Shoreline Stability Assessment Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

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Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Acronyms

AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
FERC or Commission	Federal Energy Regulatory Commission
ft	foot/feet
ILP	Integrated Licensing Process
ISR	Initial Study Report
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement
Project	Byllesby-Buck Hydroelectric Project
RM	river miles
RSP	Revised Study Plan
SPD	Study Plan Determination
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
WVDEP	West Virginia Department of Environmental Protection

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Byllesby Development is located about 9 miles north of the city of Galax, and the Buck Development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. In accordance with FERC's regulations at 18 CFR §16.9(b), the licensee must file its final application for a new license with FERC no later than February 28, 2022.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 18, 2021. Appalachian conducted a virtual ISR Meeting on January 28, 2021 and filed the ISR Meeting summary with the Commission on February 12, 2021. Stakeholders provided written comments in response to Appalachian's filing of the ISR meeting summary, which are addressed in this Updated Study Report (USR) along with study methods and results.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This USR describes the methods and results of the Shoreline Stability Assessment conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goals and objectives of the Shoreline Stability Assessment are to:

- Survey the Project's reservoirs, bypass reaches, and tailrace areas to characterize the shoreline, with the focus on erosion or shoreline instability using the Bank Erosion Hazard Index (BEHI) (Rosgen 2001; WVDEP 2015);
- Inventory, map, and document any areas of erosion or shoreline instability; and
- Prioritize any areas where remedial action or further assessment may be needed.

3 Study Area

The study area for the Shoreline Stability Assessment includes the riparian zone on each bank of the upper New River and lowermost tributary segments of Crooked Creek and Chestnut Creek and extends 3.4 miles upstream of Byllesby Dam and 1.15 miles downstream of Buck Dam, including 2.7 miles of the New River in between the two dams. The study area is located in the easternmost portion of the Mt. Rogers National Recreation area and the New River Trail State Park is also situated within the study area on the western streambank (Figure 1).

4 Background and Existing Information

Existing relevant and reasonably available information regarding geology and soils in the Project vicinity is presented in Section 5.2 of the Pre-Application Document (PAD) (Appalachian 2019). The New River within the vicinity of the Project has carved moderately steep valley walls, ranging in heights of 50 to several hundred feet (FERC 1994). Soils along the Project shoreline largely consist of steep, stony Ramsey soil or quartzite rock. Established vegetative cover is extensive along the shorelines of the Project reservoirs, which helps limit the extent and severity of erosion and movement of soils in the study area. Common causes of normal bank/shoreline erosion include wave action, significant changes in water levels, rill/gullies, bank rotation, and seepage/frost wedge.

Accumulation of sediment along some portions of the Project shoreline has formed permanent riparian wetland communities, providing additional protection against shoreline erosion. Areas of shoreline erosion are mainly concentrated in areas absent of vegetation or in areas susceptible to high flows during run-off events, such as the transition areas between riverine and reservoir at the upper limits of the study area, the rapids between the dams and the tailrace below Buck Dam, and in the larger tributaries such as Crooked Creek and Chestnut Creek.

Remediation options for areas of localized erosion commonly include adding protection in the form of new or additional rip rap, encouraging vegetation growth in areas where vegetation is sparse or absent, and reducing the angle of existing bank slopes in areas where additional space is available. Banks lacking vegetation may be planted with native species, which provides stability over time at a relatively low cost. This can be achieved with live-staking, brush-layering, and/or brush matting. Erosion control matting and seeding may also be used. In areas where the stream is heavily incised or undercut, regrading may be required to create gentler slopes and/or hard armoring. If hard armoring is necessary, ideally it will be used in conjunction with vegetative methods such as vegetated rip rap (joint planting), vegetated gabion walls, vegetated gabion mattresses, and/or live cribbing (NRPC 2004). Preferred methods to remediate sections of the Project shoreline, if needed, would ideally mimic natural conditions, if possible (USDA-NRCS 1996; NRPC 2004).

