Stabilize Riverbank at Buckeye, Mudcatcher, Station Road South, and MP 59.3 along the Cuyahoga River

Cuyahoga Valley National Park

Floodplain Statement of Findings

PMIS 224822 – PEPC 116064

Recommended:

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Lisa Petit, Superintendent, Cuyahoga Valley National Park

Certification of Technical Adequacy and Servicewide Consistency:

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Ed Harvey, Chief, Water Resources Division

Approved:

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Bert Frost, Director, NPS Regions 3, 4, 5

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CUYAHOGA VALLEY NATIONAL PARK

FLOODPLAIN STATEMENT OF FINDINGS

INTRODUCTION

Executive Order (EO) 11988, "Floodplain Management," and EO 13690, "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input," require the National Park Service (NPS) and other federal agencies to evaluate the likely impacts of actions in floodplains. The objective of EO 11988 is to avoid, to the extent possible, the long-term and short-term adverse impacts associated with occupancy, modification, or destruction of floodplains and to avoid indirect support of development and new construction in such areas wherever there is a practicable alternative. EO 13690 was issued to establish a Flood Risk Management Standard for federally funded projects to improve the nation's resilience to floods and to ensure new federal infrastructure will last as long as intended. The NPS administers floodplain policy through Director's Order 77-2: *Floodplain Management* (DO 77-2) and Procedural Manual 77-2 *Floodplain Management* (PM 77-2).

It is NPS policy to preserve floodplain functions and values and minimize potentially hazardous conditions associated with flooding, including threats to human health/life, risk to capital (NPS) investment, and impacts on natural and beneficial floodplain values. If a proposed action is found to be in an applicable regulatory floodplain with associated impacts and relocating the action to a non-floodplain site is considered not to be a practicable alternative, then a formal floodplain "Statement of Findings" must be prepared. The "Statement of Findings" must (a) quantify flood conditions and associated hazards as a basis for management decision making, (b) describe the rationale for selection of a floodplain site, (c) disclose the resources and amount of risk associated with the chosen site, and (d) explain flood mitigation plans. The "Statement of Findings" will be available for public review and comment through the National Environmental Policy Act Environmental Assessment.

This Floodplain Statement of Findings:

- Quantifies the flood hazard associated with riverbank stabilization at four locations along the Cuyahoga River in Cuyahoga Valley National Park (CUVA or Park):
    - Towpath Trail: Buckeye
    - Towpath Trail: Mudcatcher
    - Towpath Trail: Station Road South
    - Valley Railway: Mile Post (MP) 59.3
- Presents the rationale for the development of proposed project within the regulatory floodplain of the Cuyahoga River
- Documents the anticipated negative impacts of these improvements on human health/life, capital investment, and floodplain functions and values
- Presents mitigations to these impacts

LOCATION

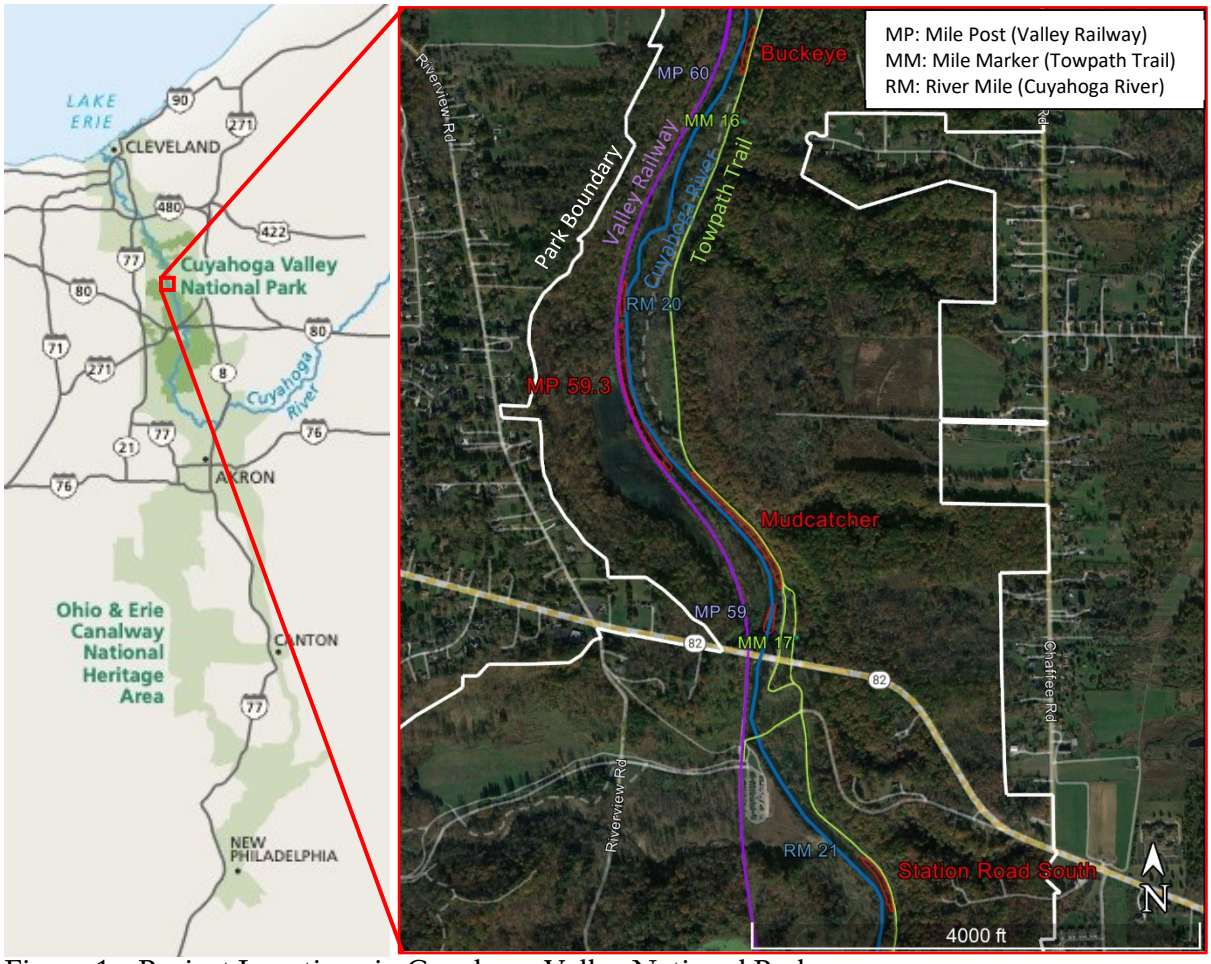

Figure 1 – Project Locations in Cuyahoga Valley National Park

This project is located along the Cuyahoga River in the North District of CUVA near State Route 82 as shown in Figure 1. Project sites on the east bank of the Cuyahoga River (Buckeye, Mudcatcher, and Station Road South) are along the historic Ohio & Erie Canal Towpath Trail and are in Summit County, Ohio. The Towpath Trail is a popular multi-use trail and an important element in the growing regional trail network that runs alongside the Ohio & Erie Canal Historic District (Ohio & Erie Canal), a portion of which is a National Historic Landmark (NHL). The project site on the west bank of the Cuyahoga River is along the Valley Railway Historic District (Valley Railway) at MP 59.3 and is in Cuyahoga County, Ohio. The Cuyahoga Valley Scenic Railroad (CVSR) is a popular tourist rail line that operates on the historic Valley Railway and is a critical element in the Park's Alternative Transportation System (ATS).

This segment of the Cuyahoga River does not meet eligibility requirements for inclusion into the National Wild and Scenic River System since it does not have a free-flowing condition (NPS, 2019, *Cuyahoga River Outstandingly Remarkable Values & Eligibility Summary*). This segment is, however, part of the Cuyahoga River Water Trail, which was established in 2019.

Approximately 20 miles of the over 87-mile Cuyahoga River Water Trail lies within the Park (Cuyahoga River Water Trail, 2019, Brochure).

PROPOSED ACTION

The purpose of the Proposed Action is to stabilize sections of the Cuyahoga riverbank for the protection of cultural resources and improve visitor experience through maintaining infrastructure and providing educational and recreational opportunities. The need for the Proposed Action is for the protection of the historic, cultural, and recreational resources, and to protect employees and the public from the erosional effects resulting from the fluvial processes of the Cuyahoga River and its tributaries within CUVA.

The Cuyahoga River Ecosystem, Ohio & Erie Canal, Valley Railway, and CUVA's Trail, Water, and Rail Network are all identified as fundamental resources and values (FRVs) in the Park's Foundation Document (NPS, 2013, *Foundation Document*). Erosion, unstable soils, and slumping are identified threats to these FRVs in the Foundation Document.
The U.S Army Corps of Engineers (USACE) completed a study (USACE Buffalo District, 2018, *Cuyahoga Valley National Park Streambank Assessment*) and identified an increasing trend in daily mean flows, caused by land use development within the watershed, as the most likely contributor to streambank erosion within CUVA. The majority of the 583-square mile watershed draining to this segment of the Cuyahoga River lies outside of the park boundary (the entire area of CUVA is just over 50 square miles). Therefore, the study concluded that since nothing can be done about development outside of the limits of the Park, projects should be implemented in the Park to (1) stabilize streambanks to directly target eroding streambanks and halt streambank erosion at project-specific locations, and (2) increase the Cuyahoga River's access to floodplains at lower flows to reduce peak flow rates during rainfall events that would normally initiate streambank erosion. The intent of this project is to address the first recommendation from the study (halt streambank erosion at project-specific locations). CUVA is planning future projects to address the second recommendation (increase the Cuyahoga River's access to floodplains at lower flows).

