APPENDIX J

STUDY REPORTS

Scott's Mill Hydropower Project

FERC Project No. 14867

APPENDIX J

STUDY REPORTS

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PRE- AND POST-PROJECT WATER LEVELS UPSTREAM AND DOWNSTREAM OF SCOTT'S MILL DAM
SCOTT'S MILL HYDROPOWER PROJECT
(FERC No. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

1.1 Background

The Scott's Mill Hydroelectric Project is located on the upper James River at river-mile 260 in Bedford and Amherst Counties, Virginia and lies within the City of Lynchburg, Virginia. The Project is approximately half a mile north-northeast of downtown Lynchburg. The existing Scott's Mill Dam was constructed in the 1840s. A 3.6-mile long pool extends upstream of the dam to the next dam upriver, Reusens Dam (FERC No. 2376). Several islands lie within the Scott's Mill Dam pool, including Daniel Island, Treasure Island and Woodruff Island. Harris Creek enters the James River from the north near Treasure Island. The nearest U.S. Geological Survey guage is at Holcomb Rock (Station No. 02025500), approximately 11 miles upstream of Scott's Mill Dam (the "Holcomb Rock Gage"). The total drainage area at the Holcomb Rock Gage is 3,256 square miles, representing about one third of the drainage of the James River Basin.
The global positioning system (GPS) location of the Project is 37.424466 N, -79.140858 W.

1.2 Project Description

The Scott's Mill arch dam was constructed between 1830 and 1840 and the Scott's Mill dam in the 1840s. From left to right looking downstream, the left overflow spillway is a 735-foot-long by 15-foot-high masonry construction with a crest elevation of 514.4 feet (NAVD 88). There is a stone pier (old fishway) between the spillway and arch sections of the dam that is 25 feet wide. The right overflow spillway (arch section) is a 140-foot-long by 16-foot-high masonry construction with a crest elevation of 514.8 feet. The right abutment is 36 feet wide and constructed of concrete. To the west of the abutment is a 22-foot side canal head gate (water works) structure with three sluice gates each measuring 3 feet by 3 feet.

The proposed facilities would consist of the following: (1) a new modular powerhouse containing nine generating units with a total installed capacity of 4.5 MW; (2) a new 1200-foot-long underground transmission line; and (3) appurtenant facilities, which include the addition of a 2-foot high concrete cap onto the existing spillway. The project would have an estimated annual generation of approximately 20,700 MWh.

The Scott's Mill Hydropower Project will be run-of-river. The 2-foot high concrete cap and reduced spillway length (because of the construction of the powerhouse at the location of the arch dam) has the potential to affect upstream water levels. Under existing conditions, water levels immediately upstream of the dam are a function of the James River discharge and the efficiency of how the Scott's Mill Dam passes the discharge. The head (or water level over the dam) can be estimated using the weir equation: $Q=C*L*H^{1.5}$ where Q is the James River discharge in cubic feet per second (cfs), C is a coefficient which is typically about 3.3 but could vary from as low 2 (typically at a very low flow) to 4, L is the spillway or dam crest length (feet), and H is the head (feet) or water level above the dam crest.

The spillway length is 875 feet with the left side being 735 feet long with a crest elevation of 514.4 feet and the right spillway is 140 feet long with a crest elevation of 514.8 feet[1]. Using a coefficient

[1] Based on survey by Hurt and Proffitt.

of 3.5, for a one foot head (i.e., water level of 515.4 feet), flow over the dam would be 2,800 cfs.[2] Table 1 below illustrates the relationship between upstream water levels and James River flows assuming steady state flow conditions.

Table 1 – James River Discharge and Upstream Water Level Relationship

Head (ft)	Water Elevation (ft)	Discharge (cfs)
0	514.4	0
0.5	514.9	925
0.75	515.15	1,770
1	515.4	2,800
1.5	515.9	5,290
2	516.4	8,270
2.5	516.9	11,660
3	517.4	15,420
3.5	517.9	19,520
4	518.4	23,930
5	519.4	33,600
6	520.4	44,300
7	521.4	56,000
8	522.4	68,000
9	523.4	82,000
10	524.4	96,000

1.3 Study Plan Objectives

The purpose of the proposed study is to develop relationships between upstream water levels and flow (i.e., verify the coefficient of discharge), tailwater level and flow, and determine upstream water levels during project operations with a two-foot cap. This information will also enable Scott's Mill accurately calculate project energy generation under different flow conditions to estimate annual energy production. The information will also be used to determine changes in flow patterns from project operation.

Water level changes will be used in part to determine water quality effects, fish habitat effects, wetlands effects, associated impacts on terrestrial species, and cultural resources effects. The impact information will be used to minimize impacts to water quality, fishery and terrestrial resources.

2. METHODS

2.1 Methods

Scott's Mill LLC placed staff gauges on both sides of the James River upstream and downstream of Scott's Mill Dam. Two, four-feet high gauges were placed on the left side of the river (north side): the upstream gauge was placed on the dam abutment just upstream of the spillway and the downstream gauge was located about 100 feet downstream of the spillway near the left bank. The

[2] Based on preliminary measurements with a head of 0.75 feet, C=3.5.

bottom elevation of the upstream gauge was approximately dam crest height in order to capture water levels at the lowest flows and moderately high discharges up to about 23,000 cfs. The downstream gauge was similarly placed on the left bank so that the zero point captured the water level during the low summer flows. Two gauges were placed on the right bank (south side) about 50 feet upstream of the arch section of the dam. One gauge had the zero point at about the dam crest elevation to measure low summer flows. The second 4-foot high gauge was placed higher on the bank with the zero point just below the four-foot level of the first gauge to provide a continuous record of water levels over about an 8-foot range. The gauges were to cover water levels from very low flows to flood flows of about 68,000 cfs. The two downstream gauges were placed on the right bank approximately 100 feet downstream of the arch section of the dam in the vicinity of the proposed tailrace. There was a similar overlap in gauge heights to span about an 8-foot range in tailwater levels.

Unfortunately, due to extremely high water/ flooding events multiple gauges were knocked down or lost. Additionally, the gauges located on the right bank (non-River Road side) were extremely difficult to access due to property access issues. As a result of this, complete information was not available from all gauges that were placed. Additionally, the majority of the data collected came from the left side of the river (River Road side) since easier access for data collection was available.

The gauge elevations were surveyed by a registered land surveyor to accurately identify the head differential from upstream to downstream and across the James River. The surveyor also measured water levels immediately downstream of Reusens Dam and at an intermediate point between Reusens and Scott's Mill to determine the hydraulic gradient in the headpond. The gauges were read manually and the time noted to enable correlation with the Holcomb Rock gauge. The goal being to take sufficient readings under various flow conditions to span water levels from flood conditions to low water. The water levels were used to verify the coefficient of discharge for the dam. Periodic measurements of the gauge located near the 7th street boat ramp were also taken to assist in the overall understanding of streamflow downstream of Scott's Mill dam.

3. RESULTS AND DISCUSSION

3.1 Results

Observations at a discharge of about 1,700 cfs indicated that downstream of Scott's Mill Dam, there is lateral flow from the right bank towards the left bank in the vicinity of the arch section of the dam. This indicates that the tailwater on the right side of the river is be somewhat higher than the left side and flow from the turbines can be discharged towards the main channel.

Upstream of Scott's Mill Dam, initial velocity measurements taken in April 2016 at a flow of about 1,700 cfs were on the order of 1/4 foot per second, indicating that there is little or no differential in water levels across the river on the upstream side of Scott's Mill dam during average or below average discharges.

Table 2 below provides the results of the gauge readings for flows up to 25,100 cfs. In comparing the water levels in Tables 1 and 2 for similar flows, the weir equation under predicts water levels at flows less than 2,000 cfs by about 0.3 to 0.4 feet. This suggests that the coefficient of discharge for low flows is on the order of 1.5 to 2 for flows of 900 and 1700

cfs. However, for flows between 8,000 and 25,000 cfs, the coefficient is about 3.5. Between 2,000 cfs and 8,000 cfs the coefficient gradually increases. For flows above, 25,000 cfs, the coefficient likewise gradually increases. However, to be on the conservative side since the actually coefficient is unknow, but is likely less than 4, Scott's Mill assumes a constant coefficient above 25,000 cfs.

Since the 2-foot cap will maintain water levels at just above the crest elevation (i/e., about ¼ inch to provide a veil over the dam during project operations), the maximum water level will be maintained at 516.4 feet until the hydraulic capacity of the project is exceeded. Table 2 also shows the upstream water level difference (US WL DIFF) between pre-and post-project conditions. This differential varies from 1.2 feet for the very low flows to 0.3 feet at the maximum hydraulic capacity of 4,500 cfs.

At inflows above 4,500 cfs, during project operations water will begin flowing over the concrete cap. Upstream water levels have been calculated in Table 2 with the reduced spillway width of 735 feet based on the weir formula. For flows of 4,800 cfs to 25,100 cfs, the water level differential increases to a maximum of 2.5 feet just before plant shut down due to high water. All calculations are based on a coefficient of 3.5. For total flows over 11,000 cfs this is a reasonable assumption and for flows less than 11,000 cfs, water levels may be slightly higher due to a lower coefficient.

For existing condition flows above 25,100 cfs, Scott's Mill relied on water levels obtained from a flood study conducted by FEMA, although Scott's Mill did observe one flow over 40,000[3]. For post-project conditions, upstream water levels were calculated based on the weir equation, assuming a coefficient of 3.5. Since the weir equation is likely greater than 3.5, the predicted water levels would be lower. Further, flows over the powerhouse are not taken into account and this would likely have a water level reduction effect. Thus, the differential would be lower than presented in the table. At the 100-year flood level and above, there is essentially no difference in pre-and post-project water levels because the dam is no longer a control point.

Table 2 – Comparison of Pre- and Post-Project Water Levels

FLOW (cfs)	EXIST HW ELEV (ft)	TW ELEV (ft)	MAX OP US WL (ft)	US WL DIFF (ft)
700	515.2	499.4	516.4	1.2
830	515.3		516,4	1.1
980	515.3		516.4	1.1
1190	515.3		516.4	1.1
1200	515.4	499.7	516.4	1.0
1440	515.4	499.8	516.4	1.0
1540	515.5	499.8	516.4	0.9
1690	515.5	500.2	516.4	0.9
1860	515.4	500.4	516.4	1.0

[3] Since this was a rapidly varying flow, it was considered unreliable and not used in the analysis.

3200	515.9	501.4	516.4	0.5	
4800	516.3	503.1	516.6	0.3	
8800	516.9	504.9	517.8	0.9	
11,700	516.8		518.4	1.6	
25,100	518.5	507.8	521.0	2.5	powerplant shut down
79,100	524.0	518.0	526.2	2.2	10 year flood from FEMA
129,300	528.0	526.0	530.0	2.0	50 year flood
159,000	532.3	532.0	532.1	0.0	100 year flood
255,000	540.0	539.0	540.0	0.0	500 year flood

Notes
1. All elevations referenced to NAVD 88.
2. Existing upstream water levels based on gauge readings. Above 25,000 cfs water levels based on FEMA analysis.
3. Tailwater levels based on measurements to 25,100 cfs. Above 25,000 cfs water levels based on FEMA analysis.
4. Operational water level maintained at or below 516.4 feet until hydraulic capacity of plant is reached (4500 cfs).
5. Operational upstream water level based weir equation Q=CLH**1.5, where Q is flow in cfs, C is coefficient (3.5),
L is spillway length in feet (735), and H is head in feet. Use FEMA level above 50 year flood.
6. Above 50 year flood backwater dominates water levels and Scott's Mill dam is no longer a control point.
Without backwater effect, estimated 500 year flood would be 2 ft below FEMA projected water level.

Table 2 also presents tailwater levels. These tailwater levels would not change during project operations.

3.2 Discussion

During project operations, the project will be operated in a run-of-river mode with constant upstream water levels until flows are at the hydraulic capacity of the powerhouse. Consequently, inflow and outflow from the Project will essentially be equal. The operators of the Scott's Mill powerhouse will monitor the flow and headpond levels, and when the river flow increases to a point that can support the addition of another unit without dropping the water level below the dam crest, a unit will be started. Conversely, units will be shut down when flow decreases to a point when flow cannot be maintained just above the crest level.

The operators at the Scott's Mill facility will have access to a live controllable video camera situated on the intake structure, which will allow them to visually monitor the headpond level and the entire crest of the dam. Additionally, a water level gauge will be situated on the right abutment of the dam which will provide headpond level relative to the crest of the dam. The level probe will provide operational input as to when it is possible to start a unit and when it is necessary to shut a unit down. The Scott's Mill facility will be operated remotely 24 hours-per-day, 7 days-per-week, and the standard operating procedure will be to review the video and water level gauge on an hourly basis. The gauge will be alarmed to alter operations if the head pond level is below the minimum veil height.

The upstream USGS gauging stations, available on the internet, basin rainfall forecasts and rainfall gauge data will also be monitored and utilized by the operators to anticipate flow changes that will be experienced at Scott's Mill over the next 24 to 48 hours. To the extent possible operations will be coordinated with the upstream Reusens Project.

Literature Cited/ References

Linsley, R. K. and Franzini, J. B., Water Resources Engineering, McGraw-Hill Publishing Company, 1992.

Federal Emergency Management Agency, Flood Insurance Study, City of Lynchburg, Virginia, June 3, 2008.

STUDY PLAN 2 REPORT
BATHYMETRIC SURVEY
OF THE
JAMES RIVER
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

1.1 Background

The Scott's Mill Hydroelectric Project would be located at the existing Scott's Mill Dam on the James River, downstream of the Reusens hydroelectric dam 147 river miles upstream from the Chesapeake Bay. The existing Scott's Mill Dam facilities include the: 1) dam, 2) reservoir, and 3) spillway. The dam is 15 feet high and 875 feet long. Additionally, the dam impounds a 316- acre reservoir, with a normal maximum water surface elevation of 516 feet MSL. The Scott's Mill Hydro Project would entail a new powerhouse containing four generating units with a total installed capacity of 4.5 MW, a new 1,200 foot-long underground transmission line, and appurtenant facilities with nine generating units. Scott's Mill Hydro will have an estimated annual generation of 20,700 megawatt-hours.