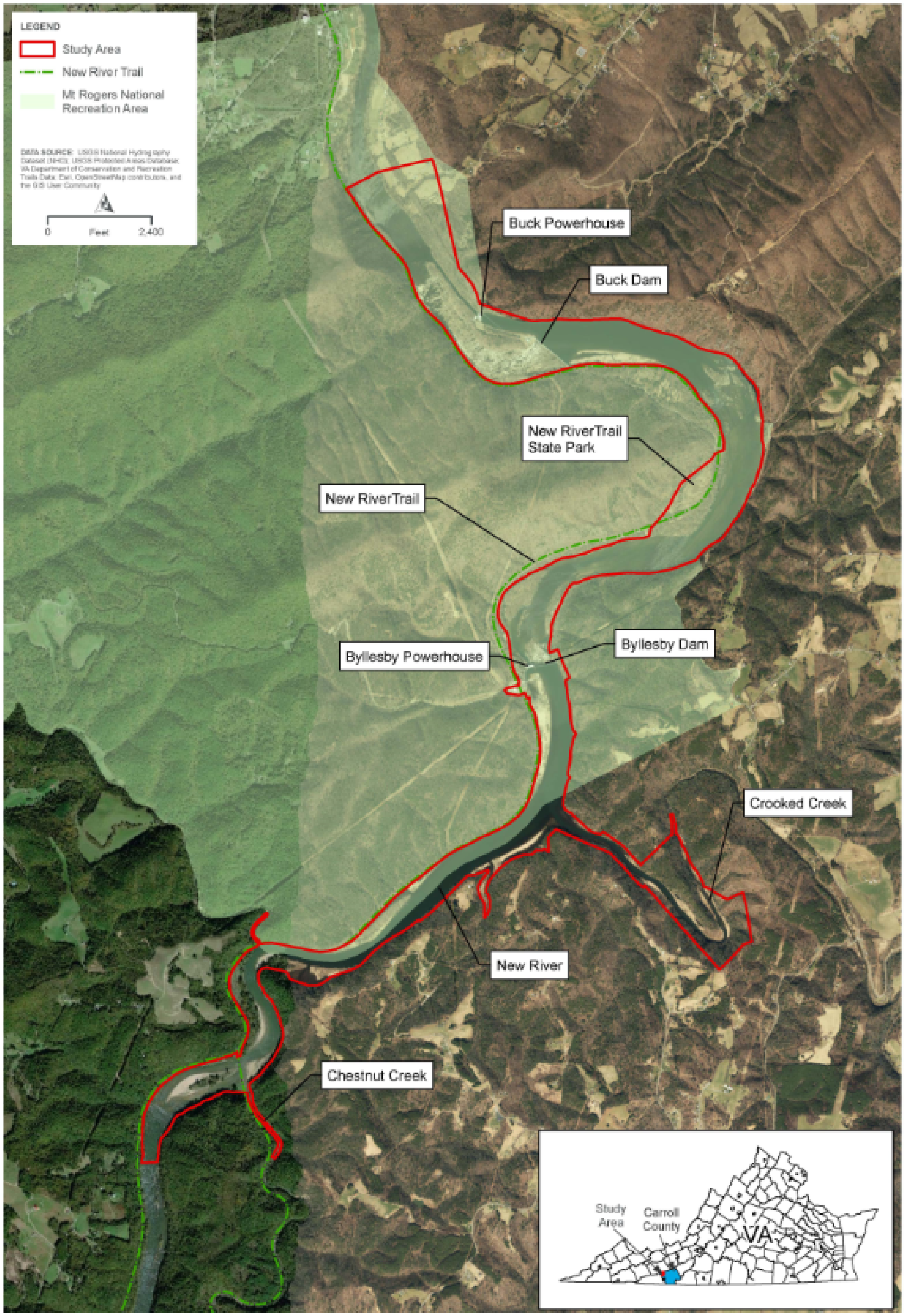

Figure 1. Byllesby-Buck Shoreline Stability Assessment Study Area

5 Methodology

The Shoreline Stability Assessment was performed as a desktop analysis followed by field confirmation of shoreline areas within the study area, including the reservoir, bypass reach, and tailrace areas identified in the desktop analysis as requiring confirmation or additional investigation. The shoreline was assessed in the field for susceptibility to erosion and the need and potential for remediation. The study methods provide adequate information to assess shoreline-erosion effects by Project operations.

5.1 Literature Review

Relevant literature and data were reviewed including ESRI Geographic Information System data, Virginia Geographic Information Network aerial photos, U.S. Geological Survey (USGS) topographic maps, and Natural Resources Conservation Service (NRCS) soil surveys to assess bank composition and erosion potential in the study area.

