

April 30, 2020

Grandad Bluff Coalition  
128 29th St S, La Crosse, WI 54601  
c/o Christine Clair

**RE: Evaluation of Bluffsides Stability, Erosivity, and Potential Degradation of Grandad Bluff  
from Mountain Bike Path Construction, Operation, and Maintenance**

**Introduction and Scope**

Based on my background and specialized expertise, I have been retained to provide an independent and professional judgment with respect to bluffsides stability, erosivity, and potential degradation of Grandad Bluff in La Crosse, Wisconsin, as related to the potential construction, operation, and maintenance of an extensive series of new mountain bike trails on virgin topography (**Figure 1**). Specifically, regarding the proposed new mountain bike paths, I have been asked to provide my expert opinion on the following subjects and if any of these assessments would potentially cause irreparable harm:

- Geology, topography, and nature of soil and rock features in Grandad Bluff;
- Potential for degradation of stability in terms of (1) soil erosivity, (2) global bluff stability, and (3) rockfalls and structural movements;
- Impact to the unique geological and cultural history of Grandad Bluff; and
- Potential impact of increased erosive flows and storm water issues related to construction, operation, and maintenance of an extensive series of mountain bike paths.

**Background and Qualifications**

I am an Associate Professor and the Director of the Geological Engineering Program at the University of Wisconsin-Madison (UW-Madison). I work primarily in the College of Engineering within the Department of Civil and Environmental Engineering but have additional appointments and responsibilities in Engineering Professional Development and Geological Engineering. Prior to joining UW-Madison in 2008 as a tenure-track professor, I worked in private industry for 13 years including positions with Caterpillar (Peoria, IL), RMT, Inc. (Madison, WI), and CH2M HILL (Denver, CO and Philadelphia, PA). I am the recipient and co-recipient of numerous awards from the American Society of Civil Engineers (ASCE), the Federal Highway Administration (FHWA), and other organizations, including a Dwight D. Eisenhower Research Fellowship, the ASCE Zone III Practitioner Advisor of the Year, the ASCE Wisconsin Section Outstanding Young Engineer, and in

2018, I was elected as an ASCE Fellow, an honor that less than 2% in my profession attain. My CV is attached as **Appendix 1**.

Over my nearly 30 years of professional practice, I have specialized technical background in the evaluation, investigation, monitoring, research, and outreach/teaching in slope stability, landslides, and other degradative forces impacting sloped landscapes, including bluff features. Within the past dozen years, I have worked on multiple projects with an emphasis on evaluating the slope stability of projects in Wisconsin. In addition, I am the director of the longest-running professional development short course on slope stability in the United States—*Slope Stability and Landslides*—which has now been offered over 40 separate times at locations across the United States (I have been involved for the past 15 offerings, the last dozen for which I am the responsible Program Director). This course has been attended by over 1,000 professionals from nearly all 50 states—many people consider this the preeminent short course on slope stability in the country. Of note, I am also an avid biker who routinely bikes upwards of 5,000 miles per year on roads and paths across the Upper Midwest. Coupled with my technical expertise in slope stability and landslides, I have a somewhat unique sensitivity to biking options and trail availability in this context.

### **Work Performed and Methodology**

In performing this analysis, I reviewed the following primary site-specific documents:

- Grandma's Gateway Trail Construction Project – Phase 1. 2020. Request for Quotation.
- Grandad Bluff Trail Project. February 2020. Phase 1 Design Trail Map.
- Grandma's Gateway Trail System. Version 1.2 190925 Working Draft. Trail Specifications.
- ISG Memo dated February 3, 2020. Grandmas Gateway Trail Construction Project – Phase 1 – RFQ 3<sup>rd</sup> Party Review.
- 12/29/19 e-mail from Kirk Olson to Jay O. with subject line of Grandad's Gateway Trail Concerns.
- Evan, T.J. 2003. "Geology of La Crosse County, Wisconsin." Wisconsin Geological and Natural History Survey, Bulletin 101.
- Hixon Forest Comprehensive Plan. 2005. City of La Crosse Planning Department. Adopted May 2005.
- City of La Crosse presentation to the community on 03/09/20.
- Community questions/City answers regarding project presentation on 03/09/20.
- MSA Professional Services. 2016. "The Blufflands, A Plan for Conservation and Recreation throughout the La Crosse-La Crescent Region." May 26, 2016 Draft Report.

