Note to:	FERC Docket No. CP16-10
Note from:	Jennifer Fink, Project Manager, Gas Branch 3
Date:	September 4, 2020
Subject:	Biological Opinion and Conference Opinion-U.S. Fish and Wildlife Service

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Attached is a Biological Opinion and Conference Opinion for the Mountain Valley Pipeline Project. This document was provided to the Federal Energy Regulatory Commission via email from the United States Fish and Wildlife Service on September 4, 2020.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

September 4, 2020

Ms. Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, D.C. 20426

Attn: James Martin, Branch Chief

Re: Mountain Valley Pipeline, LLC; Docket Number CP16-10-000; Project #05E2VA00-2016-F-0880 and #05E2WV00-2015-F-0046

Dear Ms. Bose:

On November 21, 2017, the U.S. Fish and Wildlife Service (Service) provided the Federal Energy Regulatory Commission (FERC) with a non-jeopardy biological opinion (BiOp) based on our review of the referenced project and its effects on the federally listed species in Table 1 in accordance with Section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA).

Table 1. Listed species considered in the November 21, 2017 BiOp.

Species Common Name	Species Scientific Name	ESA Status	State
Small whorled pogonia (SWP)	*Isotria medeoloides*	threatened	West Virginia (WV)
Virginia spiraea (VASP)	*Spiraea virginiana*	threatened	WV
Roanoke logperch (RLP)	*Percina rex*	endangered	Virginia (VA)
Indiana bat (Ibat)	*Myotis sodalis*	endangered	VA, WV
Northern long-eared bat (NLEB)	*Myotis septentrionalis*	threatened	VA, WV

On August 28, 2019, FERC requested reinitiation of Section 7 consultation. On September 11, 2019, the Service accepted FERC's request. On October 16, 2019, the Service requested that FERC provide additional data/information. Also in October 2019, the U.S. Court of Appeals for the Fourth Circuit stayed the 2017 BiOp pending the resolution of a legal challenge. On December 10, 2019, the Service sent FERC a letter documenting the agreement between the Service and FERC to extend the consultation period by 60 days to February 10, 2020. On February 7, 2020, the Service sent FERC a letter documenting the agreement between the Service and FERC to extend the consultation period by an additional 45 days to March 26, 2020. On March 25, 2020, the Service sent FERC a letter documenting the agreement between the Service and FERC, with the consent of the project applicant in accordance with 50 CFR §402.14(e), to extend the consultation period by an additional 32 days to April 27, 2020. On April 27, 2020, the Service sent FERC a letter documenting the agreement between the Service and FERC, with the consent of the project applicant in accordance with 50 CFR §402.14(e), to extend the consultation period by an additional 30 days to May 27, 2020.

We have drafted a new BiOp and incidental take statement (ITS) to address new data and to ensure that we continue using the best available scientific and commercial information. This revised BiOp and conference opinion (CnOp) replaces in its entirety the Service's 2017 BiOp. This document transmits the Service's (BiOp + CnOp = Opinion) Opinion based on our review of the referenced project and its effects on the federally listed species and proposed critical habitat in Table 2 in accordance with Section 7 of the ESA.[1]

Table 2. Listed species and proposed critical habitat considered in this Opinion.

Species Common Name	Species Scientific Name	ESA Status	State
VASP	*Spiraea virginiana*	threatened	WV
RLP	*Percina rex*	endangered	VA
Candy darter (CD)[a]	*Etheostoma osburni*	endangered, proposed critical habitat	VA, WV
Ibat	*Myotis sodalis*	endangered	VA, WV
NLEB	*Myotis septentrionalis*	threatened	VA, WV

[a]Added since 2017 BiOp.

On March 29, 2019, FERC requested emergency consultation (50 CFR §402.05) with the Service. This emergency consultation provision applies to "situations involving acts of God, disasters, casualties, national defense or security emergencies, etc." Specifically, Mountain Valley Pipeline, LLC (Mountain Valley) needed to address 2.47 acres of slip repair (slips are a type of slope failure that result in a downward falling or sliding of a mass of soil, rock, trees, and other debris from a steep slope onto an area below) associated with the Mountain Valley Project (MVP), in Wetzel County, WV. This action adversely affected Ibat. This Opinion incorporates

[1] By letter dated July 9, 2020, the Service concurred with FERC's determination that the project is not likely to adversely affect certain listed species, which concluded the Section 7 process for those species. The basis for the Service's concurrence is documented in the record and summarized in memoranda to the file dated July 28, 2020, and September 3, 2020.

information on the nature of the emergency actions and the impacts to Ibat, including the information and recommendations provided by the Service during the emergency consultation.

This Opinion is based on information provided in the June 23, 2017 Final Environmental Impact Statement (FEIS) (FERC 2017a); July 10, 2017 Biological Assessment (BA) (FERC 2017b); May 28, 2020 second revised Supplement to the Biological Assessment (SBA) prepared by Mountain Valley (Mountain Valley 2020); multiple responses for data and information from FERC and Mountain Valley to the Service; telephone conversations; field investigations; and other sources of information. In several instances we relied on and adopted the findings of FERC and Mountain Valley after determining that those findings were reasonable, the product of sound methodological choices, and consistent with the best available scientific data. The consultation history is located after the Literature Cited. Because the project traverses 2 states under the geographic jurisdiction of the 2 Service Field Offices in Gloucester, VA (VAFO), and Elkins, WV (WVFO), each maintain their geographic portion of the administrative record in their respective Field Office.

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BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The following is a summary of the proposed action[2] and a detailed description can be found in FERC's MVP and Equitrans Expansion Project FEIS (FERC 2017a) and BA (FERC 2017b) for MVP and the SBA (Mountain Valley 2020).

Mountain Valley is proposing to construct a 304-mile natural gas pipeline in WV and VA (Figure 1), which requires a number of state and federal approvals, including a Certificate of Public Convenience and Necessity from FERC and a right-of-way (ROW) grant from the Bureau of Land Management (BLM) (Mountain Valley 2020).

Project Route – As proposed, the 42-inch diameter natural gas pipeline will cross 17 counties within WV and VA. The pipeline route begins at an interconnection with Equitrans, L.P.'s existing H-302 pipeline at the Mobley Interconnect and Tap in Wetzel County, WV, and proceeds to the Transcontinental Gas Pipeline Company's existing compressor station 165 in Pittsylvania County, VA. Additional components include 3 new compressor stations, 4 meter and regulation (M&R) stations (i.e., interconnects), 3 taps, 8 pig launchers and receivers at 5 locations, 36 new mainline valves (MLVs), and 31 cathodic protection beds. MVP will deliver up to 2 billion cubic feet (ft) per day of natural gas from the Appalachian Basin to markets in the Mid-Atlantic and Southeastern U.S.

Per the SBA (Mountain Valley 2020), the project route and facilities remain largely unchanged from what was presented in the BA (FERC 2017b). The route at that time was approximately 303.4 miles whereas it is now approximately 304.2 miles. The additional 0.8 mile of ROW is primarily a result of MVP shifts to avoid impacts to sensitive resources or accommodate landowner requests. Original tree clearing proposed for the MVP was 4,459.37 acres and is now approximately 4714.87 acres. This change is a result of ROW alignment shifts, changes to access roads (AR), necessary additions to the MVP work area, and Mountain Valley responses to landslides. All MVP route changes were approved by FERC via the variance process and underwent ESA Section 7 review by FERC, in consultation with the Service as appropriate.

Construction Timeline (Mountain Valley 2020) – As of May 4, 2020, Mountain Valley completed construction along approximately 256 miles of the MVP, with 155 miles fully restored. Following FERC approval and receipt of necessary permits, Mountain Valley is targeting the resumption of construction in the third quarter of 2020.

[2] Although portions of the project have already been completed as discussed in more detail below, this Opinion analyzes the effects of the entire project, including activities that have already been completed and those that have yet to occur.

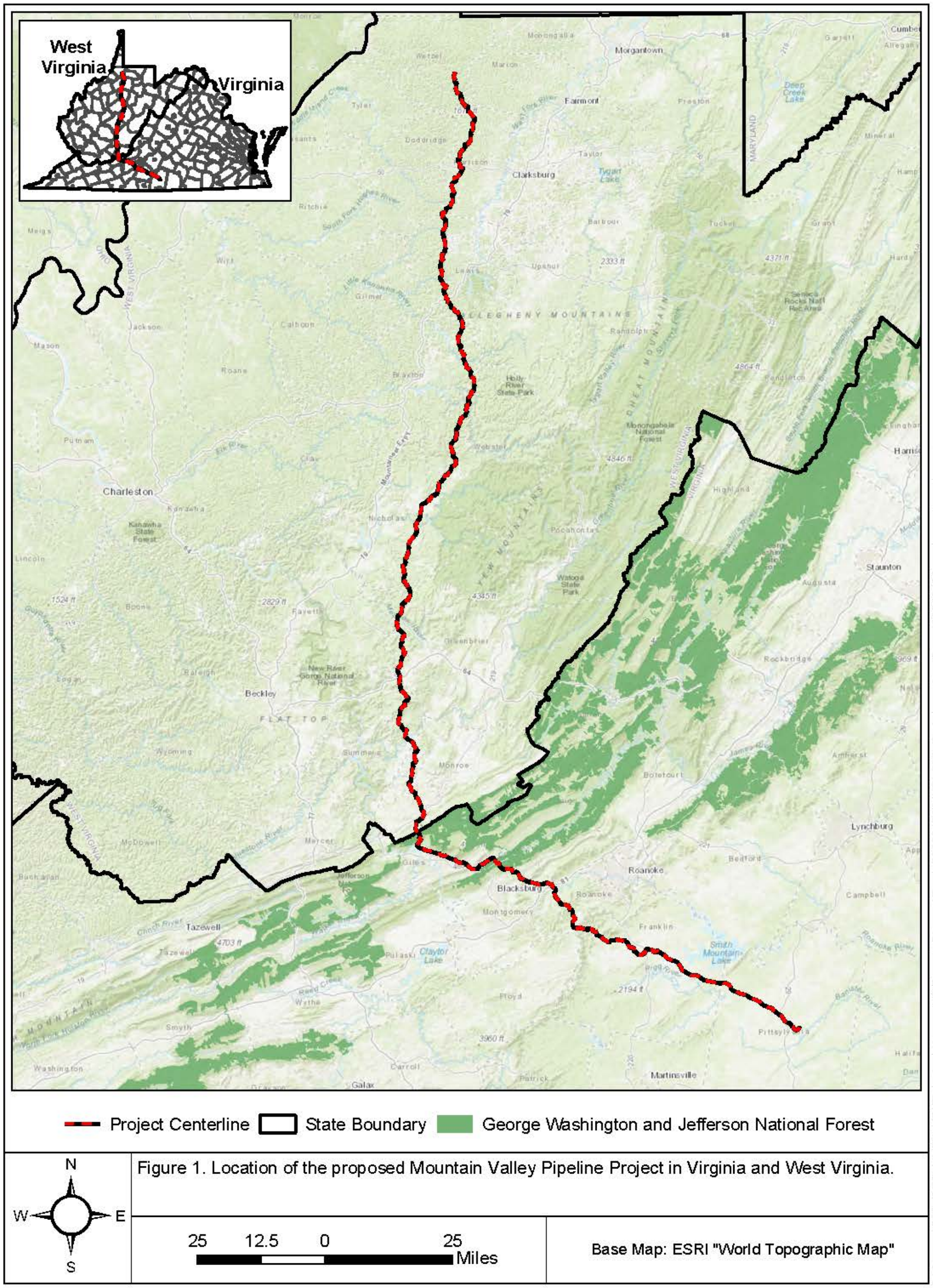


Figure 1. Location of the proposed Mountain Valley Pipeline Project in Virginia and West Virginia.

Proposed Facilities – A brief description of the 7 types of above-ground facilities are included below. Additional details describing the facilities are included in Section 2.1 of the FEIS (FERC 2017a) and Section 3.1 of the BA (FERC 2017b).

1. Compressor stations – utilize engines to maintain pressure within the pipeline to deliver the contracted volumes of natural gas to specific points at specific pressures. Designed to attenuate noise and allow for operation and maintenance (O&M) activities.
2. M&R stations – measure the volume of gas removed from or added to a pipeline system at receipt and delivery interconnects. Consist of a small graveled area with a small building(s) that enclose the measurement equipment.
3. Taps – connect the MVP pipeline with other natural gas systems operated by other companies.
4. MLVs – consist of a small system of aboveground and underground piping and valves that control the flow of gas within the pipeline and can also be used to vacate, or blowoff, the gas within a pipeline segment, if necessary.
5. Pig launchers and receivers – facilities where internal pipeline cleaning and inspection tools, referred to as “pigs,” can be inserted or retrieved from the pipeline. Generally consist of a segment of aboveground piping.
6. Cathodic protection systems – systems that help prevent corrosion of underground pipeline facilities. Typically include a small, aboveground transformer-rectifier unit and an associated anode ground bed located underground.
7. Very small aperture terminal equipment – provides telecommunication services at all compressor stations, M&R stations, and MLV sites.

Land Requirements – Construction of the MVP pipeline will disturb approximately 6,951.71 acres of land (FERC 2017b), 296.45 acres of which are associated with expected disturbance for future variances including slip repairs. Following construction, approximately 2,208.22 acres will be maintained for O&M of the pipeline. The remaining approximately 4,447.04 acres of disturbed land will be restored and allowed to revert to former use. A brief description of the 6 types of land requirements is included below. Additional details describing the land requirements are included in Section 2.3 of the FEIS (FERC 2017a) and Section 3.2.3 of the BA (FERC 2017b).

1. Pipeline ROW – the construction ROW consists of 2 portions, the temporary construction ROW and the permanent ROW. The temporary construction ROW will be restored or will revert to former use; a 50-ft permanent ROW (i.e., operational easement) will be maintained and utilized for O&M purposes. Mountain Valley will generally use a 125-ft construction ROW to install the pipeline in uplands and a 75-ft construction ROW through wetlands.
2. Additional temporary workspace (ATWS) – additional space required in particular areas necessary to complete construction of the pipeline. Examples include, but are not limited to, areas adjacent to crossings of roadways, railroads, waterbodies, wetlands, or other utilities; areas requiring extra trench depth; certain pipe bend locations; truck turnarounds or equipment passing lanes; staging and fabrication areas. ATWS will be used only during construction; after pipeline installation, all ATWS will be restored to their pre-construction condition and use.

3. Aboveground facilities – includes compressor stations, M&R stations and interconnects, taps, MLVs, and pig launcher and receivers. Temporary work areas used during construction of the aboveground facilities will be restored to their pre-construction condition and use after the facilities are built.
4. Contractor and storage yards (yards) – used to temporarily store pipe, materials, and equipment; set up offices; and mobilize workers. After pipeline installation, all yards will be restored to their pre-construction conditions and use.
5. Cathodic protection areas – used for installing cathodic protection rectifiers and groundbeds.
6. ARs – necessary to gain access to the construction ROW and aboveground facilities. Many of the proposed ARs are existing roads and virtually all existing ARs will require improvements for pipeline construction traffic.

<u>Construction Procedures</u> – Mountain Valley will design, construct, operate, and maintain the MVP pipeline and facilities in accordance with U.S. Department of Transportation regulations under 49 CFR 192 and other applicable federal and state requirements. Mountain Valley will comply with siting and maintenance requirements under 18 CFR 380.15 and other applicable federal and state regulations and implement various forms of mitigations as defined in 40 CFR 1508.20. They will adopt FERC's general construction, restoration, and operational mitigation measures as outlined in FERC's Upland Erosion Control Revegetation and Maintenance Plan (FERC Plan) (FERC 2013a) and Wetland and Waterbody Construction and Mitigation Procedures (FERC Procedures) (FERC 2013b). Construction plans include some modifications to FERC Procedures and more details can be found in Section 2.4.1.1 of the FEIS (FERC 2017a). Specific mitigation plans for National Forest lands have been determined in consultation with the U.S. Forest Service (USFS).

A brief description of the 8 types of typical construction procedures associated with the project is included below. Also provided below, where appropriate, is a description of significant work that has been completed to date and new information regarding certain construction procedures. Additional details describing the typical construction procedures are included in Section 2.4.2 of the FEIS (FERC 2017a). The typical construction procedures described below have proceeded, and will generally continue to proceed in an assembly line fashion with construction crews moving down the construction ROW as work progresses. After tree-clearing, construction and restoration at any point along the pipeline route takes about 3 weeks to complete; although progress can be delayed by topography, weather, or other factors (FERC 2017a, 2017b). Within 20 days of backfilling the trench (10 days in residential areas) all work areas are graded. The initial proposed construction schedule can be found in Section 2.5 and Table 4.9.2-1 of the FEIS (FERC 2017a).

1. Surveying and staking – marking of the limits of the construction ROW, centerline, ATWS, other approved work areas, and environmentally sensitive areas using temporary flagging or tape.

2. Clearing and grading – removal of trees, shrubs, brush, roots, and large rocks from the construction work area and leveling of the construction ROW to allow for operation of construction equipment.

<u>Tree Removal</u> – The action area (described below) includes 6 categories of Ibat habitat:

- Known use summer habitat – defined as areas within a 5-mile radius of a pregnant female or juvenile capture or within 2.5 miles of a known roost tree. Areas within these distances are generally considered the likely Ibat home range.
- Unknown use summer habitat – defined as unsurveyed areas where Ibats are reasonably likely to occur based on their location and presence of suitable habitat.
- Known occupied hibernacula – defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating Ibats.
- Assumed occupied hibernacula – defined as suitable caves/mine portals which are reasonably certain to be occupied by hibernating Ibats.
- Unknown use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of a potentially suitable hibernaculum that have not been surveyed for Ibats.
- Known use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of priority 3 and 4 hibernacula or a 10-mile radius of priority 1 and 2 hibernacula.

In addition to the categories described above, 1,252.11 acres of previously surveyed suitable summer habitat have been or will be cleared (i.e., trees felled). No Ibats were captured during these survey efforts. These areas include forested/wooded habitats in an Ibat recovery unit in which survey results, per the level of effort outlined in the Range-wide Indiana bat Summer Survey Guidelines (Service 2017a), suggest probable absence during the summer months. Because no Ibats are expected to be exposed to stressors in these surveyed areas, the Service does not anticipate any adverse effects to individuals of the species from the proposed action in those areas (see Environmental Baseline section). This habitat was previously considered its own habitat category in the 2017 BiOp (*suitable unoccupied habitat*); however, because no Ibats are expected to use these areas for any purpose, we are no longer considering these areas to be a separate habitat category for purposes of evaluating likely effects on individuals of the species. For more detailed information on these areas and the survey effort refer to the Ibat Environmental Baseline section.

Most of the tree clearing required for the MVP has been completed. Tree removal in each bat habitat category that has occurred since issuance of the 2017 BiOp is provided in Table 3. An additional 1.74 acres of trees remain to be cleared for the project (Mountain Valley 2020). These acres occur on 2 separate areas on the ROW (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 10, 2020). One area, 1.50 acres in size, within unknown use spring staging/fall swarming habitat, remains to be cleared due to occupancy by protestors. The other area, 0.24 acres in size, is within unknown use fall swarming/spring staging habitat near MP 119.7 and was not able to be cleared due to the vacatur of Mountain Valley's U.S. Army Corps of Engineers' (Corps) authorization.

Table 3. Tree clearing acreage in bat habitat category by month (Mountain Valley 2020; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, August 17, 2020). Total does not include acreage associated with NLEB because they are accounted for within one or more Ibat habitat category. This total identifies clearing that has already occurred. Numbers in rows and columns may not sum to exact totals due to rounding.

Bat Habitat Category	2018								2019						Total (acres)
	Feb	Mar	Apr	May	Jun	Aug	Sep	Nov	Mar	Apr	May	Aug	Sep	Nov	
Ibat known use summer habitat (acres cleared)	135.05	80.68	0	0	0	0	0	0	8.09	1.93	0	0.55	0	0	226.30
Ibat known use spring staging / fall swarming habitat (acres cleared)	15.49	292.70*	0	0	0	0	0	0	0	0	0	0	0	0	308.19
Ibat unknown use spring staging / fall swarming habitat (acres cleared)**	53.45	194.67	431.05	105.97	0.31	0	39.73	0	0.08	0.01	0	0	0	0	825.27
Ibat unknown use summer habitat (acres cleared)	0	268.31***	893.89	630.67	0	3.50	5.73	0.34	0.64	4.87	15.24	0.26	0.31	0	1,823.76
NLEB known use spring staging / fall swarming habitat (acres cleared)	0	15.62	0	0	0	0	0	0	0	0	0	0	0	0	15.62
Total acres	203.99	841.97****	1324.94	736.64	0.31	3.50	45.46	0.34	8.81	6.81	15.24	0.81	0.31	0	3,189.12****

*This total includes 3.21 acres that also fall within NLEB habitat.
**Approximately 32 acres of tree clearing along Pocahontas Road in Giles County, VA is included in the total. However, only tree trimming and the removal of several trees occurred along the road, making it very difficult to obtain an accurate acreage assessment. To be conservative, Mountain Valley has assumed tree felling along the entire length and width of the road.
***This total includes 6.83 acres that also fall within NLEB habitat.
****These totals do not include the 10.04 acres of habitat that overlap between NLEB and Ibat categories.

Tree Removal (slips not anticipated in 2017 BiOp) – Slips are a type of slope failure that result in a downward falling or sliding of a mass of soil, rock, trees, and other debris from a steep slope onto an area below (M. Hoover, Mountain Valley, email to C. Schulz, Service, July 1, 2020). Slips can be caused by a variety of factors, such as long duration or high-intensity rainfall events, rapid snowmelt, freeze/thaw conditions, slope height and steepness, vegetation, and underlying geology.

Unanticipated slips required tree clearing not considered in the 2017 BiOp to restore the ROW and stabilize and rehabilitate the areas impacted by the slip (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, April 3, 2020). Table 4 summarizes the acres of bat habitat by category affected by slips.

Table 4. Acreage of fallen trees by bat habitat category (P. Moore, Beveridge & Diamond PC, email to A. Bossie, DOI, April 27, 2020). All slip-related tree felling is subject to variance approval by FERC and Section 7 consultation where listed species or designated critical habitat may be affected.

Approximate MP	Estimated Acreage of Downed Trees	Bat Habitat Category	Time of Year
1.2	0.32	Ibat Known Summer Use Habitat	February 2018
1.5	0.33	Ibat Known Summer Use Habitat	February 2018
2.1	0.63	Ibat Known Summer Use Habitat	February 2018
2.3	0.29	Ibat Known Summer Use Habitat	February 2018
2.6	0.04	Ibat Known Summer Use Habitat	February 2018
3.9	4.58	Ibat Known Summer Use Habitat	February 2018
4.4	1.90	Ibat Known Summer Use Habitat	February 2018
5.0	0.03	Ibat Known Summer Use Habitat	February 2018
5.4	0.05	Ibat Known Summer Use Habitat	February 2018
5.5	0.17	Ibat Known Summer Use Habitat	February 2018
5.9	1.31	Ibat Known Summer Use Habitat	February 2018
6.0	0.25	Ibat Known Summer Use Habitat	February 2018
6.4	0.07	Ibat Known Summer Use Habitat	February 2018
6.5	0.11	Ibat Known Summer Use Habitat	February 2018
8.9	0.03	Ibat Known Summer Use Habitat	March 2018
9.3	0.03	Ibat Known Summer Use Habitat	March 2018
15.5	0.27	Ibat Unknown Use Summer Habitat	March 2018
16.0	0.05	Ibat Unknown Use Summer Habitat	March 2018
20.9	0.09	Ibat Unknown Use Summer Habitat	April 2018
21.0	0.09	Ibat Unknown Use Summer Habitat	April 2018
22.2	0.18	Ibat Unknown Use Summer Habitat	April 2018
22.3	0.04	Ibat Unknown Use Summer Habitat	April 2018
23.9	0.39	Ibat Unknown Use Summer Habitat	May 2018
28.1	0.05	Ibat Unknown Use Summer Habitat	April 2018
39.8	0.04	Ibat Unknown Use Summer Habitat	May 2018
46.8	0.65	Ibat Unknown Use Summer Habitat	March 2018
46.9	0.08	Ibat Unknown Use Summer Habitat	March 2018
47.1	0.21	Ibat Unknown Use Summer Habitat	March 2018
51.2	0.25	Ibat Unknown Use Summer Habitat	March 2018
57.3	0.13	Ibat Unknown Use Summer Habitat	April 2018
58.6	0.04	Ibat Unknown Use Summer Habitat	April 2018
62.4	0.04	Ibat Unknown Use Summer Habitat	April 2018
70.7	0.99	Ibat Unknown Use Summer Habitat	May 2018
82.8	0.27	Ibat Unknown Use Summer Habitat	April 2018
86.6	0.96	Ibat Unknown Use Summer Habitat	April 2018
Total	14.96		

Mountain Valley has adhered to all bat time-of-year restrictions (TOYRs) for tree clearing related to slips to date, except for the tree clearing associated with slips for which emergency Section 7 consultation was requested by FERC, as discussed above. When responding to future slips in known Ibat buffers, Mountain Valley will complete all tree clearing between November 15 and March 31 of any given year whenever possible (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020). In addition, in all areas of the MVP, Mountain Valley commits that it will not cut trees May 1 – July 31 to address future slips barring an unforeseen emergency arising (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020). Should an emergency arise that would require tree clearing during that period, Mountain Valley will coordinate with the Service and FERC on potential emergency consultation (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020).

Table 5 provides acreages of trees cleared due to past, ongoing, and future slips or MVP modifications for each Ibat habitat category. Mountain Valley's known future construction-related variances that require tree clearing are 6 areas that total approximately 7.13 acres of various habitat and have been incorporated into Table 5 (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 26, 2020). The details of the 6 areas are:

- MVP-HA-031.04 – the permanent AR is for continued O&M of the pipeline. It is an existing logging road that will be used to access the pipeline.
- MVP-NI-160(Ext) – the area is to provide a temporary AR to the proposed crossing of Hominy Creek and adjacent resources. It is an existing road and will be used to move equipment to and from the stream crossing. The LOD is reduced to 75 ft starting near MP 126.8 to minimize impacts to a wetland and two streams (including Hominy Creek).
- MVP-ATWS-1635 – the additional area is for safety reasons. The contractor anticipates winching equipment along the steep slope north of MP 163.2. The additional ATWS will be used to assist the winching process and to stage equipment and materials.
- MVP-MLV-AR-25.01 – the additional access is to provide permanent access to the MLVs in the vicinity. The section of the project between MP 209.3 and 209.4 is extremely steep and creates a driving hazard for standard ROW operation and maintenance vehicles.
- MVP-ATWS-1627 – the level temporary ATWS is for construction to build pipe sections and make welds rather than performing these tasks on the adjacent slopes. Once these activities are complete, the area may be used for water holding tanks that would store water for hydrostatic testing.
- MVP-PA-006 – the additional area is to allow pipe trucks to turn around and also pull off to allow other traffic to pass.

Table 5. Acreages of trees cleared due to past, ongoing, and future slips or MVP modifications for each Ibat habitat category (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, August 17, 2020).

Habitat Category	Acres of Project Tree Removal		Future Variance Estimated Tree Removal		Estimated Tree Removal to Remediate Existing Slips (all WV)	Estimated Acreage of Downed Trees Due to Slips (all WV)	Estimated Tree Removal to Remediate Future Slips		Total
	WV	VA	WV	VA			WV	VA	
Known use summer habitat	226.29	0	0	0	9.55	10.14	144.20	0	390.18
Unknown use summer habitat	1,748.98	74.78	4.85	0	11.05	4.82	86.77	3.71	1,934.96
Unknown use spring staging/fall swarming	303.91	523.12*	0	1.50	0.12	0	0	0	828.65
Known use spring staging/fall swarming	176.76	131.43	0	0.78	0	0	0	0	308.97
Total	2,455,94	729.33*	4.85	2.28	20.72	14.96	230.97	3.71	3,462.76

*Approximately 32 acres of tree clearing along Pocahontas Road in Giles County, VA is included in the total. However, only tree trimming and the removal of several trees occurred along the road, making it very difficult to obtain an accurate acreage assessment. To be conservative, Mountain Valley has assumed tree felling along the entire length and width of the road.

Any slip- or variance-associated tree clearing beyond that included in Table 5 would constitute a change in the action that could require reinitiation of Section 7 consultation. FERC and MVP should contact the Service prior to engaging in any tree-clearing beyond that anticipated in Table 5.

