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Mr. Jason Flickner
Water Resources Program Director
Kentucky Waterways Alliance
107 East Court Street
Greensburg, KY 42743

RE: Application for Section 404 Individual Permit and Section 401 Water Quality Certification for the River Metals Development, Jefferson County, Kentucky, November 2006

Dear Mr. Flickner:

As requested, I have reviewed the above referenced application. In this review, I focused on the potential effects of the proposed channel realignment on Middle Fork Beargrass Creek. The following are my preliminary observations, which are primarily based on the photographs, data, and analysis presented in the application; online information from USGS; on-line aerial photographs of the site; and my knowledge and experience in stream geomorphology and hydraulics.

The application focuses on the realignment and shortening of the Middle Fork Beargrass Creek channel from about 1400 feet to approximately 1000 feet and the **on-site effects** of the proposed realignment. Much of the presented information and results of analysis is inaccurate. The analysis lacks consideration of important hydraulic influences of bends, bridges, and debris, and it relies on uniform flow assumption (unobstructed flow) in the highly obstructed existing channel. The use of a reference reach approach in this complex urban condition is inappropriate, given the likely effects of flow constrictions and the high percentage of artificial substrate that appears to be present in the streambed and along the streambanks. The application is devoid of the non-uniform flow hydraulic analysis required to properly assess the boundary stress, flow velocity, and erosion potential in the existing reach, the reference reach, and the proposed reach. In addition, **the application does not address upstream or downstream effects of the proposed channel straightening and realignment on flood flows or channel morphology**. The existing channel is clearly cluttered with litter and debris, particularly at the access bridge, and on-site obstructions are affecting flow and may be contributing to upstream flooding. Beneficial stream restoration on-site as well as upstream and downstream could be accomplished to mitigate for the effects of the project. However, the analysis provided is inadequate for the complex conditions of the site and does not consider upstream or downstream effects that will occur as a result of the project.

Each of these issues is elaborated below.

1. Existing Versus Proposed Condition Analysis

The analysis of existing conditions does not include the backwater effects currently caused by the existing access bridge, the debris blockage of the bridge opening (see Photo 9), and the resistance of several sharp bends. Therefore, the analysis of boundary stress under existing conditions is erroneous. The backwater effects of the partially blocked bridge have an overwhelming effect on the hydraulics of the upstream riffle used to evaluate existing conditions. As a consequence of the bridge and bend effects, the increase in bed stress under the proposed conditions is likely to be several times that of the existing conditions. Thus, the predictions of the changes in flow velocity and boundary stress are substantially underestimated.

According to the proposed realignment plan, the affected reach of Beargrass Creek will be shortened from approximately 1400 feet to approximately 1000 ft, a reduction of about 29%. This decrease in length will increase the average bed slope by about 35%. Even without the backwater effects that are not considered in the analysis provided in the application, this increase in slope would cause a substantial increase of at least 35% in the channel bed shear stress, would increase channel flow velocity, and could destabilize the streambed and banks not only within the relocated channel reach but also upstream and downstream of the reach. Based on the predicted shear stress for the proposed channel at bankfull flow conditions, the entrainment chart provided in Appendix D, and the bed material gradation in the reference reach summary form, over 95% of the proposed channel bed material would be mobile during a bankfull event, and all of the material could be mobile during flood events. The information in the application offers no evidence that the upstream watershed will supply the size and load of material required to refill eroded material. Consequently, the channel and the proposed in-stream structures will fall apart over time unless large rock is added after bankfull and larger flood events.

2. Channel Bed and Bank Structures and Floods above Bankfull

As explained above, channel materials are likely to be eroded under bankfull and other high-stress flow conditions. An analysis of the probable effects on channel materials of floods above bankfull was not conducted. Under the current conditions that include the backwater effects of bridges and bends, scour holes exist up to 14 feet at bankfull stage. Under the severely increased stress conditions of the proposed project, very deep scour holes at in-structures should be anticipated for flood events. These deep scour holes are likely to cause the failure of the in-stream structures such as cross-vanes.

3. Bend Material

The photographs indicate that much if not all of the coarse fraction of the bed material is composed of man-made materials, rocks from degraded walls, or riprap. The underlying material may be silt or sand. No indication of a geotechnical

investigation of the materials at the proposed location of the channel was provided. The material on which the stream will be constructed is likely to be a combination of silt and sand, which are the materials typically composing the banks of streams of the Ohio River floodplain. The channel and proposed structures are not likely to remain stable under these substrate conditions. Given the proposed pool depths of 9-10 feet and riffle depths of 4 feet, maintaining stability of the cross-vanes will be difficult if not impossible without armoring the bed and banks of the entire restored reach with riprap.

4. Reference Reach Analysis

The design approach relies on an upstream reference reach indicated to be near a USGS gage upstream of the site. Neither the precise location of the reach nor the profile used to compute slope or other parameters was provided, however. Therefore, the extent to which bridges, culverts, or bends affect the riffle that was used as a reference for the design is undetermined. Given that the bridge was ignored in the assessment of the existing reach, the designers may have not considered potential backwater effects or man-made or imported substrate at the reference reach. The use of a reference reach without consideration of backwater effects from stream constrictions such as bridges, culverts and bends will produce channel design parameters hich are unreliable.

5. Upstream and Downstream Impacts

No analysis of probable effects was conducted for reaches upstream or downstream of the proposed site. The stream profiles ended near the property boundaries, which suggests that no upstream or downstream baseline information was collected from which potential effects can be measured or compared. No information was provided to indicate that an investigation was conducted to ensure that potential disturbances migrating from downstream would not cause the proposed project to fail. Likewise, no examination of upstream conditions was reported, other than those in the reference reach. Reducing the channel length by 400 feet, removing the bridge restriction, and removing several bends will cause an increase in the flow velocity within and upstream of the project area. This will tend to destabilize the upstream channel and may affect the stability of the channel at several upstream bridges and culverts. A thorough investigation of the potential upstream effects should be conducted for at least the bankfull flow event, the 100-year event, and other flood events that could cause instability at bridges and other infrastructure such as underground sewer lines and other utilities.

The impact of the proposed channel on upstream reaches under bankfull and higher flood conditions was not conducted. Removing the backwater effects of the bridge, stream length, debris, and channel bends and increasing the channel slope will increase the stress on the proposed channel bed and increase the stress on upstream channel reaches. No assessment of this certain impact was made.

Alternatives that would reduce upstream and downstream impacts do exist, and it would be a shame to lose this opportunity to improve the conditions of Middle Fork Beargrass Creek. Unfortunately, the analysis and plan indicate that the proposed realignment will fail, will cause instability in the upstream channel, and could potentially cause damage to infrastructure. At a minimum, additional hydraulic analysis is needed.

Sincerely,

Arthur C. Parola, Jr., Ph.D.