54,926

It is expected that the R4 works units generate the most earthwork because it involves the creation of a new stream alignment and cross section. The earthwork generated could be re-used on site to fill in the existing old alignment relocated with construction of the R4 alignment. The R2 work units will generate less total earthwork since they are being constructed within the existing stream alignment and profile. The earthwork is generated from the widening of the existing cross section to increase the floodplain bench width. Site X34 contains the highest earthwork value of the R2 work units because it is the longest. Additional assumptions were applied to the earthwork quantities by the cost engineer to reach a cost estimate.

8. Utility Impacts

Due to the urban nature of the project, utilities are present throughout the project area. Many underground utilities travel through proposed work units. Any proposed work units that involve excavation has the potential to impact existing underground utilities. The greatest potential for utility impacts will occur under work units where the ground elevation is expected to be lowered to change the hydrologic function. This will occur primarily under the R work units, and to a lesser extent under the H work units. Situations where utilities that would become exposed or have their ground cover reduced below the minimum required value would need to be mitigated. Mitigation options could include designing around the utility so that it is not affected, relocating the utility horizontally or vertically out of the impacted area, or encasing the utility in concrete or some other protection when the ground cover will be reduced below the minimum required value. This following sub-sections discuss the different types of utilities present at the sites, the information that was available when reviewing potential utility impacts, and the minimum requirements and assumptions that were used in evaluating impacts.

8.1. Sewer

Sanitary sewer utilities in the project area are owned by Louisville Metropolitan Sewer District (MSD). The sanitary sewer utilities represent the largest potential impact from constructing the proposed plan. Work unit types that impact sewers are R2, R4, and H2. Sewer lines frequently cross and run parallel to proposed riverine work units, where the existing channel cross section will be widened, lowered, relocated, or some combination. Geospatial data was reviewed that included sewer locations, invert elevations, pipe diameters, and pipe material type. Existing

ground elevation was available from LiDAR digital elevation model (DEM) data. Proposed ground elevation was available from conceptual design DEMs created for the feasibility phase. Potential sewer impacts were tabulated by comparing the elevation profile of the existing sewer against the conceptual design. The existing pipe diameter and required ground cover was added to the existing sewer invert elevation and comparing the result to the proposed ground cut design elevation. The MSD design manual states minimum ground cover for sewer lines is 4 feet in easements and 5 feet in rights-of-way. The MSD design manual states the minimum ground cover for sewer lines when crossing under existing streams, existing ditches, or proposed channel improvements and storm sewers is 2 feet if the line is encased in concrete (or capped if approved by MSD).

When gravity sewers are impacted, they would need to be relocated horizontally to preserve fall slope. Horizontal relocation would add length to a gravity sewer run, causing the slope to decrease. Any gravity sewer near the minimum slope would be difficult to relocate. If impacted sewers near the minimum slope are encountered during design, the project team would have mitigation options. The least impact mitigation would be to design that area of the project around the sewer so that it is not impacted. This may mean the channel bank elevation is raised for a short segment to maintain cover of the sewer to prevent relocation. This would be evaluated on a case by case basis during design to ensure that designing around select sewers would not have an impact on the overall project goal. Another mitigation option is to evaluate reduced pipe cover depth options with MSD engineers. The MSD design manual requires certain ground cover requirements for sewer pipes. In situations with minimum pipe slopes and difficult relocations, it may make sense to reduce the height of ground cover over the pipe to accommodate the bank grading. To compensate for the reduced cover, the pipe could be encased in concrete or a structural material layer could be placed over the pipe. All the R2 and R4 grading work takes place in stream channels, where heavy vehicle traffic is not expected, making it feasible to consider reducing cover requirements. Any reduced cover sections would need to be designed, documented, and approved by MSD engineers. A third mitigation option is to vertically relocate a sewer pipe at minimum slope that cannot be horizontally relocated. This would mean installing a sewer lift station to pump the sewage up grade to the next manhole where is would resume its gravity function.

Designing the sewer relocations was not in the scope of this feasibility study. The potential impacts were tabulated for cost and risk purposes. For a summary of the potential sewer impacts based on the proposed work units, see the site-specific discussions in section 8.

8.2. Water

Domestic water utilities in the project area are owned by Louisville Water Company (LWC). Water lines were generally observed to cross the proposed work units, but not as extensively as the sewer lines. Geospatial data was reviewed that included locations, pipe diameters, and pipe material type. Invert elevation data was not available for this analysis. Water line impacts were tabulated where the line crossed the stream in a riverine work unit that is lowering the stream bed elevation. The length of the potential impact was set as the preliminary design cross section width. LWC standard specifications state the minimum ground cover for water lines is 42 inches (3.5 feet) and the maximum ground cover is 5 feet. LWC standard specifications state the

minimum ground cover for water lines when crossing under existing streams is 3.5 feet with respect to the stream bed elevation. Water line impacts were tabulated as “potential” when the line crossed the channel under a proposed R work unit footprint. For a summary of the potential water line impacts based on the proposed work units, see the site-specific discussions in section 8.

8.3. Gas and Electric

Domestic electric and natural gas utilities in the project area are owned by Louisville Gas & Electric (LG&E). Gas and underground electric lines were observed to cross the proposed work units, but not as extensively as the sewer lines. Geospatial data was reviewed that included locations of pipes. Invert elevation data was not available for this analysis. Impacts were tabulated where the line crossed the stream in a riverine work unit that is lowering the stream bed elevation. The length of the potential impact was set as the preliminary design cross section width. Overhead electric line and power pole relocation was not included in this impact analysis. Further design assumptions would be needed to determine when overhead electric poles would need to be relocated. Underground gas and electric line impacts were tabulated as “potential” when the line crossed the channel under a proposed R work unit footprint. For a summary of the potential gas and electric line impacts based on the proposed work units, see the site-specific discussions in section 8.

9. Site Specific Discussions

The site-specific discussions contain items of note, challenging conditions, or general discussions on civil engineering topics at each site. The sub-sections also summarize utility impacts.

9.1. Site X2 - Confluence

Site X2 is located at the confluence of Beargrass Creek and the Ohio River. There is a large amount of H2 work units proposed at this site. Where Beargrass Creek joins the Ohio River, construction of 8 rock vanes is proposed. One of the proposed H2 units is bounded by River Road on the north and railroad tracks on the south, east, and west, and has no existing access. A new temporary access road and laydown is proposed to construct this work unit. The length of the proposed access road is approximately 445 feet. All other access routes are proposed on existing travel ways. The rock vanes proposed at the confluence will need access to both sides of the creek to facilitate the installation. One of the proposed H2 work units overlaps the existing LMPD impound lot. Demolition quantities were estimated to remove existing engineered surfaces under proposed work units.

