CUYAHOGA VALLEY NATIONAL PARK
Programmatic Environmental Assessment for Riverbank Management
of the Cuyahoga River

Appendix G

Combined Statement of Findings

For

Executive Order 11988 "Floodplain Management"

And

Executive Order 11990 "Protection of Wetlands"

Riverbank Management of the Cuyahoga River
Cuyahoga Valley National Park

Recommended: _____
Superintendent, Cuyahoga Valley National Park **Date**

Concurred: _____
Chief, Water Resources Division **Date**

Concurred: _____
Midwest Regional Compliance Officer **Date**

Approved: _____
Director, Midwest Region **Date**

Combined Statement of Findings

For

Executive Order 11988 "Floodplain Management"

And

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1.0 INTRODUCTION

The NPS has implemented the requirements of Executive Order (EO) 11990, "Protection of Wetlands," in its Director's Order #77-1: Wetland Protection (DO #77-1), which applies to all NPS proposed actions that have the potential to adversely affect wetlands and wetland functions. The NPS has also implemented the requirements of EO 11988, "Floodplain Management," in its Director's Order #77-2 (DO #77-2), which applies to all NPS proposed actions that could adversely affect the natural resources and functions of floodplains, or increase flood risks.

A Statement of Findings (SOF) is required as a basis for management decision making for each of the executive orders, providing a rationale for the selection of the Preferred Alternative and the potential impacts on the wetland and floodplain areas. As provided in Section 3.3 of DO #77-1, a wetland SOF may be combined with a floodplain SOF. This combined SOF is being appended to the Programmatic Environmental Assessment (EA) for the project and will be attached to the Finding of No Significant Impact (FONSI) of the Programmatic EA.

1.1 Description of Proposed Action

The Riverbank Management Program of the Cuyahoga River provides a holistic and pro-active approach to managing the threat of riverbank erosion on the resources of Cuyahoga Valley National Park (CVNP) from the Cuyahoga River and its tributaries. The most significant of these resources are the Ohio & Erie Canal Towpath Trail and the Scenic Valley Railroad, both of which are a part of the Ohio & Erie Canal National Heritage Corridor. The CVNP's List of Classified Structures includes 43 entries for the Ohio & Erie Canal, and 34 entries for the Valley Railway that are listed or eligible for listing on the National Register of Historic Places. The Riverbank Management Program includes the following major elements:

1. Expansion of the existing Riverbank Erosion Monitoring Program to provide more measures with which to monitor the threat of riverbank erosion;

2. Construction of direct measures whenever the Towpath Trail, Valley Railway or other feature is in immediate danger of being damaged or destroyed due to fluvial geomorphologic processes. Direct measures are those that repair the river bank immediately adjacent to the

threatened feature, and would typically consist of a riprap toe constructed to approximately mean annual flood elevation, and a variety of bioengineering measures above that point to the top of the eroded bank;

3. Construction of less intrusive, engineered and non-engineered measures at locations where the progress of riverbank erosion has not yet presented an imminent threat to the Towpath Trail, Valley Railway, or other feature but is expected to threaten these resources in the future.

The Programmatic Environmental Assessment for Riverbank Management of the Cuyahoga River, Cuyahoga Valley National Park, October 2003, prepared by the National Park Service, Bergmann Associates, and FIScH Engineering, examined a full range of alternatives, based on the purpose and need. The need for the Riverbank Management Program is for the protection of the historic, cultural and recreational resources, employees and the public from the erosional effects resulting from the fluvial processes of the Cuyahoga River and its tributaries within CVNP.

The purpose of this riverbank policy is to establish a clear policy of riverbank management, which will include:

- Preservation and protection the historic, scenic, natural and recreational resources adjacent to the Cuyahoga River and its tributaries within CVNP;

- Provision of safe recreational facilities for the public who use CVNP's resources and for CVNP staff who maintain these resources;

- minimal interference with the natural processes and ecological character of the Cuyahoga River and its tributaries;

- meeting the need in a reasonable, cost-effective manner.

The Riverbank Management Program is judged to be a Class I Action under DO 77-2 because it involves construction of man-made features that will perpetuate occupancy of the floodplain, and may potentially result in impacts to natural floodplain values.

1.2 Site Description

The Towpath Trail and Valley Railway, the most significant linear recreational and cultural features within CVNP, occupy the same valley corridor as its most significant natural resource – the Cuyahoga River. The river channel, as it winds through CVNP for a distance of 22 miles, is constrained by steep slopes and man-made confinements: several roads; bridges; the Towpath Trail; and the Valley Railway. A total of 36 specific locations have been identified where the Cuyahoga River threatens these resources, and new locations are added to the list as conditions change and locations are removed when engineered measures are constructed to repair the riverbank. The 36 locations are all along the Cuyahoga River itself. However, the site includes the entire length of the Cuyahoga River and its tributaries through CVNP as other specific locations are expected to be threatened in the future, as the river and its tributaries migrate. Prior

to establishment of the Park, approximately 2.7 river miles of bank stabilization were constructed. Under the current Riverbank Stabilization Program, 19 projects, involving 1.84 river miles, have been constructed.

1.3 Alternatives Considered

The programmatic EA identified other alternatives that were considered but rejected. These included:

- The repair and restoration of features only after a damaging flood,
- No provision of riverbank stabilization measures, and
- Provision of continuous protection of the Towpath Trail and Valley Railway.