- USDA Natural Resources Conservation Service. 2020. Custom Soil Resource Report for La Crosse County, Wisconsin.
- Published standards of practice, textbooks, and basis of design including:
  - Turner and Schuster (2013), Rockfall Characterization and Control, [www.TRB.org/Rockfall](http://www.TRB.org/Rockfall).
  - Brawner. 1994. Rockfall Hazard Mitigation Methods, FHWA.
  - McCauley et. al. 1985. Rockfall Mitigation, Calif. DOT.
  - Wyllie. 2015. Rock Fall Engineering, CRC Press.
  - Slope Stability and Landslides Notebook. University of Wisconsin–Madison Department of Engineering Professional Development.

In addition to my review of the above Grandad Bluff-specific documents, I visited the site on March 21, 2020. During this site visit, I walked the proposed bike trail (as marked by flagging), took photos (see attached **Photo Log**), and made general observations and notes of the geological and cultural setting of the site.

### **Summary of Opinions**

1. ***Bike paths should not be located within 100 m upslope of occupied residences or structures*** as there is the potential for safety issues related to rockfalls or other slope movements caused by disturbances of naturally steep slopes. “Rockfall” is defined as *the movement of rock of any size from a bluff or other slope that is so steep the mass continues to move down the slope* (see **Figures 2 and 3**, for example). Movement may be by free-falling, bouncing, rolling or sliding. In many regions, the greatest amount of rockfall occurrences are during rainstorms when fine-grained supporting materials are washed away from beneath larger rocks. This also holds true for wind, snowmelt and channeled runoff, such as typically occurs on artificially constructed trails on steep slopes. The second major cause of rockfall is freeze-thaw cycles. Because of the channelization and routing of water along or across trails on steep slopes, construction of trails on these steep slopes generally enhance the potential for freeze-thaw cycles and thus the potential for increased rockfall occurrences. There is further evidence that shallow slope failures are possible, associated even with structural elements (see, for example, retaining wall failure in **Figure 4**). As such, it is my opinion that any retaining elements for the proposed bike paths should be designed by a licensed professional engineer. Paths constructed on slopes steeper than 35 degrees should have similar consideration for professionally engineered designs.
2. Construction of trails on steep slopes such as those found throughout Grandad Bluff would lead to the modification of existing drainage patterns (see **Photos 2 and 4**), the removal of the thin upper soil horizon, soil compaction in places, and also the potential for an opening

of the canopy which could lead to modification in micro-topography and micro-climate. Erosion (see **Photos 3 and 5**) and increased storm water conveyance (as would be conveyed on paths as shown in **Photos 2 and 4**) would be exacerbated by climatic issues such as increased occurrence of precipitation events and intensity of such events (e.g., extreme frost depths, excessive snow, high-intensity rain events). Because of shallow surface soils across Grandad Bluff, there is very limited capacity for shallow soil to absorb, retain, and moderate stormwater conveyance. These opinions of increased erosive potential with the construction and operation of an extensive trail system is not just my individual technical opinion, but is also very bluntly detailed in a Custom Soil Resource Report prepared by the USDA Natural Resources Conservation Service for La Crosse County (2020) in which the majority of Grandad Bluff is classified as “very severe” in terms of erosion hazard specific to off-road and off-trail situations (**Figure 5**). This very severe rating indicates that ***significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.*** For paths and trail potential, this same report indicates that Grandad Bluff is rated as “very limited,” see **Figure 6**. Very limited is defined to mean:

*the soil has one or more features that are unfavorable for the specified use and that these limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.*

3. ***High-intensity mountain biking on Grandad Bluff would indelibly and irreparably impact the tranquility, setting, and nature of these areas.*** On the geological and cultural significance of Grandad Bluff, I believe that construction, operation, and maintenance of an extensive set of off-road biking paths would cause irreparable harm. La Crosse County is characterized by unique contrasts in topography and geology (see **Figure 7**) and Grandad Bluff epitomizes these contrasts. Grandad Bluff—an elevated mesa with a flat top and steep cliff sides—is a highly visible icon of geologic forces. Grandad Bluff is one of the few places for which a panoramic view of the City of La Crosse and the confluence of three rivers is found and, on a clear day, three separate states are visible. These blufflands are unique landforms that were formed over the course of tens of thousands of years and were not “bulldozed” by the Wisconsin Glaciation. Scenic America labeled these Upper Mississippi Blufflands as a top ten “last chance” landscape for which these naturally occurring, geologically significant features face harm from development and human activity. Grandad Bluff has unique rock outcroppings, including the dolomite of the Prairie du Chien group (**Photo 1**) capping Cambrian-era Jordan Sandstone. This geological setting (see **Figure 7**) is



not only geologically unique, but also susceptible to mass movements (see **Photo 1** in comparison to **Figure 8**).