One of the proposed recreation features for the project is a pedestrian bridge at this site that would span the creek and connect to the Louisville Waterfront Botanical Gardens. The work limits have been set to accommodate the proposed location of this bridge.

Access to the R2 work units is surrounded by mixed use and some one-way streets, including a short stretch with residences. Haul traffic impacts can be mitigated with time of day restrictions

in the construction contract. There are two disposal areas identified within the X2 site boundary. The route between the R2 work unit and the disposal site will not pass any residences. For the H2 work units at the site, the design goal is to balance the earthwork. See section 7.2 of this appendix for more assumptions on the H2 units. The utility impact is lower at this site, as most of the work units are located away from residential and commercial development.

Potential Utility Impacts at Site X2				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	167	-	-	-
H	-	-	-	-
Total	167	-	-	-

9.2. Site X10 - Alpaca Farm/ Zoo

Site X10 is located on the South Fork of Beargrass Creek. The site is bounded by residential development and the Louisville Zoo. All proposed access routes are on existing travel ways. A proposed laydown for the site utilizes a storage yard for the Louisville Zoo. Construction routes at the site avoid residential streets and quickly connect to larger roads. Construction routing will need to be coordinated with the Zoo for shared access that can be accommodated by all stakeholders. During site optimization, proposed work unit impact to the Alpaca Farm were reduced as low as possible based on cost and discussions with the non-Federal sponsor. The right bank of the R2 work unit will not be graded in this section. There is a paved trail that parallels the creek on the south for the length of the R2 work unit. The design will avoid altering the existing facility. Trail use will be impacted during construction of the project. Dependent on construction equipment proximity, the trail may need to be closed in sections to protect the public. Temporary trail re-routes would not be feasible where the trail is adjacent the Louisville Zoo boundary fence. Construction limitations should be considered to reduce noise impacts to nearby residential neighborhoods and the zoo. An extensive network of sewer lines run parallel and cross the creek channel, which will be heavily affected by the proposed R2 unit.

Potential Utility Impacts at Site X10				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	3197	-	-	-
H	-	-	-	-
Total	3197	-	-	-

9.3. Site X19 – South Fork / Newburg Road

Site X19 is located on the South Fork of Beargrass Creek. The site is mostly bounded by residential development. The H2 work units at the site are proposed on existing MSD basins. The basins were installed for water storage during high water events. Each basin has a concrete weir that discharges water into the creek channel. The proposed work will not reduce the available

water storage in the basins. Plantings associated with the H2 work units will take up new volume within the basin. The planting volume will be modelled so that the ground elevation of the basin can be reduced accordingly to maintain storage. Two laydown areas for the site are proposed in empty lots of a residential development. The proposed R1 work unit is bounded between residential housing, and it is planned for equipment to travel down the creek channel to construct the features. The R1 work unit does not involve grading, so construction traffic down the creek channel will be minimal. However, the equipment will still be visible from houses in the residential development. Restrictions on construction should be considered to reduce visual and noise impacts. The H2 work units are located further away from the residences and are surrounded by larger public roads. Work on these units are expected to have little impact on the public. There is a short spur proposed as new temporary access road to be constructed. The length of the proposed access road is approximately 65 feet.

Potential Utility Impacts at Site X19				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	-	-	-	-
H	-	-	-	-
Total	-	-	-	-

9.4. Site X20 – Brown Park

Site X20 is located on the Middle Fork of Beargrass Creek. There is limited available space, so a laydown area is proposed in the existing parking lot for Brown Park. The site is split from north to south by Browns Lane. A laydown area is planned to the east of Browns Lane for construction of the R2 work unit. All proposed access routes are on existing travel ways. The site is bounded by a hospital complex on the west, Kresge Way, a 4-lane road on the north, Browns Lane, a 4-lane road on the east, and Interstate 64 on the south. Most of the proposed site is planting work units, which have a lower construction impact to public facilities and the surrounding area. The planting is proposed across the entire park area. Public users of the park facilities would be impacted during planting operations. It is anticipated that the park would remain open during construction. Planting impacts may close short sections of trail for short periods of time. Using some of the parking lot to stage planting material would reduce available parking for the general public.

Potential Utility Impacts at Site X20				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	-	-	-	-
H	-	-	-	-
Total	-	-	-	-

9.5. Site X21 – Arthur Draut Park

Site X21 is located on the Middle Fork of Beargrass Creek and shares its southwestern boundary with site X20. The site entirely encompasses Arthur Draut Park. Many of the same constraints exist at site X21 as at site X20. To provide laydown for the R2 unit, an area is proposed inside the park boundary that overlaps planting units. The R2 work unit is surrounded by walking trails and other park features, so construction operations will disrupt the park usage. The project will be designed to avoid altering existing park facilities and trails. Temporary trail closures will be needed during construction of the R2 work unit. Enhanced safety measures by the contractor and inspectors will need to be implemented at this site and any other site that overlaps with a public park. All proposed access routes are on existing travel ways.

Potential Utility Impacts at Site X21				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	253	-	107	-
H	-	-	-	-
Total	253	-	107	-

9.6. Site X22 – Concrete Channel

Site X22 is located on the South Fork of Beargrass Creek. It is the closest site to the downtown Louisville area and has the densest section of public roads. The site is a collection of smaller, separated areas. Some of the work units overlap with existing MSD basins. There are MSD buildings located within one of the work areas. Close design coordination with MSD will be needed to ensure that their facilities are not impacted. The H2 work units have a design assumption that earthwork will be balanced within the unit. Site X22 is composed of H2 units, so material import and export is not anticipated. Overall impact to the surrounding urban road network is expected to be small. The southernmost area of the site proposes a H2 unit over top of an existing parking lot that is planned to be partially demolished. The parking lot is behind a mixed used building with medical offices. All proposed access routes are on existing travel ways.

Potential Utility Impacts at Site X22				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	-	-	-	-
H	-	-	-	-
Total	-	-	-	-

9.7. Site X29 – Eastern / Creason Connector

Site X29 is located on the South Fork of Beargrass Creek. It is bounded by two cemeteries, a high school, a sports field complex, a hospital, a university and residential housing. The cemeteries have required setbacks, limiting the area for available laydown. There is a large laydown area planned to support the R4 work unit at this site. Extensive grading will occur to create the relocated stream channel for the proposed R4 unit. The existing route to reach this laydown area is a one lane dead end road. Overall use of this road appears low, meaning utilization as a haul route would have low impact on current use. The route discharges to Newburg Road without passing directly through residential areas. It passes adjacent to Bellarmine University but is not the primary entrance for the school. Some of the laydown area on the west of the site is proposed to overlap with some existing parking for the sports complex. This would affect recreation at the complex by reducing available parking. The laydown areas on the west end of the site are smaller, as they will primarily support planting work units. This also means less haul traffic that might impact the sports field complex and the high school. There is a network of sewer lines parallel to the creek channel, which will be heavily affected by the channel relocation. All proposed access routes are on existing travel ways.