Mountain Valley based the slip acreage (Table 5) on what has been affected per Ibat habitat category thus far and the amount of ROW disturbed in that habitat category at the time (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). A factor was then added to that information to account for continued growth of those existing slips and the development of new slips during the rainy spring and summer months. In general, slips are often related to site-specific natural factors that are difficult to predict in advance of an occurrence.

Using engineering judgment, the following factors were developed to quantify the future acreage forecast (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). The total estimated acreage for each habitat type, A, is equal to A= x + y + z + a where:

- x = the number of acres known to be impacted by slips when the original known estimates were developed in November 2018
- y = 2x to account for additional slips and growth of the existing slip areas throughout the winter months, this is based upon known engineering principles that slip risk grows during the freeze/thaw cycle
- z = 1x to account for growth of the existing slips in previous graded areas throughout the spring construction season
- a = 1x (100% - %Graded) to account for slips that may occur subsequent to additional ROW grading

The above estimates (Table 5) assumed that final ROW restoration would be complete by the end of 2019. As of November 2019, it was estimated that 53% of the alignment will be permanently restored in 2019 and the remaining 47% was temporarily stabilized (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019) explanation regarding uncertainty and additional slips. The northern approximately 60 miles of the MVP occur within the Upper Pennsylvanian-aged Connemaugh Formation and Monongahela Formation as well as the Upper Pennsylvanian/Permian-aged Dunkard Group. These formations consist mainly of cyclic sequences of sandstone, siltstone, red and gray shale, limestone, and coal. These formations contain landslide-prone shale formations which are frequently associated with landslides that occur in the area. As these shales are exposed to water and oxygen near the surface, they weather into a thick mud. In addition, impervious layers located beneath the shale may trap water and cause the weathered shale to become saturated. Steep slopes that are often present in these areas, along with the weathered shale and mud, produce conditions that increase the likelihood for landslides.

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) further explanation regarding uncertainty and additional slips. In general, landslide susceptibility is higher in the northern and mountainous portions of the MVP due to regional geology and topography. Figure 2 demonstrates this trend. While this map shows only the likelihood of landslide occurrence and does not consider the effects of pipeline construction, the same trend is expected to occur along the pipeline alignment. The likelihood of additional slip-related tree clearing is increased in areas where the pipeline is aligned with the contours of the slope (i.e., sidehills or ridgelines) as landslides tend to damage trees above and below the movement. Usually, slips and slides occurring on planar slopes (perpendicular to contours) along the pipeline alignment affect areas already cleared of trees to facilitate pipeline construction.

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) additional explanation regarding uncertainty and additional slips. It is difficult to obtain a meaningful estimate of required acreage per month as it will be highly dependent upon precipitation. Generally, more slips are expected during the wetter months of the year (generally November through April) with fewer slips occurring during the dry summer months. Landslide occurrence is influenced by many factors that cannot be readily predicted, including precipitation. For example, while in general landslide incidence is decreased during the dry summer months, intense rainfall such as that derived from a tropical storm could trigger landslides regionally, not limited to the pipeline corridor. Landslides may occur during a relatively dry time of year, but a period of very intense rainfall may initiate numerous landslides regionally. Many slips continue to grow over time. When the initial movement occurs, the slip repair may be minimally invasive and require a relatively small amount of tree clearing. Timely remediation is critical to minimizing the tree acreage and other resources affected by slips.

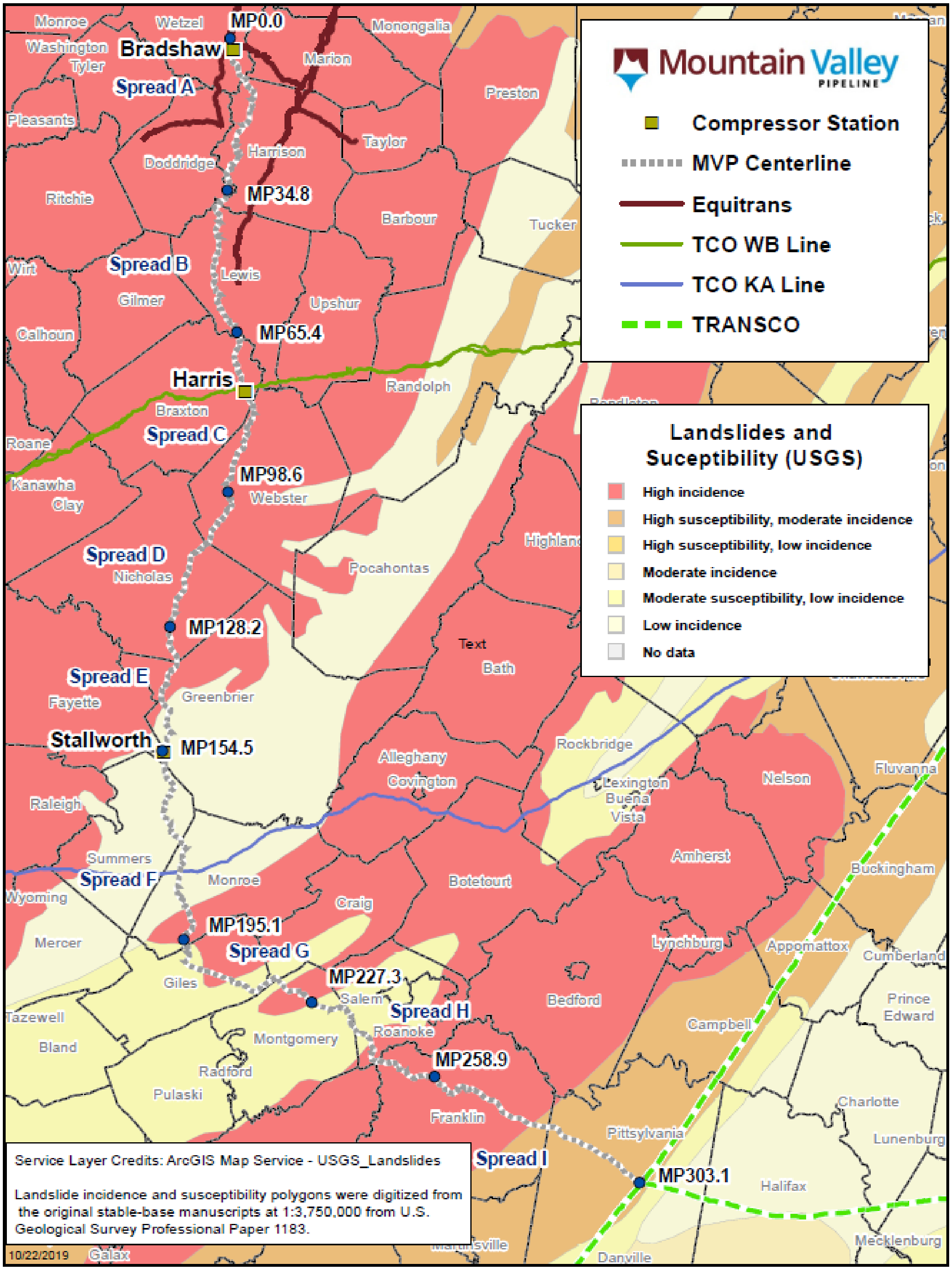


Figure 2. Landslides and susceptibility (U.S. Geological Survey [USGS]). This map was digitized from USGS manuscripts and is unsuitable for local planning due to scale (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

Trees were cleared in Ibat habitat during the Ibat tree clearing TOYRs after consultation with the Service as detailed in Table 6 (Mountain Valley 2020).

Table 6. Acres of trees cleared during Ibat tree clearing TOYRs (Mountain Valley 2020).

Ibat Habitat Category	Month Cleared	Acreage Cleared	Justification	Type and Date of Section 7 Consultation
Unknown use spring staging/fall swarming habitat	June 2018	0.31	Protestors occupied trees on top of Peters Mountain in WV near MP 196 for several months. Mountain Valley obtained approval under Variance G-4 to clear the trees following the end of the occupation.	Effects to Ibats included in 2017 BiOp (C. Schulz, Service, letter to K. Bose, FERC, June 6, 2018).
Known use summer habitat	April 2019	1.92	This tree felling was required to remediate a safety hazard caused by slips and was approved through Variances A-21 (MP 5.71), A-47 (MP 5.52), and A-55 (MP 1.2).	Emergency consultation on effects to Ibats initiated in 2019 (T. Lennon, Service, email to A. Mardiney, FERC, April 2, 2019) and after-the-fact consultation completed via this Opinion.
Known use summer habitat	August 2019	0.55	This tree felling was required near MP 1.5 to remediate a safety hazard caused by slips and was approved in Variance A-78.	Effects to Ibats included in 2017 BiOp (P. Friedman, FERC, letter to M. Eggerding, Mountain Valley, August 13, 2019).

Failed Erosion and Sediment (E&S) Controls – E&S control failures have occurred due to excessive precipitation or other factors that were not analyzed in the 2017 BiOp (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). In certain instances, sediment may have traveled beyond the MVP LOD (Table 7). When sediment leaves the MVP LOD, due to an E&S control failure, Mountain Valley immediately repaired or replaced those E&S controls (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). In many instances, additional E&S controls were added to reinforce protection of resources and to keep material within the LOD. In some instances, Mountain Valley has worked with the applicable state to redesign the controls in a particular area to reduce off ROW events (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). For listed plants, the failed E&S controls occurred in areas where Mountain Valley had previously conducted plant surveys and found none (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019).

Table 7. Instances of sedimentation beyond the MVP LOD.

MP	County, State	Spread	Listed Species Potential Habitat at Event Location	Stream ID	Stream Name	Date of Occurrence	Date Cleaned Up	Approximate Amount of Sediment (ft^3)	Approximate Length Sediment Traveled from LOD (ft)
227.2	Montgomery, VA	H	RLP	S-G36	North Fork Roanoke River	8/15/2018	8/15/2018	2	Unknown
227.2	Montgomery, VA	H	RLP	S-G36	North Fork Roanoke River	9/16/2018	Washed away	2[a]	Unable to be retrieved
227.2	Montgomery, VA	H	RLP	S-G36	North Fork Roanoke River	10/11/2018	Washed away	10[a]	Unable to be retrieved
269.8	Franklin, VA	I	RLP	S-F11	Blackwater River	9/18/2018	Washed away	10[a]	Unable to be retrieved
289.8	Pittsylvania, VA	I	RLP	S-C3	Harpen Creek	10/14/2018	10/17/2018	2	Unable to be retrieved

[a]Amount is estimated following hurricane-level storm event (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019).

3. Trenching – digging of pipeline trench by removal of soil and rock by track-mounted excavator/backhoe or similar equipment. Tractor-mounted mechanical rippers or rock trenchers may be used to fracture rock prior to removal. Blasting may be used in specific areas where hard bedrock is close to the surface.

Trenching – Table 8 reflects the amount of completed and remaining trenching within 1,060 ft of each of the 6 bat portals (M. Hoover, Mountain Valley, email to C. Schulz, July 7, 2020). The 1,060-ft is a screening distance based on the maximum charge weight used to evaluate the potential vibration and noise effects associated with blasting (Appendix G of the SBA [Mountain Valley 2020]). The maximum charge weight to date on the MVP has been 30 pounds (aside from the compressor stations, which are located over 2 miles from the closest portal), so an analysis (Appendix G of the SBA [Mountain Valley 2020]) was performed for all bat habitats within the 1,060-ft screening distance for this charge weight. The 1,060 ft distance is more fully explained in the SBA (Mountain Valley 2020).

Table 8. Amount of trenching that remains within 1,060 ft of each of the 6 bat portals (M. Hoover, Mountain Valley, email to C. Schulz, July 7, 2020).

Portal ID	Completed Trenching (ft)	Remaining Trenching (ft)
86_02	0.00	1,722.70
86_03	0.00	1,894.90
PS-WV3-Y-P1	2,345.77	0.00
44_01	0.00	1,414.87
43_01	1,708.34	0.00
23_01	0.00	2,928.58

Blasting – Blasting is minimized to the extent practical, and the need for blasting during project construction could not be determined at the time FERC issued the BA in 2017 (Mountain Valley 2020). Blasting for grade or trench excavation is short in duration, utilized only after all other reasonable means of excavation are determined to be unlikely to achieve required results, and is required in areas of shallow bedrock where unrippable subsurface rock is encountered. Blasting was required along approximately 153 miles of the MVP corridor from May to December 2018 and April to October 2019 (Mountain Valley 2020).

Table 9. Summary of blasting from May to December 2018 and April to October 2019 (M. Hoover, Mountain Valley, email to C. Schulz, July 7, 2020).

Habitat Category	Number of Miles Blasted - May to December 2018	Number of Miles Blasted - April to October 2019	Total Number of Miles Blasted
Ibat known summer use habitat	5.28	0.00	5.28
Ibat known use spring staging/fall swarming habitat	9.05	0.00	9.05
Ibat unknown use spring staging/fall swarming habitat	14.43	3.67	18.10
Ibat unknown use summer habitat	28.93	27.95	56.88
NLEB known use spring staging/fall swarming habitat	0.27	0.00	0.27
Total	57.96	31.62	89.58

During past blasting operations in Table 9, the measures described below were implemented (M. Hoover, Mountain Valley, email to C. Schulz, Service, July 7, 2020). Mountain Valley will also continue to incorporate these measures on future blasting operations. In areas where blasting occurs, Mountain Valley implements measures to prevent damage to natural and man-made features and structures, including potential hibernacula, water sources, cables, conduits, and pipelines (Mountain Valley 2020). Blasting mats or padding, restricted charge sizes, and/or charge delays are used to minimize air blast, peak sound pressure levels, and ground vibration. The 2017 Project General Blasting Plan (revised March 2018) and 2018 Site-Specific Plan for Braxton County Mine Portals describe the procedures and safety measures adhered to while implementing blasting activities (Mountain Valley 2020).

As detailed in Appendix G of the SBA (Mountain Valley 2020), based on available information, the upper range of the acceptable vibration levels at the portals is 0.20 inches per second. The International Society of Explosives Engineers outlined calculation methods and criteria levels for human response to blasting and provided a recommended limit of 0.013 pounds per square inch (psi) (equivalent to a peak, linear sound pressure level of 133 dB) for human structures. This criterion is set to limit complaints by people and avoid structural damage but does rely on people being informed of a blast event in advance. Guideline levels aimed at minimizing annoyance to people exposed to repeated blast events recommends an overpressure criterion of 115 dB linear for people. The audiogram provided in Figure 1 of Appendix G indicates it is likely that bats are significantly less sensitive than humans to the low-frequency sound generated by blasting (Mountain Valley 2020). Due to the short-term, low-frequency nature of the overpressure, it is not expected that bats would be more sensitive to this type of noise than humans.

The maximum charge weight to date on the MVP has been 30 pounds (aside from the compressor stations, which are located over 2 miles from the closest portal), so an analysis (Appendix G of the SBA [Mountain Valley 2020]) was performed for all bat habitats within the 1,060-ft screening distance for this charge weight. Of the previously performed blasting, no blasting was found to have exceeded the ground vibration or overpressure criteria during hibernation season. For other caves within 1,060 ft of the main pipeline LOD, charge weights have been presented that would ensure that surface construction blasting for the purpose of rock excavation along the pipeline route can be undertaken during the hibernation season without adverse effects to any bats that may be present in nearby features.

Mountain Valley commits to avoiding blasting during the bat hibernating season within the distances specified in the SBA (Table 2 of Appendix G) that would exceed the overpressure criterion of 115 dBA (0.0016 psi) (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). A minimum distance of 1,060 ft will be required if the charge weight is 30 pounds (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). But many of the blasting events will require a smaller charge weight, reducing the minimum distance required. For instance, if only a 10-pound charge weight is required, Mountain Valley will avoid blasting within 730 ft of a potential hibernaculum during the bat hibernating season (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Mountain Valley will also implement the procedures outlined the General Blasting Plan, which specifies the blasting specification, pre-blast surveys, inspections, and monitoring of blasting activities (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, May 18, 2020).

Mountain Valley committed to prepare a site-specific blasting plan within 0.5 mile of known or potential Ibat hibernacula (FERC 2017b). As noted in Mountain Valley's Pipeline General Blasting Plan, the site-specific blasting plan will be developed based on the conditions of that location at the time directly prior to the blasting event and will include monitoring details (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, May 18, 2020). Specifically, as noted in Section 7.6 of the General Blasting Plan, in karst terrain, the site-specific plan will be provided to the appropriate federal, state, and local authorities for review and approval 5 working days prior to conducting the blasting.

4. Pipe stringing, bending, welding, and coating – transportation of pipe segments to the construction ROW or yards and bending of pipes to fit contours of the trench. Pipeline segments are aligned and welded together. Welds are inspected and covered with protective coating.

5. Lowering-in and backfilling – lowering of pipe using side-boom tractors and backfill of trench with suitable excavated material using track-hoes, bulldozers, graders, or backfilling machines. In rocky areas, protective materials may be placed in trench to protect pipe. Trench breakers (sandbags or foam) will be installed in the trench on slopes prior to backfilling to prevent subsurface water movement along pipeline.

6. Hydrostatic testing and pipe cleaning – hydrostatic testing to ensure the system is capable of withstanding the operating pressure for which is it designed. Additional details describing hydrostatic testing are included in Section 3.1.6 of the BA (FERC 2017b). Afterwards, the pipeline will be cleaned and dried with pressurized air.

Temporary Water Withdrawals – Surface waterbodies planned for temporary water withdrawals for use in hydrostatic testing, dust control, and hydroseeding are listed in Table 10 if listed species may be affected (Mountain Valley 2020). Mountain Valley may also use water withdrawn from the sources in Table 10, except for the Gauley River, during the bore process of streams and wetlands. Water withdrawals are conducted in compliance with conditions in the West Virginia Department of Environmental Protection (WVDEP) Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics.

To reduce the potential impacts of withdrawing water from these streams, Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020).

Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). The West Virginia Water Withdrawal Guidance Tool information is based on annual flow statistics using USGS stream gauges in nearby streams. The historical information is used to determine when water can be withdrawn and still provide appropriate flow to protect the aquatic habitat. Using this tool will identify periods of low flow and drought conditions, which in turn will indicate when water can or cannot be withdrawn from the resource. Mountain Valley will use the tool each day a withdrawal is required and will adhere to any identified restrictions (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020).

Table 10. Water withdrawal locations along portions of MVP (Mountain Valley 2020).

Project Stream ID	Stream Name	WV County	Approximate	
			Latitude	Longitude
S-J29	Gauley River	Nicholas	38.270814	-80.682775

7. Commissioning – verifying that equipment has been properly installed and is working, verifying that controls and communication systems are functioning, and confirming that the pipeline is ready for service. As a final step, the pipeline will be purged of air and loaded with natural gas.

8. Cleanup and restoration – grading and restoration of all work areas to pre-construction topographic contours as closely as possible.

Specialized Construction Methods – Required when the pipeline is installed across waterbodies, wetlands, roads, railroads, foreign utilities, steep slopes, residences, agricultural lands, and other sensitive environmental resources. A brief description of the specialized construction methods is included below. Additional details describing the specialized construction methods are included in Sections 2.4.2.9 through 2.4.2.18 of the FEIS (FERC 2017a).

1. Waterbody crossings (dry open-cut crossings) –
   - Flume construction method – diversion of streamflow through flume pipes and placement of dam structures to exclude water flow from trench area.
   - Dam-and-pump construction method – diversion of stream flow using pumps and hoses and placement of dam structures to exclude water flow from trench area.
   - Cofferdam method – installation of a temporary diversion structure from 1 bank of the waterbody to the approximate midpoint of the waterbody crossing to isolate that section of the stream from the remainder of the waterbody, creating discrete dry sections around which water flows unimpeded.

<u>Updated Stream Crossing Methods</u> – The open-cut, dry-ditch crossing method was originally the proposed method for crossing streams containing federally listed species due to the controlled, visible work site and short duration of the crossing (Mountain Valley 2020). However, Mountain Valley continued to further analyze alternative options and, in cooperation with jurisdictional agencies, adjusted crossing methods to avoid and minimize potential impacts to listed species (Mountain Valley 2020). Mountain Valley changed the proposed crossing methods of the Gauley and Pigg Rivers from an open-cut dry crossing to trenchless crossing methods (Table 11) (Mountain Valley 2020). Slight modifications have also been completed or are proposed at other select stream crossings (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) (Table 11) since the 2017 BA.

Several of these crossings are complete (Table 11). The North Fork Roanoke River ROW crossing (S-G36) was installed in 2018 using an open-cut, dry-ditch method as planned (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). In 2019, the Pigg River ROW crossing (S-E11) was installed using a horizontal directional drill (HDD) method, rather than the originally-planned open-cut crossing method (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). The Pigg River crossing is the MVP’s only long-HDD crossing (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020).

Bradshaw Creek AR (MN-0276) was proposed to be crossed by temporary fill at two locations within a 92-ft stream reach, but Mountain Valley plans to utilize 2 existing stream crossings instead. A single AR approaches Bradshaw Creek (Stream ID S-OO10) and splits near the stream crossing and then rejoins after the crossing. The upstream crossing is composed of an existing multi-box, concrete culvert that has already been installed independent of the MVP and Mountain Valley intends to use this crossing without any modifications (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, April 3, 2020). The downstream crossing occurs downstream of the scour pool from the culvert (where the streambed aggrades) and is an existing ford crossing that will be upgraded to a single-span bridge (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

Of the streams with possible proposed or listed species remaining to be crossed via open-cut dry methods, Mountain Valley does not anticipate utilizing the flume crossing method, but will use the dam and pump method (M. Neylon, Mountain Valley, emails to J. Stanhope, Service, May 29, 2020, and June 10, 2020).

Table 11. Summary of MVP stream crossing locations and methods related to federally listed aquatic species (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019; J. Martin, FERC, letter to M. Eggerding, Mountain Valley, May 27, 2020; M. Neylon, Mountain Valley, email to J. Stanhope, Service, August 6, 2020).

Species	Stream ID (TT)	Stream Name	Project Feature	Change in Crossing Location (ft)	TOYR Commitment (start)	TOYR Commitment (end)	2017 BA Crossing Method	Current Crossing Method
RLP	S-G36	North Fork Roanoke River AR1	AR	0	1-Oct	30-Jun	fill/culvert	temporary, single-span bridge
RLP	S-G36	North Fork Roanoke River1	Pipeline Centerline	0	1-Oct	30-Jun	open-cut, dry-ditch	crossing completed in 2018
RLP	S-C21	Bradshaw Creek1	Pipeline Centerline	0	1-Oct	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-NN16	Roanoke River	Pipeline Centerline	0	15-Mar	30-Jun	open-cut, dry-ditch	microtunnel (changed from conventional bore)
RLP	S-D8	North Fork Blackwater River	Pipeline Centerline	0	1-Oct	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-C19	Maggodee Creek1	Pipeline Centerline	0	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
	S-F11	Blackwater River3	Pipeline Centerline	0	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-E11	Pigg River	Pipeline Centerline	16	15-Mar	30-Jun	open-cut, dry-ditch	HDD completed in 2019
RLP	S-C3	Harpen Creek1	Pipeline Centerline	9.8	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-OO10	Bradshaw Creek AR	AR	0	1-Oct	30-Jun	temporary fill	temporary, single-span bridge
RLP	S-OO10	Bradshaw Creek AR	AR	0	1-Oct	30-Jun	temporary fill	composed of an existing multi-box, concrete culvert
RLP	S-C17	Teels Creek4	Pipeline Centerline	0	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-CD6	Little Creek1.5	Pipeline Centerline	0	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-II2	Little Creek2	Pipeline Centerline	7.7	15-Mar	30-Jun	open-cut, dry-ditch	open-cut, dry-ditch
RLP	S-GH16	North Fork Roanoke River - SGH16	AR	0	1-Oct	30-Jun	temporary fill	existing single-span bridge
CD	S-J29	Gauley River	Pipeline Centerline	0	1-Jul	31-Mar	open-cut, dry-ditch	microtunnel
CD	S-S5	Stony Creek	Pipeline Centerline	0	15-Aug	31-Jul	conventional bore	conventional bore

Updated Trenchless Crossing Information – The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Within WV, horizontal boring would be performed starting near the elevation of the ordinary high water mark (OHWM) on both banks of the bored stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). The OHWM is the boundary of aquatic features, so limited impacts within the riparian zone are expected. Approved permitted E&S control and restoration best management practices (BMPs) will be followed throughout construction to limit the potential release of sediment from the ROW to the riparian zone and/or stream channel (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

The following is an explanation of conventional boring provided by Mountain Valley (M. Neylon, Mountain Valley, email to S. Hoskin, Service, May 18, 2020). Conventional boring is a collection of techniques that allows for trenchless construction across an area. To complete a conventional bore, two pits will be excavated, one on each side of the feature to be bored. The pits will be sloped or shored in line with all local, state, and federal safety regulations. The bottom of the excavations will be levelled and gravel placed to allow the track for a conventional auger bore machine to be placed in the entry pit. These pits are typically closer to the feature being crossed due to design length constraints for a conventional bore. The conventional bore pits on both sides of the crossing will be reinforced using sheet piling or trench boxes, which provide structural support, and help control groundwater. A boring machine will be lowered into one pit, and a horizontal hole (or series of holes with increasing diameter) will be bored at the depth of the pipeline installation. Boring will begin and the auger will remove all spoil from the hole and the bore. Sacrificial bore pipe will be pushed into the hole during the auger advancement towards the exit pit to case the hole in lieu of the line pipe during the boring process. Once the auger and bore casing pipe have reached the exit side, line pipe will be welded to the end of the casing and pushed through the hole with the boring machine in sections. The auger and sacrificial bore pipe will be cut up and removed on the exit side in manageable length sections until only the line pipe remains in the crossing. In some instances, the casing pipe may be left in place and the line pipe inserted through the casing. At this point, fittings and tie-ins may be made to complete construction in the area, appropriate backfilling of the excavations will be performed, and the site will be returned to natural grade. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return (IR) of these fluids within the stream.

The following explanation was provided by Mountain Valley (M. Eggerding, Mountain Valley, letter to K. Bose, FERC, May 20, 2020). Microtunneling and "Direct Pipe" are sometimes used interchangeably to describe the same crossing technique because they are very similar. Both use the same microtunneling boring machine (MTBM), the same cutting head, the same fluids, the same spoil handling strategy, and share similar capability and limitations to completing a trenchless crossing. Both directly install pipe immediately following the boring machine, resulting in a single pass installation. Microtunneling is an enhanced drilling technique that allows for trenchless construction below features. Unlike a conventional auger bore, which typically uses a non-steerable auger to establish the bore hole, microtunneling utilizes a MTBM, which uses remote operated hydraulic cylinders to steer the machine along the proposed bore path. The primary advantage of microtunneling over conventional auger boring is that the steerability of the MTBM enables drilling over longer distances and mitigates the risk of the bore deviating from the planned profile. The MTBM is typically the full diameter of the finished bore hole, and the product pipe is inserted behind the MTBM as it completes the bore and thereby significantly reduces the risk of collapse during boring and protects the rock integrity of the borehole. In comparison to HDD, microtunneling only requires one drilling pass compared to multiple drilling passes with a product pipe pullback on an HDD. The MTBM drilling head uses a drilling mud slurry for lubrication and conveyance of cuttings. While employing this method, the annular pressure is drastically reduced in comparison to the HDD method. This is because the MTBM uses fluid only at the cutting head and the annular space outside the product pipe, while cuttings are conveyed through an isolated slurry pipe that is fully contained within the product pipe. Therefore, the annular pressure in a microtunneling operation consists of only the hydrostatic pressure of drilling fluids. HDD fills the entire bore hole with drilling fluid and circulates a much larger volume of drilling fluid at higher pressure to both lubricate the hole and remove cuttings. Microtunneling's use of a much smaller volume of drilling fluid at a drastically reduced pressure greatly minimizes the risk of an IR. An HDD, in comparison, may have downhole pressures up to 10 times the downhole pressure in a microtunnel bore. By controlling the thrusting force, rate-of-penetration, and tunneling pressures, the risk for IR is drastically reduced in a microtunneling operation compared to the traditional HDD methodology. Disadvantages of microtunneling include that it is limited in crossing length compared to an HDD, but that disadvantage does not affect this project because the bore lengths are well within the envelope of the technology. Also, the bore pit logistics only enable one project pipe joint to be inserted at a time, which results in a slower drilling rate as drilling must stop to weld, test, and coat each joint.