The USACE assessment relied on estimated erosion rate and distance to critical infrastructure based on 2011 aerial imagery to recommend stabilization project locations. The sites proposed as a part of this project were refined based on further erosion that has taken place since 2011 and ground truthing the distance to critical infrastructure. USACE identified one potential floodplain access area in this segment of the river, the west overbank near MP 59.3.

A Value Analysis Workshop for this project was held on June 16 and 17, 2021 (Kirk Associates, LLC, October 29, 2021, *Value Analysis Final Report*) and focused on selecting preferred alternatives using "Choosing By Advantages" and "Life Cycle Costing", brainstorming ideas to add value to the project, maintainability, accessibility of visitors, cultural resources, protection of the natural riverine system, timely project schedule, and environmental sensitivity during construction. All four of the sites included in this project proceeded with a hybrid riprap alternative.

A topographic survey and geotechnical investigations, including a slope stability analysis, were performed at each site. The slope stability analysis indicated that the existing factor of safety is below 1.0 at each of the four sites, indicating active slope failure. A factor of safety of 1.3 or

higher is required for the Towpath Trail sites. A factor of safety of 1.5 or higher is required for MP 59.3 in accordance with the American Railway Engineering and Maintenance-of-Way Association (AREMA). A morphological assessment, ecological assessment, and hydraulic modeling were also performed, and details can be found in the 2021 Basis of Design Report for the Towpath Trail Sites (HDR, 2021, *Basis of Design Report: CUVA 224822*), the 2021 Basis of Design Report for MP 59.3 (Environmental Design Group, 2021, *Basis of Design Report for Preferred Schematic Design Alternative at CVSR MP 59.3*), and the 2023 Basis of Design Report (RiverReach Construction, et. al, August 2023, *CUVA #224822 Basis of Design Report: Four-Sites Bank Stabilization*). The hydraulic model informed the material sizing and scour calculations at each site.

The 2023 Basis of Design Report concluded that the steep and frequently vertical nature of the stream banks is a major contributor of erosion and the main driver of stabilization in this reach. The Cuyahoga River has not drastically changed in pattern over the last 70 years within this reach, except for Station Road South due to a low head dam removal at State Route 82 completed in 2020. The meanders in this reach are very slight and there is an absence of established point bars due to the presence of the State Route 82 dam until 2020. The sediment is now being mobilized through the project areas since the removal of the dam.

The project areas will become more resistant to pattern adjustment post-stabilization due to the modification of both the bank slope geometry, scour protection and bio-engineering proposed at the sites. The bendway weirs at key locations will move energies away from park infrastructure while allowing for deposition of fine sediments in the downstream slack waters behind the bendways. The proposed bank protection will not impact the channel profile. The project extents will have no major impact to the channel capacity. Depositional sandbars forming along the upper and lower extents of the project will continue to naturally form and improvements in bank height ratio and slope of the stream banks through stabilization design, as well as incorporating bendway weirs, will encourage deposition of fine sediments in this reach.

The design objective was to stabilize the streambank at these critical infrastructure locations to establish a stable slope resilient to significant slumping or settlement. The components to this design include (1) improving the slope stability to an acceptable factor of safety for the infrastructure being protected, and (2) providing protection from erosive forces from the Cuyahoga River.

The design includes installation of Longitudinal Fill Stone Toe Protection (LFSTP) along the toe of slope, bank infill with rock armored bank slope, and bioengineered soil fill with native plantings along the upper bank. The LFSTP uses a stone mass placed in front of the proposed bank toe to provide suitably sized stone material designed to launch into expected channel scouring along the bank toe. The LFSTP material is sized based on predicted scour depth and the volume of material needed to reinforce the slope toe and maintain bank stability. Each site was designed to meet the recommended stone volume of 1-ton per 3 feet of predicted scour depth. A typical section of the design proposed at each of these four sites is shown in Figure 2.

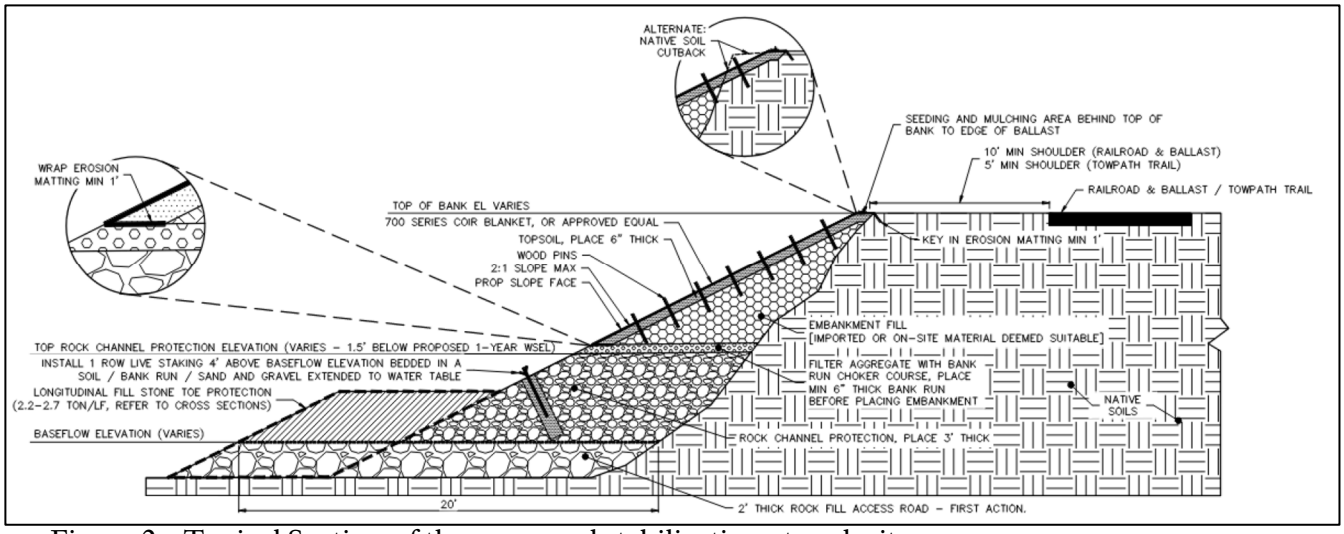

Figure 2 – Typical Section of the proposed stabilization at each site

Additionally, the design approach includes select placement of shallow rock bendway weirs to be utilized as an effective method to mitigate scour and erosion along the streambank by training the river thalweg (i.e., deepest part of river) to adjust further from the riverbank. The bendway features have been located primarily on outside meander bend locations where the river thalweg is currently shifted along the outside edge of the channel and attacking the bank toe. Each rock bendway weir feature is established to extend a minimum of 15 feet (up to 30 feet in select locations) and positioned at a 70 degree angle upstream from the new bank. The crest of weir is designed 10 feet wide and set at an elevation approximately 1 foot above the base flow water surface (see Figure 3). These rock bendway features work to retrain the river thalweg and shift the scour forming energy just beyond the end of bendway features more toward river center, where paddlers would have sufficient draft depth to float through the stabilized project reach. The placement of bendway weir features allows reduction of launch stone (i.e., LFSTP) placement for the new bank reach between bendway features and for a select distance (approximately 50 feet) downstream of the bendways. It is acceptable to reduce the stone volume for longitudinal bank armoring since the bank segments in between the bendway features typically become depositional and would not be subjected to scour forces along the bank toe. The installation of locked log features may also be utilized within segments between bendway features. These added bio-engineered features provide increased hydraulic roughness and aquatic habitat. The lock log features will also be field determined based on availability of onsite wood sources.