### **Conclusions**

Based on (1) a site visit on March 21, 2020, (2) my review of background documents and the literature, and (3) my professional experience, ***it is my expert opinion that the construction and operation of an extensive set of mountain biking trails on Grandad Bluff would cause irreparable harm to the unique geological and cultural history of Grandad Bluff.*** Structurally, I am concerned about the generally irreparable nature of erosive forces on naturally steep slopes with limited soil cover that are disturbed. Erosive features are irreparable in my opinion because once shallow surface soils erode on naturally steep or artificially over-steepened slopes due to recreational path construction, it takes years if not decades to naturally replace these soils. It is my professional opinion that erosion will undoubtedly occur unless there is a rigorous design process, enhanced design and construction features, and a robust and permanent maintenance plan. The erosion issue and interrelated rockfall potential could be significant for homes and property below the proposed trails due to personal and structure safety considerations. Because of these same safety and erosive considerations that I am opining on, the Hixon Forest Comprehensive Plan (2005) prepared by the City of La Crosse recommended that recreational activities that significantly increase threats to personal safety or which have the potential for negative impacts to habitat, the promotion of erosion, or the reduction of tranquility shall be prohibited.

It is my understanding that the current plan is for maintenance of these trails to be accomplished with volunteers, pursuant to a memorandum of understanding with La Crosse's Park and Recreation Department. If this comprehensive plan for trail development and construction moves forward, the design of a comprehensive maintenance plan, scheduling of maintenance activities, and requisite repair of any slope and/or soil cover damage should be formally defined, conducted, and reviewed with third-party oversight.

Sincerely



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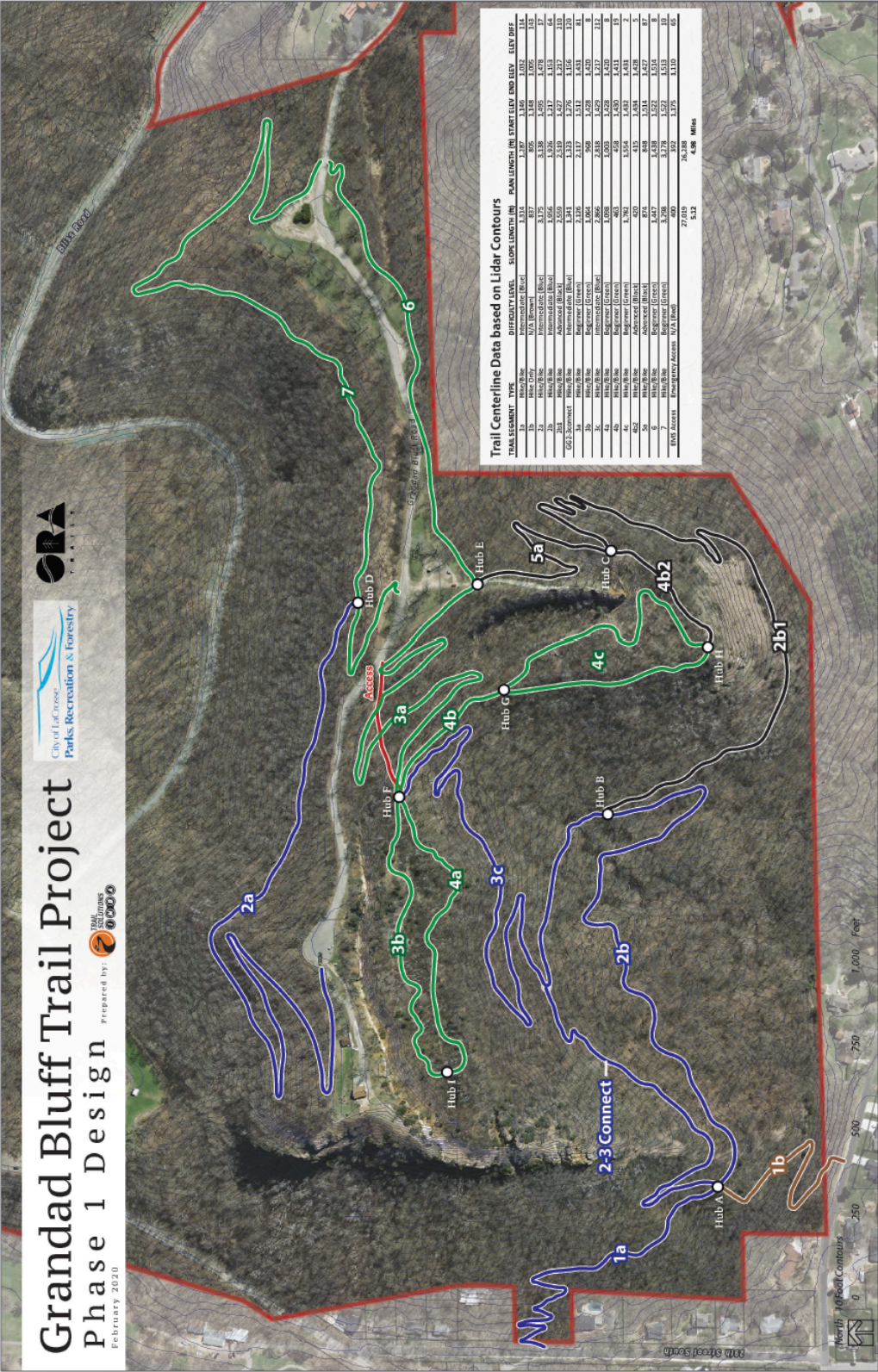