1.2 Datum

The vertical datum used during this survey is the North American Vertical Datum of 1988 (NAVD88). This same datum is used by the United States Geological Survey (USGS) is at Holcomb Rock (USGS gage no. 0202550), about 11.2 miles upstream of the Scott's Mill Dam. Elevations reported here are in feet above mean sea level. Volume and area calculations in this report are referenced to NAVD88.

2. METHODS

On April 19, 2016 a bathymetric survey of the James River was performed on two river sections: above Scott's Mill Dam (from the dam and ending just before Reusen's Dam) and downstream of Scott's Mill Dam to the mouth of Blackwater Creek). This report describes the methods used to conduct the bathymetric survey, including data collection and processing techniques. Additionally, this report includes survey results with a contour map of both surveyed areas.

The discharge at Holcomb rock during this timeframe was 1,820 cfs (cubic feet per second) and the headpond level was about 515.5 feet (or approximately 1.1 feet above the dam crest). A Humminbird Helix 9 Side Imaging GPS depth sounder with multi-frequency (83/200/455/800 kHz) dual beam technology was utilized to complete the survey. Data collection for the bathymetric survey was collected by running pre-planned range lines orientated parallel to the river channel and current.

Humminbird Autochart technology was used to create a depth contour model for the pool above Scott's Mill Dam. In addition, a contour model was also created for the area below the dam, downstream to the mouth of Blackwater Creek. Contour maps of the two areas were prepared.

3. RESULTS AND DISCUSION

Water levels immediately upstream of the main dam are shallow, gradually increasing from about 2 feet at the dam to about 8 feet 100 feet upstream (Figures 1- 4). At the lower end of Daniel Island there is an opening that connects the reach upstream of the acrch dam section to the main Channel.

Further upstream in the main channel, water levels in the center of the channel upstream to the upper third of Daniel Island vary from about 15 to 20 feet deep with some holes as deep as 25 feet. From the upper third of Daniel Island to the upstream end of Treasure Island the maximum channel depth varies from about 9 to 12 feet. From the upstream end of Treasure Island to Reusens Dam maximum channel depth varies from 6 to 12 feet. Immediately upstream of the arch section channel depths are about 8 to 10 feet. Further upstream depth varies from 6 to 12 feet.

Downstream of the main section of the dam, depths are typically 3 to 6 feet with shallower areas (boulders) encroaching on the surface, such that at low flows boaters need to be aware of the locations of these boulders. Immediately downstream of the arch section of the dam where the proposed powerplant would be located there are shallow sections with riffles about 1foot deep. However, average depth is about 3 to 6 feet in the area adjacent to the downstream island. This area is comprised of weathered bedrock and coarse gravel.

The sediment upstream of the dam appears to be in equilibrium. It is primarily comprised of silty-sand.

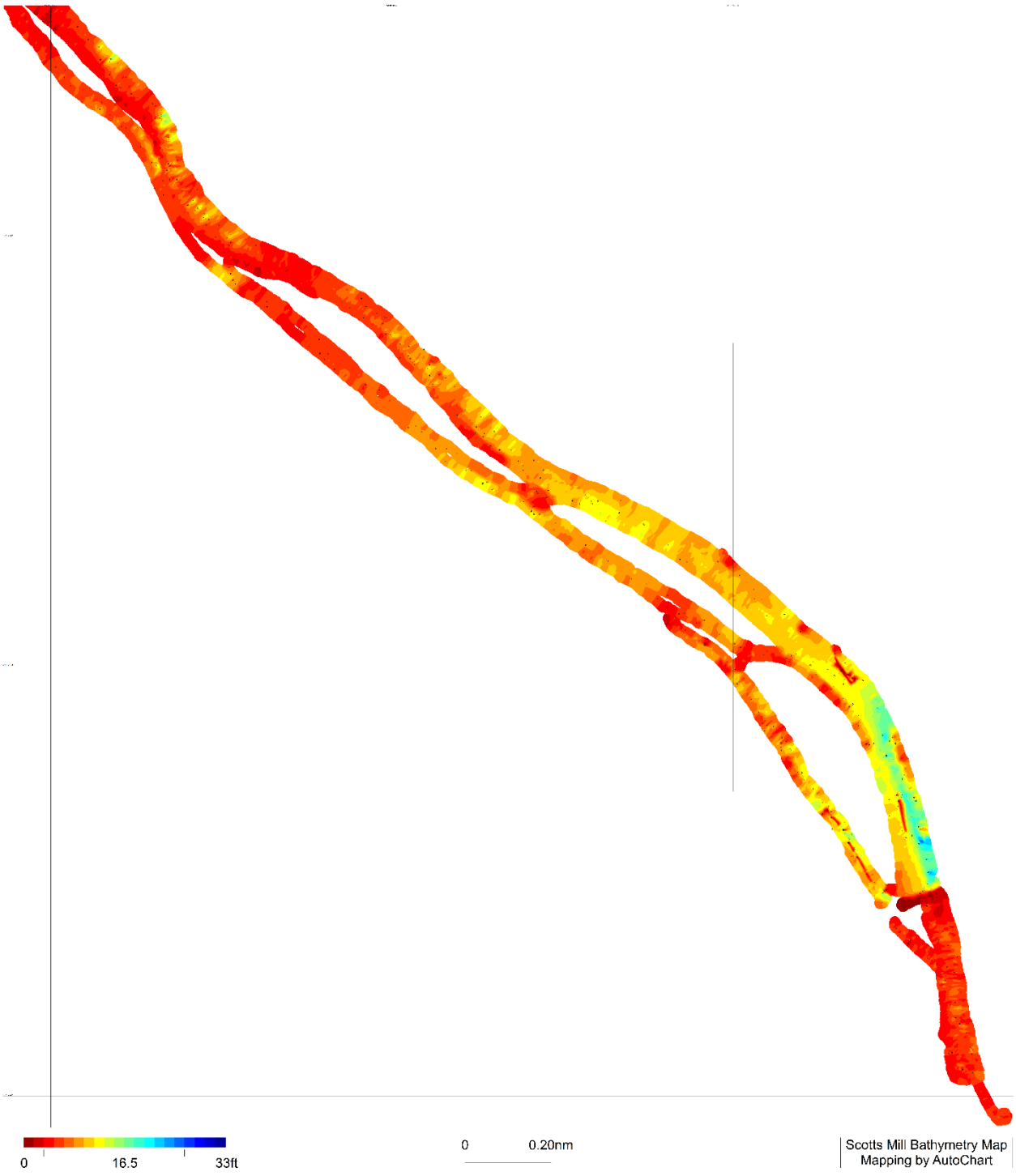


Figure 1 – Bathymetry Map

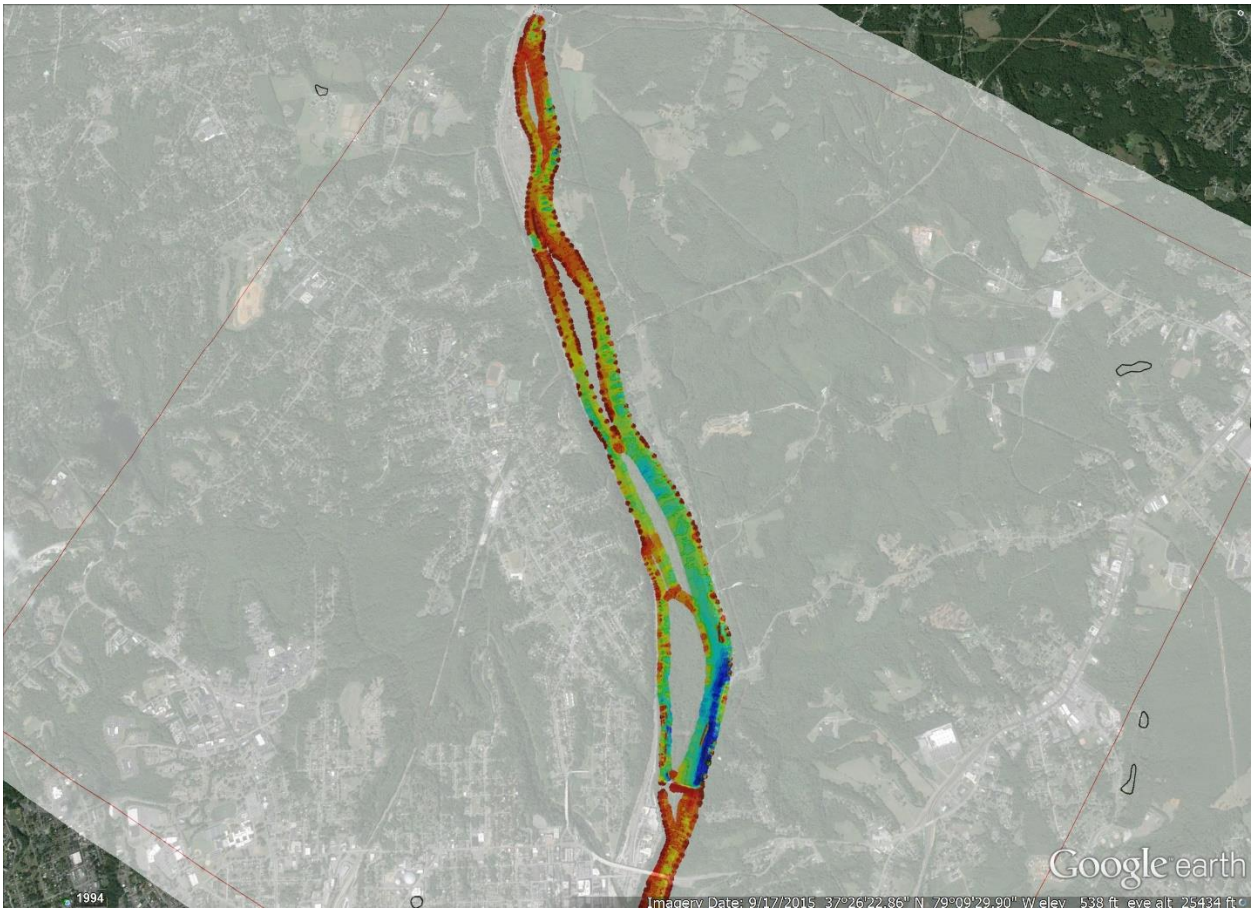


Figure 2 – Bathymetry Map

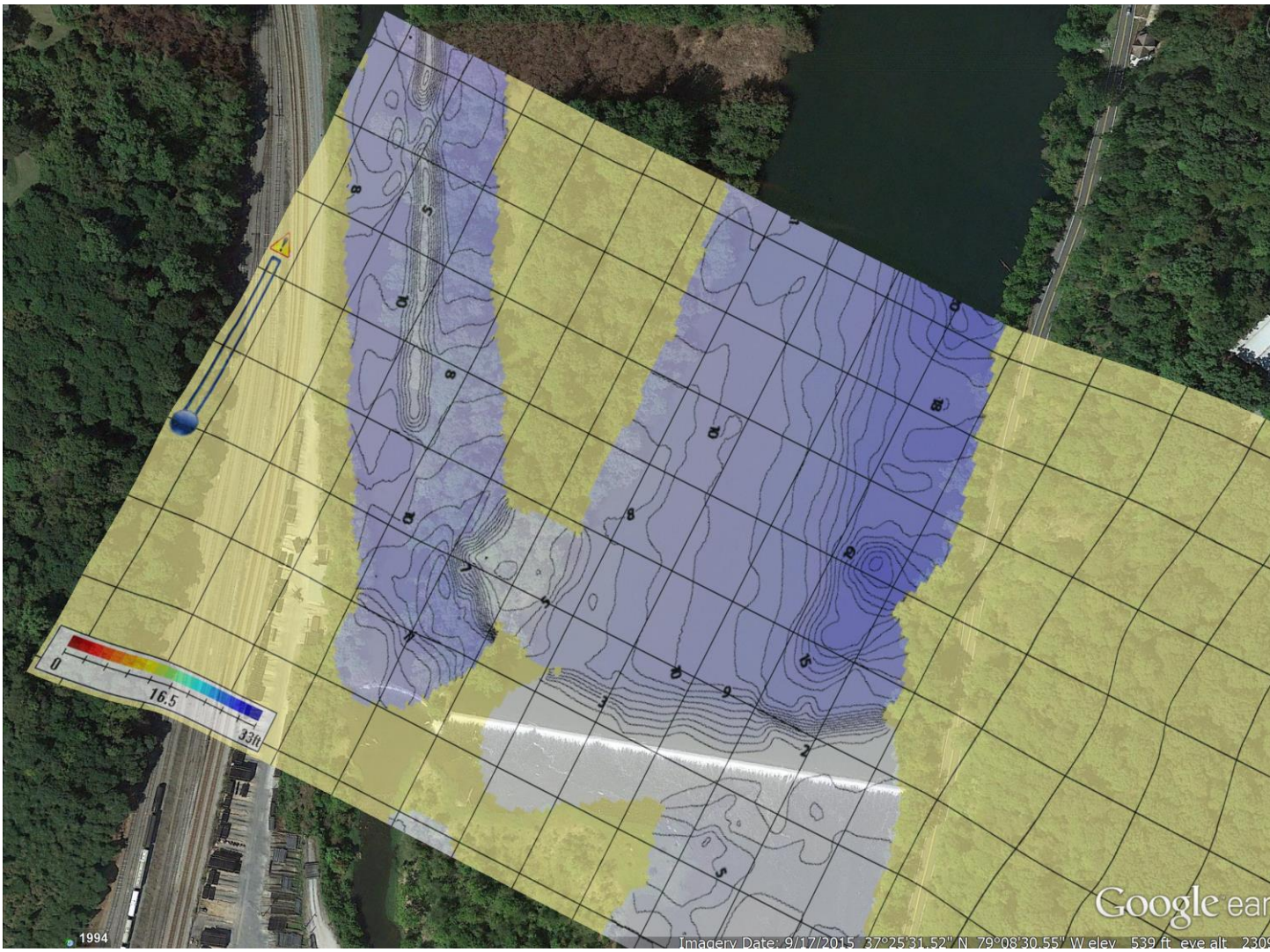


Figure 3 – Bathymetric Contours Above Scott's Mill Dam (feet)