Mountain Valley has successfully completed the trenchless crossings of a number of streams without environmental issues or instances of IR (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Table 12 describes the potential mechanism for an inadvertent release for the three remaining trenchless crossings (probability of a release, amount of release material, composition and nature of release material (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

Table 12. Potential mechanism for an IR (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

Stream	Proposed Trenchless Crossing Method	Potential for IR; Amount of Return Material in the Event of IR; Composition and Nature of Return Material
Gauley River	Microtunnel	Potential: Very low. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss. Amount: Less than 50 gallons. Composition: Water, small amount of bentonite and soda ash, cuttings/debris from borehole.
Stony Creek	Guided conventional bore	Potential: Very low. Any risk of IR is only during the pilot hole phase when fluids are used. During that phase, groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring, remote-controlled valving, and/or surface monitoring further reduce the risk of IR and minimize any potential fluid loss. No fluids are used during the conventional bore phase. Amount: Less than 50 gallons. Composition: Water, negligible amounts of biodegradable vegetable oil, cuttings/debris from borehole.
Roanoke River	Microtunnel	Potential: Very low. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss. Amount: Less than 50 gallons. Composition: Water, small amount of bentonite with additional additive, cuttings/debris from borehole.

Updated Open-Cut Stream Crossing Information Specific to RLP – The entire width of the 75-ft LOD in the stream will be necessary to complete a crossing using the open-cut methodology (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). However, trench spoils will not be placed within the limits of the stream channel. The spoils will be placed adjacent to the stream, within the LOD, and protected with the appropriate E&S control measures (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020).

Habitat disturbance within the LOD with open-cut crossings in RLP suitable habitat will include temporary dewatering of the channel and removal of bedload substrates for pipeline installation (Mountain Valley 2020). Table 13 provides the total stream crossings within each RLP habitat watershed, the number of stream crossing that are complete, and what methodology was utilized to cross those streams (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

Table 13. Total stream crossings within each RLP habitat watershed, number of stream crossings completed, and methodology utilized to cross those streams (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

Watershed Name	Approximate Watershed MP Begin	Approximate Watershed MP End	Total Streams Crossed within the Watershed	Number of Streams Complete	Number of Streams Crossed via Bore	Number of Streams Crossed via Open-Cut
Roanoke River	220.8	293.4	227	30	7	23
North Fork Roanoke River	220.8	229.8	20	4	0	4
Bradshaw Creek	229.8	232.4	5	0	0	0
North Fork Roanoke River	232.4	233.3	0	0	0	0
Pigg River	277.2	289.6	55	6	2	4
Harpen Creek	289.6	293.4	8	0	0	0

<u>*Open-Cut Stream Crossing Information Specific to CD*</u> – Mountain Valley anticipates crossing Kimballton Branch (tributary to Stony Creek, VA) with the pipeline via an open-cut dry crossing method (M. Neylon, Mountain Valley, email to J. Richard, Service, June 16, 2020). The AR that crosses Kimballton Branch is an existing private drive from Rogers Road. Mountain Valley is utilizing both the existing drive with culverts previously placed in the stream by others and the existing Rogers Road (Route 683) to access the project.

2. Wetland crossings – construction ROW through wetlands are typically 75-ft wide with ATWS located in upland areas a minimum of 50 ft from wetland edge, unless granted site-specific approval for a reduced setback. Mountain Valley has requested a ROW greater than 75 ft wide in wetlands at several specific locations as listed in Appendix G of the FEIS (FERC 2017a). Sediment barriers such as silt fence and staked straw bales will be utilized during clearing and construction. Wetlands will be crossed by wet or dry open trench lay, or open ditch push-pull methods.

3. Road and railroad crossings – railroads and paved roads will generally be crossed by boring beneath the road or railroad. Most gravel, dirt, and grass roads will be crossed by open-cut method; traffic will be maintained during construction by the use of steel plates or detours.

4. Residential construction – implement measures to minimize construction-related impacts on all residences and other structures located within 50 ft of the construction ROW

following site-specific *Residential Construction Plans* included in Appendix H of the FEIS (FERC 2017a).

5. Foreign utilities – buried pipelines and utilities will be identified and crossed without damage by implementing multiple measures, including using One-Call systems.

6. Agricultural areas – identify and flag existing irrigation systems and drainage tiles; any damaged irrigation and drainage systems will be repaired or replaced. A minimum of 12 inches of topsoil will be segregated from the construction ROW in agricultural lands, in accordance with the FERC Plan (FERC 2013a).

7. Rugged topography – temporary and permanent control measures such as silt socks, reinforced "super" silt fence, slope breakers, trench breakers, trench drains, erosion control matting, and hydro-mulching will be put in place to minimize E&S. In areas where the pipeline route crosses laterally along a slope, "two-tone" construction techniques may be used. Equipment on steep slopes will be suspended from a series of winch tractors.

8. Karst terrain – crossing of karst terrain will follow the project-specific construction, restoration, and mitigation methods, summarized in Section 4.1.2.5 in the FEIS (FERC 2017a) and described in the *Karst Mitigation Plan* (Draper Aden Associates 2017).

9. Winter construction – specialized construction methods or procedures will be utilized to protect resources during the winter season as described in the *Winter Construction Plan* (Mountain Valley 2016a).

<u>Monitoring and Post-Approval Variances</u> – Mountain Valley has developed procedures for construction monitoring and quality control, environmental inspection, compliance monitoring, and post-approval variances. A brief description of the procedures is included below. Additional details describing the procedures are included in Section 2.4.4 of the FEIS (FERC 2017a).

1. Coordination – copies of all applicable environmental permits, construction drawings, and specifications will be provided to construction contractors.

2. Environmental inspection and training – trained environmental inspectors (EIs) will be employed to ensure that construction complies with construction and mitigation plans and environmental conditions imposed by FERC and other regulatory agencies and conduct environmental training for company employees. EIs will have the authority to immediately "stop-work" for all activities and to take corrective actions to remedy instances of non-compliance.

3. FERC compliance monitoring – in addition to EIs, a third-party compliance monitoring program will be funded to provide daily environmental monitoring services during construction and daily reports to the FERC Project Manager. Other federal, state/commonwealth, and local agencies may also monitor the project to the extent determined necessary by the agency.

Increased E&S Control Inspection Frequency (T. Normane, Mountain Valley, letter to D. Sligh, Wild Virginia, February 25, 2020) – The Henrico County Circuit Court in VA approved a comprehensive Consent Decree on December 11, 2019, to resolve alleged violations that occurred through September 18, 2019. Prior to entry of the Consent Decree, Mountain Valley already committed to an increased E&S control inspection frequency (all controls inspected at least every 4 days) and an accelerated deadline to repair ineffective controls (within 24 hours). In addition to regular inspections by Mountain Valley, Virginia Department of Environmental Quality (VDEQ), and FERC staff, Mountain Valley entered into a Memorandum of Agreement with VDEQ to fund ($6.7 million) third-party inspectors contracted by VDEQ to provide additional daily inspections of the project. There are approximately 50 individual inspectors monitoring the VA portion of the MVP. That number includes Mountain Valley's inspection staff, third-party Environmental Auditors, VDEQ staff inspectors, VDEQ's third-party inspection contractor, FERC inspectors, and USFS inspectors. There are approximately 60 individual inspectors monitoring the WV portion of MVP. That number includes Mountain Valley's inspection staff, WVDEP inspectors, and FERC inspectors. In addition to their scheduled inspections, the WVDEP also conducted inspections based on citizen information. To enhance resource protection, Mountain Valley committed to a more robust inspection frequency than what is typically required in the WVDEP General Water Pollution Control Permit by requiring inspections to be completed within 24 hours following a storm event greater than 0.25 inches per a 24-hour period and every 7 days.

As a result of the Consent Decree, Mountain Valley created a comprehensive "punchlist" system to consolidate all issues identified by VDEQ, Mountain Valley, and FERC inspectors and to verify that they are addressed within the required timeframes. Mountain Valley engaged a third-party Environmental Auditor to conduct regular inspections and assessments of the project's compliance with the Commonwealth's E&S control and stormwater management requirements. The Environmental Auditor will be providing publicly available reports on the performance of Mountain Valley's full-time inspection staff and environmental field crews. Since the date the Consent Decree was entered, the Environmental Auditor has been performing field inspections and document reviews, which are summarized in biweekly and quarterly reports available at https://www.mountainvalleypipeline.info/news-info/.

4. Post-approval variance process – variance requests for minor modifications within the previously surveyed corridor that will not impact sensitive resources, and have landowner acceptance, will be submitted to the third-party compliance monitor for review and approval. Larger or more complex variance requests will be submitted to FERC staff for review and final determination.

Variances – Variances for the MVP have been approved by FERC since issuance of the 2017 BiOp (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, April 10, 2020) (Appendix E Table 14). Some variance requests have required additional surveys for the presence of federally listed species and/or their suitable habitat. All surveys were negative. See Appendix E Table 14 for details.

5. Post-construction monitoring – follow-up inspections and monitoring of all disturbed upland areas will be conducted for at least the first and second growing seasons to

determine the success of restoration, including until revegetation thresholds are met, temporary erosion control devices are removed, and restoration is deemed complete.

6. Monitoring the ROW grant for federal lands – the USFS and U.S. Army Corps of Engineers will monitor implementation of the MVP mitigation measures on federal lands to assure that the terms and conditions of the ROW Grant issued by BLM are carried out (40 CFR 1505.3) and that negative impacts from construction and operation of the pipeline on federal lands are minimized to the extent possible.

<u>O&M</u> – MVP pipeline and aboveground facilities will be operated and maintained in accordance with U.S. Department of Transportation regulations in 49 CFR 192, FERC's regulations at 18 CFR 380.15, and the maintenance provisions found in the FERC Plan (FERC 2013a) and Mountain Valley's modified FERC Procedures (FERC 2013b, 2017a). A brief description of the O&M details is included below. Additional details describing O&M are included in Section 2.6 of the FEIS (FERC 2017a) and Section 3.2 of the BA (FERC 2017b).

1. Pipeline facility O&M – an O&M plan and an emergency plan will be established that include procedures to minimize the hazards in a natural gas pipeline emergency. Vegetation removal and maintenance within the 50-ft permanent ROW will be conducted in accordance with the FERC Plan (FERC 2013a). Regular patrols, inspection, and repair of the pipeline will be conducted.
2. Aboveground facility O&M – all equipment at aboveground facilities will be routinely inspected and maintained by Mountain Valley. Routine maintenance checks will include equipment and instrumentation calibration and safety equipment testing. The aboveground facilities will be unmanned, with start/stop capabilities controlled from corporate headquarters. When the safety system or alarms are activated, personnel are notified and dispatched.

<u>Future Plans and Abandonment</u> – Mountain Valley may seek to expand or modify its facilities in the future if market conditions change. Any future expansion will require filing an amendment to its application or a new application to FERC. The expected useful lifespan of the project would be about 50 years. While there is no termination date for a FERC natural gas certificate, at the end of the 50-year period, Mountain Valley may need to repair, replace, or abandon facilities. Any of those actions would require permission from FERC. Abandonment activities would require an application to FERC under Section 7(b) of the Natural Gas Act. Facilities could either be abandoned in place or by removal.

<u>Avoidance and Minimization Measures (AMMs)</u> – Conservation measures proposed as part of the action (measures that will avoid, minimize, and mitigate effects of the proposed action on the species and/or benefit the species as a whole) are referred to as AMMs in this Opinion. AMMs are provided in the FEIS (FERC 2017a) and BA (FERC 2017b) and discussed, as applicable, in Appendix B of this Opinion.

Mountain Valley designed the project to avoid and minimize impacts to the natural environment by selecting a route that avoids to the extent possible critical or sensitive habitats, national wildlife refuges, sensitive soils, disruption to mineral resources, environmental hazards, and geologic/topographic hazards (Mountain Valley 2020). In addition to route selection, Mountain

Valley is implementing BMPs for construction, operation, and maintenance of the project to minimize impacts to wetlands, waterbodies, and associated riparian habitats (Mountain Valley 2020). Changes to AMMs identified in the BA are described below.

<u>E&S Control AMMs</u> – Mountain Valley has implemented the use of enhanced measures for E&S control throughout the MVP in both VA and WV (M. Eggerding, Mountain Valley, letter to K. Bose, FERC, May 14, 2020). Enhanced measures implemented beyond the approved E&S control plans include the following: hydraulically applied or pelletized mulch/tackifier upgraded from a less protective stabilization measure (approximately 65 miles), waterbar end treatments upgraded from single compost filter sock (CFS) to triple stack CFS (approximately 85 miles), increased size of CFS, upgrade of standard silt fence to Priority 1 belted silt retention fence, erosion control blanket installed in flow path and at the outfall end treatments of waterbars (in areas with erosive soils), temporary slope drain pipes installed to convey waterbar discharge across fill slopes where the ROW is benched, among other enhancements. Not all enhanced BMPs are expected to perform the same and should not be considered identical in terms of their reduction in expected sediment loads. Since construction commenced in 2018, approximately 65 formal enhancements have been prepared by Mountain Valley's field engineer in response to changing site conditions.

<u>AMMs Benefitting VASP</u> – (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019):

- Avoiding introduction of exotic/invasive species in organic materials brought onsite during construction by thoroughly cleaning equipment prior to mobilization to Project Area.
- Establishing equipment cleaning stations to thoroughly wash all equipment before transporting it to the next construction spread.
- Implementing selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operating of the Project.
- In wetlands, agricultural, and residential areas, stripping topsoil from the full width of the construction ROW and storing it separately from other soils in areas identified as containing higher than usual concentrations of exotic/invasive plant species.
- Minimizing the amount of time bare soil is exposed during construction to reduce opportunity for exotic/invasive plants to become established.

Impacts to VASP are expected to be minimized using BMPs for and avoidance of riparian corridors and wetlands (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). These include:

- Reducing the construction ROW width from 125 ft to 75 ft at stream and wetland crossings.
- Expediting construction within any waterbody, effectively reducing disturbance to the streambed and adjacent soils and the quantity of suspended sediments.
- Clearly marking wetland boundaries and buffers to be avoided in the field with signs and/or highly visible flagging until construction-related ground-disturbing activities are complete.
- Avoiding removal of riparian canopy or stabilizing vegetation, if possible. Crushing or shearing streamside woody vegetation is preferable to complete removal.

- Stabilizing waterbody banks and installing sediment barriers (i.e., silt fence, silt logs) within 24 hours of completing in-stream construction activities. Sediment barriers will be left in place until the site has been stabilized with perennial vegetation (typically 1 full growing season after construction).
- Aligning crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions allow.
- Attempting to maintain, at minimum, a 15-ft section of undisturbed vegetation between the waterbody and construction ROW where the pipeline parallels a waterbody.
- Conducting construction at stream crossings during low-flow conditions, to the maximum extent possible.
- Crossing streams using dry-ditch crossing methods by pumping or fluming water around if water is flowing at the time of construction.
- Conducting pipeline assembly in upland areas unless the wetland is dry enough to adequately support skids and pipe. Timber mats are used to cross wetlands.
- Minimizing the length of time that the trench is open, to the maximum extent practicable, especially within wetlands.
- Minimizing the amount of necessary construction equipment traffic to that which is needed to clear and grade the ROW, excavate the trench, install the pipeline, backfill the trench, and restore the construction ROW.
- Prohibiting construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, stored, or serviced within a 100-ft radius of any wetland or waterbody. All equipment will be inspected for leaks by an inspector at the beginning of the day. Operation will not commence or will cease until the spill is contained, cleaned up, and collected before operations continue. Leaking equipment will be removed or repaired the same day.
- Locating as many ATWS as possible at least 50 ft away from the water's edge. Storing trench spoil excavated from within a stream at least 10 ft from the top of the bank to minimize turbidity caused by erosion.
- Avoiding the use of herbicides and pesticides to maintain any portion of the Project ROW or aboveground facilities, unless requested by a land-management agency or needed to spot treat exotic/invasive species.
- Installing temporary equipment bridges within the ROW to reduce turbidity and sedimentation caused by construction and vehicular traffic.
- Minimizing crossing of the pipeline through forested wetlands to the maximum extent practicable.
- When forested wetlands are crossed, Mountain Valley will maintain no more than a 10-ft wide, herbaceous strip centered over the pipeline and only remove woody vegetation within a 30-ft wide strip centered over the pipeline.
- Allowing vegetation in wetlands to recover more rapidly by only removing tree stumps located directly over the trench line or where safety is a concern.
- Restoring each waterbody to its original configuration and contour to the maximum extent possible.
- Permanent stabilization of the banks of the waterbody and adjacent areas using erosion control measures and vegetative cover will occur as soon as possible after construction.
- Using native stone to the extent possible during stream bed restoration and stabilization.

- Promptly removing construction materials and related crossing structures from each waterbody after construction.
- Avoiding the use of surface water sources in VA for hydrostatic testing. Municipal source waters will be used instead.
- Implementing sustainable water-use practices to ensure water resources and environmentally responsible stream flows are maintained during water withdrawal activities. All water withdrawals will be performed in accordance with local, state, and/or federal regulations to prevent the localized and downstream dewatering of streams. To prevent crushing, entrainment, or entrapment of mussels and fishes, floating, screened intakes will be used. The intake end of the pump will contain an appropriately sized screen (i.e., less than 0.1875-inch mesh size), and withdrawal rates will be reduced (i.e., screen approach velocity will be 0.5 ft/second or less).
- Discharging hydrostatic test water to the ground in an upland, well-vegetated area and not directly to surface waters.

Aquatic Species AMMs –

- Mountain Valley employed enhanced E&S control measures in many places along the project. Enhanced measures include increasing the size of sediment traps, bolstering downslope perimeter controls with additional layers (e.g., adding new silt fences or compost socks), and increasing the use of soil stabilization products on exposed soil slopes. These measures provide additional protections to aquatic species by minimizing the potential for sediment to leave the project area and impact waterways during precipitation events.
- Throughout the project area, Mountain Valley located the ROW and as many ATWSs as possible at least 100 ft away from the water's edge of any stream potentially supporting federally listed aquatic species.

Mountain Valley will implement several methods to reduce potential risks during stream crossings to isolate the work area and reduce sedimentation (M. Neylon, Mountain Valley, emails to J. Stanhope, Service, May 29, 2020, and June 10, 2020):

- Open-cut stream crossings will not be started unless the weather forecast reflects limited or no upcoming rain events.
- Mountain Valley will attempt to complete stream crossings during low flow.
- Environmental monitors will be onsite during the stream crossing to evaluate any changing conditions.
- Stream crossing crews will be required to have additional sandbags and E&S control devices, back-up pumps, and spill kits on-site prior to starting the stream crossing. Additional E&S control devices, including turbidity curtains, will be deployed downstream if necessary.
- All fuel supplies and pumps will be required to be in secondary containment.
- The stream crossing team will complete stream crossings as quickly as possible to eliminate the duration in the stream.
- Any temporary impacts to the stream banks and any adjacent areas from the crossing activity will be restored directly following the stream crossing.

Voluntary Mitigation – The BA (FERC 2017b) stated Mountain Valley would, as a voluntary conservation measure, provide funding for RLP and bat mitigation. Mountain Valley was to place the funding in an interest-bearing escrow account and identify an appropriate third-party, non-profit conservation organization to develop a Memorandum of Understanding.

In WV, Mountain Valley is continuing to coordinate with the WVDNR to facilitate bat mitigation (M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 26, 2020). In VA, Mountain Valley contributed to the Comprehensive Mitigation Agreement. This Agreement establishes commitments related to forest conservation and water quality. Funds from this Agreement have been utilized for projects with the U.S. Endowment for Forestry and Communities, the Environmental Endowment, and water quality projects with the USGS.

As part of the proposed action, funds will be provided to continue and expand restoration efforts along the North Fork Roanoke River and expand on an existing successful, landscape approach that tangibly benefits the RLP within its known occupied range (FERC 2017b). While providing funds to implement restoration will likely provide conservation benefits for the RLP, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time. Further, support will be provided for stream restoration activities within the range of RLP within the pipeline corridor (FERC 2017b). Proper stream restoration activities can provide a multitude of environmental and economic benefits including, but not limited to, the following: improved water quality; augmentation of habitat diversity; re-establishment of critical watershed functions; increased property and aesthetic values; and reduction of flood damages and riparian property loss. Targeted restoration activities in or near waterbodies will take place at 55 stream crossing locations along the action area. While supporting stream restoration activities will likely provide conservation benefits for the RLP, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

Furthermore, in collaboration with the VA and WV state environmental agencies, a mitigation model has been developed for federally listed bats. The mitigation model utilizes interior forest as the benchmark to which habitat impacts are compared. The goal of the model is to identify the quantity of acres required to fully offset forest impacts from the MVP. Although negotiations with the WVDNR are ongoing, Mountain Valley has agreed to place funds in an interest bearing account for the purchase of optimal bat habitat that is essential to the recovery of the species, throughout VA and WV. In VA, Mountain Valley contributed to the Comprehensive Mitigation Agreement. This Agreement establishes commitments related to forest conservation and water quality. The amount of acreage for WV will be determined in coordination with the Service and applicable state agencies and a Memorandum of Understanding with the WVDNR is being developed to establish criteria for ensuring the funds from the conservation escrow account are disbursed in accordance with the final mitigation proposal. While implementation of this mitigation will likely provide additional conservation for the Ibat, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

ACTION AREA

The action area is defined (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." As the regulation indicates, the action area constitutes the *physical area* (land, air, or water) affected by the project as determined through deconstruction of the action into its component parts. This determination is not influenced by the presence or location of listed species or critical habitat, but should be used to help generate the species list. The potential effects to listed species are not considered in this delineation of the action area and are evaluated after the physical area affected by the project has been identified.

As described in the BA (FERC 2017b), the action area was defined by a combination of effects related to movement of dust, light levels, noise, and water quality. The extent of expected effects from the project associated with dust and light are unchanged from the BA (FERC 2017b). Additional analyses, described below, indicate that the extent of noise and water quality effects from the project warrant revising the action area from the 2017 BiOp. FERC reviewed the information provided below related to revising the action area and agreed with the revised action area (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020).

<u>Action Area for Dust Effects</u> – The extent of dust impacts are not expected to exceed 350 ft from the project construction ROW (Mountain Valley 2020).

<u>Action Area for Light Effects</u> – Any light emitted is not expected to travel more than 1,200 ft from the project construction ROW (Mountain Valley 2020).

<u>Action Area for Noise Effects</u> (Mountain Valley 2020) – Ambient or background sound levels are those emanated from natural and artificial resources that currently exist on a given landscape and are often referred to as baseline noise levels. The magnitude and frequency of ambient noise will vary over a 24-hour period and throughout the year due to weather conditions, vegetative cover, wildlife, and human activity. Noise impacts are determined by quantifying increases over ambient levels caused by a given activity. Humans cannot discern less than a 3 dBA (A-weighted decibels) increase, an increase of 5 dBA is considered clearly noticeable, and increases of 10 dBA are perceived as a doubling of noise or becoming twice as loud.

Existing ambient conditions were estimated using American National Standards Institute (ANSI) S12.9-2018/Part 3 (ANSI/ASA 2013 as cited in Mountain Valley 2020) and information obtained from project-specific ambient measurements. The ANSI standard provides estimated ambient equivalent (Leq) sound levels based on land-use categories. The lowest ambient sound levels are provided for areas described as "very quiet suburban and rural residential," which correspond to areas with population densities of less than 200 people per square mile. The estimated ambient sound level for this land-use category is 40 dBA during daytime hours and 34 dBA during nighttime hours.

The sound levels from the ANSI standard were compared to the ambient noise levels measured at proposed compressor stations, interconnect sites, and 1 stream crossing. The measured ambient noise levels vary greatly depending on location along the route and differ from day (34.7 to 57.9 dBA) to night (27.8 to 53.7 dBA). The highest and lowest measured values were found to be not representative of the project area, and the majority of the measurements were above the ANSI standards. Therefore, the measured results support use of the ANSI standards for "very quiet suburban and rural residential" for ambient conditions along the project route even though higher ambient sound levels are anticipated in many areas. This approach was taken to identify a conservative estimate of ambient conditions.

On behalf of Mountain Valley, SLR International Corporation modeled sound attenuation for noise levels produced during project development using the ISO 9613-1 standard calculation within the Cadna/A propagation software. To evaluate the effects of varying meteorological conditions on sound propagation, the attenuation calculations were conducted not only for standard atmospheric conditions (i.e., 59 degrees Fahrenheit and 60% relative humidity [RH]) but also for the general range of temperature and RH conditions for each season that will result in the least amount of attenuation (i.e., the highest sound levels, thus a broader action area) (Table 15). In general, attenuation decreases with increasing humidity, but the relationship is not linear and varies by octave band.

Table 15. Distances construction noise attenuates to ambient conditions. Nighttime noise ambient level is 34 dBA; loudest nighttime construction activity is 91 dBA at 50 ft. Daytime noise ambient level is 40 dBA; loudest daytime construction activity is 94 dBA at 50 ft (Mountain Valley 2020).

Season, Temperature, RH	Nighttime Noise	Daytime Noise
Winter, 26°F, 100%	10,750 ft (2.0 miles)	8,775 ft (1.7 miles)
Spring/Autumn, 63°F, 100%	9,750 ft (1.9 miles)	7,800 ft (1.5 miles)
Summer, 89°F, 100%	9,675 ft (1.8 miles)	7,475 ft (1.4 miles)
Standard, 59°F, 60%	9,600 ft (1.8 miles)	7,800 ft (1.5 miles)

The sounds produced by the noisiest construction equipment used during nighttime and daytime hours under varying seasonal and weather conditions will have attenuated to ambient level of 34 dBA at night, and 40 dBA during the day, within 9,600 to 10,750 ft (1.8 to 2.0 miles) and 7,475 to 8,775 ft (1.4 to 1.7 miles), respectively, from the source. Thus, sound from the project has a measurable impact no farther than 10,750 ft (2.0 miles) from the project construction ROW.

<u>Action Area for Changes in Water Quality</u> (Mountain Valley 2020) – In response to additional information received since issuance of the 2017 BiOp, Mountain Valley reevaluated the action area in aquatic systems. Specifically, Mountain Valley refined its methodology for accounting for potential increased sediment to streams and rivers attributed to the project's construction, including construction activities in upland areas.

On behalf of Mountain Valley, Geosyntec Consultants, Inc. prepared a Hydrologic Analysis of Sedimentation (Appendix B of the SBA [Mountain Valley 2020]) that was evaluated by the Service, USFS, and BLM, as well as each agencies' chosen expert reviewers, and determined to provide an appropriate means of delineating the aquatic action area (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Based on the expert reviews of the sedimentation analysis and FERC's determination, the Service accepted that the sedimentation analysis provided an appropriate means of defining the action area, but also added the mixing zones described below. The final Hydrologic Analysis of Sedimentation report was revised to address comments provided by those agencies and associated expert reviewers. The Hydrologic Analysis of Sedimentation estimated potential delivered sediment loads to 14 streams that (1) exhibit suitable habitat for at least 1 threatened, endangered, or sensitive aquatic species and (2) include project

ROW within their corresponding watersheds. The evaluation used the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997 as cited in Mountain Valley 2020) at a watershed scale together with RUSLE Version 2 (RUSLE2) (Renard et al. 2011 as cited in Mountain Valley 2020) at a site-specific scale. As described in detail in the Hydrologic Analysis of Sedimentation report, the RUSLE approach accounts for seasonal rainfall, topography, construction sequencing, climate, soils, vegetation, and management practices. The standard E&S control BMPs approved by VDEQ and WVDEP were also incorporated into the model with clearing and grading activity schedules and subsequent proposed construction tasks. By modeling standard BMPs, the models underestimate the amount of erosive protection provided in the E&S control plans and likely overpredict the amount of sediment loss during construction and restoration.

The Hydrologic Analysis of Sedimentation yielded conservative estimates (the assumptions to ensure conservativism are detailed in Section 6.2 of the Hydrologic Analysis of Sedimentation) of delivered sediment loads to each analyzed stream (stream of interest) based on 4 scenarios: (1) Baseline (pre-existing conditions), (2) Felled (trees felled and left in place prior to clearing), (3) During Construction (from time of clearing through seeding), and (4) Restoration (one-year duration from completion of seeding) (Mountain Valley 2020). Comparing the latter 3 scenarios to Baseline conditions allowed for determination of the relative impact of the project activity scenarios on the streams of interest.

These results reflect estimated sedimentation loads from all project construction activity in the respective watersheds, in addition to baseline sediment loads from other sources in the watersheds (Mountain Valley 2020). The loads were determined using stream trace downs to account for the locations upstream and downstream of the ROW crossings that may receive sediment inputs from the project within the corresponding watersheds, as opposed to the assumption that all sediment enters a stream only at the ROW or AR road crossings.