5.2 Shoreline Survey

The field surveys for the Shoreline Stability Assessment were conducted on July 20-22, 2021. Streambanks were assessed based on visual observations by two, two-person field crews either by canoe or walking along the streambanks. Best professional judgement was used to estimate root depths and density since bank materials were not disturbed or removed during the study.

Rivers are dynamic systems and streambank erosion is a natural function of flow, streambank character (i.e., erodibility), and hydraulic/gravitational forces (Rosgen 2001). Some streambank erosion is normal and necessary to maintain habitat and the dynamic equilibrium of a river system; however, excessive streambank erosion can negatively impact the function of a river and the complexity of predicting streambank erosion rates has limited the application of available models. Bank stability and erosion potential for this study effort was analyzed using the Rosgen (2001) BEHI method and the West Virginia Department of Environmental Protection (WVDEP) complete BEHI procedure (WVDEP 2015). The BEHI method assesses physical and geomorphic properties of the streambank to validate the probable sources of bank instability using streambank variables. The metrics used to estimate BEHI include ratio of bank height to bankfull height (BH), ratio of root depth to bank height (RDH), root density percentage (RD), surface protection percentage (SP), and bank angle in degrees (BA) (WVDEP 2015) (see Table 1). These metrics are associated with scores and are totaled to categorize the overall condition of the stream reach assessed. The scores and corresponding categories are shown in Table 2. Note that the BEHI total score is calculated using scores assigned to five separate physical processes/conditions determined in the field. Field assessments were carried out by HDR field scientists with Rosgen-based training; however, certain criteria in the field (e.g., location of bankfull elevation) may vary slightly between field assessors and results can be subject to user bias. The assignment of streambanks into Rosgen categories is a quantitative process, however, the category assigned to a specific reach (i.e., “high”, “moderate”) should be considered in the context of all other factors that contributed to that score. For example, four out of the five factors for an assessed streambank may yield a favorable score/category (i.e., “low”), however, because that particular stream bank had a type of vegetation prone to shallow root depth, that one variable alone could drive the score up into the higher category. Therefore, nomencla ture such as "high" or "very high" can be misleading; it is important to consider all of the variables that yielded a specific score.

Table 1. Description of Rosgen (2001) Metrics for BEHI Evaluation

Metric	Description
Ratio of bank height to bankfull height	Requires accurate identification of bankfull indicators.
Ratio of root depth to bank height	Root depth (RDH) is the ratio of the average plant root depth to the bank height, expressed as a percent (e.g. roots extending 2 feet into a 4 foot tall bank = 0.50).
Root density	Root density (RD), expressed as a percent, is the proportion of the streambank surface covered (and protected) by plant roots (e.g. a bank whose slope is half covered with roots = 50 percent).
Surface Protection	Surface protection (SP) is the percentage of the stream bank covered (and therefore protected) by plant roots, downed logs, branches, rocks, etc. In many streams surface protection and root density are synonymous.
Bank Angle	Bank angle (BA) is the angle of the lower bank – the bank from the waterline at base flow to the top of the bank, as opposed to benches that are higher on the floodplain. Bank angles great than 90 percent occur on undercut banks. Bank angle can be measured with an inclinometer, though given the broad bank angle categories, visual estimates are generally sufficient. Bank angle is perhaps the metric most often estimated incorrectly.

Table 2. Streambank Characteristics used to develop BEHI (Rosgen 2001)

BEHI Category	Bank height	BH Score	Root Depth	RDH Score	Root Density	RD Score	Surface Protection	SP Score	Bank Angle	BA Score	Total Score
V. low	1.0-1.1	1.45	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤7.25
Low	1.1-1.2	2.95	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	7.26-14.75
Moderate	1.3-1.5	4.95	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	14.76-24.75
High	1.6-2.0	6.95	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	24.76-34.75
V. high	2.1-2.8	8.5	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	34.76-42.50
Extreme	>2.8	10	<5	10	<5	10	<14	10	>119	10	42.51-50

6 Study Results

6.1 Literature Review

According to the NRCS soil survey, soils along the banks of the upper New River consist primarily of quartzite (Rr); Ramsey very stony loam, steep and very steep (RmE and RmF); Hatboro silt loam (Ha); and Buncombe loamy fine sand (Bu) (Figure 2). The streambanks are generally steep wherever bedrock or Ramsey very stony loam occur. Hatboro silt loam ad Buncombe loamy fine sand are located on relatively flat surfaces adjacent to the New River. Shoreline consisting of bedrock has a low susceptibility to erosion; however, loose material found on steeper slopes or loose fine material in floodplains are likely to exhibit some degree of erosion.