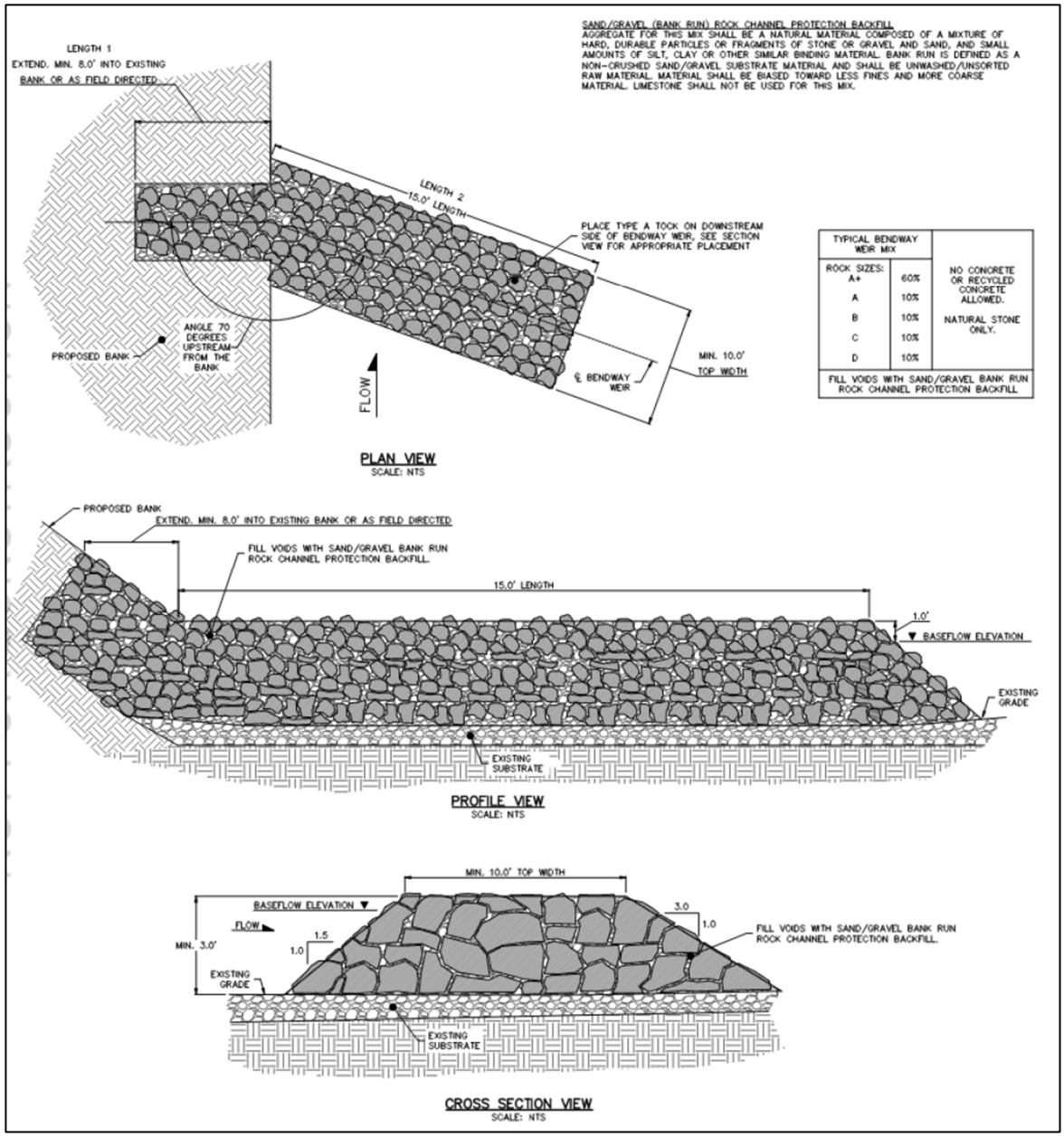

Figure 3 – Bendway Weir Detail

Construction will use a 4-phased approach for the LFSTP installation and bank stabilization. First, a stone access road approximately 15 to 20 feet wide and 2 feet thick will be built from upstream to downstream at the toe of the slope along the length of project; this material will remain and form the base of the new bank infill. The second phase will involve placement of the LFSTP overtop and adjacent to the river side of access road. The third phase includes construction of the 2H:1V bank infill, live stake layer, and bank armor stone. And the fourth phase includes the remaining backfill to reach final grade using bioengineering techniques consisting of soil fill armored with a coconut fiber erosion control mat and native seed mix. Phases 2 through 4 will be conducted from downstream to upstream, working back out along the constructed access road.

A temporary river crossing will be utilized at a shallow riffle area to access and excavate existing deposited river materials from the upstream mid-channel bar. The excavation of this area serves two purposes, one of which is to reclaim channel cross-sectional area and mitigate lateral flow diversion causing bank erosion. Secondly, the excavated sand / gravel material from mid-channel bar will be utilized to fill existing scour holes, potentially be used for bank infill, and to choke the voids in the bank armor stone and LFSTP. This will allow live stake installation along the lower portion of bank armor to get some vegetative cover along the stone, ultimately leaving a natural bank aesthetic as opposed to a stark rock riprap appearance.

Towpath Trail: Buckeye

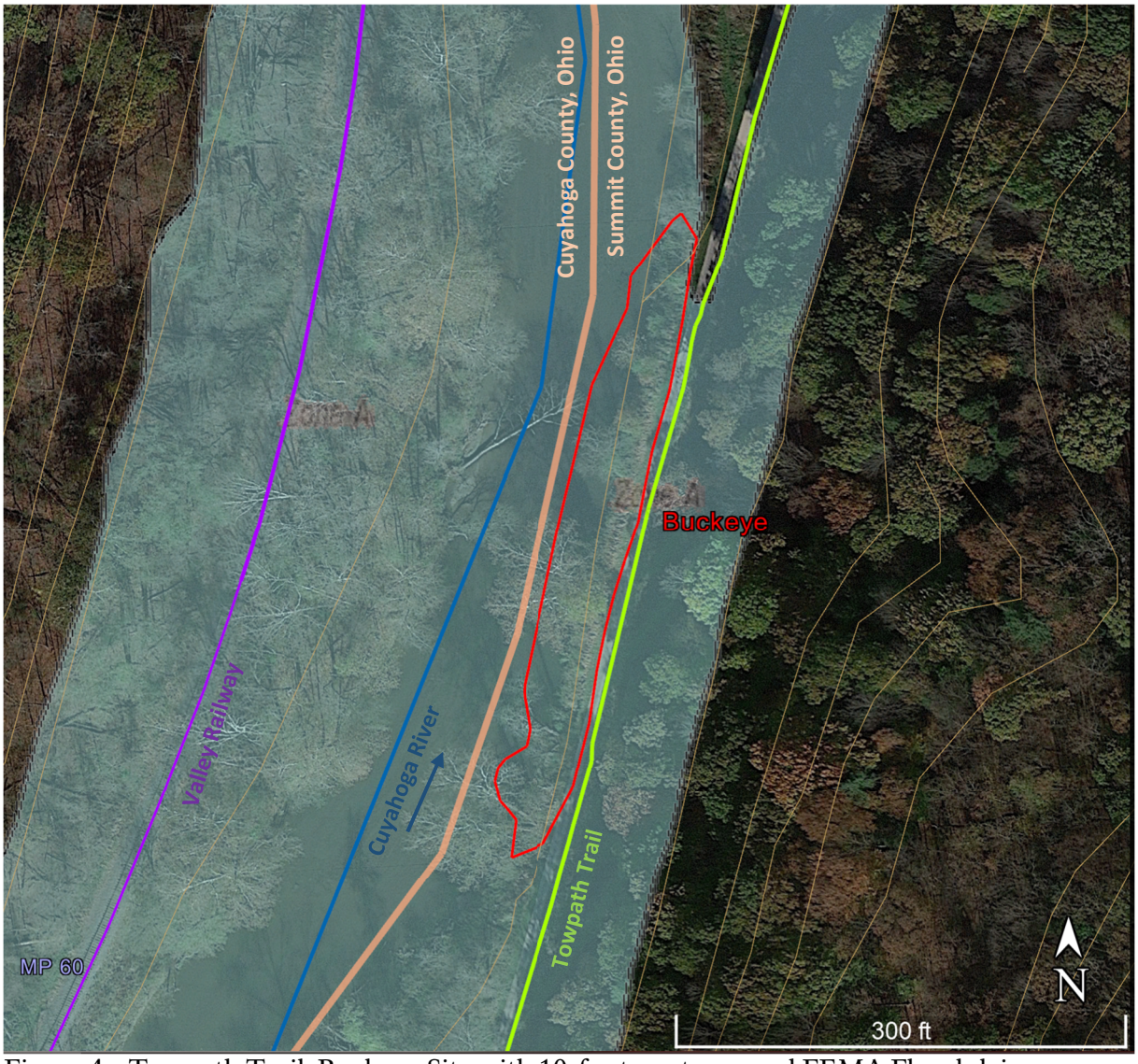

Figure 4 – Towpath Trail: Buckeye Site with 10-foot contours and FEMA Floodplain

The design for Buckeye (approximately 400 linear feet), shown in Figure 5, was developed as a bank infill project to stabilize/armor the bank slopeand re-establish a 5-foot minimum width shoulder along the towpath trail. The river is narrowed in this area, which increases energy and potential for erosive scour along the streambank. Therefore, toe scour countermeasure methods are necessary to mitigate bank failure. The predicted scour depth is in the range of 4.7 to 17.2 feet. The subsurface investigation indicates bedrock estimated at a depth 5 feet to 7 feet below the bank toe which sets the limiting scour depth. The design includes a 2.5-ton per linear foot of LFSTP measured along the toe for the full project length to counteract potential for up to 7 feet of predicted scour depth. To prevent erosive flanking behind the stabilized bank, the infill method includes trenched keys to be installed at the upstream and downstream extents and at interim spaced locations along the project reach.

A bendway weir is proposed at the upstream end of the site where there is presence of a meander bend terminating into the relatively straight reach along the Towpath Trail and project extent. The bendway feature will work to divert energies associated with the incoming stream angle away from the bank.

Leveraging any existing stability is important given the close proximity of the Towpath Trail, so cutting mature trees or conducting ground disturbance such as grading or removing roots will be avoided. Instead, infill will be placed and the grades and elevations will be kept as close as possible to the existing bank to avoid causing channel shift or erosion to the opposite bank. Since the 1-year water surface elevation (WSEL) is higher on this reach of the project, the rock armoring will extend higher on the bank slope to mitigate the predicted erosive power. Results from the hydraulic analysis at this site are summarized in Table 1.