Potential Utility Impacts at Site X29				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	3518	-	-	-
H	-	-	-	-
Total	-	-	-	-

9.8. Site X30 – Joe Creason Park

Site X30 is located on the South Fork of Beargrass Creek. It shares a boundary with site X29 on the north and site X10 on the south. The site encompasses Joe Creason Park and the Beargrass Creek State Nature Preserve. The majority of the proposed work units are planting units overtop of existing forested areas. There are two R4 work units that will relocate the stream channel from the existing alignment. Extensive grading will occur to create the relocated stream channels. Much of the cut can be re-used on site to fill in the current stream alignment. Any off haul from the western R4 unit would leave the site using the same access route as site X29. The route would exit to Newburg Road without passing through residential areas. The eastern R4 unit would be accessed directly from Trevillan Way. The site does border some residential areas, but only planting work units are proposed along those borders. The planting units are not anticipated to have an impact on the residential areas during construction. There is a network of sewer lines parallel to the creek channel, which will be heavily affected by the channel relocation. All proposed access routes are on existing travel ways.

Potential Utility Impacts at Site X30				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	5001	-	-	-
H	-	-	-	-
Total	-	-	-	-

9.9. Site X33 – MSD Basin

Site X33 is located on the South Fork of Beargrass Creek. The site is bounded by residential development on the north, Breckenridge Lane on the west, and the creek on the south. Further south past the creek is more residential development. The H2 work units at the site are proposed on an existing MSD basin. Plantings associated with the H2 work units will be modelled so that the ground elevation of the basin can be reduced accordingly to maintain available storage. It is assumed that the design will balance the earthwork within the site. The proposed laydown area for the site overlaps the H2 work unit at the end of a residential street. The only access route to the site is through the residential neighborhood along Hillcreek Road, which dead ends at the site. Because no material import or export is expected, haul impact to the neighborhood will be low. Time restrictions may be given in the construction contract to mitigate noise impacts at the site. The southern edge of the site is bounded by the creek channel, limiting available laydown and access space. No laydown is proposed on the opposite side of the creek channel. This is to avoid a creek crossing that would be needed to access the work. All proposed access routes are on existing travel ways.

Potential Utility Impacts at Site X33				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	-	-	-	-
H	97	-	-	-
Total	-	-	-	-

9.10. Site X34 – Cherokee / Seneca Parks

Site X34 is located on the Middle Fork of Beargrass Creek. The site is located along the Cherokee and Seneca Park system. The site has large planting areas and R2 work units proposed. Laydown is proposed along the stream channel in openings along the park road. Some laydown areas will require clearing and grubbing. There is some overlap proposed of laydown over planting units. Haul routes for the R2 work unit will utilize the existing park entrances/exits and roads. The park loop is one-way traffic with pedestrian and bicycle mixed use and roadside parking. The section of the loop that is adjacent to the R2 work unit flows to the northwest. Utilizing the park road as a haul route will be difficult, but it is the only option in the area. Enhanced safety measures will need to be considered by designers, contractors, and inspectors. Temporary closures or traffic control will need to be considered when appropriate. Construction will impact users of the park. Some facilities or activities will be degraded in the short term.

Construction generally takes place during the week, which will avoid the highest conflict with users. Any open excavations or other construction impacts will need to be mitigated when the contractor is off site on evenings or weekends, when park usage is the highest. Some portions of the R2 work unit borders residential areas, so operations may need to be restricted for noise impacts during construction. One new access route is proposed. It is a short spur from an existing park road crossing an open field to support a small planting unit laydown area. The length of the proposed access road is approximately 240 feet. The access road is proposed as temporary, to be removed and rehabilitated at the end of construction. There is a network of sewer utilities that parallel to the creek channel, which will be heavily affected by the proposed R2 work unit.

Potential Utility Impacts at Site X34				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	4969	325	656	138
H	-	-	-	-
Total	-	-	-	-

9.11. Site X35 – Muddy Fork and Tributaries

Site X35 is located on the Muddy Fork of Beargrass Creek. It is located within a residential area. Access and laydown will be challenging at this site, due to steep topography and dense forested areas. There is a cleared power line corridor that is proposed to be utilized to reduce impact. Where the power corridor travels over hills, it will not be feasible for access routes due to steep grades. Outside of the power corridor, access may only be available through private property. The terrain limits what is available for use, which reduces options and increases impacts to the residential neighborhood. The only available haul route for the R2 work units is the residential street that travels along the creek. The route is two-lane and windy. In some places, the available road width reduces below two lanes. Utilizing this route during construction will require increased safety from the contractor. Local traffic will be impacted by construction traffic. Time of day restrictions could be utilized in the contract to mitigate some noise impacts to residents. The site has three proposed connectivity features that are disconnected from the other work units. The features are located along a roadway, making access and construction easier for these small point features. There is a network of sewer lines that runs parallel to the creek channel, which will be heavily affected by the proposed R2 work unit. There are multiple proposed new access routes at this site to allow truck traffic to descend from the residential streets to the creek channel. The total length of the proposed access roads is approximately 1950 feet.

Potential Utility Impacts at Site X35				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	1791	100	-	-
H	80	-	-	-
Total	-	-	-	-

9.12. Site X38 – Cave Hill Corridor

Site X38 is located on the Middle Fork of Beargrass Creek. It is bounded on the north by Interstate 64 and on the south by the Beargrass Creek Greenway, a few businesses, and Lexington Road. There is a large project under construction by MSD adjacent to the site boundary. Some of the proposed laydown and access will be affected by the final extents of this project. Coordination with MSD during design will be necessary to reduce impact to both projects. The proposed H2 units connect to the creek channel and cross existing walking trails. The affected walking trails will be mitigated in place or relocated. See the proposed recreation section in the main body of the report. There is one adjacent apartment complex that could be affected by construction noise. This could be mitigated by contract timing of operations. Any haul at the site would quickly access Lexington Road and the interstate if necessary. There are no other residential areas or public facilities that may be impacted nearby. There is a large sewer line that runs parallel to the creek channel, which will be heavily affected by the proposed R2 work unit. There is a short spur proposed as new temporary access road to be constructed. The length of the proposed access road is approximately 50 feet.