The analysis of potential environmental impacts was compared with the No Action Alternative, where the threat of riverbank erosion on the resources of CVNP would be managed as it has been up to this point. Under this alternative, measurements of riverbank recession, obtained through the Riverbank Erosion Monitoring Program, would continue to be used to develop and update a priority listing of repair sites. Direct measures would continue to be implemented only when the Towpath Trail or Valley Railway is in immediate danger of being damaged or destroyed due to fluvial geomorphologic processes. No other cultural features, including archaeological sites would be protected. On average, 2 to 3 projects a year are expected. The implementation period would be expected to extend for a period of 25 years. Measures would be limited to those that repair the bank immediately adjacent to the threatened feature, and would typically consist of a riprap toe constructed to approximately mean annual flood elevation, and a variety of bioengineering measures above that point to the top of the eroded bank. Where erosion moves too close to the Towpath Trail or Valley Railway before riverbank stabilization measures can be constructed, fencing would be installed to protect staff and visitors until such construction can be accomplished. Construction of direct measures may require the removal of healthy hardwood trees and shrubs on the banks. This alternative would not include indirect measures to address potential future threats from riverbank erosion.

1.4 Flooding, Floodplain Values and Floodplain Processes

Of the 32,864 acres in CVNP, approximately 3,574 acres, or 11 percent are in the 100-year floodplain. All of the actions being considered as part of the Riverbank Management Alternative occur within the floodplain of the Cuyahoga River or its tributaries.

Information concerning these floodplains is available from two sources: National Flood Insurance Program (NFIP) Flood Insurance Studies (FIS) for enrolled communities; and hydrologic and hydraulic studies that have been conducted for CVNP as a part of the design of recent or current riverbank stabilization projects. Summit and Cuyahoga Counties are enrolled in the NFIP. Three sections of the Cuyahoga River and/or its tributaries have been studied in detail as part of the NFIP, meaning that a hydraulic model (HEC-RAS or HEC-2) has been developed to calculate water surface elevations, velocities and other hydraulic variables of interest. The

first section is the Cuyahoga River from its confluence with Tinkers Creek, downstream to the northern limit of the Park (Village of Valley View and City of Independence FIS). The second section, also of the Cuyahoga River, begins at the northern limit of the City of Akron and extends downstream to the southern limit of the Park (City of Akron FIS). The third is the section of Tinkers Creek within the Village of Valley View (Village of Valley View FIS).

A number of sections of the Cuyahoga River and two major tributaries (Brandywine and Yellow Creeks) have also had detailed hydraulic studies performed in connection with the Riverbank Stabilization Program and a culvert evaluation study, respectively. These studies have utilized portions of the FIS hydraulic models and extended these models using surveyed cross sections and available topographic mapping to specific points of interest along the Cuyahoga River or its tributaries. As CVNP continues to perform hydraulic studies in connection with managing the riverbanks, new hydrology, cross section geometry, reach lengths and other hydraulic information is added to the current HEC-RAS (version 3.0) model thus further extending the limits of the hydraulic model. While the CVNP HEC-RAS model is used in the Riverbank Stabilization Program primarily to design bank protection measures to withstand the water depths, velocities and shear stresses for a range of discharges, the model is also used to "test" proposed actions to determine their impact on the 100-year flood water surface elevation.

1.5 Affected Wetlands

CVNP has a wetland inventory in GIS format covering the park which includes wetland location, size, type, condition, species composition, and restoration/enhancement potential (Davey Resource Group, 2001). Data collection for this inventory was performed from aerial photographs and in-field using pen unit mapping and data entry devices. Actual delineation was not performed for this inventory. It may be considered an "enhanced inventory" as described in Section 5.1 of Procedural Manual #77-1, and is therefore adequate for the planning and analysis purposes (see Section 5.3.A.3 of Procedural Manual #77-1). The largest wetlands are located within the Cuyahoga River floodplain and include emergent, shrub, and forested areas. These wetlands are referred to as palustrine wetland areas in the analysis conducted for the Programmatic EA.

Besides the palustrine wetlands identified in the inventory, the U. S. Fish and Wildlife classification system includes riverine wetlands, which include all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing oceanderived salts in excess of 0.5% (Cowardin et al, 1979). Water is usually, but not always flowing in a riverine system. In the Programmatic EA analysis, these wetlands were identified as a zone between the edge of water at the bank at the mean low water (base flow conditions) to a point where the water is two meters deep.

Erosion and stabilization of the banks of the Cuyahoga River and its tributaries could affect those wetland resources located in the riparian zone and floodplain of the river. Equipment access for the construction of some stabilization measures could temporarily impact these resources, as could actions that alter the hydrology of the surface or ground water.

2.0 JUSTIFICATION FOR USE OF THE FLOODPLAIN

2.1 Why Proposed Action Must be Located in the Floodplain

The proposed action involves the protection of historically, culturally and recreationally significant resources within the Park. Significant lengths of both the Towpath Trail and Valley Railway are 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. Director's Order 77-2 applies to "all proposed actions, including the direct and indirect support of floodplain development, that could adversely affect the natural resources and functions of floodplains, . . . , or increase flood risks." Director's Order 77-2 does not apply to "historic or archeological structures, sites, or artifacts whose location is integral to their significance." Although the Towpath Trail and Valley Railway are themselves exempt from the DO 77-2 requirements, the proposed action of protecting these features has the potential to adversely affect the natural resources and functions of the floodplain and increase flood risks. It is, therefore, judged that DO 77-2 applies to the proposed action.

2.2 Investigation of Alternative Sites

The Programmatic Environmental Assessment for Riverbank Management of the Cuyahoga River, Cuyahoga Valley National Park, October 2003, prepared by the National Park Service, Bergmann Associates, and FIScH Engineering, examined a full range of alternatives, based on the purpose and need. This SOF is an appendix to the programmatic EA. There are no alternatives involved alternative locations outside the floodplain that could fulfill the purpose and need for the project.