A study was carried out for the Claytor Project relicensing (Appalachian 2008) which evaluated shoreline erosion along the banks of the Claytor reservoir (Appalachian 2008). Results of this study indicated that the run-of river Byllesby-Buck reservoirs have little retention capacity and suspended sediments are carried downstream to the Claytor Project. Further, upon examination of the Claytor reservoir shorelines, which are similar in soil/rock character and vegetation to the shorelines of the Byllesby and Buck development reservoirs, shoreline erosion was not found to be significant.

The entire western streambank of the New River within the study area is bordered by New River Trail and Buck Dam Road. Additionally, approximately a half mile of the east bank is abutted by Fowlers Ferry Road. The portions of shoreline in close proximity to the road may be impacted by human activity.

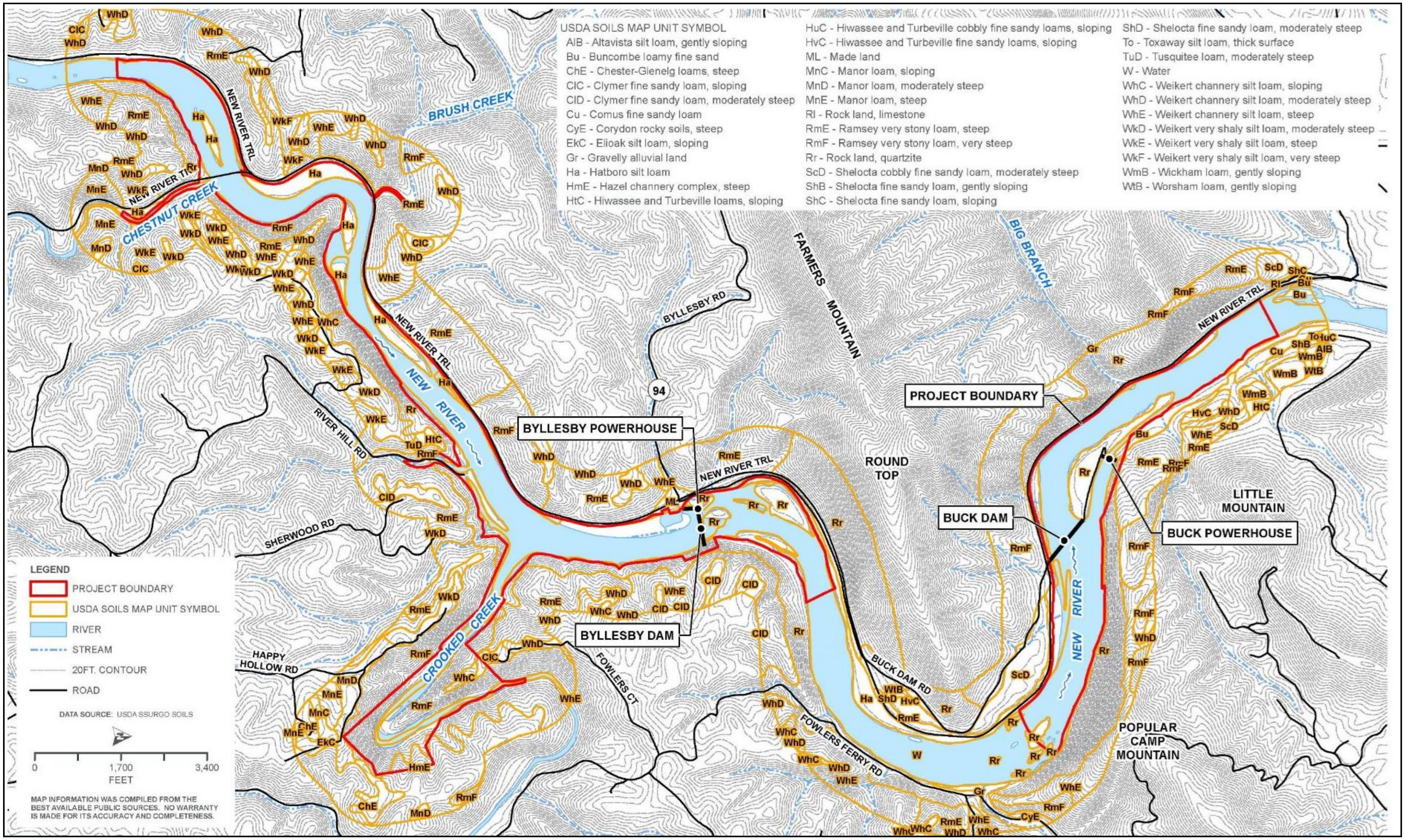

Figure 2. Byllesby-Buck Shoreline Stability Assessment Soil Map

6.2 Shoreline Survey

Of the approximately 7.25 miles of New River shoreline assessed, results of the field investigation indicated that approximately 80 percent of the shoreline within the study area exhibited no signs of erosion. The areas identified as having some degree of shoreline erosion had average BEHI scores ranging from 11.75 (low) to 33.85 (high). There were no areas categorized as having very high or extreme erosion potential. Where erosion was noted, coordinates were recorded on the upstream and downstream extent of the erosion area, and in between, if necessary. Individual points within each area of erosion fell into the same total category (i.e., extreme, very high, high, moderate, low, very low). The average scores for each area of erosion are provided in Table 3. Figure 3 shows the locations of the erosion areas assessed within the study area.