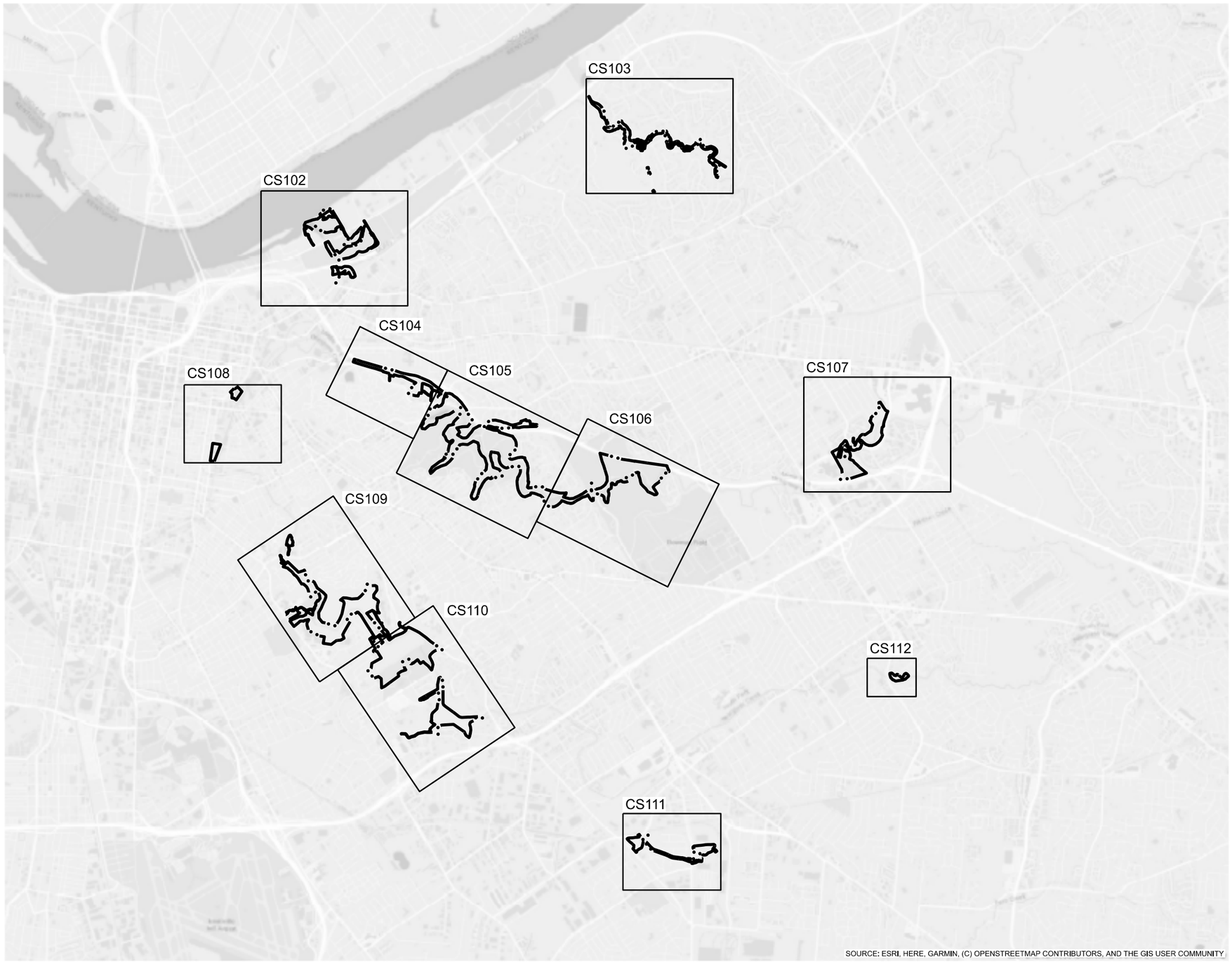
Potential Utility Impacts at Site X38				
Work Unit Category	*Sewer, Linear Impact (ft)*	*Water, Linear Impact (ft)*	*Gas, Linear Impact (ft)*	*Electric, Linear Impact (ft)*
R	3059	-	-	-
H	-	-	-	-
Total	-	-	-	-

10. Plan Sheets

Attached to the end of this appendix.

11. References

Brockman, Ruth R., Carmen T. Agouridis, Stephen R. Workman, Lindell E. Ormsbee, and Alex W. Fogle, 2012. Bankfull Regional Curves for the Inner and Outer Bluegrass Regions of Kentucky. Journal of the American Water Resources Association (JAWRA) 48(2): 391-406. DOI: 10.1111/j.1752-1688.2011.00621.x (https://onlinelibrary.wiley.com/doi/full/10.1111/j.1752-1688.2011.00621.x)



NORTH

0 5000' 10000'

A1 SITE PLAN KEY MAP

SCALE: 1" = 5000'

SHEET INDEX

SHEET ID	SITE NO	SITE NAME
CS101	ALL	OVERALL KEY MAP
CS102	X2	CONFLUENCE
CS103	X35	MUDDY FORK AND TRIBS
CS104	X38	CAVE HILL CORRIDOR
CS105	X34	CHEROKEE / SENECA PARKS
CS106	X34	CHEROKEE / SENECA PARKS
CS107	X20 X21	BROWN PARK ARTHUR DRAUT PARK
CS108	X22	CONCRETE CHANNEL
CS109	X22 X29 X30	CONCRETE CHANNEL EASTERN / CREASON CONNECTOR JOE CREASON PARK
CS110	X30 X10	JOE CREASON PARK ALPACA FARM / ZOO
CS111	X19	SOUTH FORK / NEWBURG ROAD
CS112	X33	MSD BASIN

LEGEND

PROPOSED SITE BOUNDARY, WORK LIMITS

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY: A. COMBS
DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY: MATTINGLY
SIZE: ANSI B

ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE
LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081: FY21

SITE PLAN KEY MAP

SHEET ID
CS101

APPENDIX A - CIVIL ENGINEERING

A1 ECOSYSTEM RESTORATION PLAN, CONFLUENCE, X2
SCALE: 1" = 600'

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
2. DATE OF AERIAL IMAGERY: 2018
3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
- PROPOSED BORROW OR DISPOSAL AREA
- PROPOSED ACCESS
- MATCH LINE, SITE DIVIDER LINE
- INVASIVE SPECIES REMOVAL EXTENTS
- H2
- PLANTING - AQUATIC
- PLANTING - BLUEGRASS SAVANNAH
- PLANTING - CANEBRAKE
- PLANTING - FOREST FLOODPLAIN
- PLANTING - FOREST HARDWOODS
- PLANTING - WOODLAND
- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