3.0 SITE-SPECIFIC FLOOD RISK

3.1 Recurrence Interval of Flooding

The recurrence interval of flooding for projects and features constructed as a part of the Riverbank Management Program will vary depending upon their location within the floodplain and the relative elevation of the Valley Railway track structure, and Towpath Trail finished grade. Features such as channel cutoffs (chutes), reestablishing meanders, woody debris jams, root wads, and engineered log jams, will be constructed at elevations below the average daily flow. Projects that involve engineered bank protection will typically include a riprap lining that extends from between the median and the dominant discharge (1.5-year recurrence interval storm) to the channel bottom, and bioengineering above that water surface to the top of the bank. Most plantings will be set above the dominant discharge elevation.

The recurrence interval of flooding for the Towpath Trail and Valley Railway has not been established throughout the Park. The best available sources of information are FIS Flood Insurance Rate Maps for the communities of Village of Valley View, City of Independence, City of Akron, and Summit County. The recurrence interval of flooding at specific locations where the Cuyahoga River has been modeled using HEC-RAS, is also known. The following general conclusions can be drawn from available information:

- The Towpath Trail in the Village of Valley View is overtopped for the 100-year flood for nearly its entire length. By extension, it's likely that most portions of the Towpath Trail are overtopped for the 100-year flood.

- The Towpath Trail is known to overtop for recurrence intervals at least as low as (and possibly lower than) the 10-year flood.

- The Valley Railway is typically higher in elevation than the Towpath Trail at any given location in the valley, and thus its recurrence interval for overtopping is much less frequent.

3.2 Hydraulics of Flooding

The Riverbank Management Program allows consideration of a broad range of recommended actions, from those requiring no analyses of impacts on water surface elevation to those requiring HEC-RAS analysis. Based on hydraulic modeling performed in connection with the current Riverbank Stabilization Program, impacts of proposed improvements are expected to range from Negligible to Minor Adverse, depending upon the recommended actions taken. A Negligible impact is defined as causing a rise in 100-year flood water surface elevation of less than 0.1 feet.

Hydraulic modeling results from recent Riverbank Stabilization Program projects indicate that some longitudinal stabilization measures that employ a riprap toe below a repaired bank stabilized with bioengineering measures, have been found to have no more than a Negligible impact on water surface elevations. The extension of some existing longitudinal stabilization measures that have experienced flanking, have also been found to have a Negligible impact on

water surface elevations. These types of measures typically reduce the channel cross section for the bankfull discharge by 10% or less, and have little effect on channel roughness.

A Minor Adverse impact is defined as causing a rise in the 100-year flood water surface elevation exceeding 0.1 feet but less than 0.5 feet. These increases diminish to a Negligible value within one half a meander wavelength upstream. Based on hydraulic modeling results from recent Riverbank Stabilization Program projects, longitudinal stabilization measures that employ a riprap toe below a repaired bank stabilized with bioengineering measures, have never been found to have more than a Minor Adverse impact on water surface elevations. The extension of existing longitudinal stabilization measures that have experienced flanking, have also never been found to have more than a Minor Adverse impact on water surface elevations. These types of measures typically reduce the channel cross section for the bankfull discharge by 10% or less, and have little effect on channel roughness. Based on hydraulic modeling results from recent Riverbank Stabilization Program projects, transverse stabilization measures such as riprap spurs, bendway weirs, re-establishment of meanders or encouraging large meander cutoffs, and large engineered log jams can be expected to have a Minor Adverse impact on water surface elevations. Riprap spurs and bendway weirs are typically designed to extend across approximately one-third the low flow channel width, and can occupy between 15 and 25% of the cross sectional area at the bankfull discharge. No riverbank restoration projects producing a rise in water surface elevation of greater than 0.5 feet will be constructed. The design of such projects will be modified so that the rise in 100-year water surface will be equal to or less than 0.5 feet.

Many of the recommended actions in the Riverbank Management Program, due to their limited scale, have a Minor Adverse or Negligible impact on the 100-year water surface elevation. These types of recommended actions include: planting trees or live stakes; collecting woody debris; removing trees to preempt bank failures; constructing small-scale engineered log jams; encouraging small channel cutoffs; and improving bank drainage. In almost all instances, these recommended actions would not require the development or extension of a hydraulic model to evaluate their impacts.

Proposed actions in the past have tended to be very site specific, causing no change in the 100-year flood elevation outside a distance of one-half a meander wavelength upstream of the repair area. Since adjacent locations that are monitored as part of the Riverbank Monitoring Program tend to be more than half a meander length from each other, there is little to no chance of cumulative impacts on water surface elevations from adjacent riverbank stabilization projects. Therefore, the impacts of individual actions and projects are very site specific, and can be assessed and evaluated independently from each other.

3.3 Time Required for Flooding to Occur

The time required for flooding to occur varies depending upon the flood event and the location of interest along the Cuyahoga River. Discharge hydrographs from the Independence (USGS # 04208000) and Old Portage (USGS # 04206000) gauging station records provide an indication of the rate of change in flow with time. The Independence gage is located near the downstream end of the Park at Old Rockside Road, where the drainage area is 707 sq. mi. The Old Portage gage

is located upstream of the upstream end of the Park near the North Portage Path bridge, where the drainage area is 404 sq. mi. Figure 1 shows a one-year history of the fluctuation in daily mean discharge at the Independence gage.