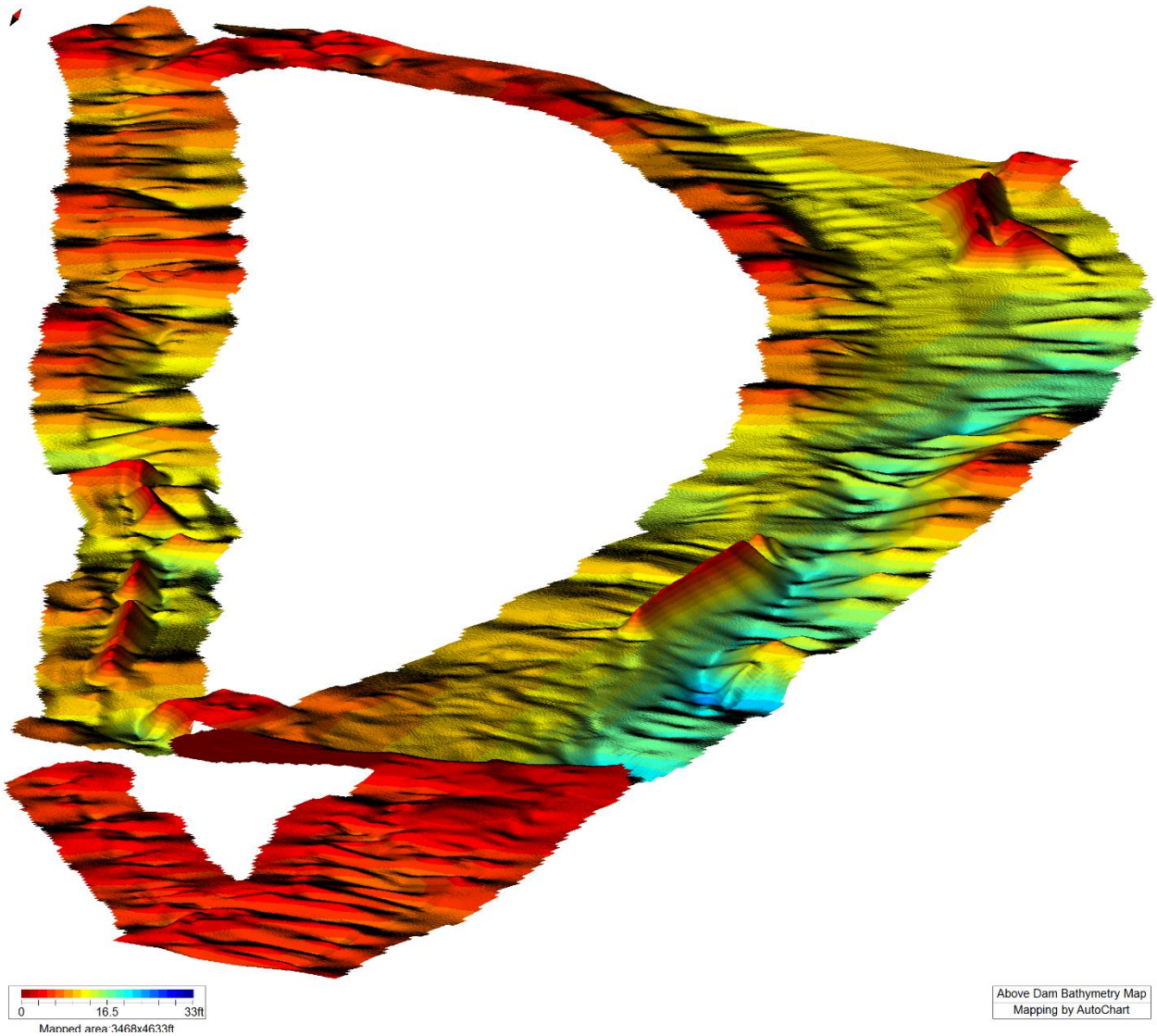


Figure 4 – Three Dimensional View of Scott's Mill Bathymetry near Dam

STUDY PLAN 3 REPORT
WATER QUALITY EFFECTS OF FLOW AND WATER LEVEL CHANGES
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION AND OBJECTIVES

Construction of the Scott's Mill Hydroelectric Project has the potential to affect water quality during both construction and operation. Because operation of the powerhouse has the potential to change flow patterns, particularly in the impoundment immediately upstream of Scott's Mill Dam and immediately downstream, Scott's Mill proposed using the water level and bathymetry data obtained during the execution of Study Plans 1 and 2, combined with the powerhouse location to assess changes in flow patterns and subsequent water quality. Resource agencies requested that water temperature and dissolved oxygen be evaluated.

Based on available existing water quality data, particularly from the downstream Percival Island water quality monitoring station, there was no need to collect additional water quality data with the exception of dissolved oxygen (DO) and temperature during low flow, summer conditions.

Scott's Mill proposed to use the information garnered in the bathymetry study and water level data obtained from staff gage measurements to predict flow patterns particularly on the north side of the James River.

2. METHODS

Scott's Mill reviewed existing maximum water temperature and minimum DO levels experienced during low flow conditions during summer and early fall. This data was augmented with in-situ measurements during late summer 2016. During 2016, the combination of low flow with hot temperatures did not occur until September.

Water temperature and DO were measured using a calibrated YSI Pro ODO meter.
A longitudinal profile of temperature and DO was measured on September 9th from Reusens Dam downstream to Scott's Mill dam and downstream of Scott's Mill Dam to the Riverside Park boat ramp. Flow was approximately 780 cfs and air temperature was 90 ^{0}F.

Late afternoon on September 9, 2016, water temperature and DO were continuously recorded immediately upstream of the arch section of Scott's Mill dam to better understand diurnal DO patterns in the headpond. The plan was to continuously record DO for several days. However, the battery unexpectedly died and recording stopped the afternoon of September 10th. When the YSI Pro ODO meter was checked on September 12th, the shortened recording was observed. However, the meter was not redeployed.

On September 12, 2016, Scott's Mill recorded temperature and dissolved oxygen at a cross section 50 meters upstream of the safety buoys upstream of Scott's Mill Dam. Three passes were made along the cross section: 1 meter depth, 2 meter depth and 3 meter depth. The passes were made by tailing the probe behind a canoe at 10 second intervals.

Temperature and DO profiles were then taken at four locations along the transect. Profiles 1 and 2 were taken within the main channel within 100 meters of the left bank. Profile 3 was taken in the deepest part of the channel and Profile 4 within 100 meters of Daniel Island. Depths at these locations varied from about 8 to 10 meters (26 to 32 feet). Profile 3 is the deepest area of the headpond. Air temperature at the time was 85 ^{0}F and flow was 700 cfs..

Flow velocities across the James River in the headpond during low flow conditions on April 16, 2016. Because of the large cross-sectional area of the river, flow velocities were expected to be on the order of one to two tenths of a foot per second upstream of the dam during the low flow conditions. Measurements were taken across the river at the buoys located several hundred meters upstream of the dam, at the channel downstream of Daniel Island and immediately upstream of the arch section of Scott's Mill Dam. Flow at the time was approximately 1800 cfs. An additional cross section measurement was to be taken, but because the flow velocities at the other locations were low at about ¼ foot per second or below the detection limit, it was determined that no useful purpose would be served by collecting velocity data during low flows.

3. DISCUSSION AND RESULTS

3.1 Discussion

The detailed water quality measurement results are presented in Appendix E – Dissolved Oxygen. Summary Tables of the longitudinal profile, cross sectional data and profile data are presented in Tables 1, 2 and 3 below.

Table 1. Longitudinal Water Temperature and DO Profile

Location	Water Temp ^{0}F	DO mg/l
10 m u/s Reusens Dam	31.5	9.6
100 m d/s Reusens Dam	27.5	7.6
1500 m u/s Scott's Mill Dam	29.5	6.4
1100 m u/s Scott's Mill (Red Dot)	29.2	8.0
300 m u/s Scott's Mill Dam	29.7	7.6
5 m u/s Scott's Mill Dam	29.5	7.4
50 m u/s arch section of dam	28.7	7.5
15 m d/s Scott's Mill Dam	28.0	7.7
300 m d/s dam (U.S. Pipe)	27.9	8.1
990 m d/s (Riverside boat ramp)	28.0	8.1
670 m d/s dam (southside boat ramp)	27.9	8.1

Table 1 indicates that there is little difference in water temperatures from the baes of Reusens Dam downstream to the Riverside Park boat ramp. However, the surface temperature in the Reusens headpond was warmer at about 31.5 ^{0}F. This suggests discharge from Reusens includes cooler

water extracted from below the water surface. Ambient air temperature at the time was only slightly warmer than the water temperatures (i.e., 32.2 ^{0}F).

Dissolved oxygen in Reusens reservoir at the surface was 9.6 mg/l. However in the tailrace the DO was only 7.6 mg/l, again suggesting that water was withdrawn from a deeper average depth. Within the Scott's Mill headpond there was some variability in DO, varying from 6.4 to 8 mg/l. Downstream of Scott's Mill Dam, DO increased by about 0.5 mg/l. This is likely because of the aeration caused by water flowing over the dam. Nonetheless, the DO was well above the state standard in the Scott's Mill headpond.

Table 2. Headpond Temperature and DO Upstream of Scott's Mill Dam Buoys

Depth (meters)	Temp Range (^{0}C)	Avg Temp (^{0}C)	DO Range (mg/l)	Avg DO (mg/l)
1	26.0-28.4	28.1	7.3-8.5	8.2
2	26.7-28.3	27.6	6.9-8.5	8.1
3	26.0-28.1	27.4	7.4-8.6	8.2

Temperatures across the cross section were consistent, indicating a mixed and generally unstratified condition. There were minor decreases in temperature with depth, but DO was generally unchanged in the first three meters.

Table 3. Headpond Temperature and DO Profiles Upstream of Scot's Mill Dam

Depth	Profile 1		Profile 2		Profile 3		Profile 4	
(m)	Temp C	DO mg/l	Temp C	DO mg/l	Temp C	DO mg/l	Temp C	DO mg/l
Surface	28.3	8.4	28.3	8.4	27.1	8.6	27.4	8.2
2	28.0	8.4	28.2	8.4	27.8	8.5	27.6	8.4
4	27.1	8.1	27.3	8.2	26.9	8.1	27	8.0
6	26.6	7.2	26.7	7.5	26.5	7.4	26.6	7.2
8	26.4	6.8	26.5	6.9	26.4	6.9	26.6	6.9
10					26.3	26.3		

Table 3 indicates that there is weak stratification with depth. Both water temperature and DO decrease with depth. However, both are within the Virginia state water quality standards, even at during hot, low flow conditions. Flow was at 700 cfs and air temperatures about 85 ^{0}F on September 12. These are not the most extreme conditions, but flows less than 700 cfs are rare.

The continuous DO recording data showed some diurnal fluctuation. At 1700 on September 9th, DO was 7.9 mg/l. DO decreased gradually reaching its minimum point at 0300 on September 10th. From there is gradually increased to 9.0 mg.l at 0900 before falling to 7.5 mg/l at 1400, at which point the recording stopped.

Although water velocities were measured at a flow of about 1800 cfs they were about ¼ foot per second, or below the detection limits. Given the large cross sectional area in the headpond, a low velocity is expected at low flows. For example at the cross section upstream of the safety buoys the river width is about 840 feet and average depth is greater than 10 feet, the average velocity is less than ¼ foot per second. With about a 2,000 acre-foot volume in the headpnd, at a flow of 1800 cfs

the retention time is less than one day. The average velocity in the 3.6 mile long reservoir would be less than a half foot per second. Even at the upper end of the headpond where the width is less and average depth is less than 5 feet the average velocity is only about 0.6 feet.

3.2 Discussion

Water temperature and dissolved oxygen appear to be within state standards, even during hot, low flow conditions. Both water temperature and DO are a product of the Reusens discharge water temperature and DO. There is little change as flows pass through the headpond. However, there is minor stratification in the deeper areas of the headpond near the dam.

The short retention time (even at low flows of 700 cfs retention time is less than 2 days) suggests that the Scott's Mill headpond has a minor effect on water temperature and DO.
The low velocity favors species that prefer lentic habitat. When the concrete cap is added to Scott's Mill Dam, the water level will increase about 1.3 feet during low flow conditions. This should increase the residence time, but it will still be short. However, if all the flow were to be in the channel immediately upstream of the arch time, it is possible that temperature and DO in the main channel of the James River could be affected. Accordingly, Scott's Mill plans to withdraw approximately half the water passing through the powerhouse from the main river channel by enlarging the opening between the main channel and the channel upstream of the arch dam section. Even though this may increase the retention time in the section of river, it will still be relatively short.

During project operations, it is likely that some of the 0.5 mg/l increase in DO provided by Scott's Mill Dam will not occur because most of the flow will go through the project turbines. DO will need to be monitored during extreme conditions and appropriate action, such as increasing flow over the dam to maintain DO standards.

Sediment samples were taken upstream of the Scott's Mill arch dam. This portion of the study and the results is described in Appendix F and not presented in this study report.

STUDY PLAN 4 REPORT
SEDIMENT CHEMICAL ANALYSIS
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

When undertaking dam projects, concerns often arise about accumulated sediment on the upstream side of an existing dam structure, particularly the potential for such sediment to contain 'legacy' pollutants (typically from previous upstream industrial activities). In order to help assess the potential for such pollutants within the study area, sediment sampling and chemical analysis were conducted for the Scotts Mill Hydropower Project.

2. METHODS

Available VDEQ ambient water quality monitoring data was reviewed prior to sediment sampling[4], as well as other publicly-accessible data from unrelated James River sediment sampling projects (or from other nearby Virginia Atlantic Slope river basin sediment sampling projects). If sediment sampling revealed elevated pollutant levels at a sampling site, repeat sampling would be deemed necessary near this site (for confirmation purposes).