Figure 1. Proposed Trail Layout.





**Figure 2. Example of dislodged boulder on Grandad Bluff.**





**Figure 3. Evidence of rock instability on Grandad Bluff.**





**Figure 4. Evidence of bluff instability as manifested by retaining wall failure.**



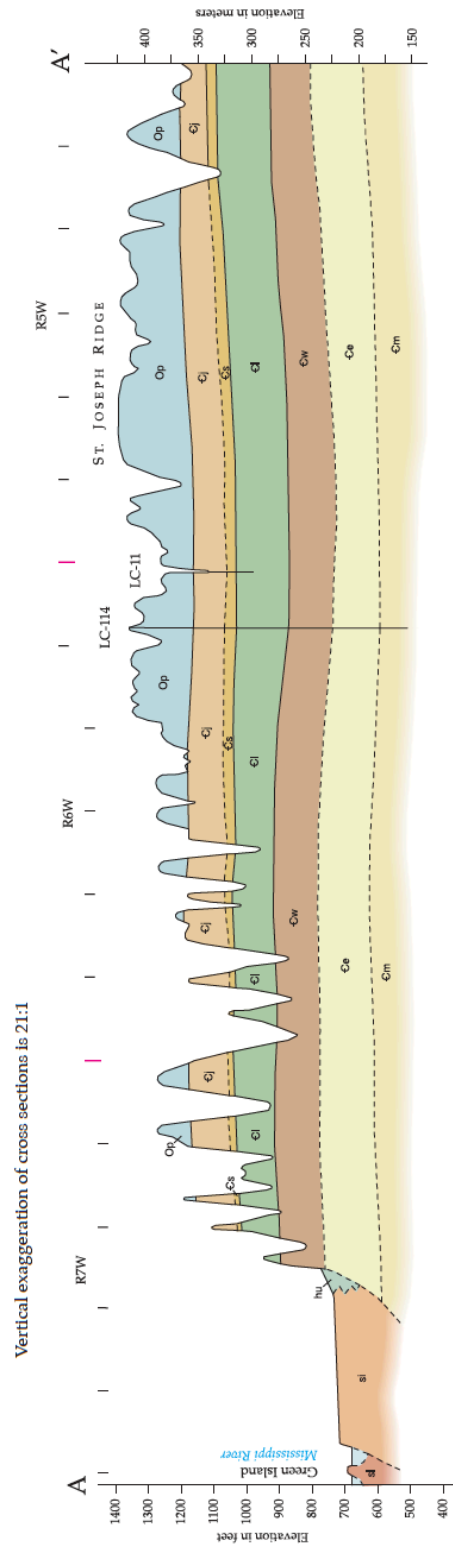


**Figure 5. Erosion Hazard for Off-Road, Off-Trail Activities on Grandad's Bluff (USDA Soil Conservation Service Custom Soil Resource Report for La Crosse County)**



