

City of Charlottesville, Virginia  
Ragged Mountain Project

B&V Project 168539  
July 30, 2010

Ms. Lauren Hildebrand  
Director of Utilities  
City of Charlottesville  
Department of Public Works  
305 4<sup>th</sup> Street, N.W.  
Charlottesville, VA 22903

**Subject: Feasibility of Modifying the Lower Ragged  
Mountain Dam  
Ragged Mountain Project**

Dear Ms. Hildebrand:

Black & Veatch is providing this letter to briefly describe the progress on the Ragged Mountain Project and offer our initial opinions for raising the Lower Ragged Mountain Dam (LRMD). The work described in this letter was performed in general accordance with the contract dated May 24, 2010. Among other issues, the City of Charlottesville (City) wishes to understand the feasibility of raising the LRMD to accommodate a corresponding raise in the normal pool level.

To assess the existing conditions and potential for raising the LRMD, Black & Veatch completed a preliminary review of historic studies as well as other relevant data about the dam including:

- Letter, from N. Wilson Davis to C.D. Carter, December 24, 1912 regarding safety of the LRMD;
- Letter, from David J. Howell (design engineer) to C.D. Carter, February 11, 1913 advising for further review of the LRMD conditions;
- Letter, from an unknown engineer to Thomas J. Michie, May 3, 1913 providing details of a physical examination of the LRMD;
- Report, Feasibility Study Upgrading the Ragged Mountain Dams, Gannett Fleming, February 28, 2003 (note that there were several missing appendices);
- Memorandum, Concept Development – Ragged Mountain Reservoir Expansion, Gannett Fleming, February 16, 2005.

To augment this existing information, Black & Veatch completed a limited intrusive investigation program of the dam. The program was designed to characterize the structural integrity of the concrete dam and condition of the interface between the dam and bedrock foundation. The investigation program consisted of three (3) test borings through the cyclopean concrete dam crest with a tele-viewer survey and pressure testing of each, and one (1) test boring through the earth buttress. The drilling program was completed July 24, 2010.

Our investigations revealed conditions that appear considerably better than indicated by the investigations performed for and documented in the above bulleted list. Review of preliminary boring logs and tele-viewer results indicate limited deterioration of the cyclopean concrete matrix and a generally tight contact between the dam and bedrock. Our investigation did not locate a previously theorized mud mat at the dam's foundation. The interface samples indicate that the contact between the dam and foundation is not smooth and planar, but rough, irregular, and interlocking, with areas where the concrete remains bonded to the rock. The shear strength of this surface is considerably higher than was assumed for the mud mat surface, which increases the safety factors.

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Therefore, at this time, Black & Veatch believes the existing LRMD can be successfully modified to meet current Virginia dam safety requirements and provide greater water storage capacity. The modifications must include an increase in spillway discharge capacity with an optional raise of the dam's crest to allow an increase in reservoir elevation.

Based on our review of the material referenced in this letter, it is feasible to raise the crest by 35 to 45 feet. A possible scenario for raising the dam crest considers installation of post-tensioned anchors through the existing dam to improve short-term stability; removal of the earth buttress; foundation preparation and grouting; and construction of a downstream raise using structural concrete or roller-compacted concrete. Other feasible scenarios for upgrading the LRMD include modifying just the spillway to meet dam safety requirements; a crest raise of 13 feet; or staggered or staged construction of the 35 to 45-foot raise mentioned previously. All of these scenarios can be constructed while maintaining nearly normal reservoir level and operation. These broadly described scenarios require additional development and evaluation to assess constructability issues and potential construction costs.

Should you have any questions or need clarification, please do not hesitate to contact me at 301-921-8244 or at [zamenskyg@bv.com](mailto:zamenskyg@bv.com).

Very truly yours,  
BLACK & VEATCH



Gregory A. Zamensky, P.E.  
Regional Practice Leader  
Dams, Levees and Reservoirs Practice

cc: File  
Rich Gorny, Black & Veatch  
Doug Brinkman, Black & Veatch