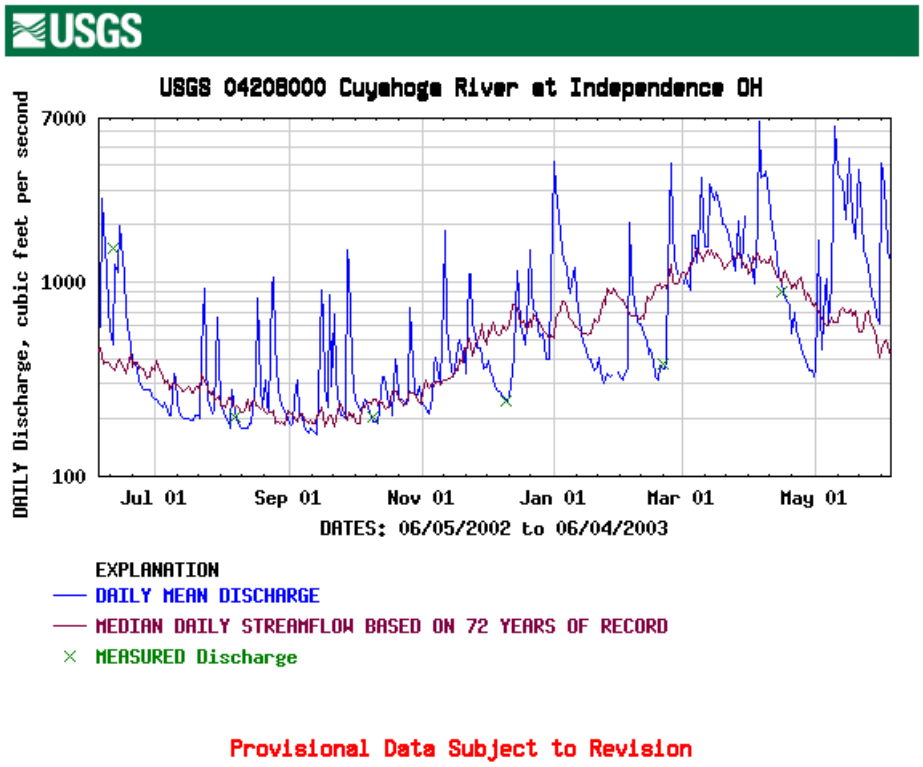

Figure G-1. Mean Daily Discharge - Independence, OH.

Figures 2 and 3 show the stage hydrograph history for an 18-day period between May 31, and June 16, 2003 at the Independence and Old Portage gages, respectively. The slopes of the rising limbs of the individual stage hydrographs shown in the May 31, and June 12, events at Old Portage indicate an average rise in water surface elevation of 0.7 and 0.5 feet per hour respectively. The May 31, and June12, events at Independence indicate an average rise in water surface elevation of 1.25 and 2 feet per hour respectively. These rates of rise coincided with region-wide precipitation events. The rates of rise could be greater with snowmelt or thunderstorm conditions.

3.4 Opportunity for Evacuation

The logical evacuation routes would be along the Towpath Trail and Valley Railway to an adjacent highway. The opportunity for evacuation of the Towpath Trail and Valley Railway is based on the profiles of these features and the rate of rise developed in the previous section. Although no formal analysis of evacuation of these features is known to exist, the opportunity for evacuation will be unaffected by the proposed action.

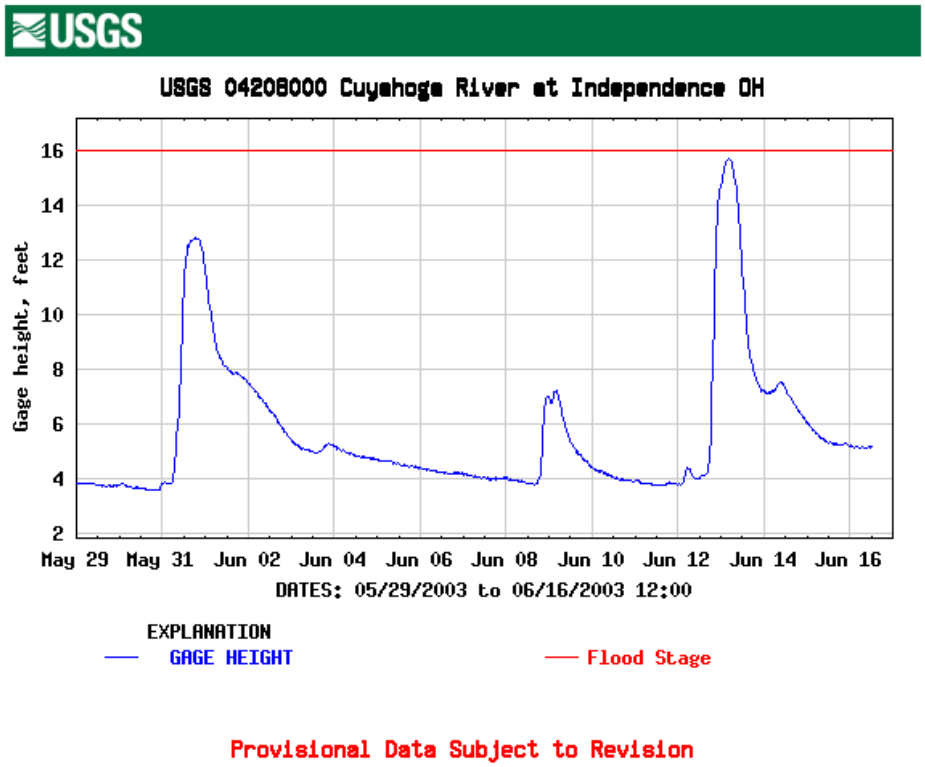

Figure G-2. Stage Hydrograph - May 31 to June 16, 2003.