The majority of the banks with some level of visible erosion had moderate root depth, low to moderate surface protection, and moderate to high bank angle. Generally, banks adjacent to the Jefferson National Forest exhibiting significant incision were least stable. High erosion potential was observed in Erosion Areas 1 and 2 on the west bank just north of Byllesby Powerhouse (Figure 3). High erosion potential was also observed in Erosion Areas 4, 5, and 6 along the west bank north of Areas 1 and 2. Erosion Area 3 immediately to the north of Erosion Areas 1 and 2 had moderate erosion potential. Erosion Area 9 on the east bank across from Area 2 also exhibited high erosion potential. Streambanks to the north near Buck Powerhouse and to the southeast near Crooked Creek were categorized as having moderate erosion potential and Erosion Area 15 exhibited low erosion potential.

Bank conditions were documented and representative photographs from each erosion area are provided in Attachment 1.

Table 3. BEHI Scores for Erosion Areas of Shoreline Stability Assessment

Erosion Area	Length (linear ft)	Average of BH Score	Average of RDH Score	Average of RD Score	Average of SP Score	Average of BA Score	Average of Total Score by Category	Category
Erosion Area 1	286	2.95	6.95	6.95	6.95	4.95	28.75	High
Erosion Area 2	92	4.95	8.50	8.50	6.95	4.95	33.85	High
Erosion Area 3	199	4.95	2.95	4.95	4.95	4.95	22.75	Moderate
Erosion Area 4	3,006	4.95	6.95	4.95	1.45	6.95	25.25	High
Erosion Area 5	423	6.95	4.95	6.95	2.95	4.95	26.75	High
Erosion Area 6	508	6.95	4.95	6.95	2.95	4.95	26.75	High
Erosion Area 7	190	4.95	4.95	4.95	2.95	6.95	24.75	Moderate
Erosion Area 8	141	4.95	4.95	4.95	2.95	6.95	24.75	Moderate
Erosion Area 9	92	6.95	4.95	4.95	4.95	6.95	28.75	High
Erosion Area 10	107	4.95	4.95	2.95	4.95	6.95	24.75	Moderate
Erosion Area 11	295	4.95	4.95	2.95	4.95	6.95	24.75	Moderate
Erosion Area 12	261	1.45	4.95	2.95	4.95	6.95	21.25	Moderate
Erosion Area 13	215	4.95	4.95	2.95	4.95	6.95	24.75	Moderate
Erosion Area 14	1,587	1.45	4.95	2.95	4.95	6.95	21.25	Moderate
Erosion Area 15	1,550	1.45	2.95	1.45	2.95	2.95	11.75	Low