The proposed sediment sampling study area was defined by the limits of the proposed dredging/sediment excavation efforts at (upstream of) the intake, and within the downstream tailrace channel. However, during field inspection, it was determined that the powerhouse and tailrace areas were primarily comprised of coarse gravel and weathered bedrock.

The following water quality parameters were measured while sediment samples are being collected (pH, temperature, conductivity, total dissolved solids, and salinity). Two composite sediment samples were collected, as follows:

Daniel Island: - 1 composite sample, from 2', 4' and 6' depth (or refusal) at downstream end of island (where dredging will occur)

Upstream of dam: -1 composite sample, from 2', 4, and 6' depth (or refusal) at intake location

Sediment samples were sent to a Virginia-certified analytical laboratory and analyzed for low-level polychlorinated biphenyls (PCB's), using US EPA Method 1668. Particular emphasis was placed on pollutants that may be bound to sediment particles.

[4] Water quality monitoring data from a nearby water quality monitoring station is provided in the Scott's Mill Pre-Application Document.

Materials
Handheld core sampler with extensions and sediment capture tubes/caps
Sonde or handheld multi-parameter water chemistry meter
Secchi disk or turbidity tube
Sample bottles/containers
Sample cooler
Boat, PPE gear
Global positioning system (GPS)
Digital camera

Methodology
USGS/USEPA sample collection methodologies and USEPA-approved sample analysis methods were followed. Compliance with professional standards was maintained by reviewing USGS and USEPA sampling methodologies prior to fieldwork, and using a state-approved water chemistry laboratory for sample analyses. The protocol for the study included sediment sample Chain of Custody (CoC) forms, sample shipping/delivery confirmation forms, analytical laboratory report, and a summary of sampling/analysis results. Additional information on methodology and lab results can be found in the PCB lab report in **Appendix F – PCB Sampling**.

4. RESULTS AND CONCLUSIONS

The laboratory results are contained in **Appendix F**. The laboratory results confirmed that PCBs are not an issue for the Scott's Mill Project.

STUDY PLAN 5 REPORT
IMPOUNDMENT FISH SPECIES PRESENCE
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The Scott's Mill Hydropower Project has the potential to impact resident, diadromous and anadromous fish species that reside within or pass through the project boundary. Additionally, the Virginia Department of Game and Inland Fisheries (VDGIF), U.S. Fish and Wildlife Service (USFWS), Atlantic States Marine Fisheries Commission (ASMFC) and National Marine Fisheries Service (NMFS) are working to restore both diadromous and anadromous fish species to the James River. As a result, an assessment of both resident and migratory fish species within the Scott's Mill Dam impoundment is needed to design appropriate mitigation measures to ensure minimal effects on any fish species.

The objectives of the study are to estimate the presence/absence of resident and migratory fish species located within the project boundaries.

VDGIF has conducted electro-fishing studies within the project area dating from the present back to 1991. This information is deemed sufficient in determining the presence/absence of all fish species located within the project boundary. As a result of this, there is no need for additional field information. The lack of a necessity for additional field studies has been confirmed by regional fishery managers at VDGIF.

2. METHODS

This study utilized existing information from fisheries studies done by VDGIF. It relied upon existing information gathered from electro-fishing studies done by the VDGIF. CPUE (catch per unit effort) studies encompass the areas directly below Scott's Mill Dam, the pool above Scott's Mill Dam, as well as the pool above Reusens Dam. These studies gathered information from years as far back as 1991 to the present day.

The VDGIF conducted annual surveys of fish resources in the upper James River, primarily targeting smallmouth bass. Results of electrofishing surveys conducted above and below the Scott's Mill Dam are available from 1991 through 2018. Smallmouth bass, telescope shiner, bluntnose minnow, rock bass, bluegill and redbreast sunfish were caught in every year sampled and were generally among the most abundant species. Survey are conducted via electrofishing from a boat which is standard practice for determining fish species presence.

3. RESULTS

During boat electrofishing conducted in September and October of 2014, a total of 48 species were documented at 27 sample sites located between river kilometer (RKM) 168 and RKM 555[5] (VDGIF 2015a). The five most numerous species collected were Smallmouth Bass, Rock Bass, American Eel, Redbreast Sunfish, and Bull Chub, comprising 25.5, 12.8, 11.0, 6.7, and 6.2 percent of the total catch, respectively (VDGIF 2015a).

During the fall 2014 VDGIF sampling in the Upper River, 905 smallmouth bass were collected ranging from 3 to 22 inches (VDGIF 2015b). Approximately 51 percent of all smallmouth bass were juvenile smallmouth bass (less than 7 inches). Conversely, adult abundance was considerably low, likely still recovering from several years of poor recruitment. The majority of the adult smallmouth bass collected in the Upper River were between 7-14 inches and only 36 individuals greater than 14 inches were collected (VDGIF 2015b). Results for the Middle River were similar.

In recent years, recruitment has been poor throughout the river due to low spring and summer flow conditions (VDGIF 2012). However, 2014 flow conditions were ideal for young-of-year bass survival; the second highest CPUE of age zero fish since 1991 was documented during VDGIF fall 2014 sampling (VDGIF 2015a).

Analysis of the 2014 data indicated no significant trend in diversity by RKM; all sites were essentially equal in diversity score with the exception of one site that is possibly influenced by the Tye River (VDGIF 2015a). However, there was a significant difference in the fish assemblage between the Upper River (Eagle Rock to Lynchburg) and the middle and lower portion of the river. The difference in fish assemblages is most likely due to the seven dams between Buchanan and Lynchburg, impeding movement of migratory species, and a change in river morphology below Lynchburg associated with a change in physiographic province.

In October 2011, VDGIF sampled the fish community in the Middle James River at six locations between Columbia and Watkins Landings (VDGIF 2012). Twenty-three species were collected. American Eel was the most abundant species collected, followed by smallmouth bass, sunfish and Channel Catfish. Smallmouth bass were present at all six sampling sites. Redbreast Sunfish and Bluegill comprised the bulk (88%) of sunfish collected. Flathead Catfish were also found in the Middle River, but not nearly as abundant as Channel Catfish. Largemouth Bass were fairly uncommon throughout the Middle James River, and when collected largemouth bass were generally small (<12 inches) (VDGIF 2012).

The VDGIF records include capture of small numbers of American Eel in the reach between Lynchburg and Cushaw Dam. The average electrofishing CPUE (catchper-unit-effort) obtained by VDGIF for sample sites downstream of Reusens Dam was around 7 eels/hour, while the CPUE upstream of Reusens averaged less than 1 eel/hour (see **Table 1**). VDGIF captured only one individual upstream of Big Island (in the 2005 fall sample) (Scott Smith, personal communication).

For its Cushaw relicensing effort, Dominion Generation conducted a field effort directed towards examining the presence of American eels in the vicinity of Cushaw Dam. The effort was developed in consultation with the USFWS, and the VDGIF. A total of 31 eels were collected over 3,881.1 hours of eel pot fishing - 26 eels were collected at Lynchburg downstream of Scott's Mill Dam, five

[5] This reach includes the Scott's Mill dam at approximately RKM 416.

were collected at Bedford downstream of Cushaw Dam, and no eels were captured upstream of the Cushaw Dam (Cushaw Application for FERC License, Dominion 2006). All eels captured in the eel pots were examined in the laboratory for the swim bladder parasite *Anguillicola crassus*. Seven of the 26 eels collected at Lynchburg (27%) were infested with *A. crassus*, with a maximum of 7 nematodes found in one 435 mm eel. No *A. crassus* were found in the eels from the Bedford pool.

TABLE 1: LIST OF FISH SPECIES DOCUMENTED IN JAMES RIVER BASIN

Common Name	Scientific Name	Snowden Pool[a]	Middle River[b]
Bass, Largemouth	Micropterus salmoides	X	X
Bass, Rock	Ambloplites rupestris	X	X
Bass, Smallmouth	Micropterus dolomieu	X	X
Bass, Spotted	Micropterus punctulatus	X	X
Bluegill	Lepomis macrochirus	X	
Bullhead, Brown	Ameiurus nebulosus	X	
Bullhead, Yellow	Ameiurus natalis	X	
Common Carp	Cyprinus carpio	X	X
Catfish, Blue	Ictalurus furcatus		X
Catfish, Channel	Ictalurus punctatus	X	X
Catfish, Flathead	Pylodictis olivaris	X	X
Catfish, White	Ameiurus catus		
Chub, Bluehead	Nocomis leptocephalus	X	
Chub, Bull	Nocomis raneyi	X	X
Chub, Creek	Semotilus atromaculatus		
Chub, River	Nocomis micropogon		
Chubsucker, Creek	Erimyzon oblongus	X	
Crappie, Black	Pomoxis nigromaculatus	X	X
Dace, Blacknose	Rhinichthys atratulus		
Dace, Longnose	Rhinichthys cataractae		
Dace, Mountain Redbelly	Phoxinus oreas		
Dace, Rosyside	Clinostomus funduloides		
Darter, fantail	Etheostoma flabellare		

Darter, glassy	Etheostoma vitreum		
Darter, johnny	Etheostoma nigrum		
Darter, longfin	Etheostoma longimanum		
Darter, Roanoke	Percina roanoka	X	
Darter, Shield	Percina peltate		X
Darter, Stripeback	Percina notogramma	X	
Darter, tessellated	Etheostoma olmstedi		
Eel, American	Anguilla rostrate		X
Fallfish	Semotilus corporalis	X	
Gar, Longnose	Lepisosteus osseus		X
Goldfish	Carassius auratus		X
Hogsucker, Northern	Hypentelium nigricans	X	X
Jumprock, Black	Moxostoma cervinum	X	X
Lamprey, Sea	Petromyzon marinus		
Madtom, margined	Noturus insignis		
Minnow, Bluntnose	Pimephales notatus	X	
Minnow, Cutlips	Exoglossum maxillingua		
Muskellunge	Esox masquinongy	X	
Perch, Pirate	Aphredoderus sayanus sayanus		
Pumpkinseed	Lepomis gibbosus	X	
Quillback	Carpiodes cyprinus		X
Redhorse, Golden	Moxostoma erythrurum	X	
Redhorse, Shorthead	Moxostoma macrolepidotum	X	X
Sculpin, Mottled	Cottus bairdi		
Shad, American	Alosa sapidissima		
Shad, Gizzard	Dorosoma cepedianum		X
Shiner, Comely	Notropis amoenus	X	
Shiner, Common	Luxilus cornutus	X	
Shiner, Crescent	Luxilus cerasinus	X	
Shiner, Golden	Notemigonus crysoleucas	X	

Shiner, Mimic	Notropis volucellus	X	
Shiner, Rosefin	Lythrurus umbratilis	X	
Shiner, Rosyface	Notropis rubellus	X	
Shiner, Roughhead	Notropis semperasper	X	
Shiner, Satinfin	Cyprinella analostana	X	
Shiner, Spottail	Notropis hudsonius	X	
Shiner, Swallowtail	Notropis procne	X	
Shiner, Telescope	Notropis telescopus	X	
Stoneroller, Central	Campostoma anomalum	X	
Sucker, Torrent	Moxostoma rhothoecum		
Sucker, White	Catostomus commersonii	X	X
Sunfish, Green	Lepomis cyanellus	X	X
Sunfish, Hybrid	Lepomis sp	X	
Sunfish, Redbreast	Lepomis auritus	X	X
Sunfish, Redear	Lepomis microlophus	X	X
Trout, Brook	Salvelinus fontinalis		
Trout, Rainbow	Onchorhynchus mykiss		
Warmouth	Lepomis gulosus		

Source:

a: Snowden Pool sampling from 1991 through 2001, no sampling occurred in 1996 (Dominion 2003)

b: Middle James River between Columbia and Watkins Landing, October 2011 (VDGIF 2012)

Literature Cited/ References

Unpublished Virginia Department of Game and Inland Fisheries 1991-2014.

RECORD OF TELEPHONE CONVERSATION

Person Called- Scott Smith
Affiliation- Virginia Department of Game and Inland Fisheries
Phone Number- (434) 525-7522
Call Originator- Luke Graham
Date- December 29, 2015

Summary of Discussion

I contacted Scott Smith of Virginia Department of Game and Inland Fisheries to ask for any pre-existing fish studies done near the Scotts Mill dam impoundment. Scott said that (VDGIF) had several years' worth of fisheries studies data available from both directly above Scotts Mill Dam (Reusens Dam impoundment) as well as directly below Scotts Mill Dam. Scott said he would send this information to me via email when possible.

I also asked Scott if he felt that any additional fisheries studies needed to be done for the project and he replied that there was no need for additional studies due to the pre-existing available information. However, he did state that additional studies may be necessary to test for the presence of Green floater (*lasmigona subviridis)* and James Spinymussel (*Pleurobema collina)*.

Prepared by

Luke Graham

STUDY PLAN 6 REPORT
EVALUATION OF ENTRAINMENT POTENTIAL AND TURBINE PASSAGE SURVIVAL
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The Scott's Mill Hydropower Project has the potential to entrain fish during project operations. Further, the USFWS, NMFS, ASMFC, and the VDGIF have a goal to restore diadromous fish to the James River. An assessment of passage survival for resident and anadromous fish was determined appropriate to determine potential mitigation measures that may be needed to avoid and minimize entrainment. Safe, timely and effective downstream passage of anadromous fish is necessary along with avoidance of impingement effects on resident and diadromous fish. The objectives of the study were to estimate resident and diadromous fish entrainment and survival through the project turbines.

2. METHODS

A desk top study of entrainment was originally proposed. The characterization of entrainment potential and fish passage survival at the Scott's Mill Hydropower Project was to be based on the existing fish population composition as well as characteristics of the proposed turbine units for a range of fish sizes. Fish entrainment and survival for different size categories were to be based on site-specific information regarding the species and size of fishes likely to be entrained. To estimate survival of fish passing through the proposed hydroelectric turbines, a combination of existing survival study results at similar hydroelectric project turbines and a predictive model to estimate turbine survival was to be undertaken. This dual approach for estimating passage survival was to provide a characterization and range of passage survival values. This approach to characterizing entrainment potential and estimating turbine passage survival would enable decisions to be made on plant structures (e.g., trash racks), possibly operations, and the need (if any) for empirical studies. This study plan assumed that adequate information on existing fish species, relative fish size distributions, and migration/dispersal timing could be obtained from previous studies at the Reusens and Cushaw hydropower projects upstream of Scott's Mill.