<u>Delineation of Aquatic Action Area</u> (Mountain Valley 2020) – To identify aquatic areas that would be reasonably expected to experience measurable or detectable environmental effects from the project, Geosyntec undertook an analysis to identify the extent of the National Hydrography Dataset (NHD) surface water features (i.e., streams) that may receive and transport measurable sediment attributable to the project. Sediment from the project may enter streams through 2 pathways: (1) sediment from direct impacts where the project crosses the stream; or (2) sediment from upland workspaces delivered via overland flow to streams.

For every stream segment that may receive measurable sediment attributable to the project, the start of the aquatic portion of the action area is defined as the most upstream point at which measurable sediment attributed to the project may enter an NHD stream segment via 1 of the 2 pathways as described above. The farthest upstream point was identified through the use of the Trace Downstream tool in ArcGIS (ESRI 2020 as cited in Mountain Valley 2020) using a digital elevation model of the watershed topography.

The downstream extent of the aquatic portion of the action area for each stream segment that may receive measurable sediment attributable to the project is defined in 1 of 2 ways: (1) the downstream point at which the stream becomes impounded to an extent that water velocity slows and sediment settles out or (2) the downstream point at which the project’s estimated maximum increase in delivered sediment concentration to the stream is attenuated to the point where an increase in measurable sediment concentration (for example, total suspended solids or suspended sediment concentration) from the project could not be discerned from background sediment concentrations (i.e., the concentration attenuation threshold). The concentration attenuation thresholds are 4.1 mg/L and 2.7 mg/L for VA and WV, respectively, which are based on the point at which small increases in concentration caused by the project could be discerned from background concentrations. Mountain Valley (2020) provides a detailed description of the analysis and assumptions for determining these thresholds. In summary, these thresholds are based on the standard deviation associated with observed average background sediment conditions for each state because a measured increase less than the standard deviation for the background concentration would not be considered a reliable indication that any increase has occurred. This action area is inclusive of stream segments upstream and downstream of dry, open-cut crossings.

For stream segments that the project crosses but is not expected to result in a measurable increase in sediment (e.g., streams that will be crossed using trenchless methods [i.e., conventional bore, microtunnel, or HDD] and will not experience measurable sedimentation from upland activities), the start of the aquatic portion of the action area is the point 200 m upstream of the crossing and the downstream extent is the point 800 m downstream of the crossing. Although these areas are not expected to experience discernible increases in sediment concentration, including them in the aquatic portion of the action area is appropriate to account for physical effects, such as increased sunlight due to tree-clearing (Alberts et al. 2018) that may be experienced due to clearing and work in riparian areas at the stream crossing. These effects are not expected to be discernible beyond the width of the ROW, but the 1,000 m area is conservatively used to meet the screening function of the action area definition.

In addition to the aquatic action area described above, the Service is including the mixing zone in a stream segment where sediment from tributaries (tributaries crossed or receiving sediment from construction activities in the upland area) is delivered to streams/rivers where listed aquatic species and/or proposed critical habitat are potentially present (i.e., "streams of interest"). Although the sediment increases for those tributaries are carried into, and reflected in the results for the streams of interest, the analysis did not take into account the mixing zone area where the sediment is initially diluted by the receiving waters, suspended sediment concentrations will be elevated, and sediment may be deposited. The size of a mixing zone depends on a number of factors including the suspended sediment concentrations in the tributary, concentrations in the receiving water, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (U.S. Environmental Protection Agency [USEPA] and Corps 1998). Due to the large number of variables, each individual mixing zone area could not be quantified. Instead, the mixing zones were qualitatively assessed and were conservatively estimated to fall within an area extending 200 m upstream and 800 m downstream, or as specified in Appendix D Table 1, of the point where the tributary enters the stream of interest. The basis for this estimate is provided below. At the Service's request, Mountain Valley further assessed and identified mixing zones in any waterbody, in addition to the streams of interest (P. Moore, Beveridge & Diamond PC, emails to J. Stanhope, Service, August 14, 2020 and August 18, 2020). The mixing zones were identified at all locations where the calculated sediment concentration in a tributary to any receiving waterbody (regardless of whether or not the receiving water is a stream of interest) drops below the concentration attenuation threshold (i.e., the point of discernibility as defined in the aquatic action methodology above) at the receiving waterbody. In other words, the mixing zone location is when the tributary concentration is greater than the concentration attenuation threshold at the point it flows into the receiving water. These additional mixing zones are also considered part of the aquatic action area. The Service reviewed the additional mixing zones in the action area and verified that they do not change our concurrence with FERC’s Section 7 determinations (C. Schulz, Service, letter to J. Martin, FERC, July 9, 2020).

Summary of Action Area – The action area is defined as the project construction ROW plus the distance where (Mountain Valley 2020):

- meaningful concentrations of dust are expected to travel outside the project area, estimated at 350 ft;
- emitted nighttime light is expected to travel from the project area, estimated at 1,200 ft;
- air or substrate-borne sound or vibration travels, estimated at 2.0 miles; and
- the dilution evaluation within streams (performed by stream reach) yield concentrations above the concentration attenuation threshold; and 800 m downstream/200 m upstream or as specified in Appendix D Table 1 in any stream crossed by the project where evaluation indicates that no measurable increase in project-related sediment is expected to occur; and the mixing zones where sediment from tributaries where the tributary sediment concentration is greater than the concentration attenuation threshold at the point it flows into the receiving water.

The scope of the terrestrial impacts described above all lie within the 2.0-mile area associated with the maximum distance that sound from the project will occur above ambient conditions. As a result, 2.0 miles is used for the terrestrial portion of the action area. The aquatic portion of the action area is

(1) the distance at which the concentration attenuation threshold is reached in each stream expected to experience a measurable increase in project-related sediment, or
(2) 800 m downstream and 200 m upstream – the area in which riparian clearing potentially could influence stream conditions – for any stream that the project crosses that is not expected to experience a measurable increase in project-related sediment, or
(3) the mixing zone in a stream segment where sediment from tributaries (crossed or receiving sediment from the project) is delivered to streams of interest.

As such, the action area for this project consists of all lands within 2.0 miles of the boundaries of the project area and approximately 1,163 miles of potentially impacted streams (note that the 1,163 miles does not include mixing zone distance due to qualitative assessment) (Figure 3). Detailed maps of the action area are in Appendix D of the SBA (Mountain Valley 2020).

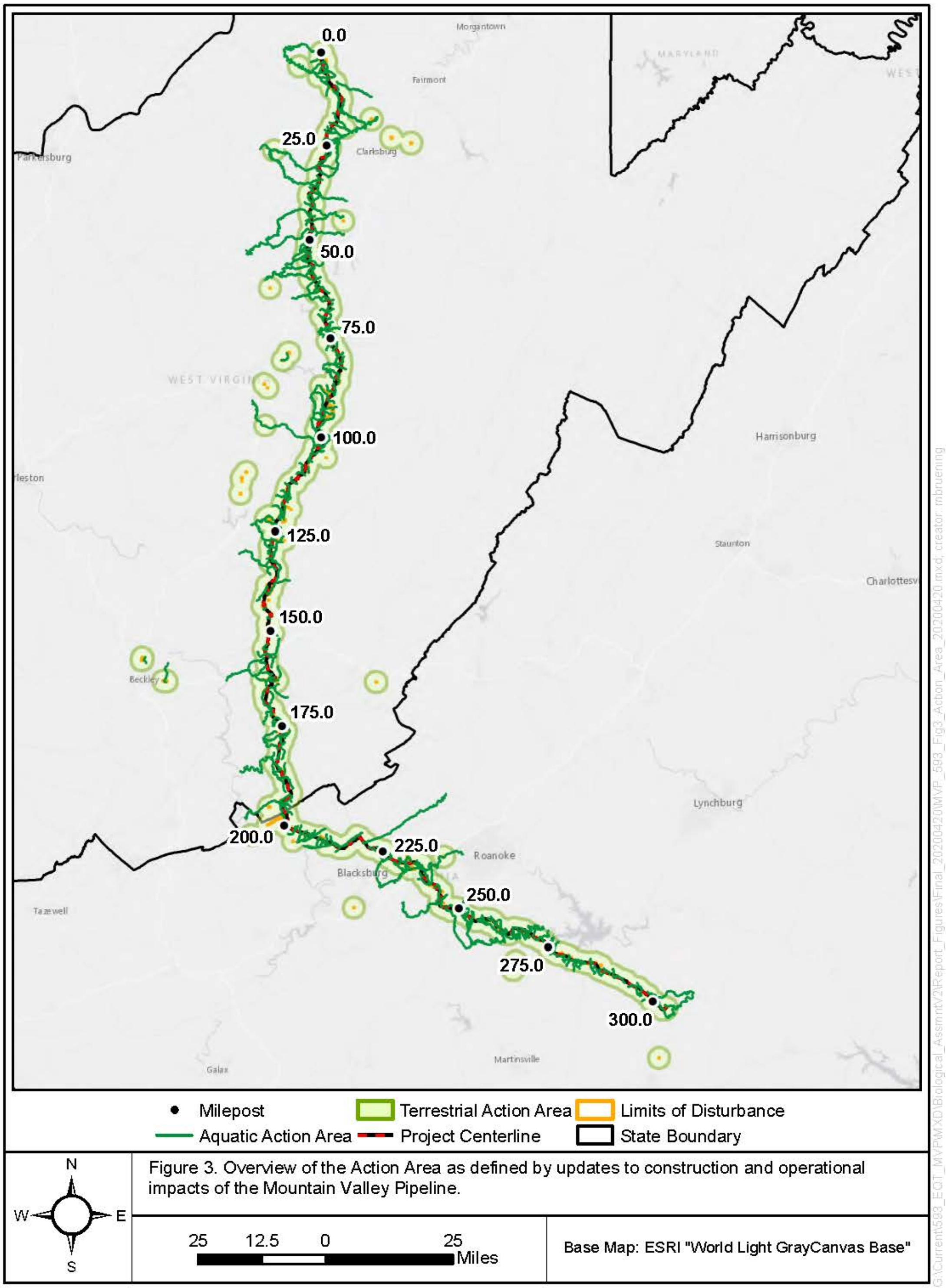


Figure 3. Action area overview.

STATUS OF THE SPECIES

Per ESA Section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat." To assess the current status of the species, it is helpful to understand the species' conservation needs. The Service frequently describes conservation needs via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3 Rs) (Shaffer et al. 2002, Wolf et al. 2015, Smith et al. 2018). The Service can then apply the appropriate regulatory framework and standards to these principals to address a variety of ESA-related decisions (e.g., listing status, recovery criteria, jeopardy and adverse modification analysis). For Section 7(a)(2) purposes, the 3 Rs can be translated into the reproduction, numbers, and distribution (RND) of a species.

Species status assessments (SSAs), listing rules, recovery plans, and 5-year reviews can serve as sources of information to describe the conservation needs of a species. Below, we summarize relevant information regarding each species conservation needs and their status in terms of meeting those needs.

Virginia spiraea (VASP)

The Service listed VASP as threatened on July 21, 1989 (54 FR 30577). The following is a summary of VASP general life history drawn from the VASP recovery plan (Service 1992a), reports, and peer-reviewed publications.

VASP is a perennial shrub that occurs in the Southern Blue Ridge and Appalachian (including Cumberland) Plateau physiographic provinces (Ogle 1991a, 1991b; Service 1992a). VASP is widely scattered within 7 states (Ohio [OH], WV, VA, Kentucky [KY], Tennessee [TN], North Carolina [NC], and Georgia [GA]) and is recorded historically in Pennsylvania (PA) and Alabama (AL). The species is clonal, with a root system and vegetative characteristics that allow it to thrive under disturbance regimes in streams and rivers. VASP habitat includes scoured banks of high gradient, second- and third-order streams and meander scrolls, point bars, natural levees, and braided features of lower stream reaches (i.e., often near stream mouth). The riverine sites where VASP occur are frequently characterized as having enough erosion to inhibit competition from trees and shrubs (i.e., less shading and greater sunlight), but also having depositional patterns to allow establishment of vegetative propagules (plant fragments from parent plant, which is an example of asexual reproduction). The single exception to species' riverine habitat is a population growing in a wet meadow along a roadway in WV.

VASP is a 1-3 m tall shrub with often profuse branching patterns and 5-22 centimeter (cm) wide corymbs (flower clusters) with yellowish/greenish to clear, pale white color. Its leaves are shaped ovate to lanceolate, 2-5 cm wide by 3-15 cm long, acute, entire or completely serrate, and glaucous beneath. Flowering is rare on first-year plants and occurs from late May to late July.

Although flowers attract insects, the species primarily reproduces asexually by vegetative propagation (Service 1992a, 2008; Ogle 2008). The species is capable of sexual reproduction, but seed production is rare and natural establishment through germination (e.g., seedlings) has never been documented (Brzyski and Culley 2011, 2013). In controlled experiments, seeds have been successfully germinated at low rates. Dispersal has only been observed by downstream distribution of propagules and no dispersal upstream or between drainage systems has been documented.

Conservation Needs

The Service finalized a recovery plan for VASP in 1992. The recovery objective for VASP is to delist the species. The Service outlined the following conditions that would result in the species no longer meeting the definition of a threatened species (Service 1992a): (1) 3 stable populations are permanently protected in each drainage where populations are currently known, (2) stable populations are established on protected sites in each drainage where documented specimens have been collected, (3) potential habitat in the states with present or past collections has been searched for additional populations, and (4) representatives of each genotype are cultivated in a permanent collection.

The primary actions to address these conditions include: (1) Protect existing populations and essential habitat. (2) Conduct rangewide searches in areas of suitable habitat for additional populations. (3) Conduct site-specific habitat manipulation to maintain existing populations. (4) Distinguish between N (the number of genetically different plants) and n (the number of genetically identifiable nodules or clones that are in reality a single plant) individuals and identify genetically different populations. (5) Maintain representative material from each known genotype in permanent cultivation. (6) Investigate the species' environmental tolerances and habitat characteristics. (7) As appropriate, reintroduce VASP in additional drainage systems within the species' historical range. (8) Develop an information packet for landowners and land managers. (9) Evaluate the effectiveness of protection and management programs and redirect efforts as necessary.

Current Condition

Now that we have described the species' basic needs, we can assess its current condition. It is difficult to determine population trends for VASP due to limited surveys and monitoring and varying terminology through time. Terms such as "clone," "population," "element occurrence" (EO), and "sub-EO" have been used to refer to an occurrence of one or more VASP stems found in a given location. An EO is the spatial representation of a species or ecological community at a specific location and originated by State Natural Heritage Programs after 1992. There is no standard conversion factor between population/clone counts and EO/sub-EO counts, thus there is a lack of clarity about the relative abundance and abundance trends of this species since the recovery plan (Service 1992a). Uncertainty about genetic variation among plants within and between sites further complicates efforts to assess population trends. However, the best available scientific information is from the experts from state natural resources agencies and the USFS and they have estimated that VASP populations are stable in GA, NC, WV, VA, and OH, increasing in TN, and decreasing in KY (Ogle 2008). Most experts caution that estimates were based on anecdotal or casual observation; little, if any, quantitative data are available for these determinations. Table 16 provides an estimate of the number of known VASP sites rangewide in 1992 and 2007.

Table 16. Number of VASP clones/EOs/sub-EOs in 1992 and 2007 (Ogle 2008, Service 2008).

State	Number of Clones in 1992	Number of EOs/sub-EOs in 2007
AL	0 (historical record prior to 1992)	0
PA	0 (historical record prior to 1992)	0
GA	7	8
KY	20	17
Louisiana	misidentification	0
NC	12	36
OH	3	5
TN	20	32+
VA	18	29
WV	27	109
All States	107	236

Threats

The primary factors influencing the status include risks posed by a limited range with increasing amounts of fragmentation within river basins leading to isolation and reduced genetic variation, invasive species, herbicide application, land disturbance along river banks, changes in hydrology due to impoundments and water release regulation, and recreational use of habitat (Service 1992a, 2008; Brzyski and Culley 2011, 2013; Brzyski et al. 2014; Horton et al. 2015; NatureServe 2019). Anthropogenic disturbance of land along streams and rivers, due to activities such as vegetation clearing, road and bridge construction/maintenance, and electric/gas lines placement, may impact VASP by directly crushing/removing the plants and altering their riverine habitat (Ogle 2008). These types of activities may also introduce invasive, non-native plants, such as Japanese knotweed (*Reynoutria japonica*), purple loosestrife (*Lythrum salicaria*), Japanese spiraea (*Spiraea japonica)*, and multiflora rose (*Rosa multiflora*), which may shade and outcompete VASP. Another threat to VASP are dams, which create impoundments and flood VASP habitat upstream of the dam. Downstream, dams regulate and stabilize the flow, which limit natural scouring during flood events. VASP is dependent on the flood events to provide the erosional and depositional forces that inhibit competition from other plants and disperse and promote establishment of propagules.

Summary

There are multiple (redundancy) populations in each state and these populations are spread across the geographic range of the species in multiple states (GA, KY, NC, OH, TN, VA, and

WV) (representation). Information about the size/abundance and health of these populations (resiliency) across the range is limited due to lack of consistent monitoring approaches and survey efforts. Many of the known populations of VASP are on publicly-owned land, which generally provides protection from habitat loss due to development. Since the recovery plan was published (Service 1992a), populations in 3 new drainages have been discovered in TN, WV, and NC and 1 population with historical documentation has been rediscovered in NC (Stine 1993, Shaw and Wofford 2003, Gardner and Moser 2007, Ogle 2008, Service 2008). Historical records from PA and AL have been examined and verified, but the species is not currently known from either state. Fairly extensive areas of appropriate habitat exist in both PA and AL, and the species may be rediscovered there. The VASP is established in cultivation, with several extant collections in arboreta and genetic conservancies. Studies of genetic diversity and structure for populations in VA, NC, WV, and KY, as recommended in the species recovery plan (Service 1992a), are in progress and will inform and guide future propagation/reintroduction efforts, if appropriate, and help determine which additional genotypes should be added to cultivation in permanent collections.

In summary, as a whole, the rangewide status of the species appears to be stable, with some populations improving and some declining (Ogle 2008, Service 2008) and the Service recommended maintaining the current classification as a threatened species in its draft 5-year review (Service 2008). For a more comprehensive account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=Q2R1.

Roanoke logperch (RLP)

The Service listed the RLP as endangered on August 18, 1989 (54 FR 34468). The following is a summary of RLP general life history drawn from the RLP recovery plan (Service 1992b), the RLP 5-year review (Service 2007a), and peer-reviewed publications.

The RLP is a small darter (fish) found in VA and NC. Genetic analysis (Roberts et al. 2013) of RLP indicated a dispersal extent of up to 80 kilometers (km); however, median lifetime dispersal distance is 6-24 km (Roberts et al. 2016a). The RLP occupies medium to large warmwater streams with moderate to low gradient (Jenkins and Burkhead 1994). Microhabitats with loosely embedded substrate free of silt appear to be critical to this species (Rosenberger and Angermeier 2003). Rosenberger and Angermeier (2003) also found that habitat use by the RLP varied among age classes and between rivers. In the Roanoke River, adults use deep, fast-flowing stream sections in areas often over gravel substrate. They were observed most frequently in runs, occasionally in riffles, and rarely in pools. Subadults in the Roanoke River were also found in runs, but within slightly shallower areas and slower velocity habitats than adults. Young-of-year (YOY) were found in backwater habitats, secondary channels, and the shallow edges of pools, riffles, and runs. Adults and subadults in the Nottoway River were found in pools, and occasionally runs, in deep, low-velocity habitats over sand and gravel (Rosenberger 2002). However, as observed in the Roanoke River, subadults were found in lower velocities and slightly more embedded microhabitats than adults (Rosenberger and Angermeier 2002).

Male RLP mature in 2 years and most females mature in 3 years (Burkhead and Jenkins 1991). Maximum age has been documented at about 6.5 years (Jenkins and Burkhead 1994). Spawning occurs in April or May. Jenkins and Burkhead (1994) observed RLP spawning behavior and reported that several males acted aggressively to each other upon locating a female. Eggs are adhesive and deposited on the stream bottom (Jenkins and Burkhead 1994) where they are subsequently fertilized. Darters, such as the RLP, that bury or attach their eggs provide no subsequent parental care (Mattingly et al. 2003).

RLP are sight feeders and flip rocks with their snout to expose invertebrates and ingest the exposed prey (Jenkins and Burkhead 1994, Rosenberger and Angermeier 2003). The species does not actively select certain taxa but consumes most food items encountered. Young feed primarily on chironomid (non-biting midge) larvae and adults primarily consume caddisfly larvae and chironomids (Burkhead 1983).

Conservation Needs

The Service finalized a recovery plan for the RLP in 1992. The recovery objectives for RLP are to downlist to threatened then, once achieved, delist the species. The Service outlined the following conditions that we believed would result in the species no longer meeting the definition of an endangered species (Service 1992b): protecting and enhancing habitat containing RLP populations, and expanding populations within river corridors that either now support this species or supported it historically.

The primary actions to address these criteria include: (1) Maintain and increase the health and vigor of present populations through a watershed-level conservation approach that addresses sediment loading and preserves ecological processes that provide ephemeral, seasonal, and persistent types of habitat required over RLP ontogeny; (2) Evaluate the feasibility of propagating RLP and determine whether a controlled propagation and reintroduction/augmentation plan should be developed; (3) Increase connectivity of RLP populations by identifying major and minor artificial movement barriers and eliminating them when feasible; (4) Prevent and reduce the risk of catastrophic extirpation from toxic spills through identification, evaluation, and improvement of present and proposed road crossings, agricultural, and industrial facilities; (5) Survey streams with suitable habitat and continue to identify habitat that is potentially suitable for RLP reintroduction/augmentation; (6) Revise the recovery plan to include measurable criteria that specifically address each of the relevant listing factors and incorporate currently available information about population abundance and distribution (Service 2007a).

Current Condition

Now that we have described the species basic needs, we can assess its current condition. It is difficult to assess long-term population trends due to the expanded range resulting from new surveys and changing methodologies used to identify populations. Four populations were known at the time the RLP recovery plan (Service 1992b) was written:

1. Upper Roanoke,
2. Pigg,
3. Smith, and
4. Nottoway Rivers.

The RLP 5-year review (Service 2007a) defined populations as "occupied areas not separated by a major dam...." Using this criterion, 8 populations were identified:

1. Upper Roanoke River drainage downstream to Niagara Dam,
2. Middle Roanoke River drainage downstream of Leesville Lake,
3. Upper Pigg River drainage upstream of Power Dam,
4. Middle Pigg River drainage downstream of Power Dam,
5. Smith River drainage upstream of Philpott Reservoir,
6. Smith River drainage downstream of Philpott Reservoir to the headwaters of Martinsville Dam,
7. Smith River drainage below Martinsville Dam, and
8. Nottoway River drainage.

However, the RLP 5-year review based the discussion of population status on the 5 major rivers/river reaches (Upper Roanoke River, Middle Roanoke River, Pigg River, Smith River, and Nottoway River) that support the 8 identified populations. The 5-year review further divided the Smith River into Upper and Lower. The resulting summary table (Table 17) of threats to RLP by population from the RLP 5-year review (Service 2007a) included 6 populations and appeared to combine the Pigg River (populations 3 and 4 in the list above) and the downstream portion of the Smith River (populations 6 and 7 in the list above).

Table 17. A summary of threats (Service 2007a) and the degree to which each RLP population is at risk based on the particular threat (N = not a present threat; L = exists as a low threat; M = significantly threatens a subset of the range occupied by RLP; H = significantly threatens the known range of the population; U = unknown).

Threat	Population					
	Upper Roanoke River	**Middle Roanoke River**	**Pigg River**	**Upper Smith River**	**Lower Smith River**	**Nottoway River**
Large dams	M	M	M	H	H	N
Urbanization	H	U	M	L	M	L
Agriculture / forestry	H	U	M	M	M	L
Channelization	M	U	N	N	U	N
Road building	H	U	H	L	M	L
Toxic spills	L	U	H	M	H	L
Riparian loss	M	U	M	M	H	L
Small barriers	L	U	M	U	U	U
Water withdrawals	L	U	U	U	U	L

The 5-year review (Service 2007a) identified genetic analysis as a tool to further refine the population designation. Subsequent to the 5-year review (Service 2007a), through additional survey efforts, RLP were discovered in new locations in VA and RLP were documented in NC. Including results of these additional survey efforts, population structure was re-assessed based on rangewide genetics work (Roberts et al. 2013). Based on the genetic analysis 7 isolated RLP populations were identified:

1. Roanoke,
2. Pigg,
3. Goose,
4. Otter,

5. Lower Smith,
6. Upper Smith, and
7. Nottoway Rivers.

Roberts et al. (2013) conducted their genetic analysis prior to the discovery of many of the NC populations. Genetic analysis by Roberts and Strickland (2017) delineated the genetic structure of RLP in NC and compared those findings to Roberts et al. (2013). Results of Roberts and Strickland (2017) indicated the sampled segments of the lower Smith, Dan, and Mayo Rivers and Big Beaver Island Creek were all the same population and have been termed the “Dan metapopulation.”

As part of their population viability analysis Roberts et al. (2016b) updated Roberts (2012) calculations of population size for 5 of the 7 populations. A minimum viable population (defined as the minimum number of individuals sufficient to sustain 99% probability of population persistence in 100 years) could not be calculated for the Lower Smith and Nottoway Rivers populations because comparable estimates of fish catch or patch spacing were not available. The Lower Smith and Nottoway Rivers populations were excluded from analysis and a refined population estimate was not calculated for these 2 populations. The calculated extinction risk for the largest population, Roanoke River, was always near 0. The Otter River population was the smallest and had a higher, more variable extinction probability. They characterized catastrophes as anthropogenic disturbances that cause fish kills that could “acutely and dramatically reduce the size of populations...” Environmental events such as floods and droughts were not included because they occur frequently and did not seem to dramatically affect RLP population size. Three catastrophe scenarios were developed 1) no catastrophes, 2) a less severe catastrophe, and 3) a more severe catastrophe. The severity of the catastrophe was the relationship of the total fish kill to the extent of the river. For example, a total fish kill of 10.1 km equals 8.6% of the known range extent (118 km) in the Roanoke River and 19.1% of the known range in the Otter River. In this example the total fish kill in the Roanoke River would be considered a less severe catastrophe and a more severe catastrophe in the Otter River. They calculated all populations had a greater than 95% probability of persisting for the next 100 years under less severe catastrophe scenario. Under the severe catastrophe scenario they calculated only the Roanoke and Pigg Rivers populations would be considered viable. They tentatively calculated a minimum viable population of 4,200 adults for the species overall. Roberts (2018) calculated a population estimate for the Dan metapopulation as part of the development of a decision document guide for RLP augmentation. Table 18 summarizes the rangewide status of the populations as currently defined.

Table 18. Status of RLP populations rangewide.

Population	Status
Roanoke River	Data indicate that the RLP population in the Upper Roanoke River is dynamic but shows no signs of decline (Service 2007a). Estimated current population size is 16,875 (Roberts et al. 2016b). Roberts (2018) reported this population was numerically and geographically stable.
Pigg River	Population appears to be increasing in size and range since the 1975 chemical spill that killed most of the individuals in the mainstem Pigg River. Estimated current population size is 9,281 (Roberts et al. 2016b). Roberts (2018) reported this population was numerically and geographically stable.
Goose	Due to the limited survey data from this waterbody, it is unknown whether this population is increasing, declining, or stable (Service 2007a). Estimated current population size is 2,111 (Roberts et al. 2016b). Roberts (2018) reported this population was geographically stable or expanding but had a high isolation risk.
Otter	Due to the limited survey data from these waterbodies, it is unknown whether these populations are increasing, declining, or stable (Service 2007a). Estimated current population size is 2,106 (Roberts et al. 2016b). Roberts (2018) reported this population was geographically stable or expanding.
Dan metapopulation (all portions of the Dan sub-basin except the upper Smith River)	Smith River (Lower and Upper) was defined as 1 population in 2007, at the time the population was considered vulnerable to fragmentation from Philpott Dam, Martinsville Dam, and small population sizes, but populations have probably remained stable since RLP was listed (Service 2007a). Estimated current population size is 11,685 (Roberts 2018). Roberts (2018) reported this population was geographically stable or expanding.
Upper Smith River (upstream of Philpott Reservoir)	Smith River (Lower and Upper) was defined as 1 population in 2007, at the time the population was considered vulnerable to fragmentation from Philpott Dam, Martinsville Dam, and small population sizes, but populations have probably remained stable since RLP was listed (Service 2007a). Estimated current population size is 13,285 (Roberts et al. 2016b). Roberts (2018) reported this population was numerically and geographically stable.
Nottoway River	Surveys indicate that threats from siltation from agricultural and silvicultural activity have declined, and the population is increasing in range and in density (Service 2007a). Estimated current population size is 16,686 (Roberts et al. 2016b). Roberts (2018) reported this population was numerically and geographically stable.