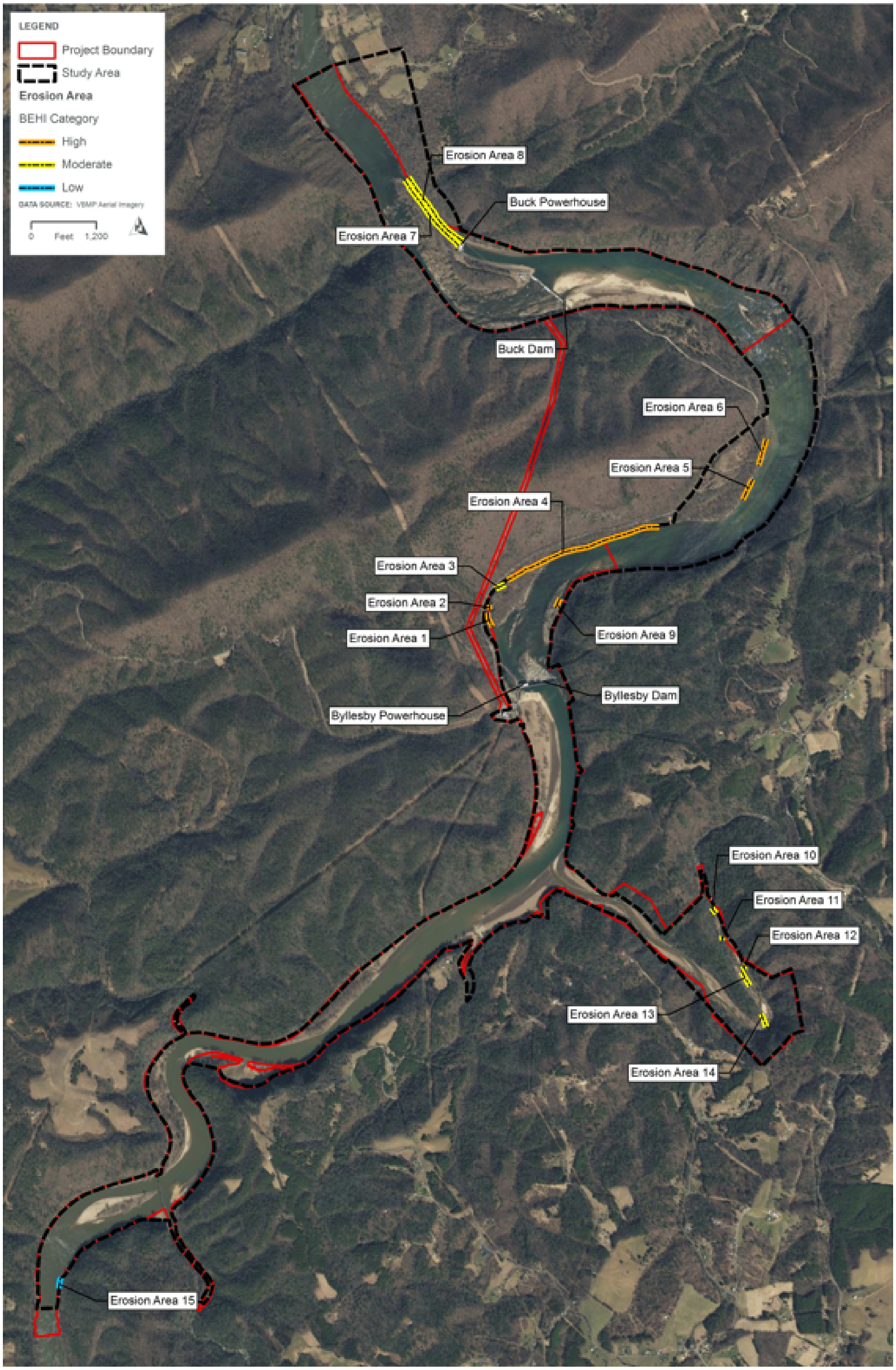

Figure 3. Erosion Areas in the Study Area Categorized by BEHI

7 Summary and Discussion

The Shoreline Stability Assessment provides an evaluation of the relative erosion hazard of 7.25 miles of New River shoreline based on the observed bank conditions. Study results indicated that approximately 80 percent of the shoreline within the study area exhibited no signs of erosion, with remaining areas ranging from “low” to “high” BEHI scores based on Rosgen’s (2001) methods (refer to categories listed in Table 2) under present conditions. Erosion Areas 1,2,4 and 9, downstream of Byllesby Dam, are the most susceptible to erosion. Erosion Areas 1 and 2, which scored “high”, are adjacent to the New River Trail State Park. Erosion Area 4 comprises one large area that was classified as “high” erosion potential; this area is also adjacent to New River Trail State Park, but the multi-use trail and road are farther from the river at these locations. Just downstream of Area 4, Areas 5 and 6 also scored “high”; these areas are farther away from the New River Trail State Park.