During the study implementation process, Applicant continued to have discussions with resource agencies. During that process, Applicant proposed a novel approach to avoid entrainment. Applicant proposed to orient the powerhouse in the direction of headpond flow rather than perpendicular to the inflow as has traditionally been done at virtually all hydro facilities. This approach is based on the highly successful mitigation plan developed for the Willamette Falls Project in Oregon.

Applicant presented the results of the Willamette Falls Project to agencies and proposed to conduct Computational Fluid Dynamics (CFD) modeling during the detail design phase. Additionally,

Applicant proposed to include guide vanes to further inhibit fish from entering the turbine intakes. From Applicant's perspective this rendered the need for a fish entrainment study as proposed moot. Applicant instead elected to look at entrainment results for the Reusens and Cushaw Projects and by comparing turbine characteristics obtain a rough estimate of entrainment survival, should fish be entrained. This analysis is presented in the FEA. Once the CFD modeling is completed, Applicant plans to work with the resource agencies to determine if additional changes to the intake design are appropriate and if necessary conduct the entrainment modeling study at that time if CFD modeling shows there is a potential for entrainment.

3. RESULTS

Applicant's entrainment analyses are presented in the FEA.

Literature Cited/ References

EPRI 1997, Turbine Entrainment and Survival Database – Field Tests. Prepared by Alden Research Laboratory, Inc. EPRI Report No. TR-108630. 13pp.

Franke, G. F., *et al.* (nine co-authors). 1997. Development of environmentally advanced hydro.

STUDY PLAN 7 REPORT
PROJECT EFFECTS ON FISH HABITAT
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

Operation of the Scott's Mill Hydroelectric Project has the potential to affect fish habitat upstream and downstream of the Scott's Mill Dam. Important parameters for fish habitat include water depth, flow velocity, water level fluctuation, water quality, and cover. All of these parameters could be affected during project operations in both the impoundment and immediately downstream.

2. METHODS

Applicant used flow data, water level data, water velocity data, the bathymetry survey, and water quality data obtained from other studies and combined that with life history data for key fish species to provide a relative index for the existing fish habitat. Applicant then superimposed proposed operating conditions to determine effects on fish habitat quality. Operating conditions with and without a two-foot high concrete cap, powerhouse location, and run-of-river conditions. Both resident and select anadromous fish species were considered, along with critical life stages like spawning and incubation. Mitigation measures were next identified.

The VDGIF and the USFWS had recommended that a PHABSIM model be used to assess habitat changes. However, velocity measurements indicated that during low flow conditions, velocities were on the order of ¼ foot per second upstream of Scott's Mill Dam, confirming that the headpond is a lentic environment. Thus, Applicant determined that applying the PHABSIM model may not be the most suitable means to determine habitat changes.

4. RESULTS

Based on the bathymetry study and the fact that water levels would remain stable for flows up to the hydraulic capacity of the powerhouse, Applicant determined that there was less potential for stranding in the headpond under post-project conditions. Above the hydraulic capacity of the power house, there is a potential for stranding due to daily flow fluctuations from upstream projects and from the natural hydrograph. However, based on water level changes that are essentially the same for pre- and post-project flows, the project was determined to have no effect on stranding.

Applicant considered the pre- and post-project water level changes upstream and downstream of Scott's Mill Dam. Downstream water levels will remain the same for both pre- and post-project conditions. A DO differential of about one half mg/l could occur, but Applicant has taken steps to ensure that water quality standards would be met. Therefore, Applicant concluded that habitat downstream would incur only minor habitat changes from the slightly lower DO. However, right

near the dam itself, cover could be affected at lower flows because less water would be flowing over the dam.

Upstream of Scott's Mill Dam, the additional depth of about one foot at low flows could provide for more habitat but this would be a minor effect. Since water levels upstream would actually be closer to the natural water level than if the project were operated at just above the crest elevation, Applicant determined adding the concrete cap would be a fishery benefit over not adding it.

STUDY PLAN 8 REPORT
EVALUATION OF FISH PASSAGE
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The Scott's Mill Hydropower Project has the potential to impede or prohibit the upstream/downstream passage of anadromous, catadromous and resident fish species within the James River. Resource agencies have a goal to restore diadromous fish species to their historic habitats in the James River. Specific species to be passed include resident species (including bass and centrarchids), freshwater mussels, American shad, river herring, Sea Lamprey, and American Eel.

VDGIF has conducted specific electro-fishing studies in the project area dating from present back to 1991. However, for some species such as American Shad there is a lack of historic information due to the fact that Boshers Dam inhibited fish passage since its construction in 1835. Since Boshers Dam was breached in 1999, anadromous fish have been able to migrate upstream of that dam. However, with the exception of American eels, restoration of diadromous fish has had limited success.

2. METHODS

Applicant had planned to conduct an iterative desktop study done in consultation with resource agencies that utilizes existing information from fisheries studies done by the VDGIF, USFWS, and NMFS. It was to include anticipated restoration timetables and conceptual approaches for moving fish upstream of Scott's Mill Dam to the Scott's Mill headpond. Initially, fish were to be transported upstream of Scott's Mill Dam with a longer-term plan for Scott's Mill and the 6 upstream dams. For upstream passage, concepts for trapping facilities at Scott's Mill were to be identified along with estimates for numbers of fish needed before upstream transport of anadromous fish species would be initiated.

However, during discussions with resource agencies, Applicant agreed to undertake a phased approach to fish passage. This approach has led to an Agreement in Principle (AIP) with the USFWS and VDGIF to immediately implement upstream fish passage for American Eel and Sea Lamprey. Downstream passage would use an approach similar to the successful downstream passage taken for the Willamette Falls Project in Oregon.

Applicant undertook a Fish Passage Initial Assessment during the project negotiations. That document follows and represents Applicant's fish passage efforts to date. Applicant's preliminary design for the American Eel and Sea Lamprey fishway are provided in Exhibit F – Design Drawings. These conceptual drawings will be refined with resource agencies during detail design pursuant to the AIP.

3. RESULTS

The Fish Passage Initial Assessment follows.

Technical Memorandum

To: Mr. Wayne Dyok, H2O EcoPower

From: Greg Allen and Steve Amaral, Alden

Date: September 21, 2017

Re: **Scott's Mill Hydro Fish Passage Initial Assessment**

Alden Research Laboratory, Inc. (Alden) has performed an initial review of potential fish passage alternatives for the proposed Scott's Mill Hydropower development. This memo provides Alden's best professional judgement regarding the type of fishway appropriate for the targeted species.

Project Background

Scott's Mill Hydro, LLC is preparing a license application to the Federal Energy Regulatory Commission (FERC) to power the existing Scott's Mill Dam. The current concept calls for locating the proposed hydropower plant at the existing arch section of the dam preliminary. Plans include adding either a two-foot high cap on the existing dam or use of two-foot high flashboards to maintain the headpond at a similar elevation to what occurs under natural conditions. The maximum gross head at Scott's Mill dam will be 17 feet and the hydraulic capacity of the plant will be 4500 cfs. During operations, the upstream water level will remain constant at just below the 516.4 foot dam crest elevation (with flashboards or a cap). As inflows increase at Scott's Mill above the hydraulic capacity of the plant, excess flow will flow over the dam. The James River is a highly variable river with annual flows often exceeding 50,000 cfs.

Fish Passage Review

H2O EcoPower requested Alden to review the following fish passage alternatives for consideration at Scott's Mill:

1. Upstream passage of American eel and sea lamprey only into the Scott's Mill headpond.
2. Upstream passage of resident and diadromous fish into Scott's Mill headpond using traditional fish passage facilities.
3. Upstream passage of resident and diadromous fish into the Scott's Mill headpond using a nature-like fishway.

4. A trap and haul program where upstream moving fish would be captured and then hauled upstream of Scott's Mill to destinations upstream of any of the seven dams located within a 22-mile reach upstream of Scott's Mill.

Relevant design information assumed for review of fish passage alternatives is provided below. The US Fish and Wildlife Service (FWS) recommends that fishways be designed to operate for a river flow range of 95% to 5% exceedance.

Target Species

Primary
American Eel
Sea Lamprey

Secondary
Resident and diadromous fish

River flow

Design high:	12,000 cfs (5% exceedance)
Average:	2,000 cfs (50% exceedance)
Design Low:	609 cfs (95% exceedance)

Head pond Elevation (assumes hydropower operation)

Design high:	519.2 ft (5% exceedance)
Normal:	516.4 ft (50% exceedance)
Design low:	516.4 ft (95% exceedance)
Head pond range	2.8 ft

Tailwater Elevation

Design high:	505.9 ft (5% exceedance)
Normal:	500.6 ft (50% exceedance)
Design low:	499.4 ft (95% exceedance)
Tailwater range	6.5 ft

Gross head: 12.5 to 17 ft

The above criteria were used to review and develop design information for each fish passage alternative. Generally, the entrance to a fishway should be located at the upstream most location of the project near the main discharge from the dam, which attracts fish migrating upstream. An understanding of the tailrace hydraulic conditions is important to properly site

the entrance considering the preferences of the targeted species. Conditions such as recirculating eddies should be avoided as these conditions can delay and hinder the success of fish finding the fishway entrance.

Alternative 1 – Upstream passage of American Eel and Sea Lamprey

American eel is a catadromous species that migrate upstream from about April through October as juveniles (glass or elver life stages) after entering freshwater systems from the ocean. Larger yellow-stage eels also may move upstream during various times of the year. Upstream passage for American eel typically involves installing an eel ramp or trap near one or both banks adjacent to the dam. Eels tend to migrate upstream in the margins of the river in slower river currents. A typical eel ramp consists of a shallow channel approximately 1.5 to 2 ft wide by 4 to 6 inches high in cross section. Eel ramps are typically placed at an inclined angle of about 30 to 45 degrees with a thin stream of water discharging down the ramp. Additional attraction flow is discharged from a pipe near the base of the ramp. The channel would be lined with substrate to aid eels ascending the ramp. Various substrates are used for different size eels (i.e., glass, elver, and yellow life stages) and ramps often include combinations of substrate within the same ladder. A geotextile mesh is recommended for smaller elvers or glass eels while a substrate with protruding pegs is recommended for larger yellow eels. Examples of substrate, eel ramp and an eel trap are shown in Figure 1 and Figure 2. Often eel ramps will include covers to reduce predation.

Figure 1. Eel Ramp Example (source CTDEEP)

Figure 2. Eel Trap Example

Sea lamprey is an anadromous species that migrate as adults upstream to spawn during the spring and early summer. Information regarding sea lamprey passage is limited. There are few fish passage facilities that are designed specifically to provide upstream passage for sea lamprey. Sea lamprey are known to use traditional fish ladders designed for anadromous species (e.g., American shad, river herring, and Atlantic salmon). However, effectiveness of traditional fish ladders for lamprey passage has not been well documented. New fishways designed specifically for sea lamprey have been developed and studied for projects on the Columbia River to improve passage of Pacific lamprey. These designs are similar to eel ramps where they use small cross sectional channels that are about 1.5 to 2 ft wide by 6 inches high set at a steep incline of about 30 to 45 degrees. A thin stream of water is discharged down the ramp, but the interior surface remains smooth, as shown in Figure 3. Sea lamprey use their suction cup-like mouth to aid in climbing ramps, as shown in Figure 4.

Figure 3. Lamprey Ladder Example (source US Army Corps of Engineers)

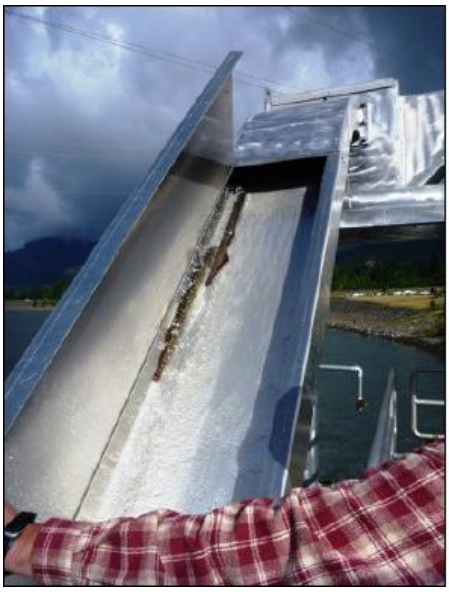


Figure 4. Lamprey Ladder Example (source US Army Corps of Engineers)

Sea lamprey traps in the Great Lakes are similar to the eel trap show in Figure 2, but use solely the plastic pegs as a substrate and have been shown to effectively trap sea lamprey. In addition, a project in Ireland at Annacotty Weir used a similar plastic peg substrate to pass sea lamprey over a small dam. Given this information, we have assumed an eel ladder that includes plastic peg substrate will be effective at passing sea lamprey.

Eel ladder and Sea Lamprey Passage at Scott's Mill

To pass sea lamprey and American eel at Scott's Mill we have assumed a design similar to the examples shown above. A ladder designed specifically for eels would be located on one or both banks set at an angle of about 30 degrees. A ladder on the powerhouse side of the river would also be designed for sea lamprey and would be located adjacent to the powerhouse discharge, which would act as attraction flow for lampreys and eels. Each ladder would be approximately 30 to 40 ft long to overcome the total head of 17 ft. Alternatively, traps could be installed to collect eels and lamprey but would require daily visits to move collected fish upstream.

A rough order of magnitude estimate for the installation is $100,000 to $500,000 depending on the design features and configuration. The design on the right bank can be incorporated into the proposed new dam and powerhouse design which will reduce the overall cost of installation.