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SUBMITTED BY: SMITTINGLY
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ISSUE DATE:
SOLICITATION NO.:
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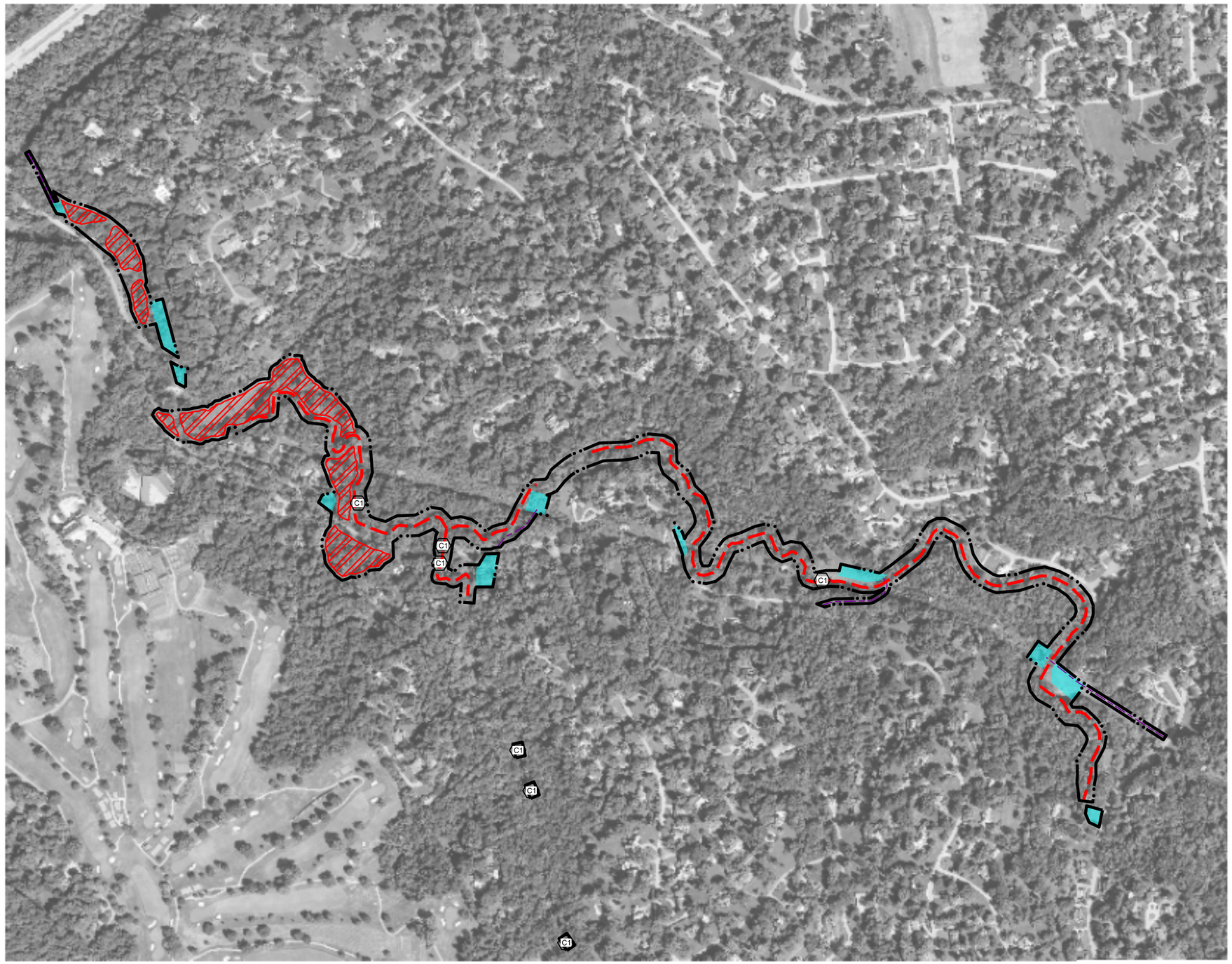
BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
CONFLUENCE
SITE X2

SHEET ID
CS102

APPENDIX A - CIVIL ENGINEERING



GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
2. DATE OF AERIAL IMAGERY: 2018
3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

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- R1
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- PLANTING - WOODLAND
- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

NORTH

0 600' 1200'

A1 ECOSYSTEM RESTORATION PLAN, MUDDY FORK AND TRIBS, X35
SCALE: 1" = 600'

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SUBMITTED BY: L. MARTINGLY	
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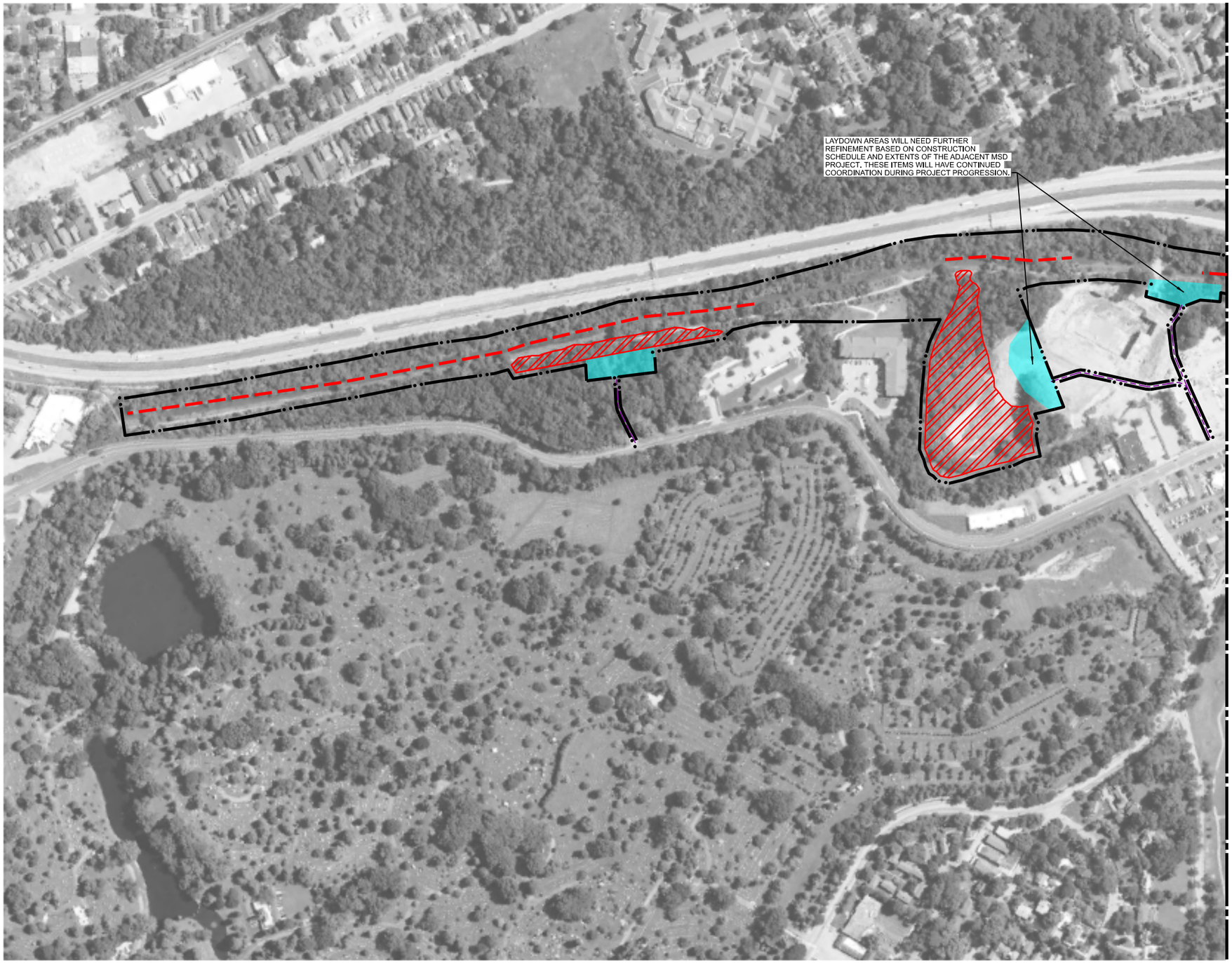
BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
MUDDY FORK AND TRIBS
SITE X35