Under the new license term, Appalachian proposes to continue operating the Byllesby and Buck developments as they are presently operated, including run-of-river operations and maintenance of existing vegetated and buffer areas. Soils along the Project shorelines largely consist of steep to very steep, very stony Ramsey soil or quartzite rock. Because much of the shoreline is exposed bedrock, the limited extent and total thickness of soils limits the depth of erosion and slips, and such areas are expected to be limited to areas where vegetation cover is absent. Established vegetative cover is extensive along the shorelines of the Project, which helps to limit the extent and severity of erosion and movement of soils in the Project area that otherwise have higher erosion potential. Additionally, accumulation of sediment along some portions of the Project shorelines has formed permanent riparian wetland communities, providing additional protection against shoreline erosion.

It is important to note that streambank erosion is often a symptom of larger, more complex problems in the watershed and long-term solutions often involve much more than bank stabilization. Streambank erosion is a normal physical process in a river system and drivers of erosion are often difficult to determine because they are integrated with other natural and anthropogenic variables and responses within the watershed. Streambed aggradation or degradation is typically a noticeable indicator of system-wide stream channel instability. Overall, visual inspection of the Project shoreline during this study indicated stable banks, no noticeable aggradation/degradation, and only localized streambank erosion, which is an important process in maintaining habitat for aquatic resources. Appalachian does not, therefore, propose remediation of any shoreline areas in the Project Boundary or study area at this time.

8 Variances from FERC-Approved Study Plan

This study was performed in accordance with the FERC-approved Study Plan.

9 Germane Correspondence and Consultation

No consultation with state or federal agencies was undertaken for this USR.

10 References

Appalachian Power Company (Appalachian). 2019. Pre-Application Document Byllesby-Buck Hydroelectric Project FERC No. 2514. January 2019.

Federal Energy Regulatory Commission (FERC). 1994. Final Environmental Assessment, Byllesby-Buck Hydroelectric Project, FERC No. 2514-003, Virginia. March 15, 1994.

Northwest Regional Planning Commission (NRPC). 2004. The Shoreline Stabilization Handbook. St. Albans, Vermont. Available at https://6eade072-06b3-4cb0-b552-9093f98282cd.filesusr.com/ugd/cf375c_3e5165613c4c4c7f9588ad6d4636f06f.pdf

Rosgen, David L. 2001. A Practical Method of Computing Streambank Erosion Rate. 7th Federal Interagency Sediment Conference, March 25-29, Reno, Nevada.

United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS).1996. Engineering Field Handbook Chapter 16 Streambank and Shoreline Protection. Available at https://efotg.sc.egov.usda.gov/references/public/IA/Chapter-16_Streambank_and_Shoreline_Protection.pdf

West Virginia Department of Environmental Protection (WVDEP). 2015. Assessing Bank Erosion Potential Using Rosgen's Bank Erosion Hazard Index (BEHI) Available at https://dep.wv.gov/WWE/getinvolved/sos/Documents/SOPs/BEHI-Overview.pdf

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Attachment 1

Attachment 1 – Erosion Area Photographs

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Erosion Area 1; Category "High"

Erosion Area 2; Category "High"

Erosion Area 3; Category "Moderate"

Erosion Area 4; Category "High"

Erosion Area 5; Category "High"

Erosion Area 6; Category "High"

Erosion Area 7; Category "Moderate"

Erosion Area 8; Category "Moderate"

Erosion Area 9; Category "High"

Erosion Area 10; Category "Moderate"

Erosion Area 11; Category "Moderate"

Erosion Area 12; Category "Moderate"

Erosion Area 13; Category "Moderate"

Erosion Area 14; Category "Moderate"

Erosion Area 15; Category "Low"