The primary factors influencing the RLP status include risks posed by large dams and reservoirs, small dams and barriers to movement, watershed urbanization, increased sediment and deposition from agricultural and silvicultural activities, channelization, roads, toxic spills, riparian/woody debris loss, and water withdrawals (Service 2007a). Climate change is an increasing threat to RLP with storm events increasing in frequency and intensity, resulting in increased periods of higher water volume, flow rates, and turbidity that affect the RLP's abilities to forage, shelter, and reproduce.

Summary

There are multiple (i.e., 7) (redundancy) populations spread across the geographic range of the species (representation); however, the health (resiliency) of those populations varies across the range. Population size ranges from 2,106 to 16,875 individuals in the 7 populations (Roberts

2012, Roberts et al. 2016b). The criteria for identifying a population has changed over the years so we cannot directly assess long-term trends. The RLP populations in VA appear to be stable or increasing (Service 2007a; J. Roberts, Georgia Southern University, email to S. Hoskin, Service, June 4, 2019). Population size of 4 of the 7 populations is above the minimum viable population level of 4,200 adults for the species overall. Roberts (2018) developed a document for resource agencies to help determine whether and where to augment RLP populations. In recent years the Service and its partners have removed large and small dams and have worked with landowners to improve their practices to help reduce sedimentation into RLP waterbodies.

In summary, as a whole, the rangewide status of the species is improving and the Service recommended maintaining the current classification as an endangered species in its last 5-year review (Service 2007a). While the recovery criteria have not yet been achieved, some of the identified threats have been reduced. For a more comprehensive account of the species description, life history, population dynamics, threats, and conservation needs, refer to: https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=E01G.

Candy darter (CD)

The Service listed the CD as endangered on November 21, 2018 (83 FR 58747). The following is a summary of CD general life history drawn from the CD species status assessment (Service 2018a), reports, and peer-reviewed publications.

The CD is a small, freshwater fish endemic to second order and larger streams and rivers within portions of the upper Kanawha River basin, which is synonymous with the Gauley and greater New River watersheds in VA and WV. The CD is a habitat specialist, and is typically found in high- to moderate-gradient, cool- or cold-water stream ecosystems, although warm-water conditions may also be tolerated. The species is most often found in riffle, glide, or run habitats, and is relatively uncommon in pool habitats. CDs are generally intolerant of excessive stream sedimentation and resulting cobble embeddedness (the degree to which cobbles are covered in fine-sized substrate particles). However, young-of-the-year and juveniles may be more capable of utilizing habitats with slower-moving water containing smaller substrate and a greater proportion of fine sediments than adults. CDs are benthic invertivores (McCormick et al. 2001) and their main prey items are benthic macroinvertebrates, such as mayflies and caddisflies.

CDs have a relatively short life cycle, reaching sexual maturity by age 2 and often dying during their third year (Jenkins and Burkhead 1994). Recent work by McBaine and Hallerman (2020) on the age structure of CD populations in VA found individuals up to age 5, with the majority of individuals in the Stony Creek, VA population in age classes 2 and 3. Spawning occurs from late spring to early summer, typically April 15 through June 30 in WV and VA. The CD is considered a brood-hiding, benthic spawner, with gravid females depositing eggs in pebble and gravel substrate among larger cobbles and boulders, where they are fertilized by attendant males. Although females may lay multiple clutches, they have a relatively low number of ova per clutch (Schoolcraft et al. 2002). Eggs incubate for 5 to 30 days depending on stream water temperature.

Ontogenetic shifts (changes in CD habitat requirements as individuals develop) and seasonal habitat plasticity (adaptability of CDs to differences between habitats as seasons change) may introduce complexity when identifying suitable habitat for some CD populations (Dunn and

Angermeier 2016). There is uncertainty whether individual CDs complete their life cycle within habitat complexes spanning relatively short distances of perhaps a few hundred meters, or if they are capable of longer, seasonally mediated movements among suitable habitat. Studies have suggested that both *Etheostoma* and *Percina* darter species may exhibit seasonal migration, in which they move from warmer mainstem waters into cooler, spring-fed tributaries during the late summer and early fall (Mundahl and Ingersoll 1983, Schaefer et al. 2003), and CDs are suspected to act similarly (S. Welsh, WVU, phone call with B. Smrekar and A. Murnane, Service, November 30, 2018).

Conservation Needs

The Service developed a recovery outline for the CD in 2018 (Service 2018b). As described in this outline, CD conservation needs include: an absence of nonnative fish species (particularly, the closely related variegate darter [*Etheostoma variatum*]); unembedded gravel and cobble substrates with minimal sedimentation; adequate water quality (temperatures, physical and chemical parameters); an abundant, diverse benthic macroinvertebrate community; and sufficient water quantity and velocities. Absence or degradation of these features could limit populations of the CD.

The primary actions to address these needs include: maintain extant populations by conserving the genetic diversity and physical and biological features on the landscape that are essential for the species' conservation; minimize the risk of variegate darter introductions or spread in areas with little evidence of introgression; investigate factors that would minimize and control hybridization, and implement those measures in currently occupied areas that are affected by ongoing hybridization; repatriate CDs to historically occupied areas where variegate darters are not present; and investigate feasible methods to remove variegate darters and repatriate CDs.

Current Condition

The historical distribution of CD was more expansive than the current distribution (Figure 4, Jenkins and Burkhead 1994). Historically, the CD occurred in 35 populations distributed across 7 metapopulations located in the Bluestone, Lower New River, Upper Gauley, Lower Gauley, Greenbrier, Upper New, and Middle New watersheds. However, the CD has been extirpated from almost half of its historical range; 17 of 35 known populations and 2 of 7 known metapopulations have been extirpated. The species is no longer known to occur in the Bluestone and Lower New River watersheds. Chipps and Perry (1993) reported on the status of CD on the Monongahela National Forest and found them to be well-distributed in the Cherry, Upper Greenbrier and Upper Gauley river systems. However, they expressed concerns for populations in the Williams River, Deer Creek and Anthony Creek and identified siltation as the major threat to these CD populations. The species has since been extirpated from Anthony Creek, largely due to hybridization with the variegate darter (Service 2018a). The most abundant remaining CD populations occur in the Upper Gauley and upper Greenbrier River watersheds, and in Stony Creek in the Middle New River watershed (Service 2018a).

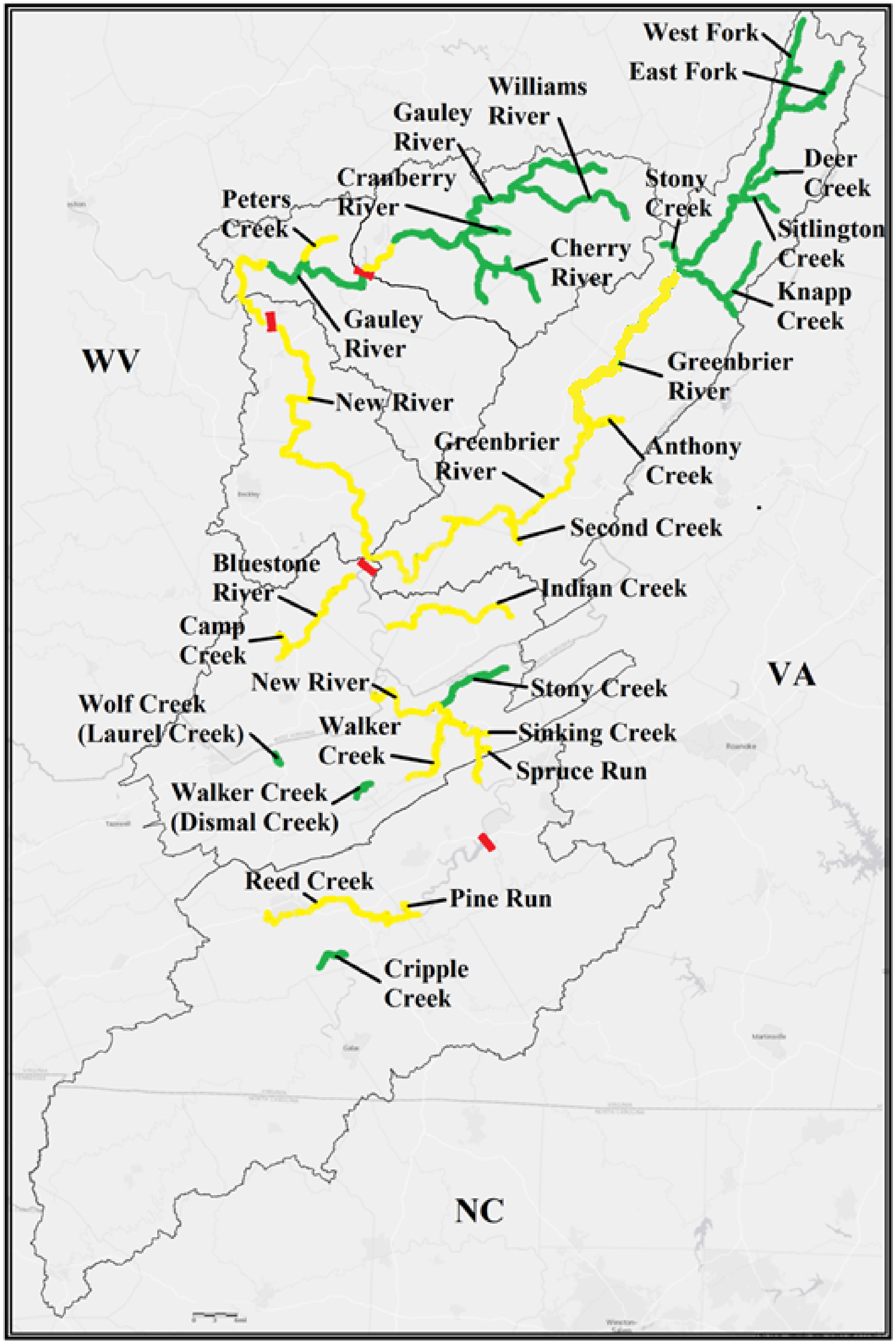


Figure 4. Current and historical distribution of the CD. Green indicates extant populations; yellow indicates historical or extirpated populations (Service 2018a). Red lines are major dams that present barriers to fish movement.

Excessive sedimentation was likely a primary cause of the historical decline of the CD (Service 2018a). The primary factor influencing the current status in WV is hybridization with the introduced but closely related variegate darter (Figure 5, Service 2018a). Other contributing threats to CD populations include increases in water temperature, excessive sedimentation, habitat fragmentation, changes in water chemistry and water flow, and competition with non-native species. Evaluation of CD range and speciation has helped to identify streams where CD populations still occur, where variegate darter are hybridizing with CD, and where there is relative robustness of remaining intact populations of CD (Switzer et al. 2008, Gibson 2017, Service 2018a).

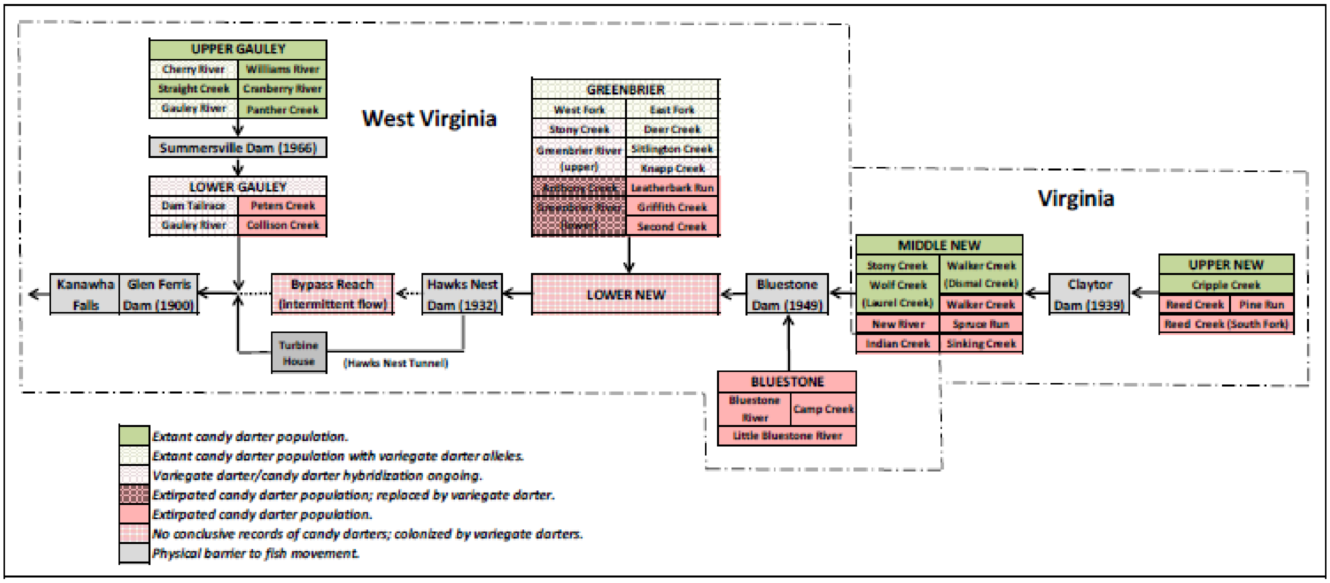


Figure 5. Conceptual model of CD distribution, connectivity, and hybridization status (as of April 2017). Arrows indicate direction of water flow (Service 2018a).

Sedimentation remains a problem in many streams within the range of the CD. In the Ridge and Valley physiographic province of WV, which includes the Greenbrier River watershed, an estimated 21.5% of the total stream miles were rated as “poor” with respect to sedimentation, 43.2% were rated “fair,” and 35.3% were rated as “good.” In the Appalachian Plateaus province, which includes the Gauley and Lower New watersheds, 41.5% of the stream miles were rated as “poor,” 36.3% as “fair,” and 22.2% as “good” (WVDEP 2012). A similar regional breakdown of stream sedimentation is not available for VA, but statewide estimates indicate that 40.0% of the stream miles were “suboptimal” with respect to sedimentation, 17.4% were “fair,” and 42.6% were “optimal” (VDEQ 2018).

Summary

Of the 18 extant populations, 5 currently have high or moderate to high resiliency. These populations are located in the Upper Gauley, the Greenbrier, and Middle New metapopulations. The remaining 2 extant metapopulations (the Lower Gauley and the Upper New River) maintain populations with moderate and low resiliency. Therefore, the CD currently maintains moderate resiliency (Service 2018a). The loss of CD populations and the areas they represented within the species’ historical range, as well as the fragmentation of extant populations, has compromised the species' ability to repatriate those areas or avoid species level effects from a catastrophic event. Therefore, the CD's current redundancy is moderate to low (Service 2018a).

The best available data for the CD indicate that there is a high level of genetic differentiation between the Greenbrier River and Upper and Lower Gauley River metapopulations. These metapopulations currently have moderate resiliency, however the loss of either would represent a substantial reduction in the species' genetic representation. Although the CD retains representation in both of the Appalachian Plateaus and Valley and Ridge physiographic provinces, the species has a different distribution than it had historically, and likely a different ability to respond to stochastic and catastrophic events, thereby putting the species at increased risk of extinction from any such events. Therefore, we conclude that the species' representation is currently moderate to low (Service 2018a).

Within these 2 physiographic provinces, the CD has been extirpated from almost half of its historical range; 17 (49%) of 35 known populations (and 2 [29%] of 7 known metapopulations), with the extirpations representing a complete loss of resiliency in those populations. Combining physical habitat metrics, non-native competition metrics, and CD demographic metrics, we have concluded that of the 18 extant populations, 5 (28%) have high or moderate to high resiliency, 9 (50%) have moderate resiliency, and 4 (22%) have low or moderate to low resiliency. The 5 populations with higher resiliency occur in 3 metapopulations (Upper Gauley, Greenbrier, and Middle New); the remaining 2 extant metapopulations (Lower Gauley and Upper New River) maintain populations with moderate and low resiliency. Therefore, we conclude the CD currently maintains moderate resiliency (Service 2018a).

In summary, as a whole, the rangewide status of the species is declining. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term. For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1396.

Indiana bat (Ibat)/Northern long-eared Bat (NLEB)

The key stages in their annual cycle are: hibernation, spring staging and migration, pregnancy, lactation, volancy/weaning, fall migration, and swarming (Figure 6). All periods outside of the hibernation period are considered to be the "active season" for the Ibat and NLEB. While varying with weather and latitude, these species generally hibernate between mid-fall through mid-spring each year. In the spring, reproductive females migrate and form maternity colonies where they bear and raise their young in wooded areas throughout the summer. In the Northeast, the spring migration period is generally from mid-March or early April to mid-May, as females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Males and non-reproductive females often do not roost in colonies and may stay close to their hibernaculum; however, some migrate to summer habitat as well. Young of both species are born between late May and early June, with nursing continuing until weaning, which is shortly after young become volant (able to fly) about a month later (mid- to late-July). Fall migration likely occurs between mid-August and mid-October (Service 2007b). The timing of these events is also influenced by weather.

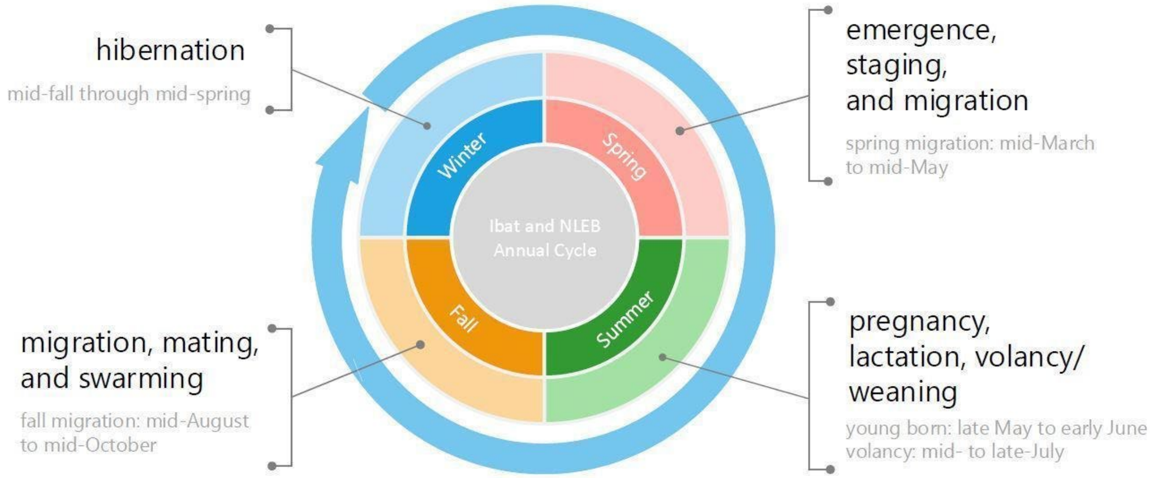


Figure 6. Illustration of major components and timing of Ibat and NLEB annual cycle.

The basic resource needs for the Ibat and NLEB across their entire range are safe winter hibernation sites; forested spring staging/fall swarming habitat; connected forested summer habitat for roosting, foraging, and commuting; forested migratory stopover habitat; safe migration passage; insects; and clean drinking water (e.g., streams, riparian areas, and wetlands).

Ibat Conservation Needs

The Ibat is a temperate, insectivorous, migratory bat that hibernates in mines and caves in the winter and spends summers in wooded areas. The Ibat was one of 78 species first listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967). The ESA extended full protection to the species. The Service prepared a recovery plan for the species in 1983 (Service 1983) and drafted a revised recovery plan that was made available for public comment in 2007 (Service 2007b). While it was not officially adopted (as white-nose syndrome [WNS] impacts were discovered during that time period and resources were shifted towards addressing this new threat), it embodies the best available scientific information and it outlines recovery actions that are relevant to the majority of stressors for the species. In addition, 5-year reviews (Service 2009, 2019b) provide current summaries of the status of the species rangewide, including updates on threats, status of hibernacula counts, and recommended priority actions. Priority actions include: incorporating WNS into the recovery plan; monitoring status of hibernacula; monitoring status of maternity colonies; implementing the North American Bat Monitoring Program; providing for continual recruitment of high quality roosting habitat; securing permanent/long-term protection of Priority 1 and Priority 2 hibernacula; conducting additional research to understand the causes and potential spread of WNS; researching management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach); continuing public education/outreach efforts about WNS; and continuing to refine survey protocols.

To assess the current status of the species, it is helpful to understand the species' conservation needs which are generally described in terms of RND. The Service frequently characterizes RND for a given species via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3 Rs) (Shaffer et al. 2002, Wolf et al. 2015, Smith et al. 2018).

The Ibat recovery plan (Service 2007b) delineates recovery units (RUs) based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 7). To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all 4 RUs. The proposed action is located within the Appalachian Mountains RU (AMRU), which includes all of WV and a portion of VA.

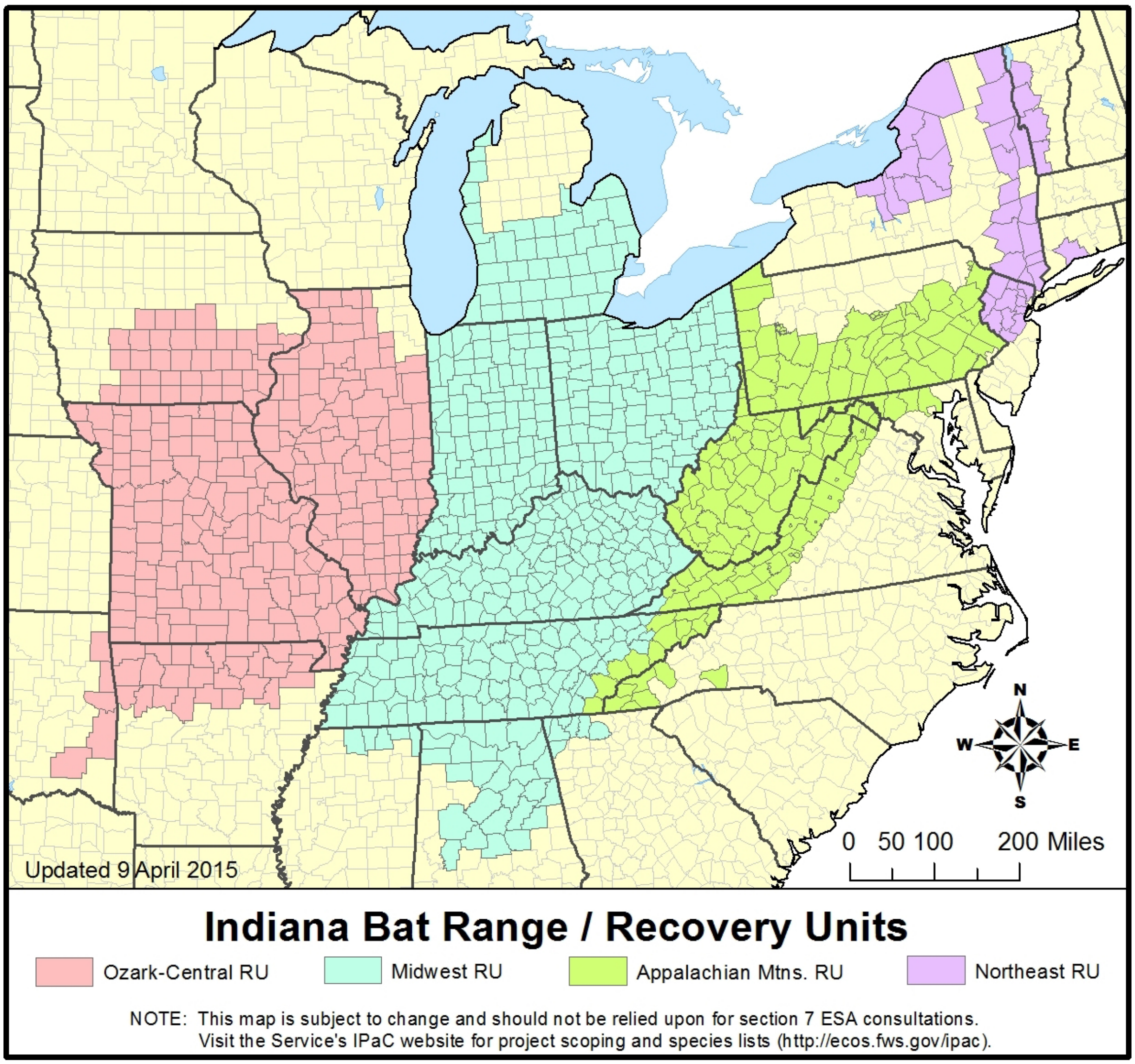


Figure 7. Ibat RUs.

Conservation and recovery of the Ibat will require conserving the species' ecological, behavioral, and genetic representation and providing redundancy and resiliency at the species level by conserving healthy bat populations across the species' current range, and managing threats acting upon the species. To do this, the Service's North Atlantic-Appalachian region tiered off the recovery plan to describe our current focus of addressing the following conservation needs (Service 2018c):

- Managing the effects of WNS;
- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating bats.

Ibat Current Condition

Now that we have described the species basic needs, we can assess its current condition. Currently, the rangewide status of the species is declining (Figure 8, Service 2019a). Declines are associated with the onset of WNS (described below) which has spread from New York (NY) south and west across the range. Impacts to Ibats to date are most severe in areas with the longest exposure to WNS (e.g., 75-99% declines in NY, WV, and PA) but declines have been observed in all RUs. The AMRU declined from 32,465 Ibats in 2011 to 1,996 Ibats in 2019.