Table 1
Hydraulic Analysis - Towpath Trail: Buckeye

	1-Yr		1.5-Yr		10-Yr		100-Yr	
	Avg	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Existing Channel Velocity (ft/s)	3.75	5.09	4.50	6.11	5.17	7.16	5.96	7.99
Proposed Channel Velocity (ft/s)	3.82	5.39	4.54	6.38	5.16	7.32	5.97	8.13
Difference: Channel Velocity (ft/s)	0.07	0.30	0.04	0.27	-0.01	0.16	0.01	0.14
Existing Shear Stress (psf)	0.28	0.47	0.39	0.64	0.52	0.86	0.65	1.13
Proposed Shear Stress (psf)	0.29	0.52	0.41	0.70	0.52	0.87	0.65	1.14
Difference: Shear Stress (psf)	0.01	0.05	0.02	0.06	0.00	0.01	0.00	0.01

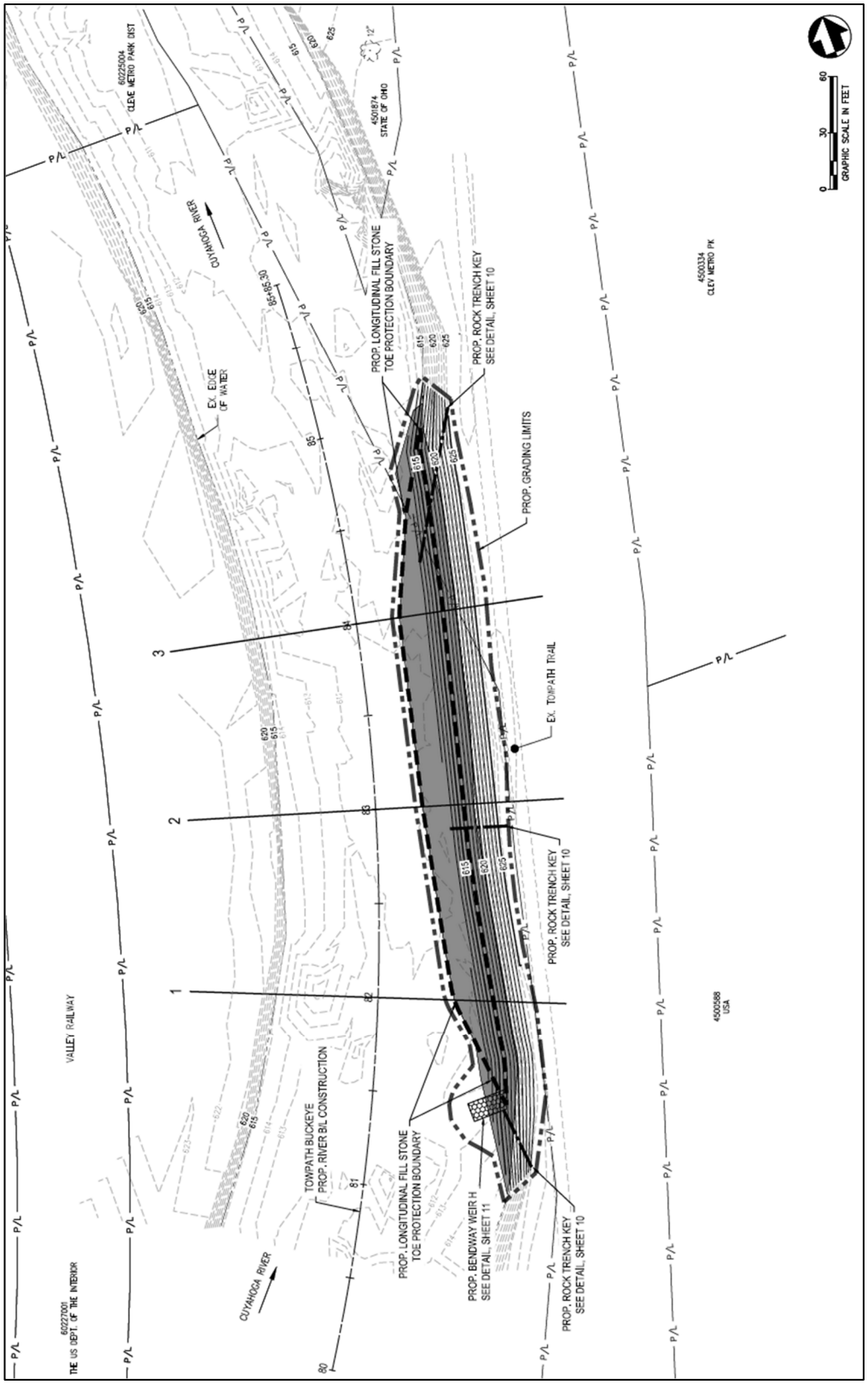

Figure 5 – Towpath Trail: Buckeye: Proposed Grading Plan (from Sheet 35 of the Drawings)

Towpath Trail: Mudcatcher

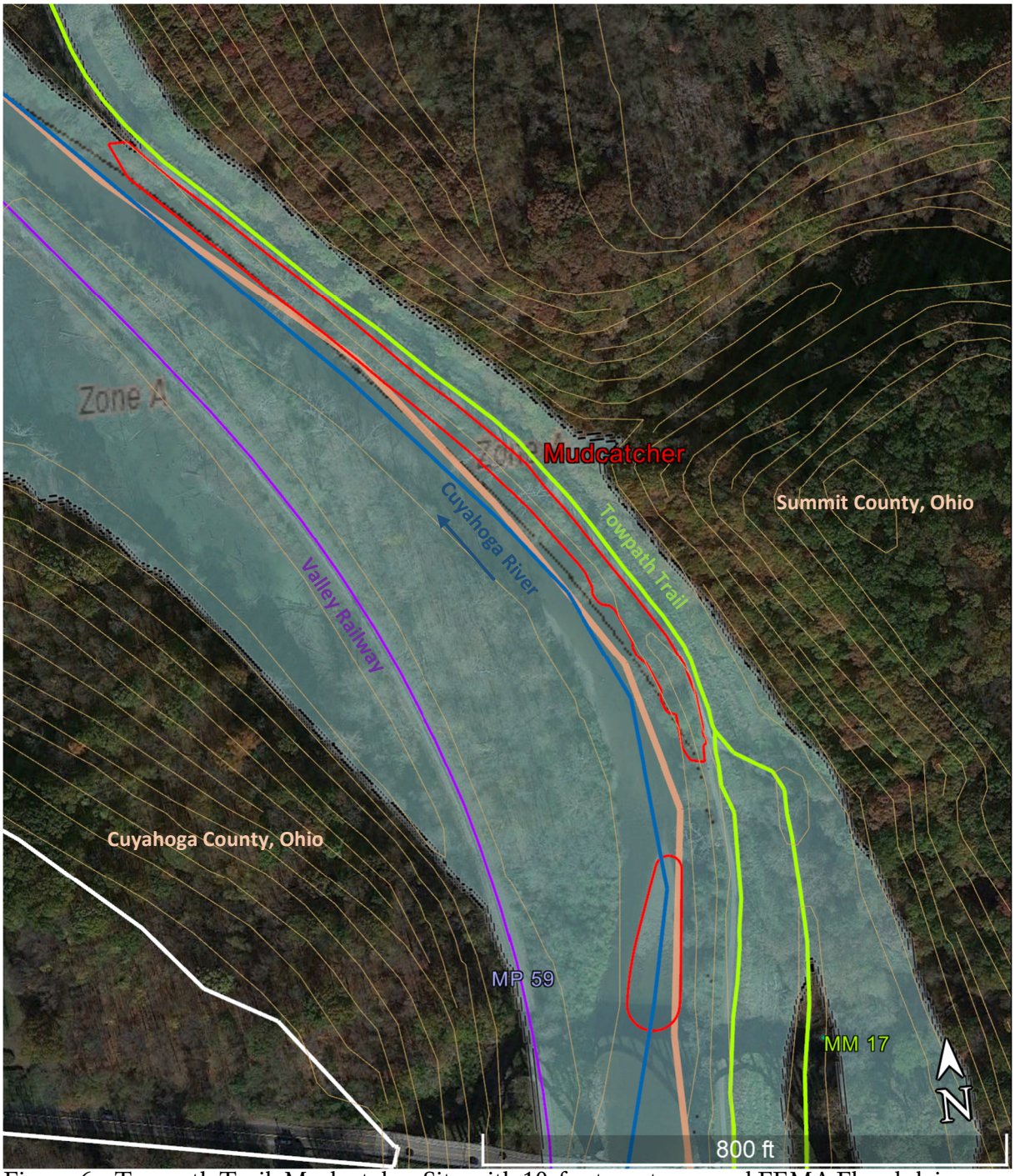

Figure 6 – Towpath Trail: Mudcatcher Site with 10-foot contours and FEMA Floodplain

The design for Mudcatcher, shown in Figure 7, was also developed as a bank infill project to stabilize the bank slope and re-establish a 5-foot minimum width shoulder along the towpath trail. The predicted scour depth is in the range of 4.8 to 18.1 feet. However, based on the subsurface investigation, bedrock is estimated at a depth 5 feet to 7 feet below the bank toe and is considered as the limiting scour depth. Therefore, the design includes a 2.5-ton per linear foot of LFSTP measured along the toe for the full project length to counteract potential for up to 7 feet of predicated scour depth. Trenched keys are called for at the upstream and downstream extents and spaced throughout the project reach.

Based on the Slope Stability analysis the infill shall be sloped no steeper than 2H:1V to the proposed toe of slope along channel bed. The Mudcatcher reach also includes three rock bendway weir features at the upstream extent of the project reach along the meander bend most subjected to direct flow forces. Mudcatcher is one of the longer stabilization sites (approximately 1,250 linear feet) and the current proposed bendways are focused at the beginning of the project in conjunction with the geometry and with intention to prevent flanking behind the stabilization area.

Wood sourced from leaning trees or deadfall in the area may be utilized for incorporation into the stabilization for lock log features between bendways. Wood sourced from the project site will maintain root ball left in place within riverbank.

The Mudcatcher site also incorporates work within the reach just upstream of the bank stabilization area where there is an existing mid-channel sand-gravel bar formation. This mid-channel bar promotes lateral flow forces, bank erosion, and channel widening. This material shall be harvested and reused in the project as a bankrun material source and will be tested (as needed) if material to be utilized for subgrade fill along the infill project. Results from the hydraulic analysis at this site are summarized in Table 2.