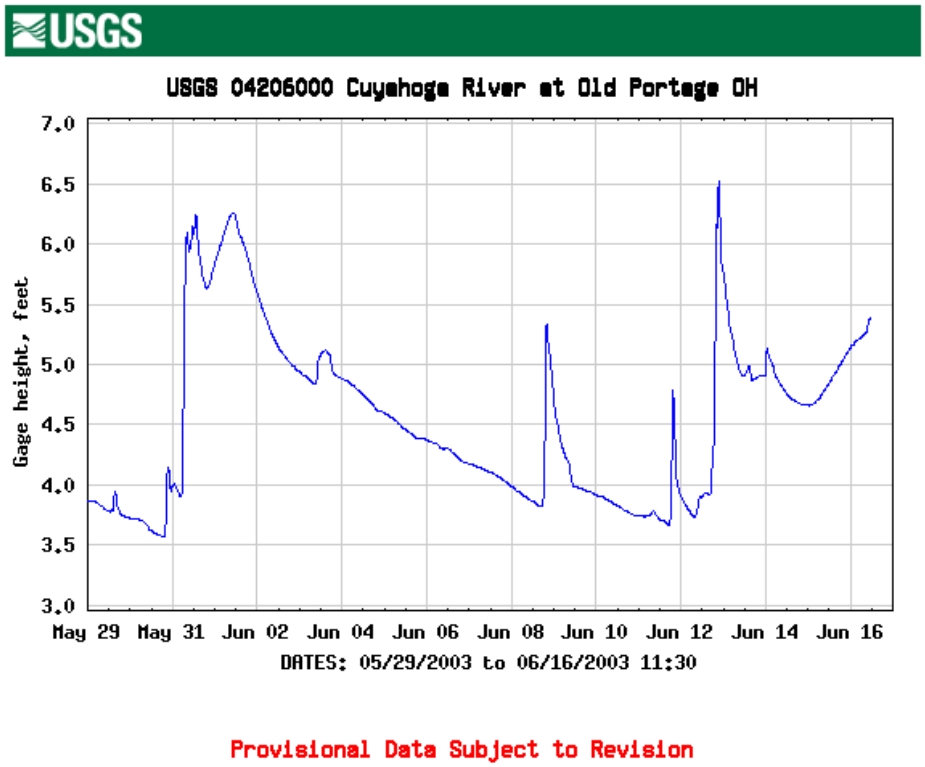

Figure G-3. Stage Hydrograph - May 31 - June 16, 2003.

3.5 Geomorphologic Considerations

Geomorphologic considerations have created the need for the Riverbank Management Program. The Programmatic Environmental Assessment for Riverbank Management of the Cuyahoga River, Cuyahoga Valley National Park, prepared by the National Park Service, Bergmann Associates, and FIScH Engineering, October 2003, examined geomorphologic considerations in detail. The following discussion was adopted from the Programmatic EA.

The Cuyahoga River generally flows from south to north in CVNP, through a confined valley ranging from 500 to 4200 feet wide. The valley and river are characterized by a gentle gradient predominated by riffle/pool sequences with long intermediate runs. Valley slope and channel slope are 0.14 percent and 0.1 percent, respectively. The river exhibits an irregular meander pattern with oxbows, oxbow lakes, and scars throughout the valley. It is moderately entrenched, with a wide floodplain on the inside meander. Stream banks are predominately vegetated with both herbaceous and woody vegetation. The outside meanders, where the majority of erosion occurs, are typically vertical cut-banks with exposed soils, mature trees and herbaceous vegetation at the top. Numerous locations provide evidence of previous stabilization efforts using measures such as riprap, large rectangular stone, and flow deflection structures, which were placed prior to the NPS taking ownership. Point bars consist of sandy loam mixed with gravel.

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 CVNP, 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 downvalley migration (expressed in distance moved along the valley, per year). The migration of channel meanders can be reasonably described by four modes of movement as shown in Figure G-4.

Bank failure is prevalent along many reaches of the river. The mechanisms 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. Of

these mechanisms, erosion at the toe and translational failures of the upper bank are most prevalent.

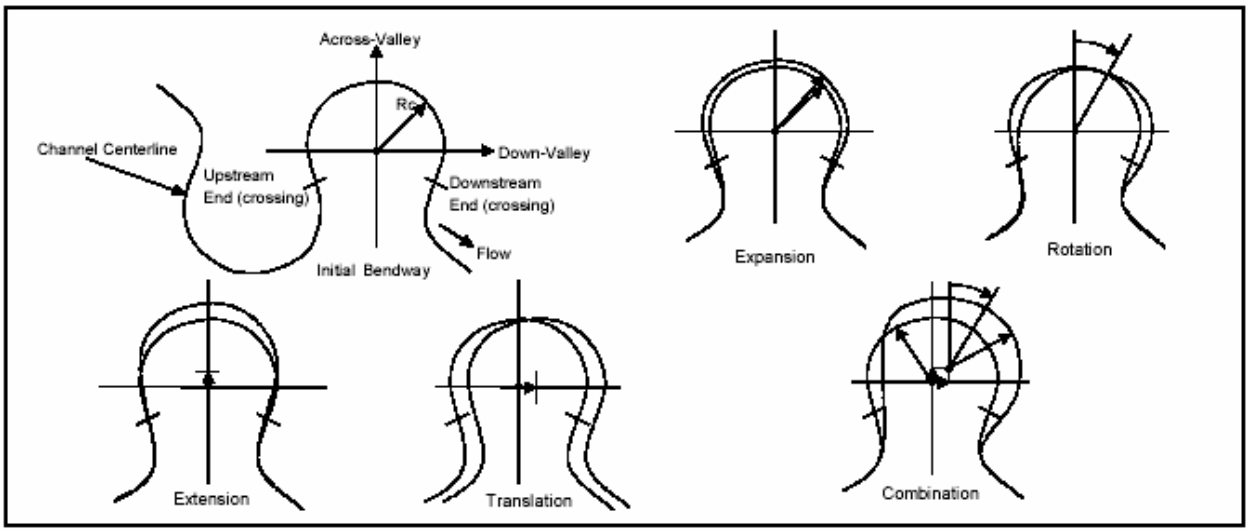

Figure G-4. Measuring Meander Migration (Spitz et al., 2001).

