MEMORANDUM

TO: Rob Foltan, P.E., Mike Mosher, P.E.

FROM: Michael Hross, Bjorn Lake, P.E.

CC: Mike Schimpff, P.E.

DATE: January 17, 2014

RE: Hawkinsville Hydraulic Modeling

INTRODUCTION

In 2007, a spillway design flood (SDF) study was performed by Kleinschmidt Associates (Kleinschmidt)[1], utilizing version 3.1.3 of the HEC-RAS software. The study utilized existing topographic data and no detailed bathymetry data or field surveyed cross sections were obtained. The results of the analysis recommended that the dam be given a hazard classification of Class B resulting in a SDF of 21,450 cubic feet per second (cfs), equal to 1.5 times the 100-year-flood.

In this study, in order to evaluate the proposed dam rehabilitation or removal options, an updated HEC-RAS model was developed using version 4.1.0 software. As part of the hydraulic evaluation, detailed impoundment bathymetry and topographic data was obtained as well as field surveyed cross sections downstream of the dam. The purpose of this memorandum is to address differences between the 2007 and the updated HEC-RAS models and reexamine the selected SDF and hazard classification for the Hawkinsville Dam.

MODEL DESCRIPTION AND DATA SOURCES

The updated model geometry extends approximately 2 miles upstream of the Hawkinsville Dam, beyond the upper limits of the dam's impoundment, and continues approximately 4 miles downstream below the Moose River Road Bridge. A U.S. Geologic Survey (USGS) stream monitoring gage (04252500 Black River near Boonville, NY) is located at the Moose River Road Bridge and was used to calibrate the model. As part of the current study, detailed bathymetric data was collected by Shumaker Consulting Engineering & Land Surveying, P.C. The data included elevations of the bottom of the Hawkinsville Dam's impoundment, the dam itself, the overbanks adjacent to the dam, bathymetry of the river to above and below the Hawkinsville Road Bridge, and bridge dimensions. The bathymetric and topographic data were converted into a digital elevation model (DEM) using ArcMap 10.1. Elevation data for the remaining model area were obtained from USGS 10 meter DEM data. All elevation data are in North American Vertical Datum of 1988. Geometry of the Moose River Road Bridge was obtained from the 2007 Kleinschmidt study.

MODEL CALIBRATION

The updated model was calibrated using flow-stage data from the USGS gage 0422500 near the Moose River Road Bridge. No other sources of calibration data were available for the model

[1] Kleinschmidt Associates. 2007. Hudson River-Black River Regulating District, Albany, New York, Hawkinsville Dam Breach Analysis, Summary of Study and Analysis to Determine Spillway Design Flood. Pittsfield, ME.

study area. Six data points with recorded water surface elevations were selected from the historical record. Flows ranged from 3,260 cfs to 12,800 cfs (the maximum flow recorded for the period of record). The model was run in steady state at each flow and the predicted water surfaces compared to the historical data. All six simulations were within 1 foot of the historical data. These results suggest that the model is satisfactorily calibrated.

RESULTS OF ROUTING THE SDF

STEADY STATE VERSUS UNSTEADY STATE SIMULATIONS

The updated HEC-RAS model was run using both steady state and unsteady state solution methods using an inflow equal to the SDF of 21,450 cfs. Both simulations produced similar results along the length of the river; however, the elevation of the water surface profile at the Hawkinsville Dam's tailwater was lower for the unsteady state simulation than it was for the steady state simulation. Figure 1 in Attachment A shows both profiles along with the bed profile. The simulation results are different because the steady state simulation in HEC-RAS solves for the water surface at each cross section using the energy equation and uses contraction and expansion loss coefficients at bridges and in-line structures while the unsteady simulation solves both the mass continuity equation and the momentum equation[2].

Both steady state and unsteady state simulations, however, indicate that the Hawkinsville Road Bridge causes a backwater effect at the dam and will result in submergence of the dam's spillway during the SDF.