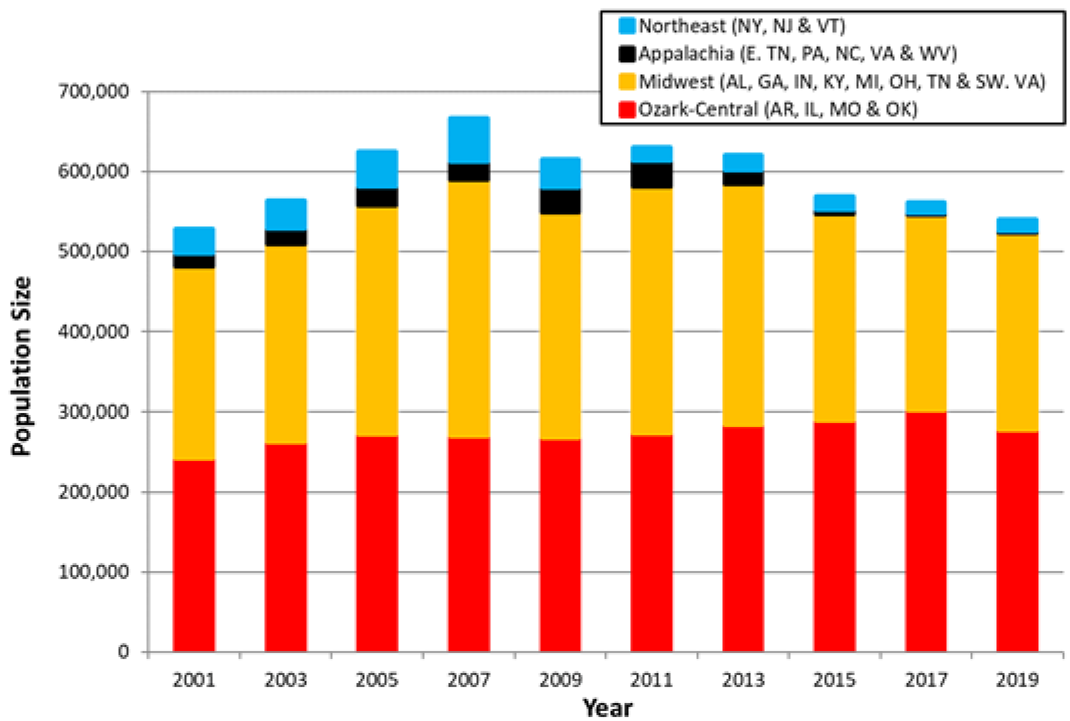
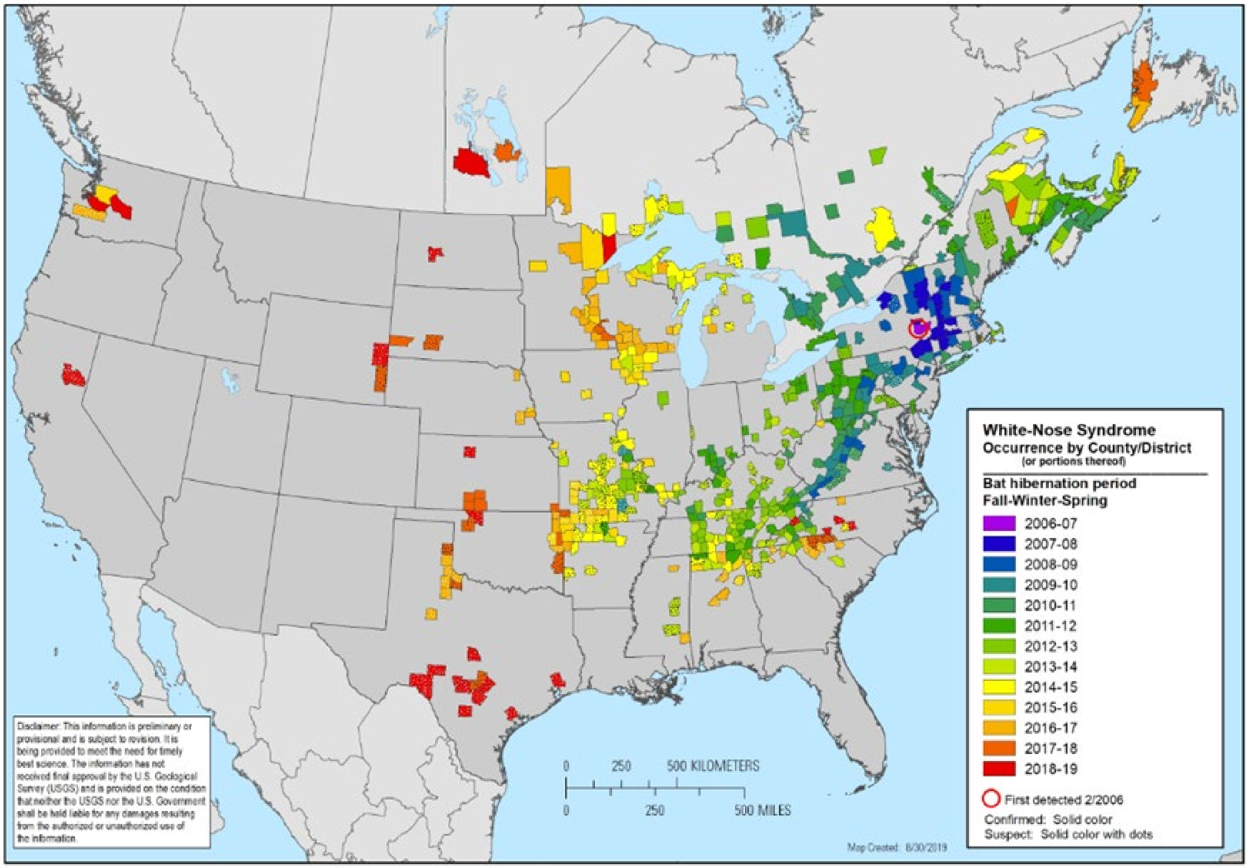


Figure 8. Ibat population estimates by RU from 2001 to 2019 (Service 2019a, Figure 4).

Redundancy of populations rangewide has been significantly reduced with several hibernacula now believed to have no Ibats and concentrations of remaining Ibats into fewer sites. For example as of February 2019, 93% (12,570 of 13,510 of Ibats) occur at 1 location in the Northeast RU and 72% (1,435 of 1,996 of Ibats) occur at 3 locations in the AMRU (Service 2019a). This concentration of individuals in a few locations puts the species at risk should adverse impacts occur at these locations. Based on winter counts rangewide, the resiliency of populations varies, with some winter populations believed to be extirpated and others with virtually no decline. We do not have an understanding of causes of variation in mortality by site and why some sites appear to have greater survival rates. We also lack a good understanding of the changes to associated maternity colonies but we expect the variation to be the same as that observed in winter.

Ibat Threats

Threats to the Ibat are discussed in detail in the draft recovery plan (Service 2007b), 5-year review (Service 2019b), and Northeast Region Indiana Bat Conservation Strategy (Service 2018c). Traditionally, occupied summer habitat loss/degradation during the active or inactive (winter) seasons, winter disturbance while Ibats are in hibernation, and environmental contaminants have been considered the greatest threats to Ibats. The draft recovery plan (Service 2007b) identified and expounded upon additional threats, including collisions with man-made objects (e.g., wind turbines). The 2009 5-year review (Service 2009) was the first review to include the threat of WNS, which is now considered the most significant threat to the recovery of the species. WNS has spread across the range of the Ibat (Figure 9) with declines varying among hibernacula. Overall, the Service finds that WNS has significantly reduced the redundancy and overall resiliency of the Ibat to withstand other cumulative threats. For example, Erickson et al. (2016) modeled the interaction of WNS and wind turbine mortality and the interaction resulted in a larger population impact than when considering the effects of either stressor alone. The primary issues addressed in this Opinion are the loss of summer habitat, spring staging/fall swarming habitat, and any compounding effects from WNS.



Citation: White-nose syndrome occurrence map - by year (2019). Data Last Updated: 8/30/2019. Available at: https://www.whitenosesyndrome.org/static-page/wns-spread-maps.

Figure 9. White-nose syndrome spread map (https://whitenosesyndrome.org accessed 10/22/2019).

In addition to extrinsic factors, there are several intrinsic biological constraints affecting Ibats. High Ibat adult female survival is required for stable or increasing growth rates (Thogmartin et al. 2013). Given the significant declines in populations across much of the range, it is essential to minimize impacts to reproductive potential for surviving Ibats. Healthy adult females have a maximum of 1 pup per year. Thus, the ability of the species to increase reproductive success is limited. Ibats also show strong philopatry to their summer maternity areas, and even interannual fidelity to specific roost trees for as long as the roost trees remain suitable and standing (Kurta 2005). Because Ibats rely on a previously established network of roosts (fidelity), roost tree loss, regardless of whether it occurs during the active or inactive (winter) seasons, may affect the fission-fusion dynamics of their maternity colonies through colony fragmentation which is expected to result in reduced thermoregulatory benefits and either increased energy expenditures or increased use of torpor resulting in: (1) reduced recruitment and/or (2) reduced adult survival.

While forest habitat is not generally considered a limited resource across the range of the Ibat, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. In other words, the impacts are associated with the losses of forest *within* the home range of Ibat colonies. Further, where Ibat colonies remain after WNS has been present on the landscape for over 10 years magnifies the importance of that particular occupied habitat for the remaining survivors of WNS. So now, more than ever, identification and protection of maternity sites is imperative for even the short-term survival and eventual recovery of the species.

Ibat Summary

At present, few healthy winter populations (and likely associated maternity colonies) remain in the Northeast RU and AMRU. WNS impacts are expected to continue across the range for years to come as are other ongoing threats (e.g., climate change, wind turbines) to the bats and their habitats. Given the species' limited reproductive potential, populations are not likely to rebound in the near term. In short, over the past decade, WNS has increased the species' risk of extinction as the resiliency, redundancy, and representation of its remaining populations have declined. The majority of the Ibats' population-based and protection-based recovery criteria have not yet been achieved, identified threats have not yet been sufficiently reduced and stable population growth at the most important hibernacula has not been sustained. In summary, as a whole, the rangewide status of the species appears to be declining (with some winter populations stabilized or improving and most declining). Improving sites may be a result of movement of Ibats from other winter sites along with reduced impacts of WNS. There are very few sites that have had this kind of response. The Service recommended maintaining the current classification as an endangered species in its last 5-year review (Service 2019b). For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to: https://www.fws.gov/midwest/endangered/mammals/inba/index.html, the Service's 2018 Northeast Region Indiana Bat Conservation Strategy at https://www.fws.gov/northeast/nyfo/es/IbatConsStrategy_20180102.pdf, and the Service's 2018 Revised Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat at https://www.fws.gov/midwest/endangered/section7/fhwa/index.html,

NLEB Conservation Needs

The NLEB is a temperate, insectivorous, migratory bat that spends summers in wooded areas and hibernate in caves and mines in the winter (with some overwintering exceptions). The Service listed the NLEB as a threatened species on April 2, 2015 (80 FR 17974). The Service issued a final 4(d) rule for the NLEB on January 14, 2016 (81 FR 1900).

To assess the current status of the species, it is helpful to understand the species' conservation needs which are generally described in terms of RND. The Service frequently characterizes RND for a given species via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3 Rs) (Shaffer et al. 2002, Wolf et al. 2015, Smith et al. 2018).

The Service has not yet approved a recovery plan for the NLEB. However, we suggest that to reduce extinction risk and help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur across the species range. To do this, our current focus addresses the following conservation needs similar to the Ibat:

- Managing the effects of WNS;

- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating bats.

NLEB Current Condition

Now that we have described the species' basic needs, we can assess its current condition. The current range of the NLEB includes 37 States, the District of Columbia, and 13 Canadian Provinces (Figure 10).

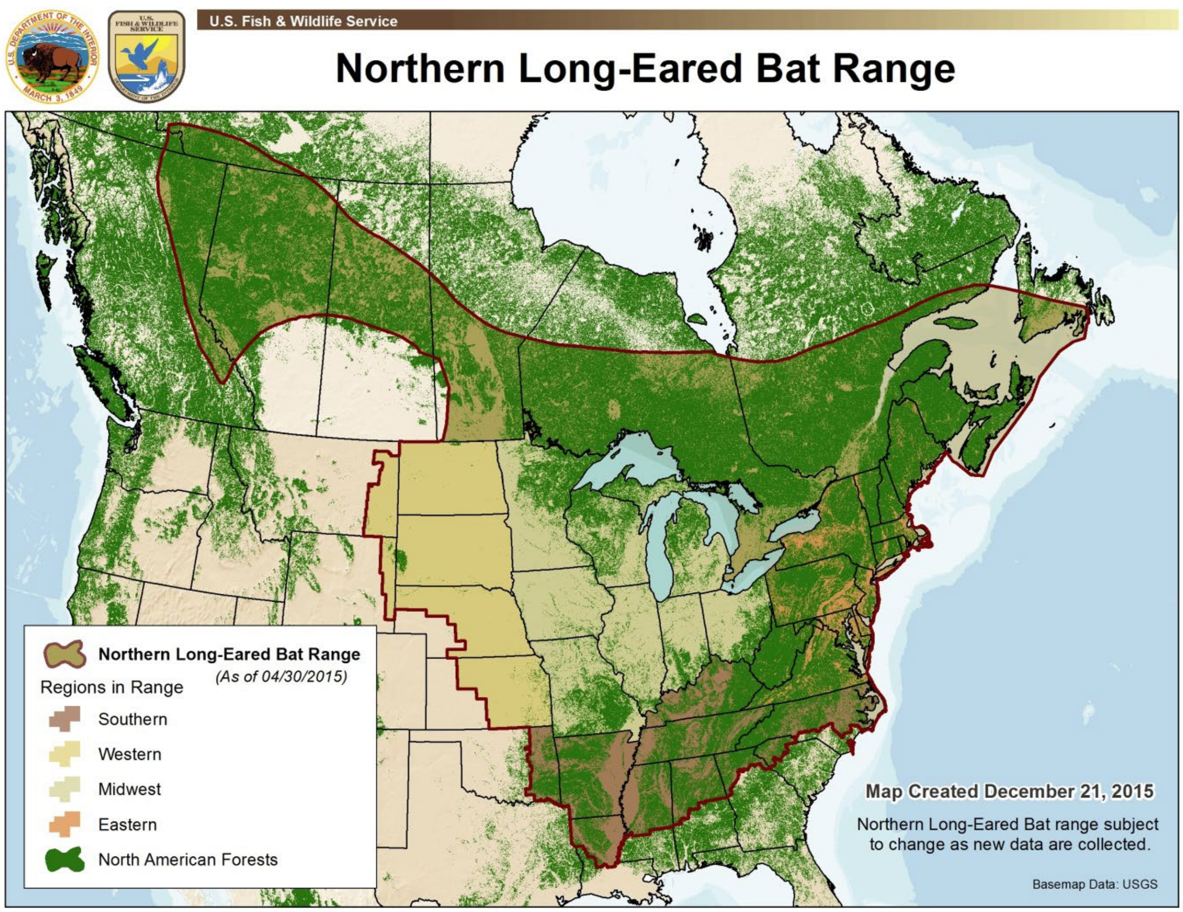


Figure 10. Range of the NLEB.

In the listing rule, the range of the NLEB in the U.S. was divided into the following 4 regions: eastern, midwest, southern, and western. The proposed action falls entirely within the eastern region. Historically, the NLEB was widely distributed in the eastern part of its range (Caceres and Barclay 2000). Prior to documentation of WNS, NLEBs were consistently caught during summer mist-net surveys and detected during acoustic surveys in the eastern U.S. (80 FR 17974). The NLEB continues to be distributed across much of its historical range, but there are many gaps within the range where bats are no longer detected or captured, and in other areas their occurrence is sparse. Similar to summer distribution, NLEBs were known to occur in many hibernacula throughout the East. Since WNS was documented, multiple hibernacula have 0 reported NLEBs. Frick et al. (2015) documented the local extinction of NLEBs from 69% of sites included in their analyses (468 sites where WNS had been present for at least 4 years in Vermont [VT], NY, PA, Maryland [MD], WV, and VA).

NLEB Threats

WNS has caused precipitous and dramatic declines in NLEB numbers (in many areas, 90–100% declines) where the disease has occurred and was the primary factor resulting in the listing of the species under the ESA. As WNS continues to spread across the NLEB's range, NLEB numbers have continued to decline to varying degrees. Notwithstanding the severity of the impact of WNS to the NLEB, there are other anthropogenic threats to NLEBs. NLEB hibernacula may be impacted by humans altering or closing hibernacula entrances. Forest conversion and management may result in habitat loss, fragmentation of existing habitats, and direct and indirect injury and mortality of individual bats. Tree removal around maternity roosts and hibernacula may cause injury and death to individual NLEBs. Environmental contaminants, in particular insecticides, pesticides, and inorganic contaminants, such as mercury and lead, may have detrimental effects on individual NLEBs. NLEBs have also been documented to collide with wind turbines.

While forest habitat is not generally considered a limited resource across the range of the NLEB, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. In other words, the impacts are associated with the losses of forest *within* the home range of NLEB colonies. Further, where NLEB colonies remain after WNS has been present on the landscape for over 10 years magnifies the importance of that particular occupied habitat for the remaining survivors of WNS. So now, more than ever, identification and protection of maternity sites is imperative for even the short-term survival and eventual recovery of the species.

NLEB Summary

In summary, as a whole, the rangewide status of the species appears to be declining. The primary threat of WNS continues to spread and effects are expected to continue across the range for years to come as are other ongoing threats (e.g., climate change, wind turbines) to the bats and their habitats. Given the species' limited reproductive potential, populations are not likely to rebound in the near term. In short, over the past decade, WNS has increased the species' risk of extinction as the resiliency, redundancy, and representation of its remaining populations have declined. For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to:
https://www.fws.gov/midwest/endangered/mammals/nleb/index.html, and the 2018 Revised Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat at
https://www.fws.gov/midwest/endangered/section7/fhwa/index.html.

STATUS OF CRITICAL HABITAT

No critical habitat has been designated for: VASP, RLP, or NLEB. Critical habitat for Ibat has been designated in 13 winter hibernacula (11 caves and 2 mines) in 6 states (including Hellhole Cave in Pendleton County, WV) (41 FR 41914); however, this action does not affect any of those areas. Critical habitat has been proposed for CD (83 FR 59232) as described below and may be affected by the proposed action.

Candy darter (CD) proposed critical habitat

A total of 370 stream miles in 5 critical habitat units were proposed for the CD in WV and VA: (1) Greenbrier River, (2) Middle New River, (3) Lower Gauley River, (4) Upper New River, and (5) Upper Gauley River, on November 18, 2018 (83 FR 59232, Figure 11).

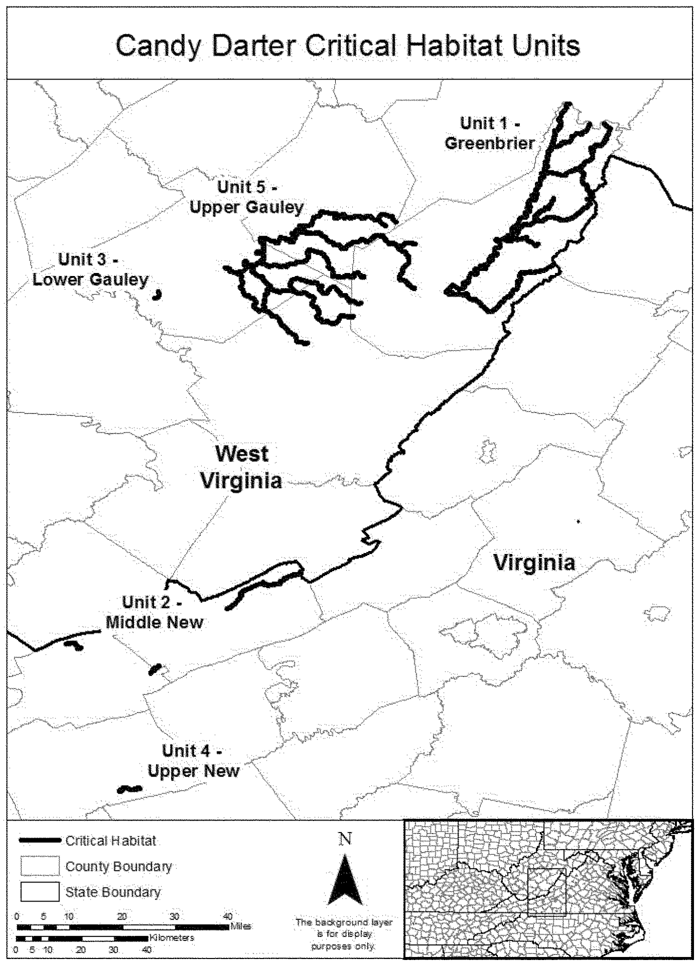


Figure 11. Proposed CD critical habitat units.

When designating critical habitat, the Service assesses whether the specific areas within the geographical area occupied by the species at the time of listing contain features which are essential to the conservation of the species and which may require special management considerations or protection. The critical habitat proposed rule (83 FR 59232) provided the overall habitat characteristics that are important for the CD. These include “sufficiently stabilized forest stream banks throughout the watersheds such that water quality allows for normal feeding, breeding, and sheltering in an area with sufficiently low numbers of nonnative species (Service 2018a). The features essential to the conservation of the CD may require special management considerations or protections to reduce the following threats: (1) hybridization with the nonnative variegate darter; (2) general increase in water temperature, primarily attributed to land use changes; (3) changes in water chemistry, including, but not limited to, changes in pH levels and contamination with coliform bacteria; (4) habitat fragmentation primarily due to construction of barriers and impoundments; (5) excessive sedimentation and stream bottom embeddedness (the degree to which gravel, cobble, rocks, and boulders are surrounded by, or covered with, fine sediment particles); and (6) competition for habitat and other instream resources and predation from nonnative fishes."

The proposed critical habitat is characterized by having the following physical or biological features (PBFs) that are essential for the conservation needs of the CD: (1) ratios or densities of nonnative species that allow for maintaining populations of CDs; (2) a blend of unembedded gravel and cobble that allows for normal breeding, feeding, and sheltering behavior; (3) adequate water quality characterized by seasonally moderated temperatures and physical and chemical parameters (e.g., pH, dissolved oxygen levels, turbidity) that support normal behavior, growth, and viability of all life stages of the CD; (4) an abundant, diverse benthic macroinvertebrate community (e.g., mayfly nymphs, midge larvae, caddisfly larvae) that allows for normal feeding behavior; and (5) sufficient water quantity and velocities that support normal behavior, growth, and viability of all life stages of the CD.

As noted in the CD proposed rule (83 FR 59232), the 5 proposed critical habitat units are currently (i.e., at the time of listing) occupied by the CD. These units are considered occupied year-round for the purposes of consultation based on current survey data. The 5 proposed critical habitat units contain one or more of the PBFs to support life-history processes essential to the conservation of the CD. Some units contain all of the identified PBFs and support multiple life-history processes. Some units contain only some of the PBFs necessary to support the CD's particular use of that habitat. In these areas, any actions that may affect the species or its habitat would also affect designated critical habitat, and it is unlikely that any additional conservation efforts would be recommended to address the adverse modification standard over and above those recommended as necessary to avoid jeopardizing the continued existence of the CD.

Of the 5 units, 4 are marginally secure, and the Upper New unit is generally insecure (Service 2018a). The Upper Gauley unit is the most secure, based on a high percentage of forest cover (an indicator of low levels of siltation and embeddedness of stream substrate), absence of variegate darters, and a high degree of connectivity among populations. The Upper Gauley unit has cold waters, with some degree of water quality impairment by aluminum, iron, or high water acidity. The Greenbrier Unit generally has better water quality than the Upper Gauley unit, but the CD has a high degree of hybridization with the variegate darter in this watershed (Service 2018a).

Variegate/CD darter hybridization is known to occur in the Greenbrier and Lower Gauley units, while variegate alleles in CD are present in portions of the Upper Gauley unit at very low prevalence. There are no variegate darter hybridization or alleles in CD in the Middle New or Upper New units. Non-native trout species, which are CD predators, are known to occur in all units. The Upper Gauley and Middle New units are partially within the action area. The other units are not within the action area.

The proposed critical habitat designation does not include all streams known to have been historically occupied by the species; instead, it focuses on occupied streams within the historical range that retain the necessary PBFs that allow for the maintenance and expansion of existing populations (83 FR 59232). In summary, as a whole, the status of proposed critical habitat is stable to declining for most proposed critical habitat units. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term. For more information about CD proposed critical habitat, refer to: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1396.

ENVIRONMENTAL BASELINE

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Greene Interconnect – Greene Interconnect is a metering and regulating station located adjacent to MVP, near MP 180.5 in Monroe County, WV. The project is designed to deliver approximately 1 billion feet per day of natural gas from MVP to Columbia Gas Transmission, LLC's KA transmission system. Greene Interconnect is a distinct project that had not been proposed at the time the 2017 BiOp was finalized. On June 4, 2019, Mountain Valley filed with FERC in Docket No. CP19-477 to request authorization to construct the interconnect. In August 2019, the Service's WVFO completed Section 7 consultation on the Greene Interconnect project. The Service concluded that the project not likely to adversely affect any listed species or designated critical habitat and any take of NLEB is exempted under the 4(d) rule (D. Bremer, Service, letter to D. Swearingen, FERC, August 1, 2019). The Greene Interconnect is within the MVP action area.

MVP Southgate – MVP Southgate is a natural gas pipeline system that will run approximately 75 miles from the terminus of the MVP at the Lambert Compressor Plant in southern VA into central NC. MVP Southgate is a distinct project that had not been proposed at the time the 2017 BiOp was prepared; the project proponent submitted its application to FERC requesting authorization to construct the pipeline on November 6, 2018. In March 2020, the Service's Raleigh, NC Field Office completed Section 7 consultation on the MVP Southgate project. The Service concluded that MVP Southgate is not likely to adversely affect any listed species or designated critical habitat (P. Benjamin, Service, letter to K. Bose, FERC, March 19, 2020). A small section of MVP Southgate overlaps with the MVP action area.

Because the Service concluded that MVP Southgate and the Greene Interconnect are not likely to adversely affect listed species or designated critical habitat, the projects do not materially alter the environmental baseline for MVP described below.[3]

Status of the Species within the Action Area

Virginia spiraea (VASP)

The proposed action crosses portions of the Gauley, Greenbrier, and Meadow Rivers, in Nicholas and Summers Counties, WV, which provide habitat for VASP (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1728). VASP surveys were completed near these rivers across a 300 ft wide environmental study corridor (a total of 3.64 acres along 0.14 mile) (ESI 2015a) in 2015 and no VASP was found (ESI 2016a). Route realignments and variance requests have occurred since the issuance of the Service's 2017 BiOp; however they did not necessitate additional surveys because they did not impact any additional potential habitat for this species.

Due to restricted access, 2.3 acres (parcel WV-SU-046) within the construction ROW, ARs, and ATWS in close proximity to the Greenbrier River in Summers County was not surveyed prior to the issuance of the Service's 2017 BiOp. A survey for VASP was conducted within the parcel on December 20, 2017. However, the survey was conducted during a time of year (i.e., December) when surveys for VASP cannot confirm presence or absence of the species, and the photos/summary of the habitat included in the reports (ESI 2018a, ESI 2018b) did not otherwise confirm that VASP habitat is not present. Therefore, the Service is not able to confirm that the 2.3-acre parcel does not contain suitable occupied VASP habitat.

Potentially suitable habitat for VASP has been identified in the 2.3-acre area based on the VASP habitat model (WVDNR 2017). Because VASP occurs along rivers, streams, and wetlands, we used National Wetlands Inventory maps to confirm that the 2.3 acres contain suitable habitat. Thus, for the purposes of this Opinion, presence of VASP suitable habitat is assumed within the 2.3 acres.

To estimate the extent of VASP within the 2.3 acres, we used 1996-2010 VASP occurrence data from the Greenbrier River (Table 19). This data was collected from 3 VASP occurrences (WVDNR 2011), which together are considered 1 population (the Greenbrier River population). More recent data is available for these occurrences. The more recent data was collected using the stem count method, instead of the extent of VASP coverage method used in previous years. The stem count method focuses on the number of individual stems present rather than the amount of area occupied. Therefore, because of the difficulty in using this new data to determine extent of coverage, we are utilizing the 1996-2010 data. However, the more recent stem count surveys indicate the occurrences appear to be healthy and comparable in size to previous years (WVDNR 2019).

[3] For the same reason, if MVP Southgate and the Greene Interconnect are considered consequences of the MVP, the projects would not materially change our analysis of the effects of the action detailed below.

Based on the survey data collected from the Greenbrier River population, the extent of VASP coverage averaged 221.33 m^2 (0.05 acre) for each occurrence (Table 19). It is unlikely that there would be more than one VASP occurrence within the 2.3-acres because of the limited amount of suitable habitat present within the parcel. Therefore, we are assuming the extent of VASP coverage within the 2.3 acres is 0.05 acre, and that the VASP on this 0.05 acre is 1 occurrence, which is also part of the Greenbrier River population.

Table 19. Estimated coverage of VASP at a WVDNR monitoring site on the Greenbrier River (WVDNR 2011).

Year	Extent of Coverage (m^2)
1996	205.31
1997	183.00
2001	226.37
2003	226.37
2005	233.07
2007	237.61
2010	237.61
Average	221.33

Since VASP is a species that occurs along rivers, streams, and wetlands, we are assuming that within the 2.3 acres the 0.05 acre of VASP is either along a 406.45 linear ft reach of an unnamed tributary of the Greenbrier River (S-EF53) or within a 1.21-acre wetland (W-MM20-PFO), between MP 171.2-171.4, that overlaps with the construction ROW, ARs, and ATWS (Figure 12). Tributary S-CV 17 (Figure 12) was not considered potential VASP habitat because it is not a direct tributary of the Greenbrier River, which is where VASP is known to occur; therefore it is unlikely that the Greenbrier River population would be able to establish an occurrence in Tributary S-CV 17.