The Cuyahoga River within CVNP was divided into the following eight reaches for the purpose of assessing existing conditions and evaluating impacts of proposed actions:

Study Reach 1 - Bath Road to Bolanz Road
Study Reach 2 - Bolanz Road to Peninsula Dam
Study Reach 3 - Peninsula Dam to 2000' downstream of Boston Mills
Study Reach 4 - Boston Mills to 1.5 miles upstream of Brecksville Dam
Study Reach 5 - 1.5 miles upstream of Brecksville Dam to Brecksville Dam
Study Reach 6 - Brecksville Dam to Tinkers Creek
Study Reach 7 - Tinkers Creek to Rockside Road
Study Reach 8 - Rockside Road to northern limit of CVNP

Physical and geomorphological conditions determined during a field visit are summarized, by study reach, in Table G-1.

Table G-1. Summary of Physical Characteristics by Study Reach.

	River Mile		Elevation						
Study Reach	Upst (mi)	Dnst (mi)	Upst (ft.)	Dnst (ft.)	Valley Length (ft.)	River Length (ft.)	Slope %	Slope (ft/mi)	Sinuosity
1	37.3	33.2	725	709	15000	21600	0.074%	3.9	1.4
2	33.2	29.05	709	684	16900	22100	0.113%	6.0	1.3
3	29.05	26.4	684	648	11300	14500	0.248%	13.1	1.3
4	26.4	22.05	648	626	14700	22700	0.097%	5.1	1.5
5	22.05	20.6	626	626	6500	7600	0.000%	0.0	1.2
6	20.6	16.4	620	610	19600	22900	0.044%	2.3	1.2
7	16.4	13.3	597.46	582.5	12200	16000	0.094%	4.9	1.3
8	13.3	12.3	582.5	582.1	5400	5500	0.007%	0.4	1.0

The field investigation provided a current and independent assessment of conditions at specific sites that are presently in the Riverbank Erosion Monitoring Program. It also provided a baseline against which the feasible alternatives can be evaluated with respect to their effects on natural river processes. The existing effects on natural river processes are organized in Table G-2 by study reach in terms of the length of bank armoring and the total river bank length that is armored with riprap, gabions or other revetment divided by the reach length and expressed as a percentage. The source of the armoring (stabilization actions prior to NPS, Riverbank Stabilization Program actions, and stabilization actions planned, designed and approved for construction) is also indicated.

Table G-2. Riverbank Armoring (in Feet).

Study Reach	Stabilization Actions Prior to CVNRA	Riverbank Stabilization Program Actions	Planned, Designed & Approved for Construction	Total	Percent Harden-ing (%)
1	775	635	0	1410	3.3
2	255	1080	0	1335	3.0
3	200	2660	0	2860	9.9
4	1335	300	435	2070	4.6
5	570	0	0	570	6.2
6	5230	4155	400	9785	21.4
7	3868	900	720	5488	17.2
8	2130	0	0	2130	19.4
Total	14363	9730	1555	25648	9.6

Proposed actions under the Riverbank Management Program may have an effect on fluvial geomorphologic processes which, for the purposes of this discussion, are referred to as natural river processes. The effect on natural river processes will be related to the length of armoring of existing eroding channel banks that presently provides a source of fine-grained sediments to the river or stream.

The Cuyahoga River and its tributaries, 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) as discussed below.

The most widely known relationship used to express the equilibrium concept was developed by Lane (1955) which states:

$$QS \propto Q_s D_{50}$$

where Q is the water discharge, S is the slope, Q_s is the bed material load, and D_{50} is the median size of the bed material. This relationship is commonly referred to as Lane's balance. When a channel is in equilibrium, it will have adjusted these four variables such that sediment supplied to a stream reach is transported out without significant aggradation or degradation.

In a disturbed system, one of the parameters has been adjusted causing one or more of the remaining variables to adjust. For example, downstream of a dam, sediment supply, $Q_{s,}$ and median size of the bed material, D_{50}, are both decreased due to entrapment of sediment in the dam's reservoir, thus reducing the value of the right side of the equation. In response, streams are known to reduce their slope, causing the channel to experience degradation. This results in a corresponding reduction in the value of the left side of the equation. A channel cutoff, will increase the slope, S, of a channel reach, thus increasing the value of the left hand side of the equation. In response, streams are known to increase their bed load, Q_s by eroding the bed or banks of the channel. This results in a corresponding increase in the value of the right side of the equation. Although fluvial geomorphology is a very complex process that is influenced by numerous variables, this relationship may be used conceptually to consider the effect of actions taken to protect the Towpath Trail and Valley Railway by armoring of the adjacent riverbank.

Using Lane's relationship, as an evaluation tool, the types of changes that may be considered typically do not change Q, S, or Q_s. An exception to this would be if meander cutoffs were created or meanders were reestablished. Based on data from the Riverbank Stabilization Program, riverbank stabilization projects change the bank surface conditions from one that consists of between 60 and 90% silts and clays ($D_{50} < 0.1$ mm) to a riprap armored lower bank with $D_{50} > 0.5$ m, and an upper bank that is stabilized with vegetation. This action reduces the local sediment supply, Q_s, to the system, and in the absence of other sources of sediment, would result in a decrease in channel slope, S. 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.

Since adjacent locations that are monitored as part of the Riverbank Monitoring Program tend to be more than half a meander length from each other, there is little to no chance of cumulative impacts on natural river processes from adjacent riverbank stabilization projects. Therefore, the impacts of individual actions and projects are very site specific, and can be assessed and evaluated independently from each other.

In an effort to quantify the impacts of the Riverbank Management Program on natural river processes, Table G-3 was developed to calculate the change in armored bank length, and the increase in percentage of streambank armoring, by study reach.