Alternative 2 – Upstream passage of Resident and Anadromous Fish with a Technical Fishway

Upstream passage of anadromous and resident fish at Scott's Mill would be provided by a traditional technical fishway. Various fishway designs have been employed for anadromous fish, such as pool and weir, Denil, and vertical slot designs. Selecting the appropriate style

ladder is dependent on the target species and estimated migration run size. Given the inclusion of resident fish (e.g., smallmouth and largemouth bass, sunfishes, catfishes and bullheads, suckers, minnows and carps), which will vary considerably in size and swimming capabilities, we would recommend a vertical slot type fish ladder. A vertical slot fishway is also expected to provide better passage for eel and sea lamprey than other technical fish ladders. However, the Alternative 1 design described above should also be installed for passage specifically for eels and sea lamprey. An example of a double vertical slot fish ladder design is shown in Figure 5.

Figure 5. Double Vertical Slot Ladder Example

Resident and Anadromous Fish Passage at Scott's Mill

Using guidelines developed by FWS a vertical slot fishway installed at Scott's Mill would have the following features:

- 34 pools with a 0.5 ft drop per pool
- Slot width of 16 inches
- Pool width of 11 ft and length of 14 ft
- Total length of ~520 ft, excluding turning pools
- Slope of 3.8%

The fish ladder would be configured so that the entrance would be located adjacent to the powerhouse on either the right or left side adjacent to the turbine discharge. The fishway could occupy the area to the left of the powerhouse where the existing remnant foundation is located. Given the overall length, the fishway would start with an entrance near the

powerhouse discharge, extend downstream approximately 260 ft, and then switchback upstream another 260 ft with an exit just upstream of the dam. The overall foot print of the ladder would be about 30 ft by 300 ft.

An order of magnitude rough cost estimate of the vertical slot fish ladder described above would be $5M to $10M, depending on design features.

Alternative 3 – Upstream passage of Resident and Anadromous Fish using a Nature-like Fishway

A nature-like fishway (NLF) is a channel that emulates a natural stream channel, typically with a low gradient, sinuous and a roughened bed to dissipate energy. NLF channels are constructed out of irregular natural materials that create diverse hydraulic conditions which are suitable for a wide variety of aquatic species. NLF channels are a relatively new technology for fish passage and there have been very few evaluations of effectiveness. Studies suggest that a gradient of 1:20 to 1:100 is recommended for riverine and anadromous fish depending on the design and species of interest. NLF can be designed as rock ramps extending the full width of the river downstream of a dam, a partial width rock ramp, or as a bypass channel routed around the dam.

Nature-like Fishway at Scott's Mill

A NLF rock ramp the full width of the river is not practical for 17 ft of head at Scott's Mill, because it would require substantial fill material and the entrance would be located too far from the powerhouse discharge. Rock ramps are typically considered for much lower dams without hydropower. Therefore, a NLF bypass channel around the dam was considered. Example NLF photographs are provided in Figure 6. A NLF designed for Scott's Mill would have the following recommended design features to pass both riverine and anadromous fish based on guidelines from FWS and NOAA and performance of existing NLFs.

- Channel bottom width of 20 ft
- Channel depth of 2 to 6 ft
- Slope of 1V:50H, (2%)
- Length of 850 ft

Figure 6. Nature-like Fishway Examples (source NOAA)

The entrance to the NLF should be located near the powerhouse discharge to attract fish to the entrance. There is limited space available on the right bank adjacent to the proposed powerhouse due to the U.S. Pipe Co. property, pipe yard and railroad. Route 685 is located near the left bank of the river leaving little space for a NLF on the left bank. Given the site constraints, a NLF does not appear to be feasible due to lack of space.

An order of magnitude estimate if space was available would be $4M to $6M.

Alternative 4 – Trap and Haul Program

A trap and haul program could be implemented at Scott's Mill to collect fish and distribute them to habitat upstream. Trap and haul can be an attractive option at high head dams or where there are multiple dams located within a short reach of river, similar to the James River upstream of Scott's Mill. Trap and haul programs can be an efficient means of passage compared to the cumulative performance of multiple fishways at each dam. Trap and haul is also a quicker means to open upstream habitat than building fishways on multiple dams that could take several years or decades.

<u>Trap and Haul at Scott's Mill</u>

A trap and haul program at Scott's Mill would include the installation of a fishway trap, hopper lift, and holding tanks. The design is similar to that of a fish lift with a fishway flume entrance located adjacent to the powerhouse. Fish that enter the fishway flume are crowded over a hopper and then lifted and discharged into holding tanks. Trucks would then collect fish from the holding tanks and transport them to habitat upstream of any of the seven dams. Pictures of a trap and haul facility are provided in Figure 7.

Order of magnitude rough costs for a trap and haul facility at Scott's Mill would be between $4M and $7M depending on the design features and overall size. Incorporating the design into

the proposed dam/ powerhouse will likely reduce the overall costs. This cost is based on cost data from other projects that were retrofitted after the powerhouse and dam had been constructed. The in river footprint of a trap and haul facility would be about 15 ft wide by 40 ft long.

Figure 7. Trap and Haul Facility Example

Recommendations

Table 1 presents the advantages and disadvantages of each alternative reviewed above. We recommend a phased approach to implementing fish passage at Scott's Mill based on the migratory and movement needs of the species present. The first phase would include the installation of passage for eels and lamprey. This initial phase could be incorporated into the design of the proposed development. If an anadromous run (shad or herring) is established in the James River or if there is a need to pass riverine fish then a later phase would include installing passage for anadromous and riverine fish. Of the options reviewed, we recommend Alternative 4 as the most timely and effective option.

Note that this initial review was based on limited information. We recommend further development of fish passage concepts to provide more refined designs for consideration and cost estimates.

Table 1. Fish Passage Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages	Rough Estimated Costs
1. Upstream passage of American Eel and Sea Lamprey	Relatively small inexpensive passage facilities; Efficient upstream passage for eels; Flexible design and inexpensive to modify if needed	Only provides passage for eels and lamprey; Uncertain performance for lamprey and may require modifications depending on performance; Requires fishways on both sides of the river	$100k to $500k
2. Upstream passage of Resident and Anadromous Fish	Provides passage for anadromous and riverine species; Provides volitional passage; Effectively operates over a wide range of head pond levels	Relatively large foot print and expensive Opens habitat to only the impoundment to Reusen's Dam	$5M to $10M
3. Upstream passage of Resident and Anadromous Fish using a Nature-like Fishway	If there was space available a NLF would provide passage for a wide variety of aquatic species	There doesn't appear to be space available for a NLF; Large foot print; Does not operate effectively for varying head pond water levels without a flow control structure	$4M to $6M Not feasible
4. Trap and haul facility	Opens habitat to the entire upper James River; Provides opportunity to collaborate with upstream owners; Effective at passing a wide variety of fish species; Could be integrated as part of the proposed powerhouse/ dam structure to save construction costs	Annual operation and maintenance requirements; non-volitional passage	$4M to $7M

STUDY PLAN 9 REPORT
MUSSEL SURVEY
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

The Mussel Survey Study Plan report is provided in Appendix H.

STUDY PLAN 10 REPORT
WETLAND ASSESSMENT
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

Based on a preliminary assessment of water levels under varying flow conditions (see Study Plan Report 1), about 50 percent of the time, the water level upstream of Scott's Mill Dam is about one foot or less above the crest elevation (i.e., flows below median discharge). With a two-foot high cap, an additional foot (vertical elevation) of shoreline will typically be inundated on a daily basis. For flows above the median, the water level will range from 0.3 feet to 2.5 feet above current levels. However, at flood flow levels, that differential would decrease such as at the 100-year flood there would be little difference. These are the difference as seem at the dam. Further upstream where the James River is narrower and shallower, the difference would be less since the higher water levels would results in a lower energy gradient. With this backdrop, Applicant conducted a terrestrial (including wetlands) habitat reconnaissance of the area. Details of the site reconnaissance are provided in **Appendix J, Terrestrial Habitat Assessment.**

A 2013 survey of Daniel Island in 2013 indicated that about 19.1 acres of wetlands exist on the southern portion of the island. The total acreage of Daniel Island is 59 acres. The Preliminary Jurisdictional Determination is presented below. Because the project has the potential to affect these and other wetlands, an experienced biologist conducted the survey, which included the project construction site, the north and south shorelines up to Reusens Dam, and James River island shorelines within the Scott's Mill headpond.

Applicant's approach is to avoid wetlands impacts, if possible and minimize and mitigate for any wetlands than cannot be avoided.

2. METHODS

Available aerial photographs, topographic/terrain maps, VDEQ stream maps, USDA hydric soils maps, and USFWS NWI maps were utilized to provide background information for the study area. A field investigation was then undertaken. Because the river banks and islands in the James river are all steep (generally greater than 2:1 slopes) and high (six to tem feet on average), Applicant determined that the terrestrial habitat that might be affected would be largely limited to the actual river

banks and island shoreline themselves. Accordingly, Applicant did not asses the potential for wetlands on the islands, since they would not be affected, except for the potential tip of Daniel Island.

Applicant also conducted a reconnaissance of the construction site. It is highly disturbed with overgrown brush.

Although the study plan called for an additional work effort to determine the presence/absence of potentially-jurisdictional wetlands, only the areas identified as possibly be affected were identified.

3. RESULTS

Applicant determined that the effect on shoreline wetlands due to the water level changes would not be significant due to the steep shoreline and the fact that much of the shoreline near the railroad on the southern shore has protective rip rap. However, there is a small tip at the downstream end of Daniel Island that may be wetland and could be affected by the enlargement (dredging) of the existing opening between the main channel and the side channel upstream of the arch section of dam. Since the area downstream of the existing opening is not classified as wetland, Applicant intends to dredge that location and avoid the wetlands. During detail design, if there is a need to further expand the opening the USACE Joint Permit Application would be amended from "no wetlands" impacts to the actual square footage of wetlands that would be affected.

Literature Cited/ References

US Army Corps of Engineers, 1987. Wetland Delineation Manual - Wetlands Research Program Technical Report Y-87-1. USACE Waterways Experiment Station, Vicksburg, MS.

US Army Corps of Engineers, 2012. Eastern Mountains and Piedmont Regional Supplement Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region ERDC/EL TR-12-9 (Version 2.0), April 2012. USACE Engineer Research and Development Center, Vicksburg, MS.

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1096

Reply to
Attention of
REPLY TO
ATTENTION OF

January 22, 2014

PRELIMINARY JURISDICTIONAL DETERMINATION
Western Virginia Regulatory Section
NAO-2013-1609 (James River)

Liberty University
c/o Mr. Tim Reynolds
Reynolds-Clark Development, Inc.
PO Box 556
Gretna, Virginia 24557

Dear Mr. Reynolds:

This letter is in regard to your request for a preliminary jurisdictional determination for waters of the U.S. (including wetlands) located on a 59 acre parcel in Amherst County and the City of Lynchburg, Virginia.

The map entitled "James River-Daniel Island-Liberty University-Wetland Delineation Map", dated July 30, 2013 with a revised date of November 5, 2013 and Corps date stamped as received November 12, 2013 (copy enclosed) by Reynolds-Clark Development, Inc. provides the location of wetlands on the property listed above. The basis for this delineation includes application of the Corps' 1987 Wetland Delineation Manual and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region and the positive indicators of wetland hydrology, hydric soils, and hydrophytic vegetation.

The Norfolk District has relied on the information and data provided by the applicant or agent. If such information and data subsequently prove to be materially false or materially incomplete, this verification may be suspended or revoked, in whole or in part, and/or the Government may institute appropriate legal proceedings.

Discharges of dredged or fill material, including those associated with mechanized landclearing, into waters and/or wetlands on this site may require a Department of the Army permit and authorization by state and local authorities including a Virginia Water Protection Permit from the Virginia Department of Environmental Quality (DEQ), a permit from the Virginia Marine Resources Commission (VMRC) and/or a permit from your local wetlands board. This letter is a confirmation of the Corps preliminary jurisdiction for the waters and/or wetlands on the subject property and does not authorize any work in these areas. Please obtain all required permits before starting work in the delineated waters/wetland areas.

This is a preliminary jurisdictional determination and is therefore not a legally binding determination regarding whether Corps jurisdiction applies to the waters or wetlands in

question. Accordingly, you may either consent to jurisdiction as set out in this preliminary jurisdictional determination and the attachments hereto if you agree with the determination, or you may request and obtain an approved jurisdictional determination. This preliminary jurisdictional determination and associated wetland delineation map may be submitted with a permit application.

Enclosed is a copy of the "Preliminary Jurisdictional Determination Form". Please review the document, sign it and return one copy to the Corps, (PO Box 3160, Lynchburg, VA 24503) within 30 days of receipt and keep one for your records. This delineation of waters and/or wetlands is valid for a period of five years from the date of this letter unless new information warrants revision prior to the expiration date.

If you have any questions, please contact me at 434.384.0182 or jeanne.c.richardson@usace.army.mil.

Sincerely,

Jeanne C. Richardson

Jeanne C. Richardson
Western Virginia Regulatory Section

Enclosures:
Wetland/Waters Delineation Map
Preliminary Jurisdictional Determination Form
Supplemental Preapplication Information

Copies Furnished:
Mark Bushing, Department of Environmental Quality, Lynchburg
Erin Hawkins, Department of Water Resources, Lynchburg
Jeremy Bryant, Department of Planning and Zoning, Amherst

JAMES RIVER - DANIEL ISLAND

LIBERTY UNIVERSITY

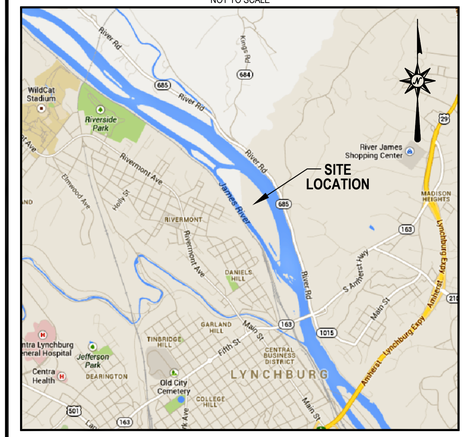
AMHERST COUNTY / CITY OF LYNCHBURG, VIRGINIA

WETLAND DELINEATION MAP

JULY 30, 2013

US Army Corps of Engineers
CENAO-REG
West Central Field Office
Received by JCR
Date: November 12, 2013

VICINITY MAP
NOT TO SCALE



Reynolds-Clark DEVELOPMENT, INC.