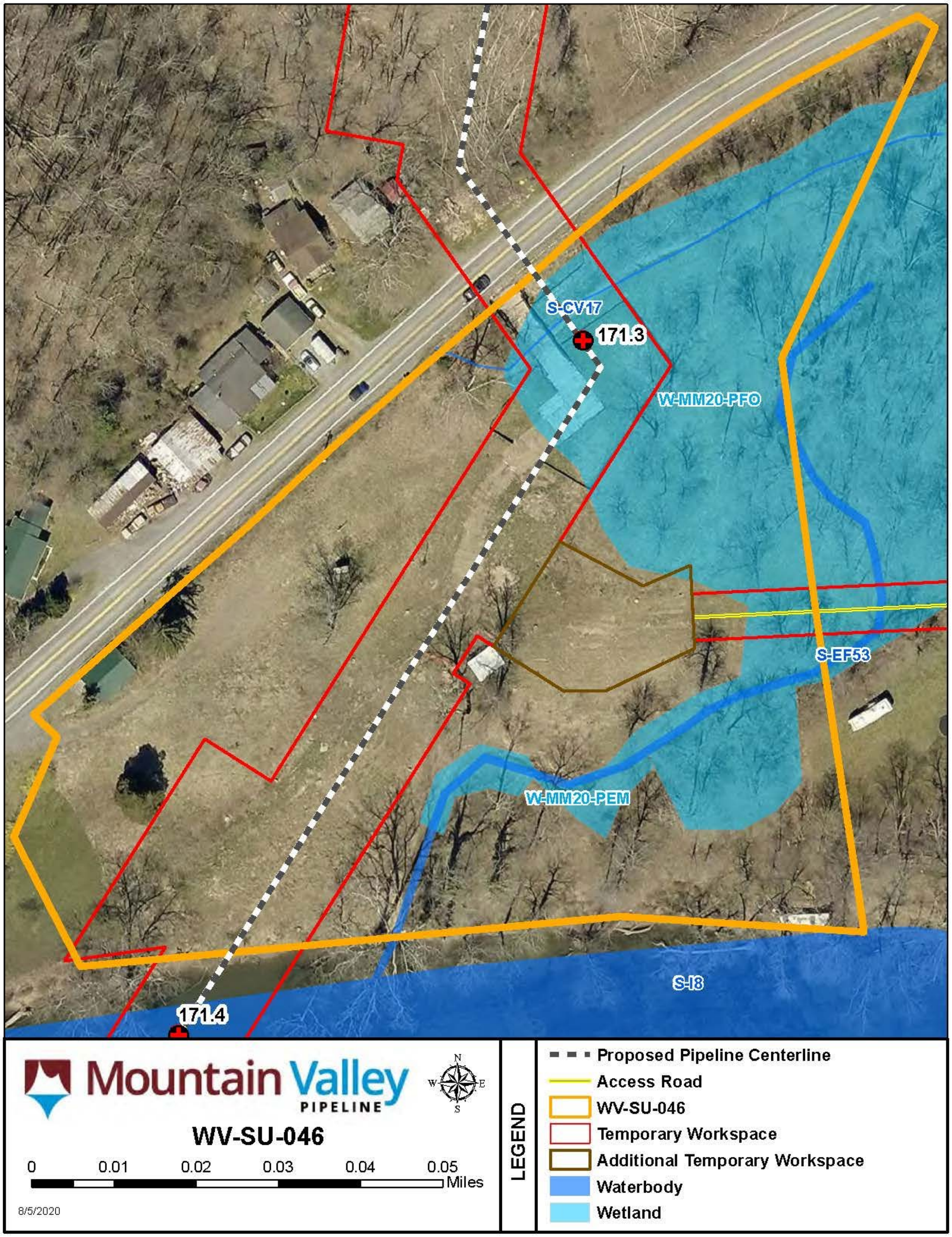


Figure 12. 2.3-acre parcel and the construction ROW, ARs, and ATWS.

On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). A travel lane will be reinstalled within the previously approved LOD for construction to access stream crossings in 2020 (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

Aside from the construction activities noted above, we are not aware of specific activities that have occurred or will occur in the action area adversely affecting VASP. Potential threats to the species' habitat within the action area include: invasive species, such as Japanese knotweed and purple loosestrife that compete with VASP; changes in water flow regimes from weather related factors; and construction of boat docks or other streambank modifications (Service 2008). All of these threats may affect the amount of habitat available for the species along the streambanks in the action area.

The role of the action area with regards to conservation/recovery of the species is that the project area provided habitat for 1 assumed VASP occurrence on the Greenbrier River (Figure 12). The action area also contains VASP potential habitat; these areas were previously surveyed and VASP was not documented. There is also suitable, unsurveyed, VASP habitat located upstream and downstream of the single assumed occurrence, within the action area. However, this suitable, unsurveyed habitat will not be disturbed by construction or post-construction activities in a manner that could adversely affect VASP (if present) or that could make the habitat unsuitable for the species.

Roanoke logperch (RLP)

Presence/absence surveys for RLP were not conducted for the proposed action. RLP presence in the action area is assumed where suitable habitat was identified within potential habitat and in areas known to support RLP. Genetic analysis (Roberts et al. 2013) of RLP indicated a dispersal extent of up to 80 km; however, median lifetime dispersal distance is 6-24 km (Roberts et al. 2016a). The following MVP waterbody crossings were categorized as RLP suitable habitat identified by desk-top analysis or in-situ assessment: Bradshaw Creek 1 (MP 230.9), Bradshaw Creek AR (MP 231.6), North Fork Blackwater River (MP 249.8), Teels Creek 4 (MP 262.4), Little Creek 1.5 (MP 262.7), Little Creek 2 (MP 263.4), Maggodee Creek 1 (MP 269.4), Blackwater River 3 (MP 269.8), and Harpen Creek 1 (MP 290). The following MVP waterbody crossings were categorized as known to support RLP-presence assumed: North Fork Roanoke River AR1 (MP 227.4), North Fork Roanoke River AR2 (MP 231.7), North Fork Roanoke River (MP 227.4), Roanoke River (MP 235.6), and Pigg River (MP 289.2).

To date, survey efforts have not documented RLP in the Blackwater River drainage, which includes the North Fork Blackwater River, Teels Creek 4, Little Creek 1.5, Little Creek 2, Maggodee Creek 1, and Blackwater River 3 crossings. Subsequent to the 2017 BiOp, environmental DNA (eDNA[4]) analysis detected RLP in the Roanoke River drainages but not in the Blackwater River drainage (Strickland and Roberts 2019 and SBA Appendix A [Mountain Valley 2020] Mountain Valley 2020). Mountain Valley sampled the South Fork Blackwater, North Fork Blackwater, and Blackwater Rivers and Maggodee, Teels, and Little Creeks and did not detect RLP eDNA (SBA Appendix A [Mountain Valley 2020]). Moreover, no instream work will occur at these crossings from March 15 - June 30, which is the RLP spawning season. Based on the lack of evidence via traditional survey methods or eDNA that RLP occupy the Blackwater River drainage and implementation of the RLP TOYR, no impacts to RLP are anticipated from the MVP Blackwater River drainage crossings and the crossings will not be discussed further in this Opinion.

The North Fork Roanoke River AR2 crossing (MP 231.7), Montgomery County, VA, is known to support RLP. Reese Mountain Road, an existing road that includes a paved bridge across the river, will be used as the AR to reach the construction site; therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

The North Fork Roanoke River AR1 crossing (MP 227.4), Montgomery County, VA, is known to support RLP. The crossing method is a temporary single span bridge (Table 11). Mountain Valley has committed that no temporary fill placement will occur at the temporary ARs (M. Stahl, EQT, email to S. Hoskin, Service, November 9, 2017). Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Bradshaw Creek AR crossing (MP 231.6), Montgomery County, VA, is 5.8 km above the confluence of Bradshaw Creek with the Roanoke River. To date, RLP have not been documented in Bradshaw Creek but it contains suitable RLP habitat based on the in-situ assessment (ESI 2016b) and RLP occupancy is assumed since RLP have been documented in the Roanoke River near the confluence with Bradshaw Creek. Bradshaw Creek AR (MN-0276) is composed of 2 existing stream crossings within a 92-ft stream reach. A single AR approaches Bradshaw Creek (Stream ID S-OO10) and splits near the stream crossing and then rejoins after the crossing. The upstream crossing is composed of an existing multi-box, concrete culvert that was installed independent of the MVP and Mountain Valley intends to use this crossing without any modifications (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, April 3, 2020) (Table 11). The downstream crossing occurs downstream of the scour pool from the culvert (where the streambed aggrades) and is an existing ford crossing that will be upgraded to a single-span bridge (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) (Table 11). Mountain Valley has committed that no temporary fill placement will occur at the temporary ARs (M. Stahl, Mountain Valley, email to S. Hoskin, Service, November 9, 2017). Therefore, no instream construction impacts or impacts to RLP are anticipated at these crossings and these crossings will not be discussed further in this Opinion.

[4] Environmental DNA sampling is described in the SBA (pp. 5-6, 49) (Mountain Valley 2020). Although eDNA testing results alone are not currently a definitive means for determining presence/probable absence, the results may corroborate or supplement existing information indicating the probable absence of a species in an area.

Roanoke River crossing (MP 235.6), Roanoke County, VA, is known to support RLP. The proposed crossing method is microtunnel (M. Neylon, Mountain Valley, email to J. Stanhope, Service, August 6, 2020) (Tables 11 and 12). This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Pigg River crossing (MP 289.2), Pittsylvania County, VA, is known to support RLP. The crossing method was HDD, which was completed in 2019 (Table 11). This trenchless crossing method minimized impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching was performed, the stream channel itself was not impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

There are 3 MVP waterbody crossings where adverse impacts to RLP are expected: Bradshaw Creek 1 (MP 230.9), Harpen Creek 1 (MP 290), and North Fork Roanoke River 1 (MP 227.4) (Table 11).

Additionally, we anticipate adverse effects to RLP from upland sediment contributions in the following waterbodies: Bradshaw Creek, North Fork Roanoke River, South Fork Roanoke River, Roanoke River, and Pigg River. More details are provided in the RLP Effects of the Action section.

Roanoke River Watershed

Bradshaw Creek 1 crossing (MP 230.9), Montgomery County, VA, is 2.5 km above the confluence of Bradshaw Creek with the Roanoke River. The Predicted Suitable Habitat layer for RLP (Virginia Natural Heritage Program 2017) identifies this crossing as potential RLP habitat and RLP presence is assumed. At the crossing site Bradshaw Creek was classified as moderately low gradient with narrow and shallow riffles. The construction ROW is 22.86 m wide at this crossing, the wetted width is 6 m. Bradshaw Creek contains suitable RLP habitat based on the in-situ assessment (ESI 2015b). RLP in this creek are part of the Roanoke River RLP population. As stated earlier, the RLP occupies medium to large warmwater streams with moderate to low gradient, therefore based on the creek width and proximity to the Roanoke River, we expect RLP will use Bradshaw Creek when water levels are high and RLP from the Roanoke River enter the creek; therefore we anticipate RLP numbers are lower in this creek than in the Roanoke River, but to be conservative we will assume density levels will be the same.

The North Fork Roanoke River 1 crossing (MP 227.4), Montgomery County, VA, is 34 km above the confluence of the North Fork Roanoke River with the Roanoke River. The Predicted Suitable Habitat layer for RLP (Virginia Natural Heritage Program 2017) model identifies the crossing as potential RLP habitat and RLP presence is assumed at this location. The construction

ROW is 22.86 m wide at this crossing. The crossing was completed in 2018. No RLP were observed during the fish removals associated with 2 dewatering events (July 17-18, 2018 and August 15-17, 2018) at this crossing (Mountain Valley 2020). The North Fork Roanoke River is known to support RLP and is part of the Roanoke River RLP population. The North Fork Roanoke River is a VA Department of Game and Inland Fisheries (VDGIF) designated threatened and endangered species waters, which "identifies streams and rivers that contain documented occurrences of federal/state- or state-listed threatened or endangered species and their associated habitat."

The South Fork Roanoke River (which is part of the impact area described below) is known to support RLP and is part of the Roanoke River RLP population. The South Fork Roanoke River is a VDGIF designated threatened and endangered species waters. RLP presence is assumed in the impact area described below.

The Roanoke River is known to support RLP and is part of the Roanoke River RLP population. It is a VDGIF designated threatened and endangered species waters. RLP presence is assumed in the impact area described below. Portions of the Roanoke River are identified as impaired segments for aquatic life use based on impaired benthic macroinvertebrate communities and are on the Virginia 303(d) list of Impaired Waters. The benthic macroinvertebrate standard is a metric that corresponds to sediment load in the waterbody and is discussed in more detail below.

Pigg River Watershed

Harpen Creek 1 crossing (MP 290), Pittsylvania County, VA, is 2.3 km above the confluence with the Pigg River. Harpen Creek contains limited suitable RLP habitat based on the in-situ assessment (ESI 2015b), but RLP presence is assumed. RLP in this creek are part of the Pigg River RLP population. At this crossing Harpen Creek was classified as low gradient with shallow riffles that exhibit heavy embeddedness and siltation. The construction ROW is 22.86 m wide at this crossing, the wetted width is 5 m. As stated earlier, the RLP occupies medium to large warmwater streams with moderate to low gradient, therefore based on the creek width and proximity to the Pigg River, we expect RLP will use Harpen Creek when water levels are high and RLP from the Pigg River enter the creek; therefore we anticipate RLP numbers are lower in this creek than in the Pigg River, but to be conservative we will assume density levels will be the same.

The Pigg River is known to support RLP and is part of the Pigg River RLP population. The Pigg River is a VDGIF designated threatened and endangered species waters. RLP presence is assumed in the impact area described below.

The microhabitat inhabited by the RLP differs between the Roanoke and Pigg Rivers. The Roanoke River has the highest gradient, largest substrates, and highest bottom velocities in riffle microhabitats and the Pigg River is the most heavily embedded with silt (Rosenberger and Angermeier 2002) perhaps because it is the smallest and shallowest of the rivers inhabited by RLP.

RLP decline in the action area is primarily the result of destruction and modification of habitat and fragmentation of the species range. Primary causes of RLP habitat degradation include chemical spills, non-point runoff, channelization, impoundments, impediments, and siltation. However, since the time of listing additional populations have been discovered and some habitat has been restored. Numerous instream and bank restoration projects have been completed in the action area and 4 impediment removal project have reconnected a total number of 282 miles of RLP habitat; 97 miles in the Pigg River and 185 miles in the Roanoke River.

In summary, the Roanoke and Pigg River systems provide feeding, breeding, and sheltering for the RLP. The Pigg River in particular provides an unobstructed dispersal corridor, which allows for unrestricted gene flow. Because these systems cover a large geographic extent, contain an estimated large population, and run a lower risk of being susceptible to extirpation (Roberts et al. 2016b) we expect they underpin the recovery of the species.

Candy darter (CD)

Presence/absence surveys for CD were not conducted for the proposed action. CD presence is assumed based on recent surveys and research by WVDNR, VDGIF, and researchers from West Virginia University and Virginia Tech. These surveys have repeatedly documented CD presence in Stony Creek, VA, and the Gauley River, WV. Data available during the CD SSA indicated recent (2016) survey detections in the lower Stony Creek, VA watershed and multiple locations throughout the Gauley River with CD detections in 2016. During the listing process for the species, the Service determined that, although all sections of Stony Creek and the Gauley River have not been surveyed for CDs, the lower 21.2 miles of Stony Creek and 64.5 miles of the Upper Gauley River contain habitat that is suitable for the species; thus, CD presence is assumed throughout Stony Creek and the Gauley River within the action area.

The Gauley River, Nicholas County, WV, (Stream Project ID S-J29) water withdrawal location (Table 10) is known to support CD. Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD are anticipated from water withdrawals at this location and this water withdrawal will not be discussed further in this Opinion.

The Gauley River pipeline crossing (Stream ID S-J29) (Table 11) is known to support CD. The proposed crossing method is microtunnel. This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

The Stony Creek pipeline crossing (Stream ID S-S5) (Table 11) is known to support CD. The proposed crossing method is conventional bore. This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Kimballton Branch (tributary to Stony Creek) AR crossing is not known to support CD. The proposed crossing method is an existing private drive from Rogers Road (Route 683). Mountain Valley is utilizing both the existing drive with culverts previously placed in the stream by others and the existing Rogers Road to access the project (M. Neylon, Mountain Valley, email to J. Richard, Service, June 16, 2020). Because an existing road and culverts will be used, the stream channel itself and stream banks would not be impacted. Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Kimballton Branch (tributary to Stony Creek) pipeline crossing is not known to support CD. The crossing is located approximately 900 m upstream from the confluence of Kimballton Branch and Stony Creek and CDs are present in Stony Creek. The proposed crossing method is open-cut dry crossing using the dam and pump method (M. Neylon, Mountain Valley, emails to J. Richard, Service, June 16, 2020 and July 13, 2020). Due to the distance from the confluence with Stony Creek, impacts to CD from this crossing are not anticipated and this crossing will not be discussed further in this Opinion.

We anticipate adverse effects to CD from upland sediment contributions in the following waterbodies: Stony Creek and the Gauley River. More details are provided in the CD Effects of the Action section.

Recent work by McBaine and Hallerman (2020) addressed demographics and population genetics of CD populations in VA. These studies found that CD relative density measured by catch-per-unit-effort (CPUE) within Stony Creek was highest in the midpoint of the watershed, with lower abundances closer to the confluence with the New River. Comparisons of CPUE data between Dunn (2013) and McBaine and Hallerman (2020) found the populations to be relatively stable between the 2 time points. Though there was a 13% decrease in CPUE for the middle Stony Creek site from 2013 to 2018, McBaine and Hallerman (2020) indicated that these figures should be interpreted with caution and should not be interpreted as signs of a declining population size. CD age structure analysis found individuals from ages 0 to 5 in Stony Creek, with the greatest proportions comprised of age-2 and age-3 individuals (McBaine and Hallerman 2020). Observed movement patterns within Stony Creek found that movements were generally upstream and short-distance (average 53 m), though 1 individual moved 4.2 km upstream. Because short-distance movements are detected more frequently than long-distance movements (Albanese et al. 2003), it is possible that longer movements by CD may occur more regularly than observed.

A survey of Stony Creek found CD in 74% of habitat units sampled (n = 942) throughout the 13.8-stream km (skm) (8.6-smi [stream miles]) survey length (Leftwich et al. 1996). CD were observed in all stream habitat types (82% of riffles, 90% of runs, 79% of glides, and 41% of pools) with densities ranging 0-30 CD per 100 m^2. The highest densities were found in riffles, with an average of 10 CD/100 m^2 (Leftwich et al. 1996). Similar surveys have not been conducted for the Gauley River.

Although CD population estimates for Stony Creek and the Gauley River are unavailable, both populations have been found to contain very few variegate darter alleles, and are considered to be among the most genetically pure populations (Gibson et al. 2019). This gives added importance to these particular populations for the future conservation and recovery of the species. Based on a review of physical habitat metrics, non-native competition metrics, and population demographic metrics, CD populations in Stony Creek and the Gauley River were determined to be "generally secure" in the SSA (Service 2018a), and are considered so in the action area for the purposes of this Opinion.

The role of the action area with regards to conservation/recovery of the species is that the project area provides habitat for feeding, breeding, and sheltering of CD in two metapopulations. The Gauley River above Summersville Lake provides feeding, breeding, and sheltering habitat for CDs as well as important connectivity between the other populations in the Upper Gauley metapopulation, including Panther Creek, Williams River, Cranberry River, and Cherry River. These areas within the Upper Gauley metapopulation represent the majority of extant CD populations with a "good" population condition score. Thus, their continued existence and connectivity within the watershed is critical to the recovery of the species. Within the Middle New and Upper New CD metapopulations, Stony Creek is the only CD population with a "good" population condition score (Service 2018a). The Upper Gauley and Middle New metapopulations are relatively free from hybridization, making them essential to the recovery of the species.

<u>Indiana bat (Ibat)</u>

The terrestrial action area (1,002,627.7 acres) is located within the Ibat AMRU (51,400,965.4 acres) (Service 2007b), which includes 8,788,657.5 acres in VA and 15,506,118.3 acres in WV, as well as additional acreage in TN. Approximately 166,696.78 acres of the action area in VA are outside of the AMRU and Ibats are unlikely to occur in this area. The action area comprises approximately 1.626% of the AMRU (1.87% in VA and 4.32% in WV). The Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat (6,369,616.47 in VA and 12,519,436.45 in WV), based on NLCD 2016 land cover data. The total amount of suitable Ibat habitat that will be removed by the MVP within the AMRU is 4,714.87 acres, or 0.025% of the total amount of suitable Ibat habitat in VA and WV.

Based on existing data and surveys conducted by ESI, we define 6 categories of Ibat habitat within the action area: known occupied hibernacula in VA and WV, assumed occupied hibernacula in VA and WV, known use spring staging/fall swarming habitat in VA and WV, unknown use spring staging/fall swarming habitat in VA and WV, known use summer habitat in WV, and unknown use summer habitat in VA and WV.

Hibernacula and Associated Spring Staging/Fall Swarming Habitat

Known hibernacula are defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating Ibats. Assumed occupied hibernacula are defined as suitable caves/mine portals which are reasonably certain to be occupied by hibernating Ibats. Potential hibernacula surveys for Ibats were conducted within the original 0.6-mile action area (i.e., "all lands within 0.6 miles of the boundaries of the Project Area..." FERC 2017a in VA and WV between November 2014 and September 2017 (FERC 2017b; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 10, 2020). Initially, potential hibernacula surveys yielded a total of 134 suitable caves/mine portals within 5 miles of the 0.6-mile action area from the 2017 BiOp. Of these, 85 potential hibernacula were determined to be suitable based on field survey results or information provided by a team of karst specialists with demonstrated experience in karst and karst hydrogeology in southern WV and southwestern VA (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). Of those hibernacula that were deemed suitable, 16 were within the 0.6-mile action area (M. Stahl, EQT, email to T. Lennon, Service, November 9, 2017). Since the issuance of the 2017 BiOp, 3 additional portals have been discovered, 1 of which MVP determined to be potentially suitable for hibernating bats (portal P-BTH-001 near MP 207.5 in Giles County, VA). However, upon further review by the Service, WVDNR, and VDGIF it was determined that this portal is not reasonably likely to support federally listed bats given the internal dimensions and relatively small entrance size and steep downward angle (A. Silvis, WVDNR, email to T. Lennon, Service, June 23, 2020; R. Reynolds, VDGIF, email to S. Hoskin, Service, July 1, 2020). Therefore, for the purposes of this Opinion, the Service does not consider portal P-BTH-001 to be a suitable Ibat hibernacula and it will not be discussed further.

The expansion of the terrestrial action area from 0.6 to 2.0 miles from the project ROW, as a result of sound attenuation associated with construction noise (discussed in Action Area section), resulted in additional suitability analyses for 47 portals. Based on field investigation, sampling (harp trap) results, desktop analyses, and coordination with karst specialists, the updated total portal and cave features evaluated for potential use by Ibats within the 2.0-mile action area is as follows:

- 2 known occupied hibernacula;
- 62 suitable features; and
- 125 unsuitable features.

The 2.0-mile action area is within 5 miles of 2 known Ibat hibernacula, 1 in VA and 1 in WV, and the most recent Ibat population estimates for each are summarized in Table 20. Based on the protections included in the Karst Mitigation Plan provided in the FEIS (FERC 2017a), the hydrologic and geologic analysis (FERC 2017b) that was completed for Tawney's Cave in VA, the information provided in the November 9, 2017, Potentially Suitable Hibernacula within the Action Area table (M. Stahl, EQT, email to T. Lennon, J. Stanhope, and S. Hoskin, Service, November 9, 2017), the AMMs and analyses included in the SBA (Mountain Valley 2020); and Mountain Valley's supplemental comment response documents (e.g., all blasting activities within close proximity to known and assumed occupied hibernacula will occur outside of the bat hibernating season, and site-specific blasting plans will be developed for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula to avoid adverse overpressure or vibration impacts to any bats occupying the features and to ensure the structural integrity of both the aboveground and subsurface features of a cave or portal during blasting events), we do not expect hibernating Ibats in any known or assumed occupied hibernacula to be exposed to the stressors associated with MVP construction (e.g., noise, vibration, feature collapse/modification, etc.). We also expect no impacts to the hibernacula themselves that would render them unsuitable for future use by Ibats.

Table 20. Known Ibat hibernacula within 5 miles of the action area (Powers et al. 2015; Service 2007b; A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020).

County, State	Hibernaculum Name	Approximate Distance (miles) to Project[a]	Hibernaculum Priority Number[b]	WNS Status (date)	Ibat Population Estimate (date)
Monroe, WV	Greenville Saltpeter Cave	2 (AR)	3	Confirmed[c] (2012)	3 (2012) 16 (2014) 4 (2016) 2 (2018)7 (2020)
Giles, VA	Tawney's Cave	0.04 (ROW)	4	Confirmed[d] (2009)	14 (2007) 0 (2013) 0 (2019)

[a]ROW – construction ROW, AR – access road.
[b]Priority 1 is highest priority, and most essential to recovery of the species. Priority 4 is least important to recovery (Service 2007b).
[c]A. Silvis, WVDNR, email to T. Lennon, Service, June 30, 2020.
[d]https://microbiology.usgs.gov/documents/Swezey_Garrity_2011.pdf.

Known use spring staging/fall swarming habitat is defined as roosting and foraging habitat within a 5-mile radius of a known priority 3 and 4 hibernacula or a 10-mile radius of a known priority 1 and 2 hibernacula. There are 2 known Ibat (priority 3 and 4) hibernacula within 5 miles of the action area[5] (Table 20 and Figure 13). Approximately 17.5 miles of construction ROW and 7.5 miles of ARs, a total of 308.97 acres (132.21 acres in VA and 176.76 acres in WV), occurs within known use spring staging/fall swarming habitat, 308.19 acres of which has already been cleared (Table 21).

[5] The 2017 BiOp noted that Patton Cave was within 5 miles of the action area. However, upon further review and coordination with the WVDNR it was confirmed that this hibernacula is not within 5 miles of the action area.

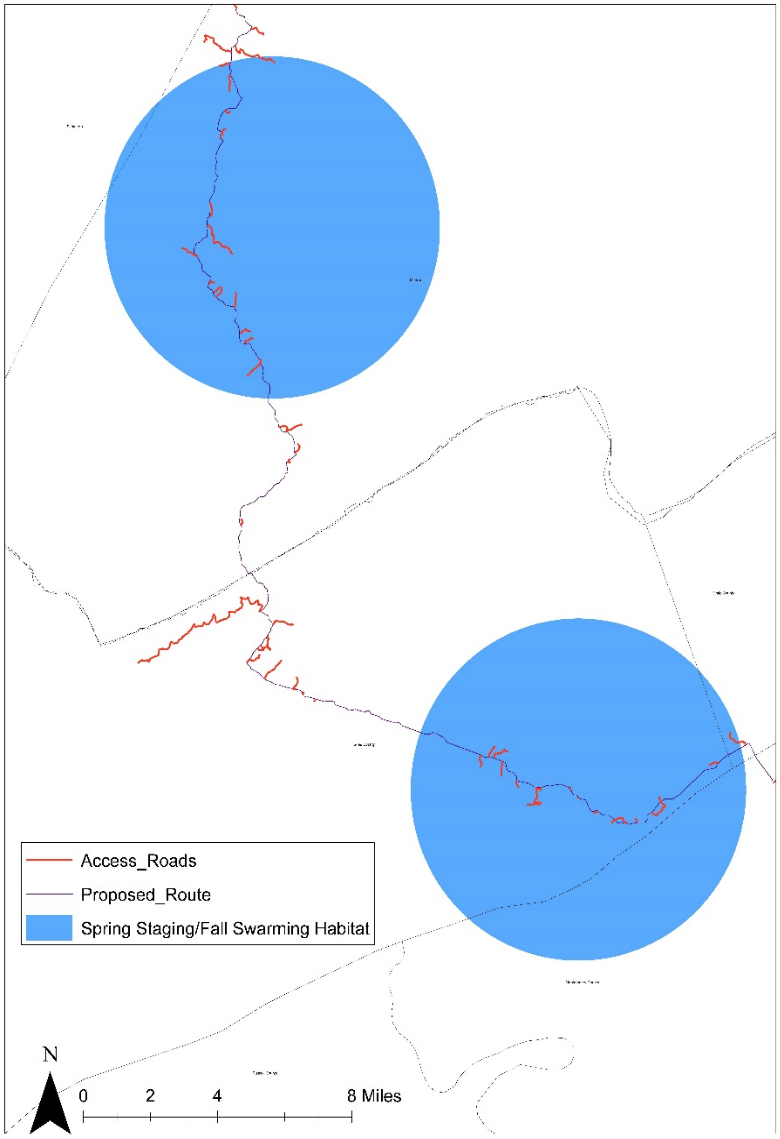


Figure 13. Ibat known use spring staging/fall swarming habitat.

Unknown use spring staging/fall swarming habitat is defined as roosting and foraging habitat within a 5-mile radius of potentially suitable hibernaculum that have not been surveyed for Ibats. There are 69 suitable caves/mine portals that FERC is assuming are occupied hibernacula within 5 miles of the MVP (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020), 62 of which are located within the 2-mile action area discussed above. However, it is not reasonable to assume that all 69 suitable features would be occupied post-WNS. Therefore, the Service used known cave occupancy data from VA and WV to estimate how many of the suitable features within the action area are likely to be occupied by Ibats. To estimate this, the Service first determined the proportion of caves reasonably likely to be occupied by Ibats by dividing the total number of suitable caves within WV and VA known to contain Ibats (59) by the total number of caves surveyed to date (395) in WV and VA. The total number of initially assumed occupied features (69) was then multiplied by the proportion of caves with known Ibat occurrences (0.15) to estimate the number of assumed occupied Ibat caves within the action area (10.35 caves was rounded down to the nearest whole cave = 10 caves).