COMPARISON TO 2007 DAM BREACH AND SDF ANALYSIS

The results of the current HEC-RAS model differ from the results of the 2007 model used for the dam breach and SDF analysis. Specifically, the 2007 model predicted a tailwater elevation at the Hawkinsville dam of approximately 1,042.9 feet during the SDF compared to the current model prediction of 1,045.4 feet. There are two main reasons for the differences between the two models. The updated model utilizes surveyed bathymetry data both upstream and downstream of the dam, while the 2007 model did not have any bathymetry data and used estimated bottom elevations. The 2007 model also assumed a constant elevation of 1032.3 feet at the tailwater cross section, but surveyed data indicates that the elevation is not constant. At its lowest the bottom elevation is approximately 1,032 feet, but the most consistent elevation at the toe of the dam is 1,034 feet. Additionally, the 2007 model did not utilize ineffective flow areas upstream or downstream of the Hawkinsville Road Bridge. The ineffective flow areas reduce the total area of available conveyance of the river and its overbanks, which is caused by the bridge's abutments and piers, resulting in increased tailwater elevation.

UPDATED DAM BREACH ANALYSIS

Analysis of the tailwater level during flood flow conditions indicated that increased tailwater conditions at the dam will likely reduce the breach wave that would result from a failure of the dam. Therefore, the updated model was used to reassess the impacts of a dam breach at the Hawkinsville Dam as well as analyze the hydraulic impacts for options for increasing the discharge capacity of the dam. The current study adopted the breach parameters that were used in

[2] U.S. Army Corps of Engineers. 2010. HEC-RAS River Analysis System Hydraulic Reference manual. Davis, CA.

the 2007 study which assumed a failure of the spillway. The breach parameters used had been approved by the New York Department of Conservation (NYDEC) as part of the 2007 analysis and are listed in Table 1 below. The model assumes a constant inflow of 21,450 cfs into the reach for the duration of the simulation, which is a valid assumption due to the minimal storage in the impoundment, the short length of the reach modeled, and the short time it takes for the reach to pass the breach wave.

The dam was set to breach once the headpond reached the maximum elevation occurring during the SDF non-breach simulation, 1,050.63 feet.

TABLE 1 – BREACH PARAMETERS

BREACH PARAMETER	VALUE
Breach Development Time (minutes)	12 (0.2 hr)
Bottom Width (ft)	112.5
Side Slope (H:V)	0:1
Breach Bottom Elevation (ft)	1032.0

UPDATED DAM BREACH ANALYSIS RESULTS

1.5 TIMES THE 100-YEAR-FLOW

The results of the updated dam breach show maximum dam failure at the current SDF flow will result in a breach flow of approximately 25,400 cfs downstream of the dam. The breach wave will cause a maximum incremental rise of approximately 1.1 feet at the Hawkinsville Road Bridge. Once downstream of the bridge, the incremental rise for the remaining downstream length of the model will be less than 2 feet at all cross sections. Figure 2 in Attachment A shows the hydrograph for the breach event just upstream of the Hawkinsville Road Bridge. Figure 2 shows that the breach wave will pass and normal inflow conditions will return within approximately 2.5 hours.

CONCLUSIONS AND RECOMMENDATIONS

The updated HEC-RAS model indicates that a breach of the dam during the SDF will not cause a significant incremental impact (taken as a rise greater than 2.0 feet, which could be considered a life-threatening impact). Additionally, simulations were run using the 100-year-flood and also a Sunny Day flow, and both did not cause significant incremental impacts. Therefore, it is our opinion that the Hawkinsville Dam be reclassified as a Class A hazard dam. Under NYDEC regulations, the SDF for the dams with a Class A classification would be equal to the 100-year-flood. Collection of additional calibration data at the Hawkinsville Road Bridge would be useful in order to better quantify the contraction effects caused by the bridge on the tailwater. Once the dam reclassification is completed, analysis of options for dam rehabilitation or removal could be continued based upon the new SDF.