Table 2
Hydraulic Analysis - Towpath Trail: Mudcatcher

	1-Yr		1.5-Yr		10-Yr		100-Yr	
	Avg	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Existing Channel Velocity (ft/s)	3.99	5.24	4.65	5.77	5.84	7.47	6.43	8.21
Proposed Channel Velocity (ft/s)	4.08	5.58	4.67	6.05	5.82	7.72	6.38	8.08
Difference: Channel Velocity (ft/s)	0.09	0.34	0.02	0.28	-0.02	0.25	-0.05	-0.13
Existing Shear Stress (psf)	0.32	0.51	0.41	0.60	0.60	0.99	0.71	1.30
Proposed Shear Stress (psf)	0.34	0.57	0.42	0.63	0.61	1.08	0.71	1.35
Difference: Shear Stress (psf)	0.02	0.06	0.01	0.03	0.01	0.09	0.00	0.05

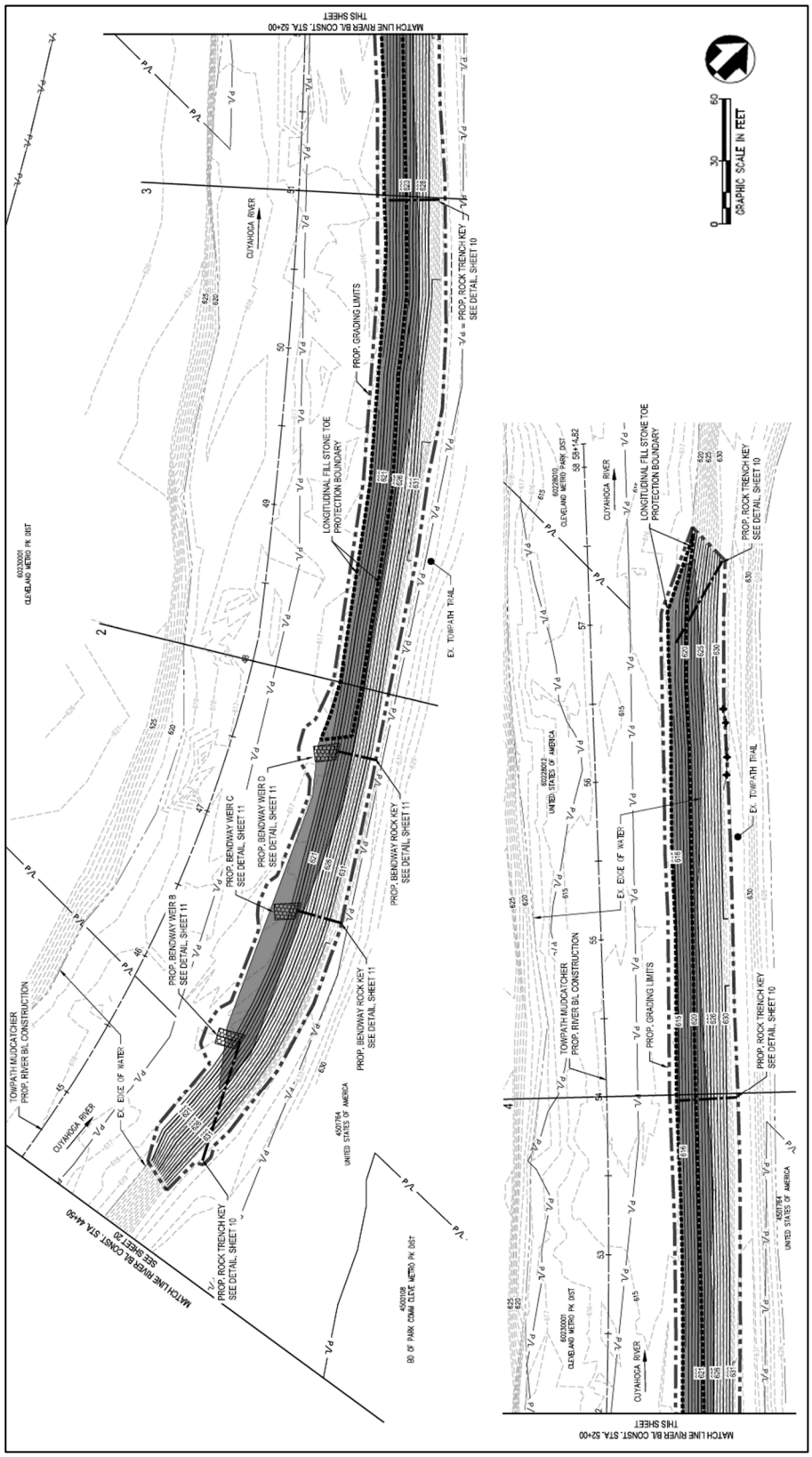

Figure 7 – Towpath Trail: Mudcatcher: Proposed Grading Plan (from Sheet 21 of the Drawings)

Towpath Trail: Station Road South

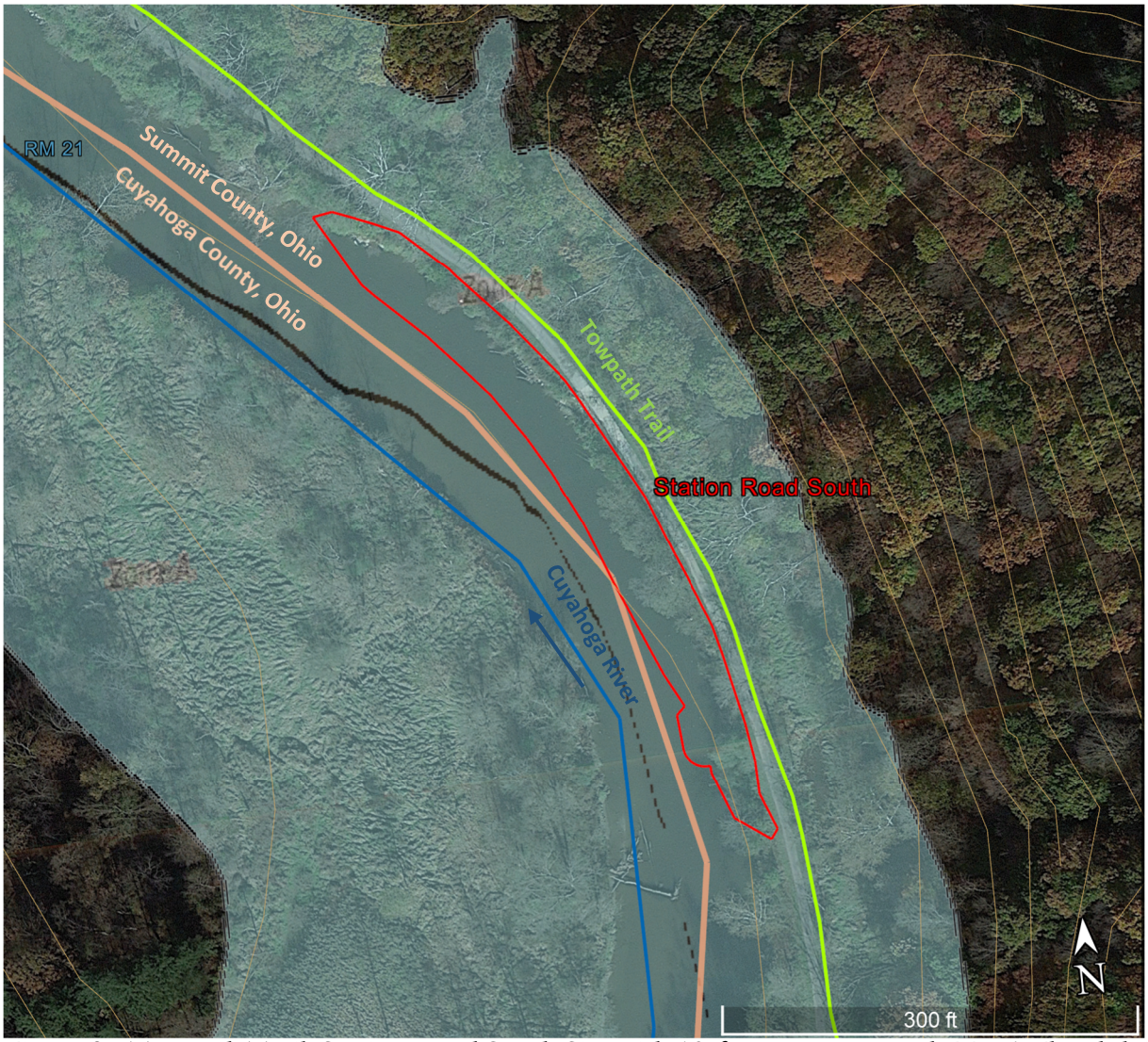

Figure 8 – Towpath Trail: Station Road South Site with 10-foot contours and FEMA Floodplain

The design for Towpath Station Road South (approximately 500 linear feet), shown in Figure 9, was developed as a bank infill project to stabilize the bank slope and re-establish greater than a 5-foot minimum width shoulder along the Towpath Trail. The river reach is narrowed in this area, which increases energy and potential for erosive scour along the streambank. Therefore, toe scour countermeasure methods are necessary to mitigate bank failure. The predicted scour depth as is in the range of 5.2 to 8.7 feet. However, based on the subsurface investigation, bedrock is estimated at a depth 5 to 8 feet below the bank toe and is considered as the limiting scour depth. Therefore, the design includes a 2.7-ton per linear foot of LFSTP measured along the toe for the full project length to counteract potential for up to 8 feet of predicated scour depth. This bank infill method includes trenched keys to be installed at the upstream and downstream extents and at interim spaced locations along the project reach. These keys are

installed to tie back the rock revetments and prevent erosive flanking behind the stabilized bank.

Based on the Slope Stability analysis, the infill shall be sloped no steeper than 2H:1V to the proposed toe of slope along channel bed. The narrowed river section also causes increased flood stage height within the project reach. The 1-year water surface elevation (WSEL) is higher on this portion of streambank and is cause for extension of the rock armoring higher on the bank slope to mitigate the predicted erosive power.

The stabilization site also includes implementation of a rock bendway weir feature at the upstream extent of the project reach. The bendway rock feature is designed to further mitigate potential for cut-back bank erosion from flanking the leading edge of the restored bank. Results from the hydraulic analysis at this site are summarized in Table 3.