112 South Main Street - Post Office Box 556 - Gretna, Virginia 24557
Phone: 434.656.8961 - Fax: 434.656.8995 - Web: www.reynoldsclark.com

Revisions:
1. USACE Comments 11-05-13
2. _____
3. _____
4. _____

GOOGLE EARTH AERIAL VIEW
NOT TO SCALE

U.S. GEOLOGICAL SURVEY (USGS) MAP
1" = 2,000'

USGS QUADRANGLE: LYNCHBURG, VA
USGS HYDROLOGIC UNIT CODE (HUC): 02080203
CONTOUR INTERVAL: 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929.

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS.

TOPOGRAPHY BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS TAKEN IN 1962. FIELD CHECKED IN 1963.

REVISIONS SHOWN IN PURPLE AND WOODLAND COMPILED IN COOPERATION WITH COMMONWEALTH OF VIRGINIA AGENCIES FROM AERIAL PHOTOGRAPHS TAKEN IN 1982 AND OTHER SOURCES. MAP EDITED IN 1984.

SITE INFORMATION:

1.) PARCEL TAX MAP #: 44-18-001

2.) PARCEL OWNER: LIBERTY UNIVERSITY
1971 UNIVERSITY BLVD.
LYNCHBURG, VA 24502
PHONE: 434.592.4131

3.) PARCEL ACREAGE: ± 59 ACRES

4.) LATITUDE/LONGITUDE AT CENTER OF PROJECT SITE: 37° 25' 46" N , -79° 08' 41" W

PROJECT INFORMATION:

WETLAND DELINEATION PERFORMED BY:

TIMOTHY C. REYNOLDS, P.E.
REYNOLDS-CLARK DEVELOPMENT, INC.
P.O. BOX 556 - GRETNA, VA 24557
PHONE: 434.656.8961
EMAIL: treynolds@reynoldsclark.com

NOTES:

1.) USGS NORMAL POOL ELEVATION = 511.00

2.) DELINEATED WETLAND ELEVATION = 524.00
(BASED ON USACE DELINEATION MANUAL GUIDANCE)

PROBABLE WETLAND AREAS

GRAPHIC SCALE

100 0 50 100

1 INCH = 100 FEET

STUDY PLAN 11 REPORT
TERRESTRIAL RESOURCES
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The Scott's Mill Hydroelectric Project primarily involve work within the channel of the James River. However, some activities may occur on the shoreline of the river and the concrete cap will result in upstream water level changes that could affect terrestrial resources. In order to assess potential effects of these activities, existing upland conditions (e.g., habitats, vegetation, land cover, etc.) were assessed within the study area limits of disturbance (LOD), and potential effects of the project were evaluated.

The goals of the study were to: 1) describe existing natural resources, habitats, vegetative communities, and previous impacts within the construction area (approximate five acre LOD area), 2) describe terrestrial resources within an approximate 10 foot elevation band above the spillway crest elevation to account for water level changes from concrete cap installation and project operation, and 3) evaluate potential project impacts in these areas/on these resources.

Previous/existing land use activities (relic mill foundation and roadway on the northeast shoreline, and operational pipe foundry on the southwest shoreline) have significantly altered natural resources within these portions of the study area. Portions of islands within the study area have also been previously affected by various land uses, but such land uses largely ended following a devastating 1985 flood (and these islands have since become largely naturalized).

The study area included the estimated five-acre LOD extent, which includes material storage areas, construction limits, vehicle parking areas, and temporary disturbance areas. The focus of the study was on assessing existing terrestrial/upland natural resources, including vegetation, wildlife, and soils. To assess water level effects, terrestrial area assessment efforts included all upstream shoreline areas subject to a greater frequency of inundation, up to 10 feet above the existing spillway crest elevation.

2. METHODS

Existing conditions and natural resources (flora, fauna, and soils) were documented within the project study area / LOD area. The following steps were taken:

1) Review of available background data

This effort did include review of USDA soils data, USGS topographic mapping, USFWS habitat information, as well as current and previous aerial photographs.

2) Field investigation

Field investigation include documentation of vegetative communities/species, soil conditions, wildlife observations, and the extent of existing/previous impacts.

A field visit was conducted to identify existing natural resources. Vegetative species were documented, wildlife observations were noted, previous impacts described, existing land uses detailed, and representative photographs taken. Latitude/longitude (position) of significant features were also noted.

Field investigation included assessment of existing vegetation (health/vigor, species composition, evidence of stress), wildlife observations (species, available habitats, hibernacula, loafing, feeding, roosting areas, hazards, etc.), and soils (e.g., presence of strata, evidence of disturbance, indications of fill or excavation, soil moisture, and compaction).

Professional standards were maintained during fieldwork implementation and project review efforts using experienced environmental scientists to perform background research, conduct the site visit, and prepare the report.

Effects that land disturbance may have on the terrestrial resources in the immediate area of the dam were identified. Effects on vegetation, particularly in the zone between the spillway crest elevation and the top of the concrete cap were assessed. Impacts to vegetation above the new dam crest were qualitatively assessed as there will be some increased frequency of inundation in the zone that is typically flooded when flows are between 4,000 cfs and 50,000 cfs.

3. RESULTS

The results of this study effort are presented in **Appendix G, Terrestrial Habitat Assessment.** This includes characterization of the vegetation in the project area and immediate area downstream, and an assessment of project effects..

STUDY PLAN 12 REPORT
PROTECTED SPECIES
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The protected species study was conducted to help ensure compliance with Section 7 of the Endangered Species Act (ESA). Specific goals of this effort were to: 1) document species present within the terrestrial and aquatic habitats in the project study area, and 2) evaluate potential project effects on these species.

This study was undertaken in conjunction with the Terrestrial Habitat Assessment (See Study Plan Report 11) and followed the same approach.

The USFWS Information Planning and Conservation (IPaC) system lists the following protected species that may be present near the study area:

James Spinymussel (*Pleurobema collina*) – freshwater mussel (FE)

The VDGIF lists the following protected species in the Virginia Fish and Wildlife Information System (VAFWIS):

James Spinymussel (*Pleurobema collina*) – freshwater mussel (FESE)
Northern long-eared bat (Myotis septentrionalis) – mammal (FT)
Green floater (Lasmigona subviridis) – freshwater mussel (ST)
Atlantic pigtoe (Fusconaia masoni) – freshwater mussel (ST)
Peregrine falcon (*Falco peregrinus*) – bird (ST)
Upland sandpiper (*Bartramia longicauda*) – bird (ST)
Loggerhead shrike (*Lanius ludovicianus*) – bird (ST)
Migrant loggerhead shrike (Lanius ludovicianus migrans) – bird (ST)

The Virginia Department of Conservation and Recreation (VDCR) Natural Heritage (NH) database lists the following protected species within the Middle James River-Buffalo River Basin (HUC 02080203), James River-Opossum Creek sub-watershed (JM11):

Green floater (*Lasmigona subviridis*) – freshwater mussel (ST)
Smooth coneflower (*Echinacea laevigata*) – vascular plant (FE)

FE – Federally Endangered	*SE – State Endangered*
FT – Federally Threatened	*ST – State Threatened*

2. METHODS

In order to document species presence within the study area, a terrestrial habitat survey and freshwater mussel survey were completed. Each of these studies aer described further in Study Plan Reports 11 and 13. Available USFWS, VDGIF, and VDCR data were also reviewed, along with results from other project-related studies (e.g., wetlands, terrestrial habitats, bathymetry, etc.), and other James River / Atlantic Slope river studies).

The methodology follows that described in Study Plan 11 Report.

3. RESULTS

The study results are are largely qualitative and are presented in **Appendix G, Terrestrial Habitat Assessment**. The freshwater mussel survey was conducted by a USFWS-approved survey firm, in accordance with standard survey methodologies. The methods and results are presented in that report and in **Appendix H – Freshwater Mussel Survey**.

STUDY PLAN 13 REPORT
BAT SURVEY
SCOTT'S MILL HYDROPOWER PROJECT
(FERC NO. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

During the study planning process, it was determined that the Scott's Mill Hydropower project had the potential to impact bat roosting habitat during construction and operation. A presence/absence survey for bats and critical bat habitat (roosting areas) was thought to be the best way to design appropriate mitigation measures in consultation with different resource agencies. Accordingly, a field survey which tests for the presence of bat species within the project area was envisioned. Additionally, the study was to identify any critical bat habitat (roosting areas) located within the project area.

However, after Applicant conducted the pre- and post-project water level studies and the terrestrial habitat study, Applicant determined that the change in water levels was unlikely to affect bats and determined that the study was unnecessary. The USFWS noted (see USFWS comment 22 on Draft License Application) that "The Applicant concluded no further Section 7 consultation under the Endangered Species Act is required, even though the Terrestrial Habitat Assessment lacks any hydrological study or modeling, and relies on visual determinations and estimates of inundation impacts to the nearly 2.5 miles of island habitats that includes wetlands…The Service generally agrees with the Applicant's northern long-eared bat assessment. While flooding may slowly kill trees on the islands, this is not likely to affect northern long-eared bats, because no felling of trees will occur during the breeding season."

Applicant appreciates the USFWS comment. Applicant believes that the pre- and post-project water level study constitutes a reasonable hydrologic assessment of post-project conditions. Applicant further relies on the professional opinion of the biologist who conducted that study and based on the hydrology and steepness of the shoreline, including the islands, determined bat habitat would not be significantly affected. Therefore, the proposed bat study was not conducted.

STUDY PLAN 14 REPORT
RECREATIONAL RESOURCES
Scott's Mill Hydropower Project
(FERC No. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The James River, Virginia's longest river, is an important recreational resource. It typically supports about 100,000 angling trips and about 50,000 boating trips annually (Stanovick et al., 1991), and is designated a State Scenic River in certain reaches including a reach that is upstream of the Cushaw Project. The Scott's Mill Project is within 60 miles (approximately a one-hour drive) of numerous recreational opportunities, including boating, fishing, hiking and viewing nature.

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) identifies river recreation as an important need. Although there are boat launches downstream form Scott's Mill Dam, participants at the December 2, 2015 Joint Meeting identified boating access in the Scott's Mill impoundment as a need. Further, a portage or canoe flume was identified as a second important need. Additional clarification of recreational needs was provided via telephone conference call with Amherst County and by the James River Association in a letter dated February 2, 2016.

Applicant conducted a recreation resources study to assess the viability of proposed recreation enhancements. FERC regulations (18 Code of Federal Regulations Section 2.7) require an applicant to consider recreation facilities as part of hydropower development. Because of the industrial nature and confined river corridor in the Scott's Mill area, incorporation of hydropower at Scott's Mill affords an opportunity for recreational enhancements for local and regional recreationists.

The area focused upon for the recreational resources study includes:

1. The Scott's Mill Headpond/ Impoundment (316 acres)
2. The tailrace area located immediately below Scott's Mill Dam
3. Public Access Points/ Boat Launches located of the east side of the James river along River Road.

2. METHODS

Applicant utilized a variety of information provided by pre-existing recreational studies done within the state of Virginia and near the proposed project site. Studies prepared by Virginia Dept. of Game and Inland Fisheries, as well as the 2013 Virginia Outdoors Plan (State Comprehensive Outdoors Recreation Plan or SCORP) were used in determining recreational resources with in the area.

Applicant considered a portage or safe navigation around Scott's Mill Dam, a boat access in the impoundment, public fishing access, trails, camping, parkland, historical interpretation (signage), and possibly other recreation facilities consistent with identified local needs.

Applicant evaluated the feasibility of installing a safe passage past Scott's Mill Dam or portage on the north side of the river. Applicant considered the hydraulic head to be

dissipated based on similar Virginia projects like the Bartlick Dam on Russell Fork. If determined feasible, Applicant was to develop conceptual plans and a cost estimate and compare the cost to a conventional portage.

Applicant consulted with VDCR, Lynchburg, Bedford County and Amherst County to identify a location for public boating access in the impoundment. Consideration was given to areas along River Road in Amherst County and on the Lynchburg side of the river. However, access on the southeast (Lynchburg) side of the river would be more complicated due to the railroad.

Applicant also consulted with these parties to assess the feasibility of using River Road for public fishing access and a public walking/multi-use trail. Areas both upstream and downstream of the Scott's Mill Dam were considered. Applicant also considered the potential for a connector trail to the Blackwater Creek Trail Network.

Applicant cursorily investigated a public camping and parkland for Treasure Island and Daniel Island. Such facilities would likely require bridge access and were determined to be beyond the scope of the licensing, but could be put into a longer-term plan.

Applicant considered a historical interpretation plan in consultation with licensing participants. It was determined that the Historic Properties Management Plan would provide the basis for information to be conveyed.

As part of the study, was also to consider the effects that flashboard installation and changing water levels from peaking and storage operations would have an existing recreation uses within the impoundment and immediately downstream. However, Applicant concluded that the project would be operated in run-of-river mode. Additionally, Applicant elected to install a concrete cap to maintain post-project water levels near existing water levels during average flow conditions. Since the water quality assessment and associated mitigation suggested only minor water quality effects, Applicant determined that fishery effects would likewise be limited. Therefore, the existing recreational fishing was not likely to be affected, negating the need for further assessing effects on existing recreation uses in the reservoir or downstream. However, the fish passage efforts led to a decision to construct a fishway for American Eel and Sea Lamprey during project construction. This was qualitatively determined to be beneficial to upstream recreation.

3. RESULTS AND DISCUSSION

Applicant determined that the existing Water Works canal could be suitable for a safe passage project. However, the length of the recreational passageway would need to extend well up-river. Because of the significant concern for safety and security at the U.S. Pipe Company facility adjacent to the Water Works canal, Applicant determined that it would be preferable to site recreation facilities on the north side of the river.