Attachments: Attachment A – Model Figures

ATTACHMENT A

MODEL FIGURES

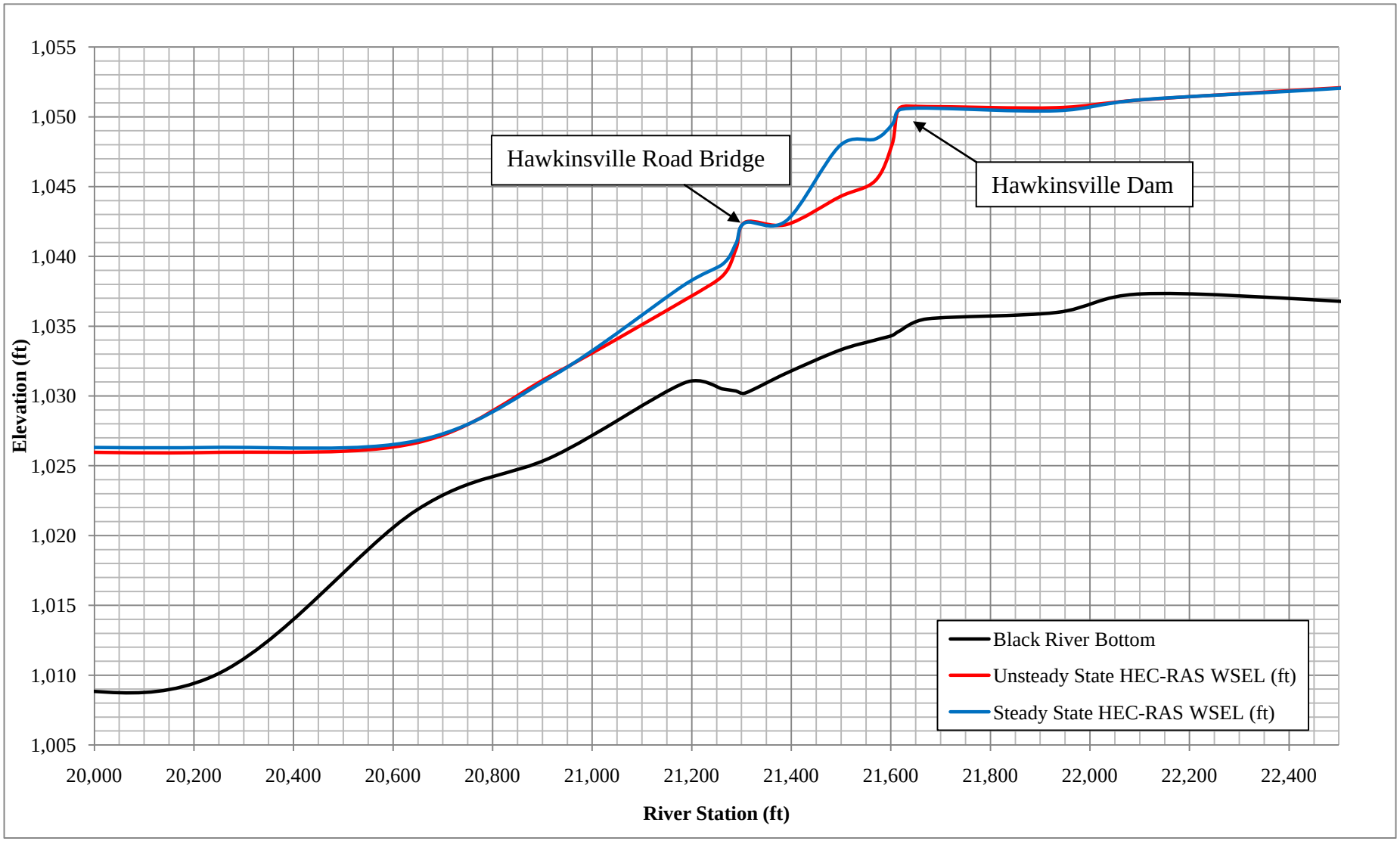

FIGURE 1 – COMPARISON OF HEC-RAS STEADY