Table 3
Hydraulic Analysis - Towpath Trail: Station Road South

	1-Yr		1.5-Yr		10-Yr		100-Yr	
	Avg	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Existing Channel Velocity (ft/s)	4.53	5.78	4.61	6.34	4.95	6.70	5.05	6.56
Proposed Channel Velocity (ft/s)	4.68	7.18	4.68	6.46	4.98	6.76	5.08	6.59
Difference: Channel Velocity (ft/s)	0.15	1.40	0.07	0.12	0.03	0.06	0.03	0.03
Existing Shear Stress (psf)	0.40	0.61	0.41	1.25	0.43	1.19	0.42	1.57
Proposed Shear Stress (psf)	0.45	1.09	0.43	1.21	0.44	1.21	0.43	1.53
Difference: Shear Stress (psf)	0.05	0.48	0.02	-0.04	0.01	0.02	0.01	-0.04

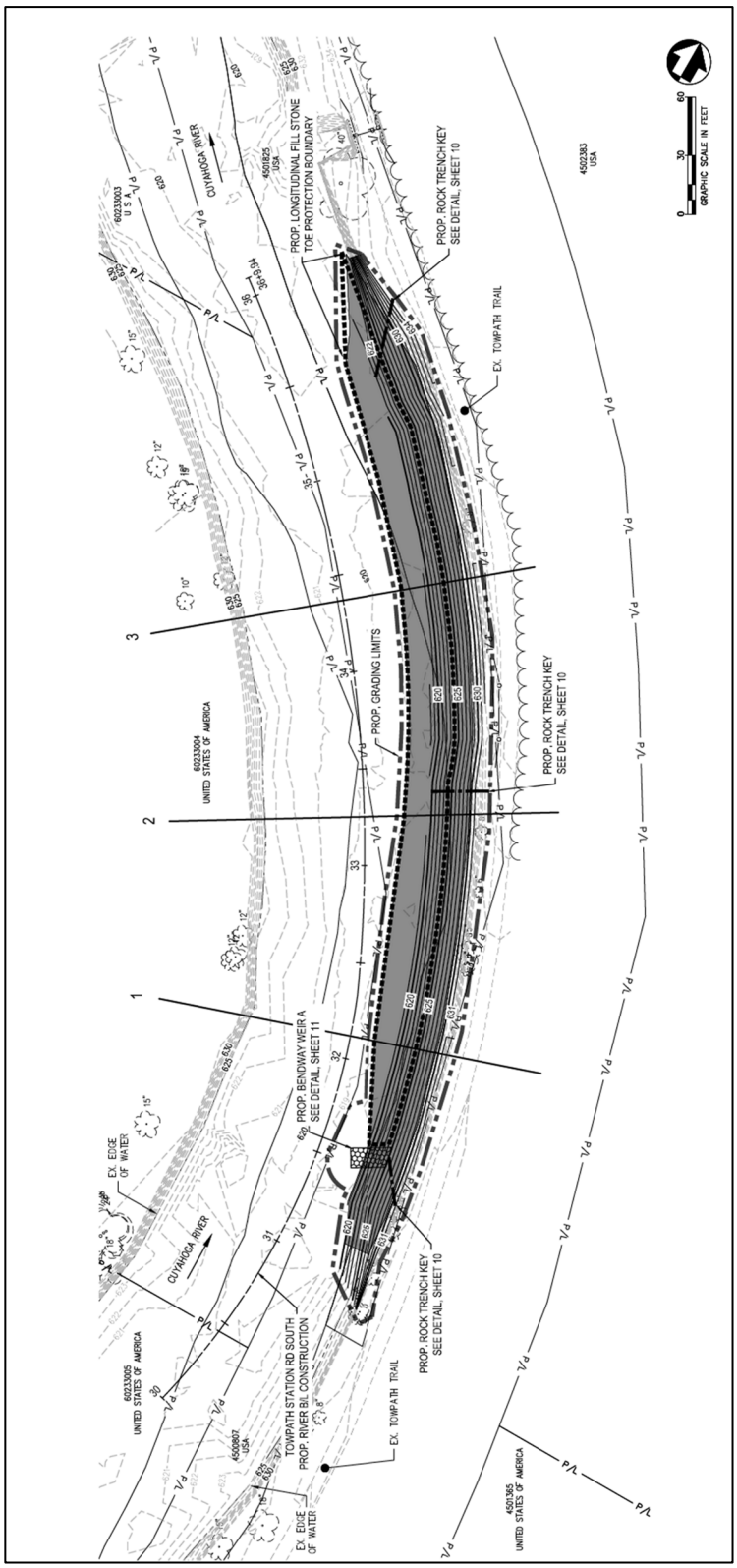

Figure 9 – Towpath Trail: Station Road South: Proposed Grading Plan (from Sheet 14 of the Drawings)

Valley Railway: MP 59.3

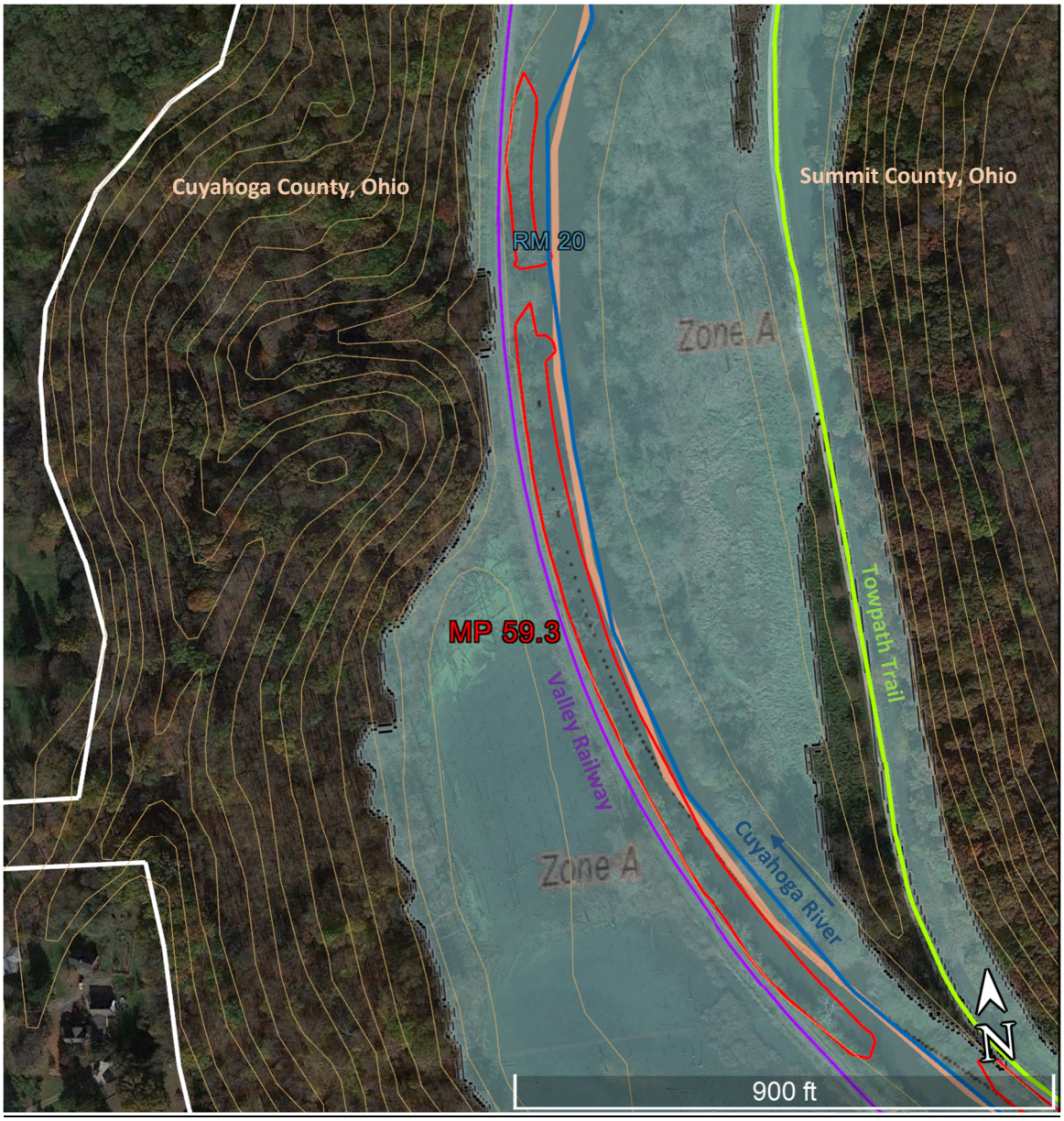

Figure 10 – Valley Railway: MP 59.3 Site with 10-foot contours and FEMA Floodplain

The design for Mile Post 59.3 (approximately 1,550 linear feet), shown in Figure 11, was developed as a bank infill project to stabilize the bank slope and re-establish a 10' minimum width shoulder along the railway ballast. To minimize the extent of infill, the proposed alignment has been established tight to the eroded bank edge so as to limit reduction of the channel cross-sectional flow area and potential impact of the opposite bank. Based on the Slope Stability analysis, the infill shall be sloped no steeper than 2H:1V to the proposed toe of slope along channel bed. The upstream extent will include an appropriate bank tie-in and will transition from the downstream end of the Mudcatcher site. A segment of riverbank in the

lower reach will also be left undisturbed. The intent is to leave the established vegetation and potential underlying stable landform rather than excavate or disturb this area.