SHEET ID
CS103

APPENDIX A - CIVIL ENGINEERING



A1 ECOSYSTEM RESTORATION PLAN, CAVE HILL CORRIDOR, X38

SCALE: 1" = 400'

NORTH

0 400' 800'

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
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3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
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- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

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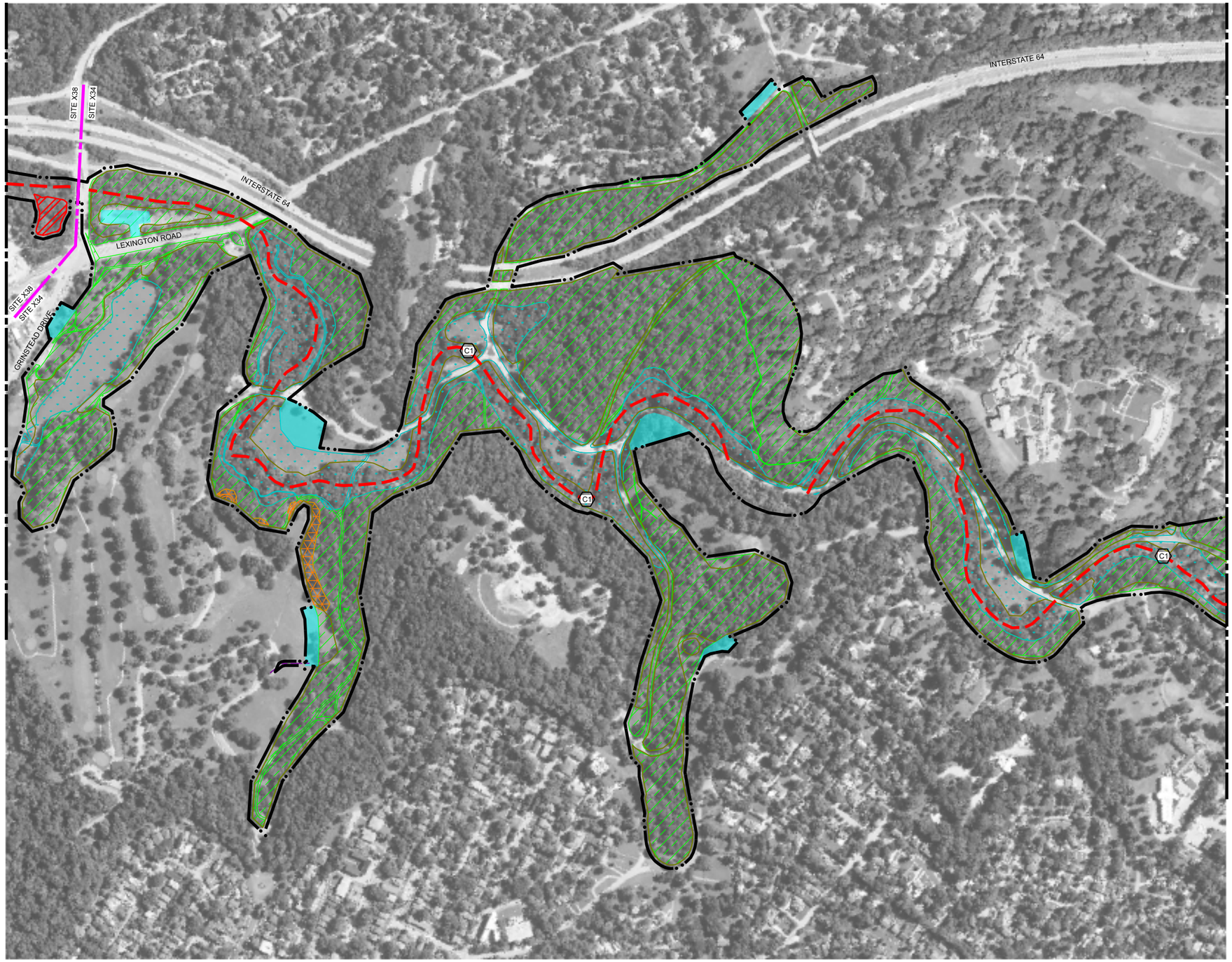
BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
CAVE HILL CORRIDOR
SITE X38

SHEET ID
CS104

APPENDIX A - CIVIL ENGINEERING



A1 ECOSYSTEM RESTORATION PLAN, CAVE HILL CORRIDOR (X38), CHEROKEE / SENECA PARKS (X34)

SCALE: 1" = 600'

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
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3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
- PROPOSED BORROW OR DISPOSAL AREA
- PROPOSED ACCESS
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- PLANTING - FOREST HARDWOODS
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- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

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BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
CAVE HILL CORRIDOR, CHEROKEE / SENECA PARKS
X38, X34

SHEET ID
CS105

APPENDIX A - CIVIL ENGINEERING

GENERAL SITE NOTES

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2. DATE OF AERIAL IMAGERY: 2018
3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
- PROPOSED BORROW OR DISPOSAL AREA
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- PLANTING - WOODLAND
- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