Applicant consulted with Amherst County, which was preparing a recreation plan for James River. A key aspect of that plan is funding. Because funding has not become available, Applicant determined that a coordinated plan to provide a passageway on the north side would not be feasible at this time. Installing a passageway around the dam would be challenging because of the limited width between the dam and River Road. This would be further complicated by the installation of the American Eel and Sea Lamprey fish passage facilities. A recreation passageway could possibly be constructed within the James River adjacent to the north abutment. However, for safety reasons the passageway would need to extend upstream some distance for safety reasons. This would require the top section of the dam to be lowered at that location and a wall separating the main portion of the river from the passageway constructed for some distance upstream. Applicant did not cost this option, but determined it to be too expensive. Applicant elected to develop a portage around the dam in lieu of the passageway. However, when American shad passage is considered in the future, a recreation passageway can be considered as part of the design if it is feasible.

Applicant has not fully designed the canoe portage around Scott's Mill Dam because it must be done in conjunction with the American Eel/Sea Lamprey fishway because of the limited space between the dam and River Road. However, based on other portages and for safety reasons the portage take-out needs to be upstream of the dam buoys. Applicant envisions a light metal structure for the take-out and a wooden or gravel walkway around the dam. The light metal structure will be designed to withstand the frequent water level fluctuations in the headpond.

In conjunction with the portage, Applicant has included a fishing platform to replace the informal fishing area. This will be handicap accessible. The fishing platform will be constructed immediately downstream of the fishway. The portage put-in will be immediately downstream of the fishing platform. Designs cannot be prepared until the fishway is finalized because the downstream end location is likely to change from the conceptual design.

Parking for the portage and fishing platform may need to be ungraded from the approximate 10 spaces currently available. This will need to be worked out with local and state transportation officials to ensure safety of recreationists and motorists. Applicant expects this to include appropriate signage and possibly paving of the shoulder areas for parking.

For impoundment access, Applicant was in agreement with licensing participants that there should be boating access along River Road. Applicant reviewed potential parcels and identified a site owned by Liberty University. Applicant has had initial discussion with Liberty University but does not yet have access rights. However, Applicant believes that Liberty University will be amenable to use of their lands for boat access.

Although there are hiking and walking trails along Blackwater Creek and in downtown Lynchburg, the Applicant surveyed these trails but could not identify any locations that could link these trails to the project area because of the Chesapeake and

Ohio railroad and the U.S. Pipe industrial facility. On the east side of the river development of a hiking trail along River Road is constrained by the steep shoreline topography, the adjacent steep hillside and River Road itself. Therefore, hiking and walking trails, natural areas, and bicycling trails are not included in Applicant's recreation facilities.

Applicant is committed to ensuring that adequate recreation access is allowed within Scott's Mill Pool and the project area. Applicant plans to continue coordination with local officials and resource agencies to ensure that the recreation facilities best meet the public needs. The Parties will cooperatively determine the location and design of the facilities. Construction and maintenance will be the responsibility of Scotts Mill, LLC.

STUDY PLAN 15 REPORT
CULTURAL RESOURCES
Scott's Mill Hydropower Project
(FERC No. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

The Scott's Mill Hydropower Project has the potential to affect cultural resources that are eligible for or listed in the Virginia Landmarks Register (VLR) and the National Register of Historic Places (NRHP). A cultural resources inventory and assessment within the project's preliminary Area of Potential Effect (APE) was undertaken to enable Applicant to avoid, minimize or mitigate potential adverse effects to historic properties. The objectives of the study were to inventory and assess cultural resources in the APE.

Several historic resources have been recorded within the project's APE. These consist of two architectural resources (James River and Kanawha Canal Sites in Lynchburg, Virginia (VDHR ID# 118-0209) and the Glamorgan Pipe and Foundry Company (VDHR ID# 118-0109)) and one archaeological site, called simply "canal lock" (VDHR Site # 44CP0069).

The James River and Kanawha Canal Sites in Lynchburg, Virginia (VDHR ID# 118-0209) are a series of discontinuous features that are listed in the VLR and NRHP as the last visible remnants of the c. 1830s canal in Lynchburg (Attachment 1: 118-0209 Site Form). Elements of the historic property that are located in the current APE consist of the waterworks dam, water works canal, James River (Scott's Mill) dam and guard locks. The guard locks are also recorded as archaeological site 44CP0069, although the location specified in the VDHR's Virginia Cultural Resources Information System (V-CRIS) seems to erroneously place them in a location identical to the gate at the head of the waterworks canal (Attachment 2: 44CP0069 Site Form). A Civil War period map indicates that the guard locks were located further away from river right, beneath the current railway tracks. Photographs of the project vicinity taken on February 5, 2016 confirm that only the waterworks canal remains visible on river right.

The Glamorgan Pipe and Foundry Company (VDHR ID# 118-0109), now the U.S. Pipe Company, is located east of the mill dam along river right. The pipe company property serves as an access route to the project and will be subject to installation of an underground electrical line to serve the powerhouse. The resource was recorded on January 1, 2000 by the Louis Berger Group and found not eligible for listing in the NRHP by the VDHR on June 8, 2000 (Attachment 3: 118-0109 Site Form).

Although several extant structures in the APE have been listed in the VLR and NRHP as part of a larger district, the site form and nomination form provide very limited detail

regarding the sequence of construction, reconstruction and repair of these resources. Further, there is little information given concerning construction methods and materials. For example, one source states that the original water works dam, built in the late 1820s, was destroyed by an 1847 flood and rebuilt (www.lynchburgonline.com/history.html). An architectural survey of the water works dam, water works canal, James River (Scott's Mill) Dam and James River and Kanawha Canal guard locks would provide the missing information. Furthermore, the stone foundation of Scott's Mill is extant on river left and should be recorded as an archaeological site. Additionally, archival research should be undertaken to predict the potential for underwater archaeological sites in the James River immediately above and below the existing dam.

The geographic scope of the study included the Scott's Mill Dam, the potential location of project facilities on river left and two potential locations of a powerhouse on river right at the head of the former Water Works Canal and James River and Kanawha Canal. It also includes the downstream end of Daniel Island, a smaller island immediately downstream of the dam and a portion of the U.S. Pipe property where an approximately 1200-ft. above ground and long underground electrical line will be installed.

The APE did not include the entire retention pool for the hydro project because that area was not included in the APE. However, based on FERC's comments on the draft license application, the project boundary was expanded to include the entire headpond to the upstream Reusens project.

The normal headwater elevation of the James River is about 515.5 feet (median flow). The project proposes installation of a concrete cap that would increase the normal elevation to a maximum of 516 feet, also under median flow conditions. At higher flow conditions, the water level could be up to 2 ½ feet higher. High river levels are frequently attained by the river currently and there are no projected additional effects to cultural resources predicted in the larger pool. On the south bank of the river along the railroad, shoreline protection measures have been implemented to prevent erosion. On the north bank, much of the shoreline has been developed. The current downstream elevation of 499 feet is not anticipated to be significantly impacted by the proposed project. Therefore, shoreline areas were not surveyed for cultural resources.

2. METHODS

This study consisted of two parts. First, an intensive (Phase II) architectural survey was completed which includes the individual elements of the James River and Kanawha Canal Sites in Lynchburg, Virginia (VDHR ID# 118-0209), the entire existing dam (water works dam and James River (Scott's Mill) Dam), water works canal, and guards locks. Second, the ruins of Scott's Mill, located on river left, were recorded as an archaeological site. The site's potential for listing in the VLR and NRHP is being coordinated with the VDHR. An archival research was planned to determine the potential for underwater archaeological sites in the APE. However, this was not done, because water level changes would not affect these resourcs.

All proposed work was conducted pursuant to the National Historic Preservation Act of 1966 (as amended), the Archaeological and Historical Preservation Act of 1974, Executive Order 11593, and Title 36 of the Code of Federal Regulations, Parts 60-66 and 800 (as revised). All field survey and preparation of materials were consistent with the procedures established by the U.S. Department of the Interior, National Park Service *Guidelines for Local Surveys: A Basis for Preservation Planning* and VDHR's *Guidelines for Conducting Historic Resources Survey in Virginia* (2011). Project personnel met or exceeded the qualifications contained in the Secretary of the Interior's Professional Qualifications Standards (48 *Federal Register* 44738-44739).

Intensive Architectural Survey:

Prior to beginning fieldwork, the senior architectural historian completed the background research needed for this project. Applicant examined records at the VDHR Archives, the Library of Virginia, the Virginia Historical Society, local historical societies, as well as Lynchburg City and Amherst County government records.

The reconnaissance-level survey was completed by a senior architectural historian. The survey included the exterior of all canal-related resources in the APE. A site plan was drawn of the resources, exterior photos taken, and boundaries proposed.

Preparation of Survey Materials: VCRIS Entry, Photo Labeling, Digital Images, and Site Plans

The preparation of survey materials include a site plan. The V-CRIS form for the resource was updated with the information gathered during the survey. In addition, the photos and digital images were prepared and labeled according to VDHR standards.

Archaeological Studies

Applicant's archaeological Principal Investigator conducted a reconnaissance level investigation of the Scott's Mill ruins. The investigation resulted in recording the ruins in V-CRIS and assessing their potential eligibility for listing in the VLR and NRHP.

3. RESULTS

The Phase II Architectural Survey Report is provided in **Appendix I**. The results will form the basis for consultation and the preparation of a Programmatic Agreement (PA) and Historic Properties Management Plan (HPMP) that will be prepared after the license exemption has been issued.

11. Literature Cited/ References

www.lynchburgonline.com/history.html (accessed on February 7, 2016).

2011 *Guidelines for Conducting Historic Resources Survey in Virginia*. Virginia Department of Historic Resources, Richmond.

STUDY PLAN 16 REPORT
VISUAL RESOURCES
Scott's Mill Hydropower Project
(FERC No. 14867)
Lynchburg City and Amherst Counties, Virginia

1. INTRODUCTION

Scott's Mill Dam has been in existence since the 1840s. Water has continuously flowed over the spillway since the dam was constructed. The local public can observe the flow over the dam from River Road and the 5th Street bridge immediately downstream of the dam. When the Scott's Mill Hydroelectric Project is completed, flow rate over the dam will continue but be reduced making the water fall less visually appealing. To assess the visual effects of the project, Applicant developed this study plan to document the visual quality of flow over the spillway from key viewing areas (KVA) at various flow conditions.

The geographic scope of the study was the Scott's Mill dam itself as seen from KVAs. The KVAs are River Road, the 5th Street bridge downstream of the dam, and Norwood Street on the south side of the river on the ridge above the U.S. Pipe Company industrial facility.

2. METHODS

Applicant photographed spillway flow during low flow, median flow, and high flow conditions. Low flow conditions were defined as flows under 1,000 cfs. Median flows are flows at about 2,000 cfs. Applicant documented of high flow conditions of 25,000 cfs. Flows of 12,000 cfs and above occur only about 5 percent of the time (i.e., about 17 days per year). The photographs will be taken from KVAs downstream of the project on River Road, from the 5th Street bridge, and from Norwood Avenue. Photographs were also taken from Scott's Mill dam of the 5 homes on Norwood Avenue that have a view of the dam and proposed powerhouse area. For the impact analysis, considered the change in views from having less flow over the spillway and with a veil over the dam. The veil flow would occur about 77 percent of the time.

Applicant considered the visual effects of the upstream water level changes as they may affect vegetation. Applicant relied on information from the terrestrial resources study (Study Plan 11).

3. RESULTS

Photographs of flow over the dam are presented in **Appendix C** of the FEA. Photograph 8 illustrates a low flow condition of 800 cfs flowing over the dam. The veil is thin and

not visually outstanding. Photographs 12, 9, and 7 were taken at flows of 1400, 1500 and 1800 cfs. These views are more visually attractive but not spectacular. Photograph 13 shows flow over the dam at 3,200 cfs. This flow is more visually appealing. Photographs 10 and 11 illustrate flow over the dam at flows of 25,000 cfs. These flows are more spectacular, but the water is turbid and the tailwater level is high, and lessens the outstanding qualities of the dam.

Under existing conditions, a thinner veil (i.e., less than 2000 cfs) occurs about 50 percent of the time, while more visually attractive flows from 2,000 cfs to 3,000 occur about 15 percent of the time, and the most spectacular flows occur 35 percent of the time. During project operations a very thin veil flow would occur 77 percent of the time. Flows over the dam similar to the lower existing condition flows (i.e., total flow between 4,500 and 6,500 cfs or less than 2,000 cfs over the dam and 4,500 cfs through the powerhouse) would occur about 10 percent of the time and the more spectacular flows greater than 3,000 cfs (i.e., total flow greater than 7,500 cfs) over the dam about 11 percent of the time. In essence, the more visually appealing flows over the dam would occur 24 percent of the time less than during existing conditions.

While this reduction in opportunities to observe the more pleasing flows over the dam equates to 88 fewer days, observers would still see the higher flows over the dam an average of 40 days per year. As can be seen in Photographs 16 and 17, vegetative screening along River Road is significant during the foliate season. During the defoliate season, the view from River Road is still partially obstructed. The far field views from the 5th Street bridge can be seen by passers-by but vehicles are not allowed to stop on the bridge (Photograph 19). Additionally, views from Norwood Street are partially obstructed (Photograph 20) and the 7 homes that have views of the dam (see Photograph 22) also look over the industrial operations at U.S. Pipe. These homes and passers-by would incur the greatest visual effects because they can observe the Scott's Mill Dam daily.

Applicant concludes that the project will have significant visual effects, but because there will be constant flow over the dam and spectacular flows over the dam will still occur 11 percent of the time, no additional mitigation is proposed. The basis for this determination includes the partial screening of the views from the KVAs (River Road and Norwood Street) and the limited number of homes that have a view of the dam. Views from the 5th Street Bridge were not considered as important because they are further away and vehicles cannot stop on the bridge.

Applicant also notes that Photograph 21 also shows that the horseshoe part of the dam is not readily visible. Hence views from Norwood Street would not likely include the proposed powerhouse.