The predicted scour depth is in the range of 3.8' – 13.5'. However, based on the subsurface investigation, bedrock is estimated at a depth 2 to 5 feet below the bank toe and is considered as the limiting scour depth. Using a predicted 5-foot scour depth, the calculated volume of LFSTP required is 1.67-ton per lineal foot. However, for consistency with the design at adjacent Mudcatcher site, and to build in some conservatism due to proximity to the railway asset, the LFSTP volume was increased by 30%. This results in the design including a 2.2-ton per linear foot of LFSTP measured along the toe for the full project length to counteract potential for up to 7 feet of predicated scour depth. Trenched keys are also called for at the upstream and downstream extents and spaced throughout the project reach.

The stabilization site also includes implementation of rock bendway weir features at the upstream/downstream extent of the stabilization zones within this project reach. The rock feature is designed to shift the scour forming energy of river away from the streambank toe and provides a means to protect against scour and minimize cut-back bank erosion from flanking the leading edge of the restored bank. The proposed bendway feature was sized to minimize shifting the river energies too far and creating problems on the opposite bank. However, the proposed bendway lengths are elongated sufficiently beyond the LFSTP material to deflect the thalweg appropriately to protect the undisturbed portion within the lower reach area. Results from the hydraulic analysis at this site are summarized in Table 4.

Table 4
Hydraulic Analysis - Valley Railway: MP 59.3

	1-Yr		1.5-Yr		10-Yr		100-Yr	
	Avg	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
Existing Channel Velocity (ft/s)	3.75	5.58	4.49	6.56	5.66	8.14	5.63	7.85
Proposed Channel Velocity (ft/s)	3.91	6.10	4.61	7.05	5.60	8.45	5.63	8.05
Difference: Channel Velocity (ft/s)	0.16	0.52	0.12	0.49	-0.06	0.31	0.00	0.20
Existing Shear Stress (psf)	0.28	0.57	0.39	0.76	0.57	1.18	0.54	1.14
Proposed Shear Stress (psf)	0.30	0.69	0.42	0.88	0.57	1.25	0.55	1.24
Difference: Shear Stress (psf)	0.02	0.12	0.03	0.12	0.00	0.07	0.01	0.10

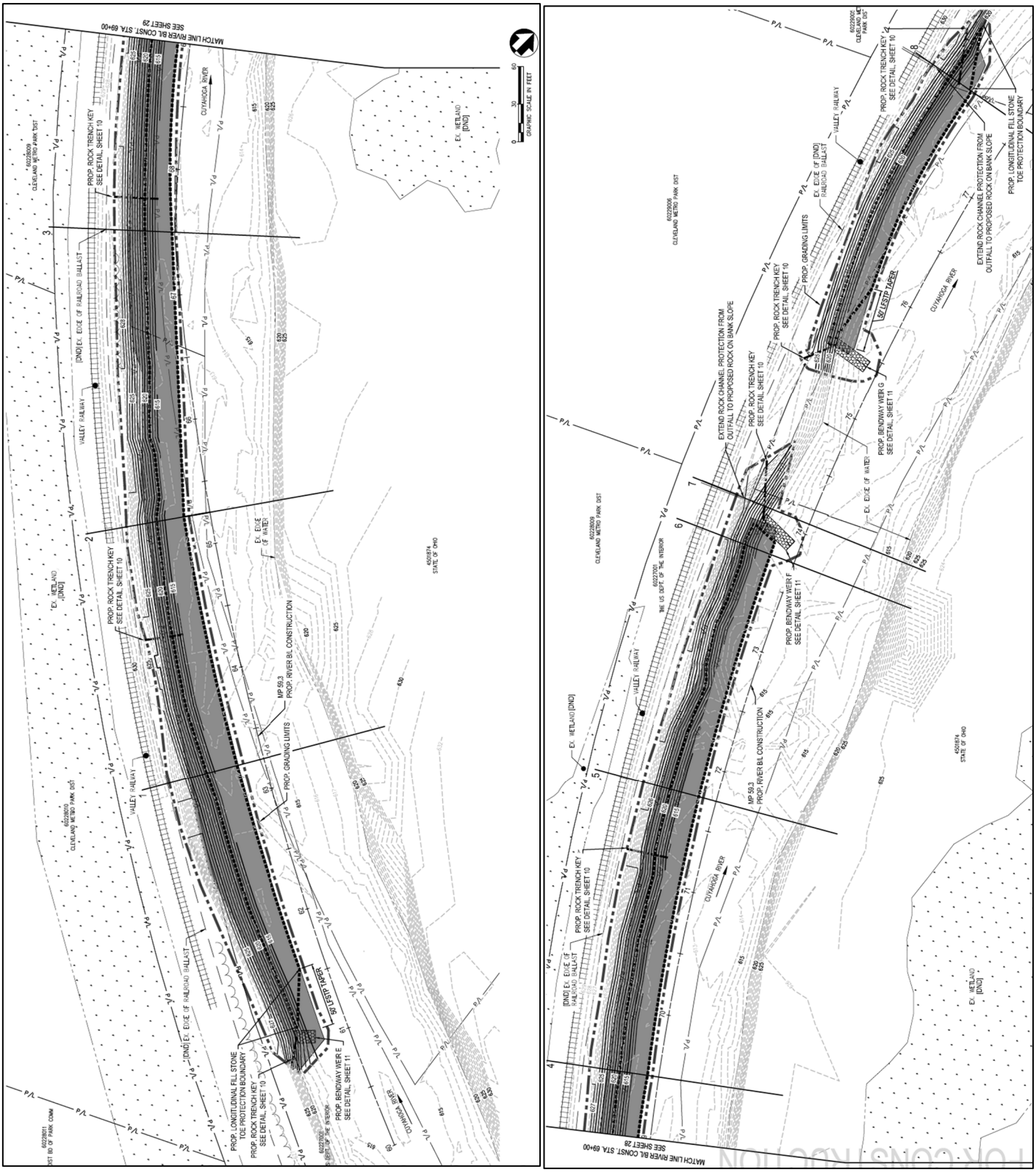

Figure 11 – Valley Railway: MP 59.3: Proposed Grading Plan (from Sheets 28 and 29 of the Drawings)

JUSTIFICATION FOR USE OF THE FLOODPLAIN

INVESTIGATION OF ALTERNATIVE SITES

No practicable alternatives exist for locating the project outside of the regulatory floodplain because the proposed action involves the protection of two significant historic, cultural, and recreational resources within the Park that are already located within the floodplain. The location of the proposed action in the floodplain is dictated by the location of the resources that the proposed action is intended to protect.

JUSTIFICATION FOR FLOODPLAIN LOCATION

The 2004 Programmatic Environmental Assessment (NPS, 2004, Final Programmatic Environmental Assessment for Riverbank Management of the Cuyahoga River) evaluated a no action alternative. While no action would partially accomplish the objective of preserving the values of the Cuyahoga River, its tributaries and its floodplain by allowing the natural processes of scour and deposition to continue unabated, it significantly diminishes the historic, cultural, and recreational values of the Towpath Trail and Valley Railway. Also, the sediment processes on the Cuyahoga River and its tributaries cannot be regarded as naturally occurring given the level of development within the watershed. The Cuyahoga River is presently in an altered state due to man-induced actions. No action would result in the eventual closing of the Towpath Trail and Valley Railway.

Further, CUVA has an active Cooperative Agreement (NPS, 2018, Cooperative Agreement Between the United States Department of Interior National Park Service and Cuyahoga Valley Preservation and Scenic Railway Association) in which NPS agrees to maintain all trackage, turnouts, railbed, bridges and culverts, embankments, grade crossings, parking areas, station and platform facilities, and any other railroad related infrastructure. The Agreement indicates that NPS will maintain the tracks to Class 2 standards for the provision of excursion passenger railroad operations, and an alternative transportation system, in CUVA.

FLOODPLAIN DESCRIPTION, STANDARDS AND RISK

DETERMINATION OF ACTION CLASS AND REGULATORY FLOODPLAIN

Following PM 77-2, three action classes were considered when establishing the regulatory floodplain:

1. Class I Actions include location or construction of administrative, residential, warehouse, and maintenance buildings; non-excepted parking lots; or other man-made features which by their nature entice or require individuals to occupy the site, are prone to flood damage, or result in impacts to natural floodplain values.
2. Class II Actions include any activity for which even a slight chance of flooding is too great such as construction of schools, medical facilities, emergency services, hazardous material storage, and records/collections storage.
3. Class III Actions include any action that involves human occupation or substantial human exposure in high hazard areas such as drainages subject to flash flooding.

This project constitutes a Class I Action. The regulatory floodplain for Class I actions is the 1-percent annual exceedance probability flood, also referred to as the 100-year flood or the base flood (DO #77-2).

DETERMINATION OF FEDERAL FLOOD RISK MANAGEMENT STANDARD

Additionally, following EO 13690, any proposed action that involves federal capital investment must include a Federal Flood Risk Management Standard (FFRMS) for new construction, substantial improvement, or repairing substantial damage. Per the Federal Emergency Management Agency's implementing guidelines for EOs 11988 and 13690, agencies may select one of three approaches to implementing the flood resiliency:

- Climate-Informed Science Approach (CISA) – the elevation and flood hazard area that result from using the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding, including climate change and other physical processes (e.g. land-use change)
- Freeboard Value Approach (FVA) – the elevation and flood hazard area that result from adding an additional 2 feet to the base flood elevation for non-Critical Actions and by adding and additional 3 feet to the base flood elevation for Critical Actions
- 0.2-Percent Annual Chance Flood Approach (0.2PFA) – the area subject to flooding by the 0.2-percent annual chance flood

For the proposed project, a Freeboard Value Approach establishing FFRMS flood elevations is employed. This method adds 2 feet to the base flood elevation (BFE). Therefore, the regulatory floodplain for the proposed action is the 100-year flood elevation plus 2 feet added to the BFE.