STATE VERSUS UNSTEADY STATE SDF RESULTS

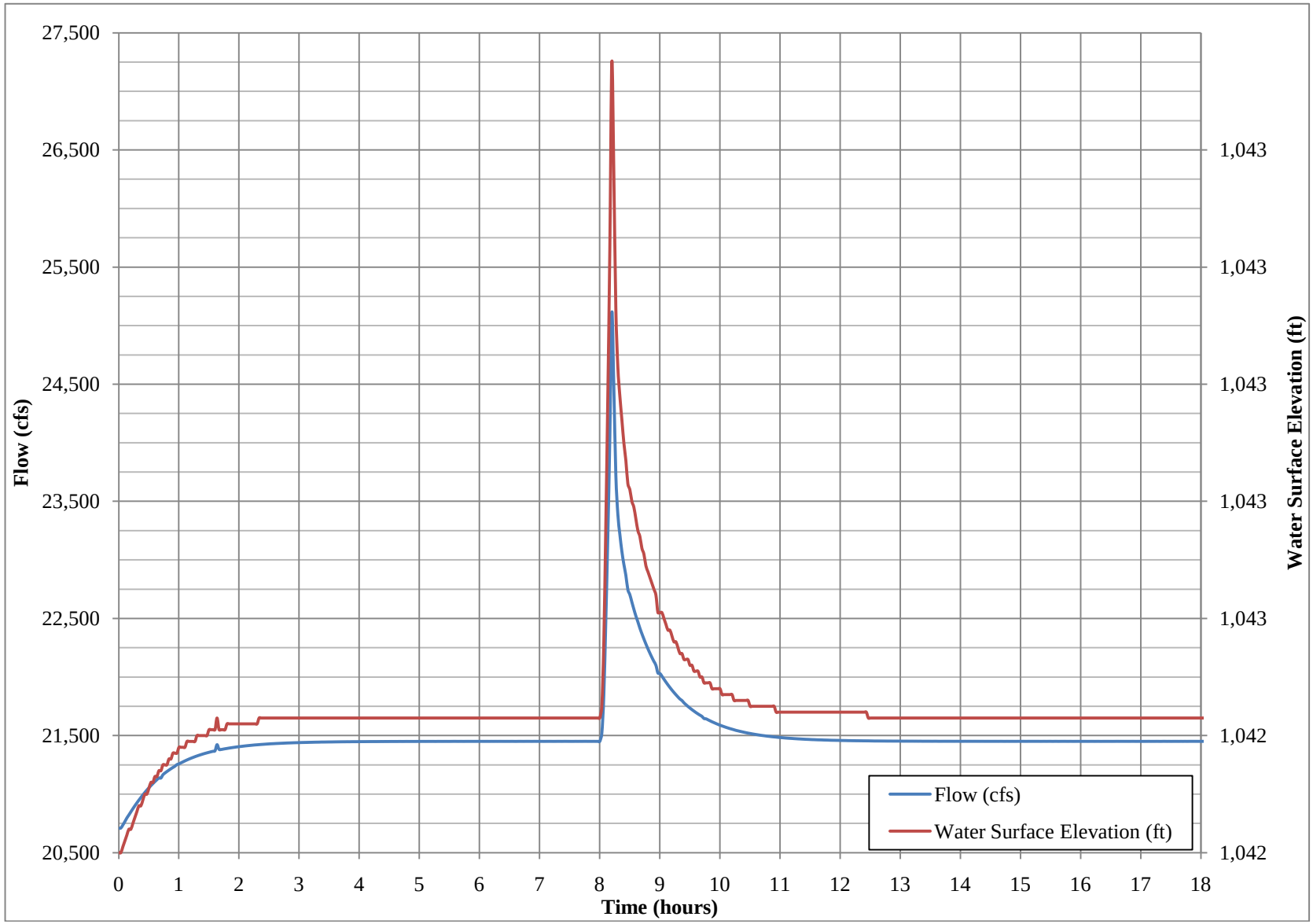

FIGURE 2 – FLOW HYDROGRAPH AND STAGE UPSTREAM OF HAWKINSVILLE ROAD BRIDGE