Based on the field classification of 36 sites, the Riverbank Management Program will increase the length of bank armoring by 1,770 feet, a 7% increase in the length of armored bank as compared to existing conditions. On an overall basis, this is classified as a Negligible impact. A

Negligible impact is not detectable, changes in the length and percentage of bank armoring are less than 10%, and impacts result in frequency, magnitude and duration measurements that are well within the NRV. Minor Adverse impacts would occur in Reaches 3, 4 and 7. In Reach 3 the length of armored channel bank would increase by 440 feet, corresponding to a 15% increase in channel bank armoring. In Reach 4 the length of armored channel bank would increase by 240 feet, corresponding to a 15% increase in channel bank armoring. In Reach 7 the length of armored channel bank would increase by 620 feet, corresponding to a 13% increase in channel bank armoring. Minor Adverse impacts are detectable. Changes in the length and percentage of bank armoring for a stream are between 10 and 30%. Frequency, magnitude, and duration measurements are expected to remain within the NRV, possibly showing small, short-term disruptions as the river or stream makes minor adjustments. Disruptions to natural river processes are expected to be short-term and within the NRV. Details of this evaluation are presented in Table G-3.

Table G-3. Summary of Existing and Proposed Bank Armoring Conditions.

Study Reach Number	River Length (feet)	Existing Armoring		Proposed Bank Armoring Conditions Riverbank Management Program			
		Length (ft.)	%	Inc. Length (ft.)	% Change	Total Length (ft.)	%
1	21,600	1,410	6.5%	0	0.0%	1,410	6.5%
2	22,100	1,335	6.0%	120	9.0%	1,455	6.6%
3	14,500	2,860	19.7%	440	15.4%	3,300	22.8%
4	22,700	1,635	7.2%	240	14.7%	1,875	8.3%
5	7,600	5,800	76.3%	0	0.0%	5,800	76.3%
6	22,900	4,155	18.1%	350	8.4%	4,505	19.7%
7	16,000	4,768	29.8%	620	13.0%	5,388	33.7%
8	5,500	2,130	38.7%	0	0.0%	2,130	38.7%
TOTAL	132,900	24,093	18.1%	1,770	7.3%	25,863	19.5%

4.0 FLOOD MITIGATION PLANS

4.1 Flood Mitigation Plans

The Riverbank Management Program will not significantly increase the risk of flooding or significantly increase the hazards to human life and property. Impacts to floodplain values will also be minimized, as primarily natural materials (rock, dead trees, plantings and cuttings) will be used to provide the necessary features for the Riverbank Management Program. Therefore, neither flood hazard mitigation measures nor measures to mitigate impacts to floodplain values will not be required.

4.2 Facility Improvements and Environmental Mitigation Measures

The structures and facilities associated with Riverbank Management Program 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 in the Riverbank Management Program 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 the NFIP [44 CFR Part 60.3(d) (3)]. However, since the CVNP 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, the Riverbank Management Program can be considered to comply with the intent of the NFIP regulations in this regard.

5.0 IMPACT ON WETLANDS

Definitive information on the functions and values of the wetlands that may be disturbed from the Riverbank Management Program is not available at this time. Rather than site-specific plans, the program describes the methods and techniques available to be utilized. The Riverbank Monitoring Program will determine when and where some form or Riverbank Management is needed. In order to perform an analysis of potential impacts to wetlands, the Programmatic EA utilized the current monitoring locations, making assumptions for each. Potential impacts to palustrine wetland areas (see Section 1.5) were estimated from the CVNP wetland inventory. Potential impacts to riverine wetland areas were estimated using the average width of the repair footprint for four recently constructed areas, 36.6 feet. This was conservative since the riprap was placed on the existing slope, instead of excavating the riverbank. This had the effect of building the riverbank out to "reclaim" some of the bank that had been lost to erosion. The stone was typically placed at a slope of 1.75 to 1. Based on this, impact areas were calculated for sites projected to require direct measures as described in Section 1.1.

Only one location of the sites being monitored included palustrine wetland areas more than 0.01 acres in size in the area of potential impact (see Table G -4). Some of the riverbank stabilization measures would be some form measure that would involve construction equipment. To be conservative, an impact was assumed at this site and it was assumed to be permanent.

In those areas where direct measures are probable, impact areas to the riverine wetlands were estimated along the lengths of each location. A conservative calculation of this area according to the methodology above is shown in Table 5-2, where the riverine wetland impact areas are then added to those for the palustrine wetlands.

The total wetland area of potential adverse impact for the Riverbank Management Program was conservatively estimated to be 1.52 acres. The same methodology was applied to an extension of the current program (the No Action Alternative described in Section 1.3) where direct measures were assumed for all of the monitoring locations. The total impact area for this alternative was estimated to be 10.84 acres. It is anticipated that when site specific direct measures would be taken, some wetland areas could be avoided and others could be minimized through best management practices.

Table G-4. Summary of Potential Wetland Impacts.

Station/Mile Post	River Mile	Reach	Armoring Length (Feet)	Potential Wetland Impacts (Acres)		
				Riverine Wetland Area	Palustrine Wetland Area	Total Wetland Area
1233+00	31.65	2	120	0.10	0.04	0.14
52.47	29.40	2	0	0.00	0.00	0.00
1130+00	29.05	2	0	0.00	0.00	0.00
Reach 2 Total			**120**	**0.10**	**0.04**	**0.14**
1115+00	28.76	3	300	0.25	0.00	0.25
1107+00	28.61	3	0	0.00	0.00	0.00
1100+00	28.38	3	0	0.00	0.00	0.00
1075+00	27.95	3	0	0.00	0.00	0.00
1045+00	27.40	3	0	0.00	0.00	0.00
1010+00	26.67	3	140	0.12	0.00	0.12
Reach 3 Total			**440**	**0.37**	**0.00**	**0.37**
Fitzwater Rd Bridge		4	100	0.08	0.00	0.08
55.31 to 55.36	24.58	4	140	0.12	0.00	0.12
900+00	24.00	4	0	0.00	0.00	0.00
875+00	23.83	4	0	0.00	0.00	0.00
57.24	22.70	4	0	0.00	0.00	0.00
57.36	22.64	4	0	0.00	0.00	0.00
Reach 4 Total			**240**	**0.20**	**0.00**	**0.20**
57.77	21.90	5	0	0.00	0.00	0.00
57.94	21.75	5	0	0.00	0.00	0.00
805+00	21.18	5	0	0.00	0.00	0.00
790+00	20.99	5	0	0.00	0.00	0.00
781+00	20.88	5	0	0.00	0.00	0.00
Reach 5 Total			**0**	**0.00**	**0.00**	**0.00**
Rail Spur		6	100	0.08	0.00	0.08
758+00	20.45	6	0	0.00	0.00	0.00
59.34 to 60.0	20.23 to 19.7	6	150	0.13	0.00	0.13
710+00	19.50	6	50	0.04	0.00	0.04
680+00	19.20	6	0	0.00	0.00	0.00
60.70	18.83	6	0	0.00	0.00	0.00
60.86	18.67	6	0	0.00	0.00	0.00
61.10	18.43	6	0	0.00	0.00	0.00
61.26	17.80	6	50	0.04	0.00	0.04
610+00	17.19	6	0	0.00	0.00	0.00
Reach 6 Total			**350**	**0.29**	**0.00**	**0.29**