The existing floodplain in the project area was mapped using the National Flood Hazard Layer, which is based on Cuyahoga County Flood Insurance Study (FIS) 39035C (Effective 2010), Flood Insurance Rate Map (FIRM) 39035C0329E and in Summit County FIS 39153C (Effective 2016), FIRM 39153C0030F. Both counties have the project mapped as a Zone A, so BFEs were calculated by GPD Group (RiverReach Construction, et. al, August 2023, *CUVA #224822 Basis of Design Report: Four-Sites Bank Stabilization*) utilizing USACE's 2-dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling program version 6.3.1. BFEs are shown in Table 5.

DESCRIPTION OF SITE-SPECIFIC FLOOD RISK

Each of the four sites becomes inundated during the base flood. Table 5 quantifies the flooding of the infrastructure (Towpath Trail or Valley Railway) at each site.

Table 5: Site-Specific Flood Risk

Project Site	Infrastructure Elevation (ft)	FFRMS Flood Elevation (ft)	Existing BFE (ft)	Proposed BFE (ft)	Difference in BFE (ft)
Buckeye	625	630.54	628.54	628.56	0.02
Mudcatcher	631-635	635.29	633.29	633.42	0.13
Station Road South	633-635	641.66	639.66	639.71	0.05
MP 59.3	630	635.29	633.29	633.42	0.13

As defined in the 2004 Programmatic Environmental Assessment, any rise in the BFE of less than 0.1 feet (Buckeye and Station Road South) is considered negligible. A rise in the BFE exceeding 0.1 feet but less than 0.5 feet (Mudcatcher and MP 59.3) is considered a minor adverse direct impact. The proposed action results in no impacts beyond the Park boundary.

Potential Risk to Human Health and Safety

The proposed action does not increase potential risk to human health and safety. CUVA has a Flood Response Pocket Guide (CUVA, 2019, *CVNP Flood Response Pocket Guide*) and a Flood Plan (CUVA, Unknown Year, *CUVA Flood Plan*) that mitigates any potential risk to human health and safety for those recreating or working on the Valley Railway or Towpath Trail in the vicinity of these project sites.

Potential Risk to Property

The proposed action does not increase potential risk to property. There are no facilities, including buildings, restrooms, or campgrounds, in the floodplain in this area. The only property at risk is the Towpath Trail and Valley Railway, which this project's purpose is to protect.

Potential Risk to Floodplain Values

The proposed action will affect fluvial geomorphologic processes, which are referred to as natural river processes. As referenced in the 2004 Programmatic Environmental Assessment, a fluvial geomorphology assessment of the Cuyahoga River was conducted in 1997. The river was classified using the Rosgen Classification System which quantifies a stream's variables, or morphologic characteristics, in varying levels of resolution from broad characterizations to site specific descriptions. The key variables used in the analysis include gradient, bankfull width and depth, sinuosity, valley confinement, and particle size. Bankfull refers to the discharge that fills a stable alluvial channel up to the elevation of the active. Sinuosity is defined as the stream length divided by the valley length. The first four variables are used to categorize the stream into one of seven major types. The last variable, particle size, is used to further define the stream type. Particle size is the median diameter of channel materials, as sampled from the channel bed surface, between the bankfull stage and thalweg elevations. It was determined that, in general, the river exhibits characteristics of a type C5 morphology within most of CUVA, with some reaches exhibiting a type F5 morphology. Both C5 and F5 streams are typically very highly sensitive to disturbance, have a very high sediment supply, and have a high to very high streambank erosion potential.

The threats to the Valley Railway and Towpath Trail result primarily from the migration of channel meanders. Channel migration includes lateral channel shift (expressed in terms of distance moved perpendicular to the channel center line, per year) and down-valley migration (expressed in distance moved along the valley, per year).

The mechanisms of bank failure include: erosion at the toe (the lowest part of the embankment); erosion of the upper banks; bank failures resulting from mass removal of the toe; translational failures related to seepage lenses in the bank; and rotational failures due to surcharge loads and moment forces from large trees on the banks.

The effect on natural river processes relates to the length of armoring of existing eroding channel banks that presently provides a source of fine-grained sediments to the river. The Cuyahoga River, apart from any significant outside influences, may be considered to be in a state of dynamic equilibrium where the overall system has adjusted its width, depth and slope so that the channel is neither aggrading nor degrading. Dynamic equilibrium, as defined here, is not a static condition, but one in which the river or stream is free to adjust laterally through bank erosion and bar building. So a channel that is migrating laterally by eroding one of its banks and depositing material on the opposite bank at a similar rate is still considered to be in a state of dynamic equilibrium, within the Natural Range of Variability (NRV).

These riverbank stabilization projects change the bank surface conditions from one that consists of silts and clays to a riprap armored lower bank and an upper bank that is stabilized with vegetation. This action reduces the local sediment supply to the system, . This implies channel degradation (if critical shear stresses are less than the bed shear stresses) if the channel bottom is not armored, which could cause toe erosion in nearby locations of the stream. Proven tools to quantify these effects do not exist; however, as the length of channel bank armoring increases, deficiencies in sediment supply must be offset by an increase in sediment supply from other sections of channel bank, or from the channel bed. So tracking the change in the percentage of riverbank armoring can be used as an indicator of possible impacts on natural river processes. As shown in Table 6, the proposed action will increase the length of bank armoring by 3,700 feet in reaches of the Cuyahoga River defined in the 2004 Programmatic Environmental Assessment.

Table 6
Proposed Stabilization Lengths

Project Site	Reach No.	Stabilization Length (ft)
Station Road South	5	500
Total Reach 5		**500**
Buckeye	6	400
Mudcatcher	6	1,250
MP 59.3	6	1,550
Total Reach 6		**3,200**
TOTAL		**3,700**

Building on the methodology laid out in the 2004 Programmatic Environmental Assessment, the proposed change in streambank stabilization using armoring techniques was calculated as shown in Table 7. The proposed action results in a 35.1% increase in the length of armored banks as compared to existing conditions. On an overall basis, this is classified as a moderate adverse direct impact. A moderate adverse impact is detectable. Frequency, magnitude, and duration measurements are expected to be outside the NRV for short periods of time, but return to the NRV as the river makes minor adjustments. Disruptions within the NRV may be long-term.

Table 7 Summary of Armoring Conditions							
		Existing Armoring		Proposed Armoring			
Reach No.	River Length (ft)	Length (ft)	%	Inc. Length (ft)	% Change	Total Length (ft)	%
5	7,600	570	7.5%	500	87.7%	1,070	14.1%
6	22,900	10135	44.3%	3,200	31.6%	13,335	58.2%
TOTAL	30,500	10,705	35.1%	3,700	34.6%	14,405	47.2%

The cumulative impact results from the addition of the past armoring with that of the proposed action. Table 7 shows this cumulative impact to be 47.2% which is still defined as a moderate adverse impact.

Impacts on aquatic habitat were also evaluated using a methodology outlined in the 2004 Programmatic Environmental Assessment, which relied on a rapid assessment procedure based on the EPA's Rapid Bioassessment Protocol. The eight parameters considered included: streambank epifaunal substrate/available overbank cover, instream substrate characterization, morphological diversity of channel and flow, bank vegetative diversity and condition above bankfull, channel stability (base level), bank stability, riparian vegetative zone width, and riparian management potential. This action will result in minor adverse impacts, indicating that potentially adverse impacts would be detectable to one or more category, but they would not be expected to have any long-term effects on native species, their habitats, or the natural processes sustaining them.

FLOODPLAIN IMPACT MITIGATION MEASURES

The proposed action will not significantly increase the risk of flooding or significantly increase the hazards to human life and property, therefore flood hazard mitigation measures are not required Impacts to floodplain values will be moderate. and mitigated, to some extent, through use of natural materials (rock, dead trees, plantings and cuttings) for the riverbank stabilization.

The structures and facilities associated with this action are required to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60). To comply with the intent of these regulations, all new construction will:

- Be designed (or modified) and adequately anchored to prevent floatation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy; [44 CFR Part 60.3(a) (3) (i)]
- Be constructed with materials resistant to flood damage; [44 CFR Part 60.3(a) (3) (ii)]
- Be constructed by methods and practices that minimize flood damages; [44 CFR Part 60.3(a) (3) (iii)]; and
- Maintain or increase the distance of the buffer from the edge of the average water surface to the Towpath Trail or Valley Railway. Within this buffer, plantings and bioengineering features will be added to provide zones of new habitat and to ensure the long-term stabilization of the riverbank. [44 CFR Part 60.5 (b) (2)]

Most of the actions for the riverbank stabilization will infringe upon either an adopted regulated floodway or upon a floodway if one were to be calculated. It will not be possible to comply with this aspect of DO 77-2 and the NFIP [44 CFR Part 60.3(d) (3)]. However, since CUVA occupies both sides of the Cuyahoga River, and a portion of the Park's mission is to restore and preserve the natural and beneficial values served by the floodplain, the floodplain will never be developed to a significantly greater extent than it is now. Therefore, this action can be considered to comply with the intent DO 77-2, EO 11988, and EO 13690 in this regard.

SUMMARY

The NPS has determined that implementing the proposed action to stabilize the riverbank at these four sites along the Cuyahoga River is an essential preservation maintenance action needed to protect portions of two linear historic districts affected by the migration of the river channel. There are no practicable alternative locations for this action and there is no risk to human health and safety or property. Impacts to the floodplain values resulting from the proposed project are moderate and mitigation strategies will be implemented as possible.

Therefore, it is determined that the Proposed Action is consistent with Executive Order 11988 (*Floodplain Management*), Executive Order 13690 (*Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input),* Director's Order #77-2 (*Floodplain Management*), and NPS Procedural Manual #77-2 (*Floodplain Management*).

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