A1 ECOSYSTEM RESTORATION PLAN, CHEROKEE / SENECA PARKS, X34

SCALE: 1" = 600'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

ISSUE DATE:
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DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY: M. MATTINGLY
SIZE: ANSI B

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LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081; FY21

ECOSYSTEM RESTORATION PLAN
CHEROKEE / SENECA PARKS
SITE X34

SHEET ID
CS106

APPENDIX A - CIVIL ENGINEERING

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
2. DATE OF AERIAL IMAGERY: 2018
3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
- PROPOSED BORROW OR DISPOSAL AREA
- PROPOSED ACCESS
- MATCH LINE, SITE DIVIDER LINE
- INVASIVE SPECIES REMOVAL EXTENTS
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- PLANTING - AQUATIC
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- PLANTING - CANEBRAKE
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- PLANTING - WOODLAND
- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

NORTH

0 600' 1200'

A1 ECOSYSTEM RESTORATION PLAN, BROWN PARK (X20), ARTHUR DRAUT PARK (X21)
SCALE: 1" = 600'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:

DESIGNED BY: A. COMBS
DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY: L. MARTINGLY
SIZE: ANSI B

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE
LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
BROWN PARK, ARTHUR DRAUT PARK
SITE X20, X21

SHEET ID
CS107

APPENDIX A - CIVIL ENGINEERING

A1 ECOSYSTEM RESTORATION PLAN, CONCRETE CHANNEL, X22
SCALE: 1" = 400'

NORTH

0 400' 800'

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
2. DATE OF AERIAL IMAGERY: 2018
3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

- PROPOSED SITE BOUNDARY, WORK LIMITS
- R1
- R2
- R4
- PROPOSED BORROW OR DISPOSAL AREA
- PROPOSED ACCESS
- MATCH LINE, SITE DIVIDER LINE
- INVASIVE SPECIES REMOVAL EXTENTS
- H2
- PLANTING - AQUATIC
- PLANTING - BLUEGRASS SAVANNAH
- PLANTING - CANEBRAKE
- PLANTING - FOREST FLOODPLAIN
- PLANTING - FOREST HARDWOODS
- PLANTING - WOODLAND
- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:

DESIGNED BY: A. COMBS
DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY:
SCALE: AS NOTED
ANSI B

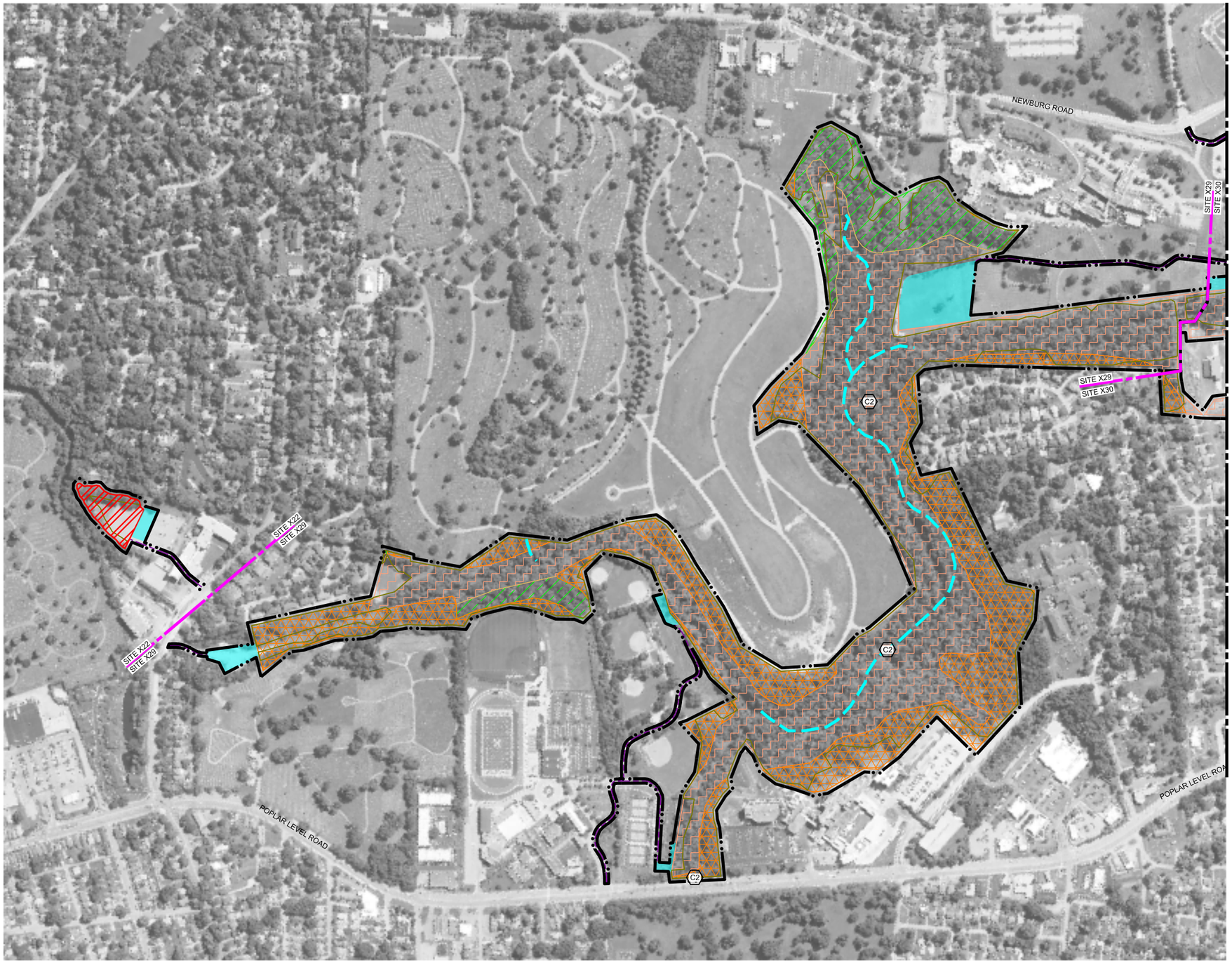
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE
LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
CONCRETE CHANNEL
SITE X22

SHEET ID
CS108

APPENDIX A - CIVIL ENGINEERING



A1 ECOSYSTEM RESTORATION PLAN, CONCRETE CHANNEL (X22), EASTERN / CREASON CONNECTOR (X29), JOE CREASON PARK (X30)
SCALE: 1" = 600'

GENERAL SITE NOTES

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- PROPOSED LAYDOWN AND ACCESS