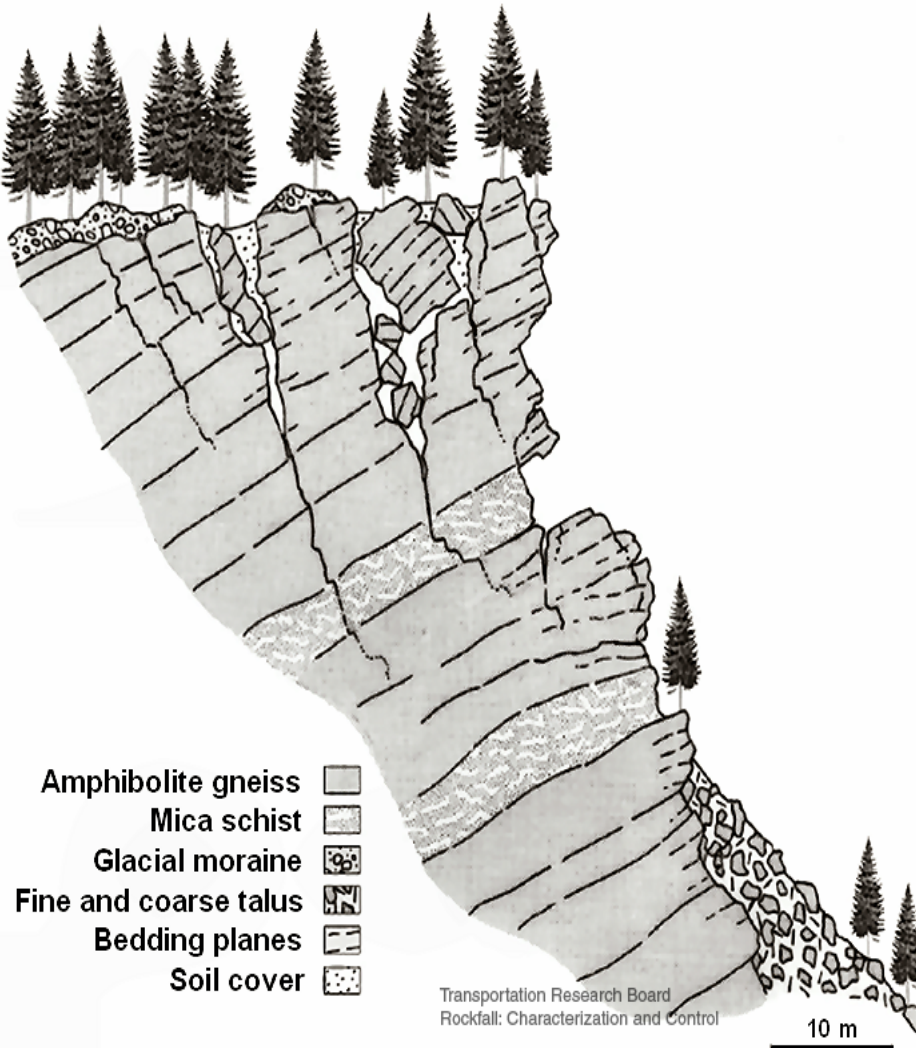


**Figure 6. Suitability for Paths and Trails on Grandad's Bluff (USDA Soil Conservation Service Custom Soil Resource Report for La Crosse County)**



**Figure 7. Geologic Map and Cross Sections of La Crosse County, Wisconsin (from Evan 2003) showing the unique and irreplaceable natural geology of the Blufflands.**





**Figure 8. Example Schematic of a Bluff that is Susceptible to Rock Falls and Mass Movements (from Turner and Schuster, 2013). This schematic is partially representative of Grandad Bluff, see Photo 1.**



**Photo 1:** Capstone Rock (Prairie du Chien Dolomite) at Grandad Bluff (03/21/20).





**Photo 2:** Compaction leading to depressed path and conduit for stormwater flow and Grandad Bluff (03/21/20).





**Photo 3:** Example of the power of erosion on Grandad Bluff (03/21/20).





**Photo 4:** Existing path cuts across a moderately steep slope on Grandad Bluff (03/21/20).





**Photo 5:** Erosion prevalent on steeper slopes, shown is a 47.9-degree portion of mid-slope of Grandad Bluff (03/21/20).