Table G-4. Summary of Potential Wetland Impacts.

Station/Mile Post	River Mile	Reach	Armoring Length (Feet)	Potential Wetland Impacts (Acres)		
				Riverine Wetland Area	Palustrine Wetland Area	Total Wetland Area
62.42	16.30	7	250	0.21	0.00	0.21
62.60	16.12	7	0	0.00	0.00	0.00
63.05 to 63.08	15.73	7	0	0.00	0.00	0.00
514+00	15.20	7	100	0.08	0.00	0.08
64.14 to 64.17	14.23	7	0	0.00	0.00	0.00
64.30	13.60	7	270	0.23	0.00	0.23
448+00	13.40	7	0	0.00	0.00	0.00
Reach 7 Total			**620**	**0.52**	**0.00**	**0.52**
65.73	12.3	8	0	0.00	0.00	0.00
Reach 8 Total			**0**	**0.00**	**0.00**	**0.00**
Total			**1,770**	**1.48**	**0.04**	**1.52**

6.0 WETLAND COMPENSATION

Director's Order #77-1 provides that wetland compensation should be in the form of restoring wetland functions in degraded or former wetland habitats on NPS lands. Since definitive information on the functions and values of the wetlands that may be disturbed from the Riverbank Management Program is not available at this time, restoration of areas with equivalent acreage, type and function are required to the extent practicable. Since this project disturbs riverine wetlands, the proposed compensation consists of restoring similar areas through the restoration of riparian buffer along the Cuyahoga River.

The NPS has expressed a goal of reestablishing a 120-foot wide forested buffer along an estimated 17,500 feet of riverbank along the Cuyahoga River. This includes restoration needed on riverbanks adjacent to fields recently mowed or in agricultural use. These areas are in the process of being taken out of active use through implementation of the park's Riparian Buffer Plan for Proposed Agricultural Areas (NPS, 2002). They typically lack woody vegetation which would be present on undisturbed riverbanks. This leads to instability and bank failure which continues to impact the river at the point of failure as well as downstream. Additionally, erosion in these areas provides footholds for the non-native invasive plant Japanese knotweed (Polygonum cuspidatum) which already infests much of the riverbanks within the park. This further degrades the plant communities in the riparian buffers, and may prevent a flourishing native plant community from establishing itself in these areas.

Restoration would entail, among other things, restoring native plant communities, planting native woody plants, control of harmful non-native exotics such as Japanese knotweed, and potentially temporary biotechnical slope stabilization to protect banks until the woody species are able to effectively establish a healthy buffer.

The width of riverine wetland estimated to be restored or enhanced from the establishment of this riparian buffer is not known. If one assumes the same width as that which was calculated for impact (36.6 feet), the area of riverine wetland to benefit from this compensation is 14.70 acres. This is 9.7 times the amount of wetland impact estimated for this alternative.

7.0 SUMMARY

The preferred alternative will not change the monetary investment and the risk to both human life and property due to its location within the floodplain. The measures to be used in the Riverbank Management program to stabilize riverbanks in locations that require it have been found, through evaluation of these same measures in areas of CVNP where they have been constructed, to have Minor Adverse or Negligible effects on water surface elevations, velocities and geomorphology. The evaluation of proposed mitigation measures will minimize risk, provide compliance with the applicable provisions of 44 CFR Part 60, and restore and preserve some existing floodplain values.

Because of the proximity of riverine wetlands to riverbank areas, it is not possible to totally avoid impacts to wetlands. Care was taken to select an alternative that would minimize the impacts on wetlands, while meeting project objectives. The preferred Riverbank Management alternative minimizes the potential impacts to wetland areas from 10.84 acres estimated for the No Action Alternative to 1.52 acres. The 1.52 acres may be reduced once site-specific mitigation methods are employed. The park will restore to scrub/shrub and forested habitat approximately 17,500 feet (14.70 acres) along the Cuyahoga River. The compensatory mitigation ratio for this project is 9.7 acres of restored riverine wetland for every acre of wetland fill. This project is consistent with the NPS's no net loss of wetlands policy. The National Park Service, therefore, finds that this project is in compliance with Executive Order 11990: "Protection of Wetlands."

8.0 REFERENCES

Cowardin, L.M., W. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetland and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Service. Washington D.C. FWS/OBS-79/31.

Davey Resource Group. 2001. GIS Wetlands Inventory and Restoration Assessment - Cuyahoga Valley National Park, Cuyahoga and Summit Counties, Ohio. Unpublished Report 38 pp.

National Park Service, U.S. Department of the Interior

2002. Procedural Manual #77-2: Floodplain Management.

Procedural Manual #77-1: Wetland Protection (http://www.nature.nps.gov/wetland/indexpro.html)