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600 DR. MARTIN LUTHER KING JR. PLACE
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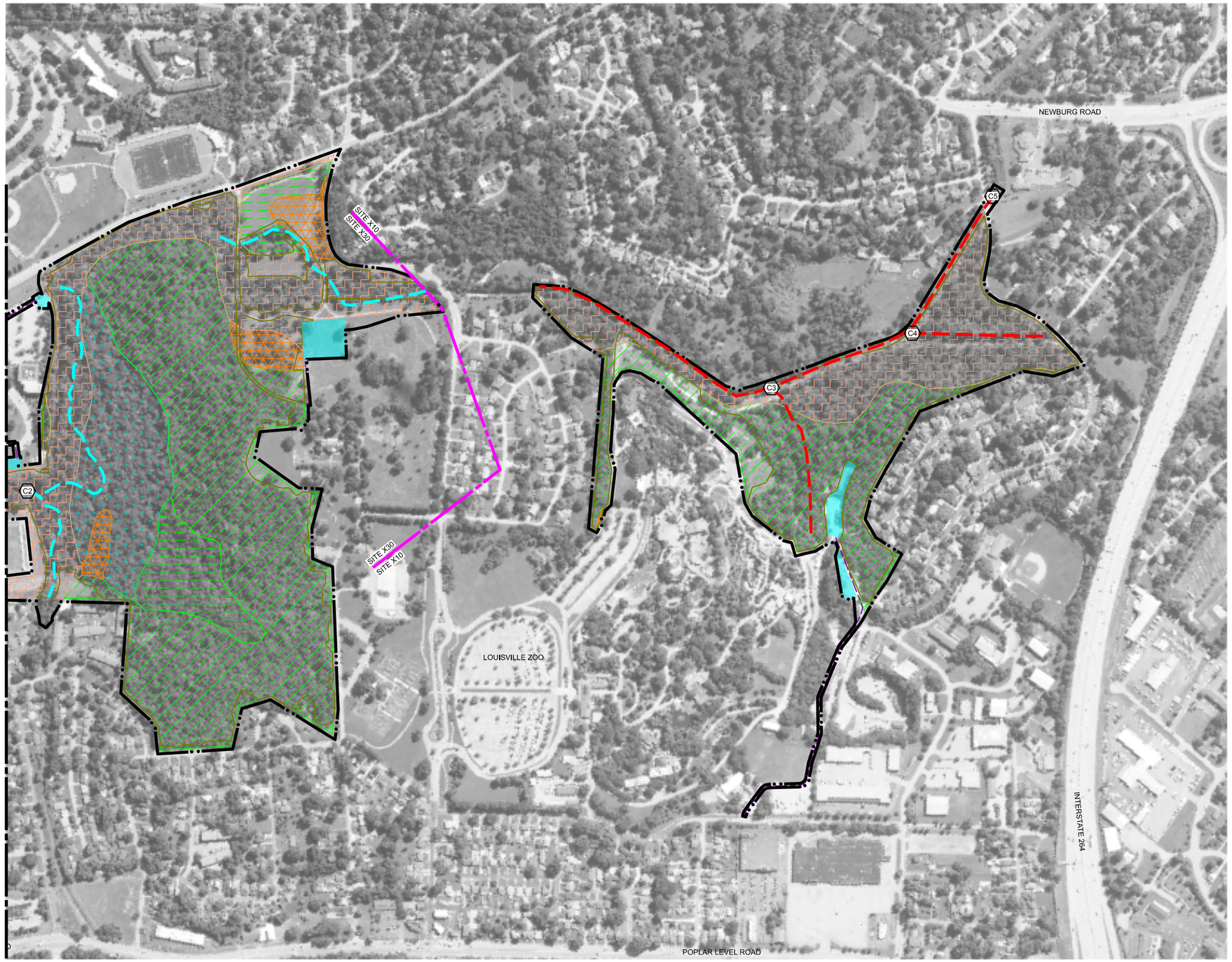
BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
CONCRETE CHANNEL, EASTERN / CREASON CONNECTOR
JOE CREASON PARK, SITE X22, X29, X30

SHEET ID
CS109

APPENDIX A - CIVIL ENGINEERING



A1 ECOSYSTEM RESTORATION PLAN, JOE CREASON PARK (X30), ALPACA FARM / ZOO (X10)

SCALE: 1" = 600'

NORTH

0 600' 1200'

GENERAL SITE NOTES

1. SOURCE OF AERIAL IMAGERY: U.S. DEPARTMENT OF AGRICULTURE, NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP)
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3. RESOLUTION OF AERIAL IMAGERY: 1 METER

SHEET KEYNOTES

C1. ADD RIFFLE

C2. RIVERINE CONNECTIVITY FEATURE

C3. CULVERT REMOVAL, CHANNEL RECONNECTION

C4. REMOVE DAM AND PROTECT SEWER LINE

C5. RIVERINE CONNECTIVITY, CURRENTLY PERCHED CULVERT

LEGEND

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- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

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SUBMITTED BY: MATTINGLY
SCALE: AS NOTED
SIZE: ANSI B

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LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
JOE CREASON PARK, ALPACA FARM / ZOO
SITE X30, X10

SHEET ID
CS110

APPENDIX A - CIVIL ENGINEERING

GENERAL SITE NOTES

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- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

NORTH

0 400' 800'

A1 ECOSYSTEM RESTORATION PLAN, SOUTH FORK / NEWBURG ROAD, X19
SCALE: 1" = 400'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

ISSUE DATE:
SOLICITATION NO.:
CONTRACT NO.:
DESIGNED BY: A. COMBS
DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY: SMATTINGLY
SIZE: ANSI B

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LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE
LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 466081, FY21

ECOSYSTEM RESTORATION PLAN
SOUTH FORK / NEWBURG ROAD
X19

SHEET ID
CS111

APPENDIX A - CIVIL ENGINEERING

GENERAL SITE NOTES

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- PLANTING - WOODLAND FLOODPLAIN
- PLANTING - WOODLAND HARDWOODS
- PLANTING - WOODLAND HARDWOOD BOTTOMS
- PROPOSED LAYDOWN AND ACCESS

NORTH

0 200' 400'

A1 ECOSYSTEM RESTORATION PLAN, MSD BASIN, X33

SCALE: 1" = 200'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY: A. COMBS
DRAWN BY: A. COMBS
CHECKED BY: R. HARRIS
SUBMITTED BY: M. MATTINGLY
SIZE: ANSI B

ISSUE DATE:
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U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
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LOUISVILLE, KENTUCKY 40202

BEARGRASS CREEK ECOSYSTEM RESTORATION
JEFFERSON COUNTY, KY
P2 465081, FY21

ECOSYSTEM RESTORATION PLAN
MSD BASIN
X33

SHEET ID
CS112

APPENDIX A - CIVIL ENGINEERING