Approximately 42.3 miles of construction ROW and 32.2 miles of ARs, a total of 828.65 acres[6] (524.62 acres in VA and 304.03 acres in WV), occurs within unknown use spring staging/fall swarming habitat, 827.03 acres of which has already been cleared (Table 21). As most of the acreage has already been cleared, it is not possible to verify what percentage, if any, was in fact utilized by Ibats for spring staging/fall swarming prior to clearing.

Table 21. Ibat forested habitat removal categories in VA and WV (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020).

Habitat Category[a]	Acres of Tree Removal						
	VA	WV	Future Slips	Variance Requests (all VA)	Existing Slip Remediation (all WV)	Downed Trees Due to Slips (all WV)	Total
Known use spring staging/fall swarming habitat	131.43	176.76	0	0.78	0	0	308.97
Unknown use spring staging/fall swarming habitat	523.12	303.91	0	1.50	0.12	0	828.65

[a]Habitat categories are based on the 2.0-mile terrestrial action area.

Determining the Number of Ibats Hibernating within the Action Area – The Service (2019a) estimates the 2019 hibernating Ibat population is 648 in VA and 620 in WV; these numbers indicate a 30.9% increase in VA and a 42.4% decline in WV since the 2017 census. WNS was first detected in VA and WV during the 2008/2009 winter hibernacula surveys (Stihler 2012, Powers et al. 2015). VA and WV hibernacula surveys indicate Ibat populations have decreased at least 95% since the discovery of WNS (https://www.fws.gov/midwest/endangered/mammals/inba/pdf/2019_IBat_Pop_Estimate_6_27_2019a.pdf).

To determine the current status of the species within the action area, the Service used the best scientific data available to estimate the number of hibernating Ibats that may be present within all assumed occupied hibernacula[7] (10) and known hibernacula (2) (Table 22). The Service used

[6] Because the majority of the suitable features (69) within the action area overlap, the Service applied the estimated acreages provided within the SBA (Mountain Valley 2020) for all of these features to the 10 assumed occupied hibernacula.

[7] The Service assumes that all hibernating bats will utilize the habitat surrounding the 10 assumed occupied hibernacula during the spring staging/fall swarming periods. This habitat is considered to be unknown use spring staging/fall swarming habitat.

2017-2020[8] winter cave count data and harp-trap survey data to determine the median number of hibernating bats per hibernacula within the states. The median number of hibernating bats per hibernacula (8) was then multiplied by the number of assumed occupied Ibat caves (10) and known occupied hibernacula (2) to estimate the total number of hibernating Ibats within the action area (96).

Given the previous survey results in Greenville Saltpeter Cave and Tawney's Cave, and the information discussed above, it is reasonably likely that 10 unknown Ibat hibernacula occur within the action area, in addition to the 2 known Ibat hibernacula. It is also reasonable to conclude that each of those 10 hibernacula and the 2 known hibernacula support approximately 8 Ibats[9]. Therefore, an estimated 96 individual Ibats (associated with 10 assumed occupied hibernacula and 2 known hibernacula) may be present within the action area during the winter and spring staging/fall swarming period.

Table 22. Summary of Ibat hibernacula data and estimates.

Total number of suitable hibernacula features within 5 miles of the MVP	69
Median number of hibernating Ibats per known P3 and P4 Ibat hibernacula in WV and VA	8
Total number of caves with Ibats in WV and VA	59
Total number of caves surveyed for bats in WV and VA	395
Proportion of caves occupied by Ibats	0.15
Number of assumed occupied Ibat caves within the action area	10
Number of known occupied Ibat caves within the action area	2
Total number of estimated hibernating Ibats within the action area	96

Summer Habitat

Known use summer habitat is defined as areas within a 5-mile radius (home range) of a pregnant female or juvenile Ibat capture or within 2.5 miles of a known Ibat roost tree. None occurs in the VA portion of the action area. A pregnant female was captured during a 2010 survey approximately 1.7 miles from the project ROW in WV. Approximately 10.3 miles of construction ROW and 10.3 miles of ARs, a total of 390.18 acres, occurs within the potential Ibat home range defined above (Figure 14), 236.43 acres of which has already been cleared or fallen as a result of slips (Table 23). Habitat surveys were conducted in 2015 and suitable roosting and foraging habitat was documented throughout the LOD (e.g., 413 potential roost trees were located within the 236.43 acres that were cleared, of which 74 were potential primary trees and 339 were potential secondary trees) (M. Stahl, EQT, email to T. Lennon, Service, November 8, 2017).

Additionally, in March 2019, FERC initiated emergency Section 7 consultation with the Service as a result of landslides that occurred within and adjacent to the MVP's LOD. This consultation addressed the removal of suitable habitat (2.47 acres total) within Ibat known use summer habitat. Approximately 1.92 acres and 0.55 acres was cleared during the bat active season in

[8] The Service only included the most recent post-WNS data and excluded winter count data for P1 and P2 hibernacula. Based on the effects of WNS, and because no additional P1/P2 hibernacula have been identified since the 1970s as a result of cave surveys conducted within the AMRU, it is unreasonable to assume that any of these suitable features (69) would support as many hibernating bats as a P1/P2 hibernaculum.

[9] The median number of hibernating bats (8) is similar to the amount of documented Ibats in Greenville Saltpeter Cave (7), and is therefore considered a reasonable estimate for Tawney's cave and all 10 assumed occupied caves.

April and August 2019, respectively. The removal of this habitat during the active season was not evaluated in the 2017 BiOp and is being included in this Opinion as an after-the-fact consultation pursuant to 50 CFR 402.05.

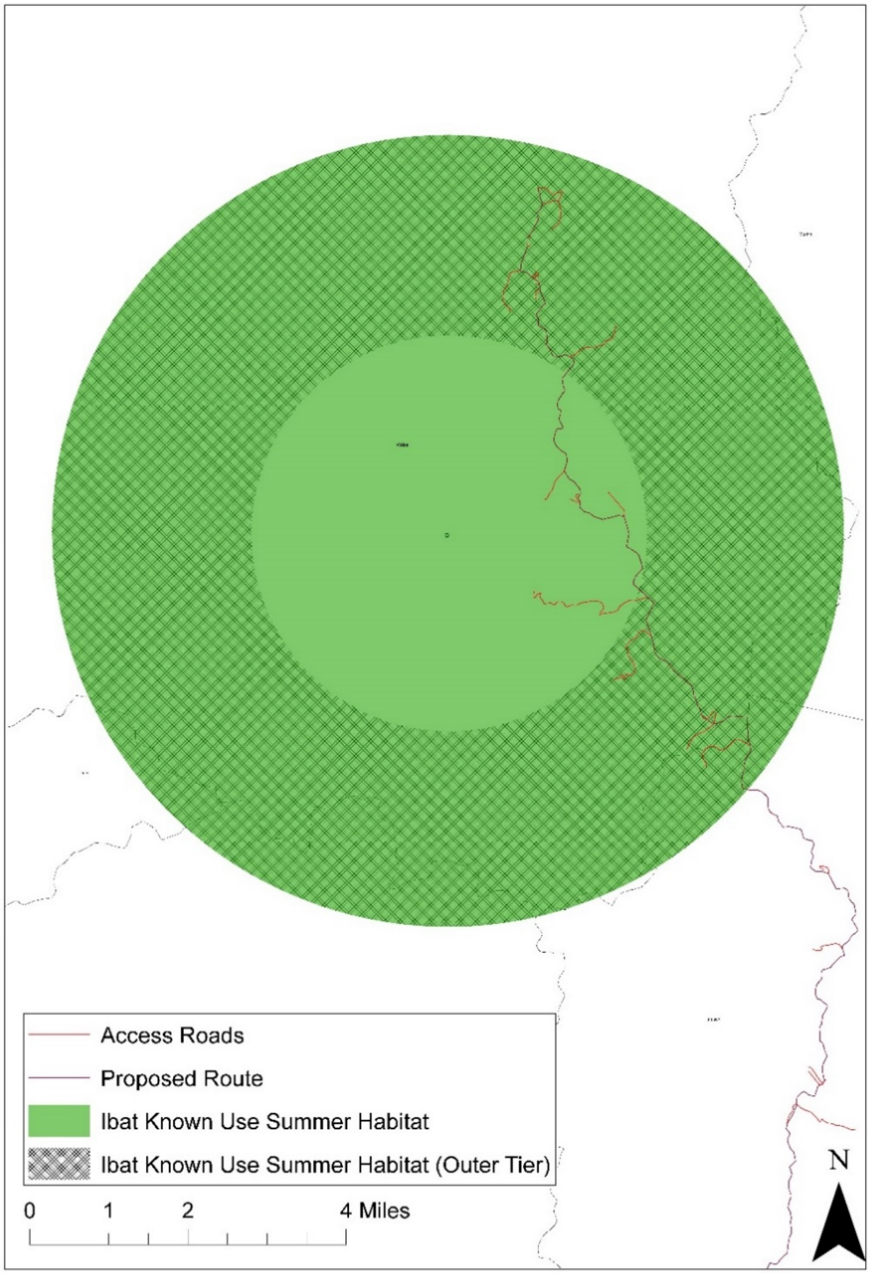


Figure 14. Ibat known use summer habitat in Wetzel County, WV.

To determine the presence or probable absence of potential Ibat maternity colonies, summer mist-net surveys were conducted in 2015 and 2016 following the Range-wide Indiana Bat Summer Survey Guidance current at that time (Service 2015, 2016). As stated on page 1 of the guidance, "The following guidance is designed to determine whether Indiana bats are present[10] or likely absent at a given site during the summer (May 15 to August 15)." These guidelines have been in use for many years and have been periodically updated based on new scientific information and public feedback[11]. While they are not the same as regulations, the Service accepts the results of surveys if they were conducted in accordance with the guidelines. The exception to this is when there is new information or a better understanding of other existing site specific information.

Since 2018 (Service 2018d), the Service has accepted negative surveys rangewide for a minimum of 5 years unless new information (e.g., other nearby surveys) suggest otherwise, and prior to that it was a minimum of 2 years. There is no automatic expiration of survey results after that time, as these are minimums. Through discussions with the local Service field office, applicants and action agencies may consider conducting additional surveys or continue to use prior survey results, particularly where (as in this case) there is no new information to suggest the results are no longer valid. This has been applied across the range of the species and this approach is consistent with the use of these guidelines.

Mist-net surveys in suitable summer habitat were conducted between May 15 and August 15, 2015, and May 15 and May 26, 2016 (FERC 2017b) along approximately 140.9 miles (64.6 miles in WV and 76.3 miles in VA) of the construction ROW and 79.7 miles (43.0 miles in WV and 36.7 miles in VA) of ARs (ESI 2015c, 2015d; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). A total of 1,398 bats of 9 species were captured at the 441 mist-net sites (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). No Ibats were captured, suggesting probable absence during the summer months. Because no Ibats are expected to be exposed to stressors in these surveyed areas, the Service does not anticipate any adverse effects in individuals of the species in those areas from the proposed action. While the Service provided a description of *potential effects* of clearing suitable unoccupied summer habitat in one instance relating to a separate project (Atlantic Coast Pipeline project BiOp; Service 2017b), we made no similar preliminary finding regarding potential effects for this project. Further, where (as here) survey results indicate that Ibats are not present, those potential effects are not anticipated and are not reasonably certain to occur. The surveys described above were completed in accordance with the survey guidelines and no new captures/detections or roost tree records have been reported within the action area since the issuance of the Service's 2017 BiOp. Therefore, the best available data indicates that Ibats were not using the surveyed areas at the time tree clearing occurred and that they are not currently using those areas. Further, because Ibats exhibit summer site fidelity (see Status of the Species section for more information), and based on continuing declines in winter hibernacula counts in the AMRU due to WNS, there is no basis for assuming that Ibats moved into the previously-surveyed areas since the surveys were conducted or are likely to move into the previously-surveyed areas in the foreseeable future.

Approximately 485.31 acres in VA and 766.80 acres in WV (1,252.11 acres in total) of suitable but unoccupied summer habitat have been surveyed for Ibats. Of those 1,252.11 acres, 17.77

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[10] The guidance is not intended to be rigorous enough to provide sufficient data to fully determine population size or structure.

[11] https://www.fws.gov/midwest/endangered/mammals/inba/surveys/inbaSummerSrvyGuidncHistory.html.

acres associated with existing/future slip repair work and variance requests still remain to be cleared. However, as discussed above, because no Ibats are expected to be present and exposed to stressors in these surveyed areas, the Service does not anticipate any adverse effects to individual Ibats from this additional clearing.

In addition to the areas that were surveyed, there are portions of the MVP within the range of the Ibat that were not surveyed and contain suitable summer habitat. These areas are defined as unknown use summer habitat and FERC has elected to assume Ibat presence because Ibats are reasonably likely to occur in these areas based on their location and the presence of suitable habitat. Mist-net surveys were not conducted along approximately 128.9 miles (42.4%) of the construction ROW and 102.3 miles (50%) of ARs in WV and VA (ESI 2015c, 2015d).

Approximately 97.5 miles of construction ROW (4.9 miles in VA and in 92.6 miles WV) and 56.4 miles of ARs (1.1 miles in VA and 55.3 miles in WV), a total of 1,934.96 acres (78.49 acres in VA and 1,856.47 in WV), occurs within unknown use summer habitat, 1,828.58 acres of which has been cleared or fallen as a result of slips. Habitat surveys were conducted in 2015 and suitable roosting and foraging habitat was documented throughout the LOD (e.g., 2,505 potential roost trees were located within the 1,828.58 acres that has been cleared, of which 470 were potential primary trees and 2,082 were potential secondary trees) (M. Stahl, EQT, email to T. Lennon, Service, November 8, 2017). No additional habitat assessments, including potential roost tree surveys, have been conducted within these areas since the issuance of the 2017 BiOp.

Table 23. Ibat summer habitat removal categories in VA and WV (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020).

Habitat Category[a]	Acres of Tree Removal							
	VA	WV	Future Slips VA	Future Slips WV	Variance Requests (all WV)	Existing Slip Remediation (all WV)	Downed Trees Due to Slips (all WV)	Total
Known use summer habitat	0	226.29	0	144.20	0	9.55	10.14	390.18
Unknown use summer habitat	74.78	1,748.98	3.71	86.77	4.85	11.05	4.82	1,934.96

[a]Habitat categories are based on the 2.0-mile terrestrial action area.

Mountain Valley anticipates that suitable Ibat habitat will be removed within known and unknown use summer habitat, and spring staging and fall swarming habitat, as a result of existing/future slip repair work and variance requests (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 26, 2020) (Table 21 and 23). All tree removal is expected to occur prior to final ROW restoration. A detailed description of how these estimates were calculated is provided in the Description of Proposed Action.

There is the potential that certain areas of spring staging/fall swarming habitat (known and unknown use) may also contain summer maternity habitat. However, determining where this overlap may occur and the quantity of the overlap is impracticable based on the information available. Thus, for the purposes of this Opinion, total Ibat habitat removed will be classified as either summer habitat or spring staging/fall swarming habitat (Table 22 and 24).

Determining the Number of Ibat Maternity Colonies within the Action Area – As discussed above, there is 1 known Ibat maternity colony within the action area and additional acreage of summer habitat that has not been surveyed for the presence of Ibats, but for which it is reasonable to expect that Ibats are or were present within all or a portion of that habitat. Most of the unknown use summer habitat has already been cleared or fallen as a result of slips (1,828.58 of 1,934.96 acres). To determine the status of the species within the action area, the Service used the best scientific data available to estimate the number of additional Ibat maternity colonies that may have been or may be present within these unsurveyed areas. The Service used 2009-2018[12] capture data collected from projects in forested areas located within WV counties intersected by the MVP project (hereafter referred to as the counties of interest[13]) to develop a ratio of Ibats captured per survey and then derive an estimate of the number of maternity colonies within the action area.

Because bat surveys results available to the Service for this calculation are tracked on a per survey basis rather than a per project basis, it was not possible to directly estimate the number of Ibats captured by project acreage. Therefore, to estimate the number of Ibats within unsurveyed areas, the Service used Ibat capture rate per survey and the number of surveys that the MVP would represent. Ibat capture rate per survey (0.299) was calculated by dividing the total number of Ibat captures (47) by the number of surveys conducted within the counties of interest (157). The number of surveys that the MVP would have represented (114.29) was calculated by dividing tree removal from the MVP (1,934.96 acres) by the average tree removal in projects tracked by the Service (16.93[14]), thereby putting capture rate on equivalent habitat scales. By multiplying the capture ratio (0.299) by the number of surveys the MVP would represent on a habitat basis (114.29), the Service determined the estimated number of Ibats (34.17 rounded to the nearest whole individual = 34 Ibats). Using the Ibat capture ratio, the Service determined the proportion of captures representing a colony by dividing the number of adult Ibat females/juveniles[15] captured in the counties of interest (4) by the total number of Ibats captured (47). The proportion of captures representing a colony ratio (0.09) was then multiplied by the number of Ibats expected to be captured within the project area (34) to determine the number of colonies affected by the MVP (3.06 colonies was rounded to the nearest whole colony = 3 colonies[16]) (Table 24).

Capture data and information regarding average amount of forest loss per project was not available for Giles, Montgomery, Craig, and Roanoke counties, VA. However, because the average percent forest cover in VA is similar to the average percent forest cover in WV (65.12% in VA and 80.21% in WV[17]), the approach to estimating the number of colonies over the

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[12] The Service only included post-WNS capture data and excluded survey results for bat box monitoring and cave surveys, because this data is associated with long-term monitoring efforts at documented Ibat locations and would bias our estimates.
[13] The following WV counties are referred to as the counties of interest: Braxton, Doddridge, Fayette, Greenbrier, Harrison, Lewis, Monroe, Nicholas, Summers, Upshur, Webster, and Wetzel.
[14] This value was calculated based on the average amount of forest loss per project for 1,177 projects in WV from 2016-2018.
[15] The Service is assuming that only adult female and juvenile captures represent maternity colonies.
[16] Conventional rounding to the nearest whole number is appropriate and consistent with the best available information because a colony is either present in an area or it is not; there are no "partial colonies" of Ibats.
[17] Average percent forest cover was only calculated for the VA and WV counties intersected by the MVP. Percent forest cover per county data can be found here: https://www.fws.gov/midwest/endangered/section7/fhwa/index.html.

unknown use summer habitat was reasonable.

Given the previous survey results in Wetzel County, WV, and the capture data discussed above, it is likely that 3 Ibat maternity colonies occur within the action area in addition to the 1 known Ibat maternity colony.

We have no detailed information about the current status of the 1 known maternity colony within the action area because Ibats have not been captured and tracked and no emergence surveys have been conducted, and such information cannot be readily obtained during consultation. This is because Ibats comprising a summer colony are spread out across multiple roost trees and switch trees every couple of days. Attempting to conduct an accurate population count of the colony would entail month-long radio tracking studies of a large percentage of individual adults associated with the colony. To conduct radio tracking, researchers would first need to capture individual bats. Extensive mist-netting would be required to capture even a few individuals and the likelihood of capturing multiple adult females from the same colony is quite low. After bats are captured, transmitters are attached and bats would be tracked daily until the transmitters fall off (which can be after just a few days) or until the battery fails. Additional bats would need to be captured throughout the summer to find more roosts. At night, multiple people would need to conduct emergence surveys at every tree identified as a roost (adding new trees daily) and count all bats that exit. Not every bat exits on a given night. Once the baseline number of adult females is established, monitoring would need to continue throughout the next month to attempt to estimate the number of newly produced volant young. After multiple years of monitoring a colony of Ibats, we still may still not have an actual estimate of the number of Ibats in that colony.

As discussed above, we have estimated 3 additional unknown maternity colonies within the action area. These colonies could be located anywhere throughout the action area. Therefore, to determine baseline numbers, many years of surveys would need to be conducted throughout the entire action area where suitable habitat occurs and no presence/probable absence surveys have been previously conducted.

However, we would expect that the status of the known and unknown colonies within the action area is the same as the current rangewide and AMRU status of the species (declining). Prior to impacts from WNS, estimated maternity colony sizes averaged from 80-100 adult female bats (Harvey 2002, Whitaker and Brack 2002).

Given the on-going observed winter count decline[18] of Ibats in the AMRU by 95%, we expect that associated maternity colonies will be substantially less than 80-100 adult female bats in size. It is likely that some maternity colonies have been extirpated, while other colonies may have fragmented resulting in reduced colony size (although we expect that they will continue to occupy their prior home ranges because of their high site fidelity). Since we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 20-40 adult

[18] It is possible to count live Ibats in the winter when they are readily observable because they are in torpor and on the side of cave/mine walls in large clusters.

female bats per colony and 1 pup per female. This range is reasonable given that the pre-WNS average was 80-100 adult females per colony, and that winter Ibat counts in the AMRU have declined significantly since the onset of WNS. This range is also consistent with post-WNS emergence count studies conducted at a nearby long-term Ibat monitoring site in Kanawha and Fayette County, WV (Apogee 2018).

Therefore, an estimated 160-320 adult females and pups (associated with 4 maternity colonies) may be present within the action area during the summer maternity season. Adult males are not included in this estimate because they typically stay close to hibernacula and do not coalesce with adult females and pups during the summer months.

Table 24. Summary of Ibat maternity colony estimates.

Ibats per project (capture ratio)	0.299
Total forest loss within the MVP project area (unknown suitable summer habitat only)	1,934.96 acres
Average project forest loss	16.93 acres
Number of average surveys MVP represents	114.29
Number of Ibats expected to be captured within the project area	34
Proportion of captures representing a colony	0.09
Estimated number of Ibat maternity colonies in MVP project area	4[a]
Estimated number of adult females in each colony	20-40
Estimated number of pups in each colony	20-40
Total number of Ibat present. This range includes adult females and pups	160-320

[a]Includes the known maternity colony in Wetzel County, WV.

Northern long-eared bat (NLEB)

As discussed above, the Service issued a final 4(d) rule for the NLEB on January 14, 2016 (81 FR 1900). Section 4(d) of the ESA directs the Service to issue regulations deemed "necessary and advisable to provide for the conservation of threatened species." 16 U.S.C. 1533(d). It allows the Service to promulgate special rules for species listed as threatened that provide flexibility in implementing the ESA. The Service uses 4(d) rules to target the take prohibitions to those that provide conservation benefits for the species. This targeted approach can reduce ESA conflicts by allowing some activities that do not harm the species to continue, while focusing our efforts on the threats that make a difference to the species' recovery.

In the 4(d) rule for the NLEB, the Service determined that WNS is such an overwhelming threat to the NLEB that regulating most other sources of harm or mortality will not help conserve the species at this time. Focusing on WNS will allow the Service and our partners to concentrate on finding a solution to the disease. Applying blanket prohibitions on all forms of take across the 37-state range of the bat would not slow the spread and impact of WNS nor would it benefit the NLEB at the population level. Therefore, the 4(d) rule focuses prohibitions on protecting bats in areas affected by WNS and when and where bats are most vulnerable: maternity roost trees during June and July pup-rearing and at hibernation sites.

Under the 4(d) rule, for areas of the country impacted by WNS (which includes the project action area in VA and WV) incidental take of NLEBs is prohibited only under the following circumstances:

- If it occurs within a hibernaculum;

- If it results from tree removal activities and the activity occurs within 0.25 mile (0.4 km) of a known hibernaculum; or
- The activity cuts or destroys a known, occupied maternity roost tree or other trees within a 150 ft radius from the maternity roost tree during the pup season from June 1 through July 31.

The Service completed Section 7 consultation and issued a non-jeopardy programmatic BiOp for the finalization and implementation of the 4(d) rule. (https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/BOnlebFinal4d.pdf). That BiOp accounts for the effects of incidental take that is not prohibited under the rule. For federal activities that result in non-prohibited incidental take, federal agencies can rely upon the Service's non-jeopardy finding to fulfill their project-specific Section 7 responsibilities (see 81 FR 1900, 1903; January 14, 2016). The assessment below therefore focuses on the areas in which prohibited take may occur under the 4(d) rule: areas within 0.25 miles of documented NLEB hibernacula and 150 ft from documented NLEB roost trees.

Hibernacula and Associated Spring Staging and Fall Swarming Habitat

Known hibernacula are defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating NLEBs. Assumed occupied hibernacula are defined as suitable caves/mine portals which are reasonably certain to be occupied by hibernating NLEBs. The 2017 BiOp discussed 3 known NLEB hibernacula in the action area: Canoe and Tawney's Caves, Giles County, VA, and PS-WV3-Y-P1, Braxton County, WV, based on hibernacula surveys or harp trapping.

Hibernacula surveys documented 1 NLEB in Canoe Cave in 1982 and 0 NLEB in 2015. Hibernacula surveys documented 1 NLEB in Tawney's Cave in 2011, 2009, 1990, and 1986 (R. Reynolds, VDGIF, email to S. Hoskin, Service, October 30, 2017) and 0 NLEB in 2013 and 2020 (Mountain Valley 2020). Given the difficulty in finding NLEB in the winter, these sites are still considered occupied or known hibernacula.

Harp trap surveys in October 2015 captured 1 NLEB at PS-WV3-Y-P1 (FERC 2017b). While harp trap surveys cannot confirm absolute use of a hibernaculum, they are a good indication of potential use. Since January 2018, Mountain Valley has conducted internal and external acoustic monitoring at PS-WV3-Y-P1. The highest activity of bat calls occurs during summer and fall swarming. Mountain Valley concludes that it is unlikely that PS-WV3-Y-P1 is a NLEB hibernaculum; however, Mountain Valley and the FERC are considering PS-WV3-Y-P1 as assumed to be occupied by NLEB for this project. Further, the WVDNR and Service consider this an occupied hibernaculum (T. Lennon, Service, email to P. Friedman, FERC, and M. Stahl, EQT, January 16, 2018) and given the high amount of summer activity, it is appears there is periodic use in the summer as well.

In addition to the 3 sites discussed previously, there is a 4^{th} NLEB hibernaculum within the action area, the Greenville Saltpeter Cave in Monroe County, WV. NLEB have been documented at this site in 2006, 2012, 2016, and 2018 (A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020). This site had a total of 1,134 observed hibernating bats and 0 NLEB observed during surveys in February 2020 (A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020). There are no activities proposed within 0.25 miles of this hibernaculum and this site will not be discussed further, as any impacts are not prohibited by the 4(d) rule and are accounted for in the BiOp on the 4(d) rule.

Finally, as discussed in the Status of the Species in the Action Area section, 3 additional portals were discovered after issuance of the 2017 BiOp, 1 of which (P-BTH-001 near MP 207.5 in Giles County, VA) Mountain Valley determined to be potentially suitable for hibernating bats. However, upon further review by the Service, WVDNR, and VDGIF it was determined that this portal is not reasonable likely to support federally listed bats given the internal dimensions and relatively small entrance size and steep downward angle (A. Silvis, WVDNR, email to T. Lennon, Service, June 23, 2020; R. Reynolds, VDGIF, email to S. Hoskin, Service, July 1, 2020). Therefore, for the purposes of this Opinion, the Service does not consider portal P-BTH-001 to be a suitable or known occupied NLEB hibernacula and it will not be discussed further.

The Service received a site-specific plan dated March 14, 2018, for construction activities within 0.5 mile of portal PS-WV3-Y-1 (M. Stahl, EQT, email to T. Lennon, Service, March 14, 2018). The plan ensured that no alteration occurred, physical or otherwise, to the portal's entrance or environment that would have adversely affected its use by federally listed bats, including those hibernating within the portal (Mountain Valley 2020).

Mountain Valley conducted a hydrologic and geologic analysis of the risk of the pipeline to Canoe and Tawney’s Caves (Mountain Valley 2020). In summary, they determined that the catchment area for Canoe Cave is topographically higher than and upgradient of the pipeline and the pipeline is approximately 900 ft from the nearest entrance and 800 ft from the nearest mapped passage. Similarly, the pipeline will be on an opposite ridge west of Tawney’s Cave, topographically higher, and below the known cave passages (FERC 2017b).

Based on the protections included in the Karst Mitigation Plan provided in the FEIS (FERC 2017a); the information provided in the November 9, 2017, Potentially Suitable Hibernacula within the Action Area table (M. Stahl, EQT, email to T. Lennon, J. Stanhope, and S. Hoskin, Service, November 9, 2017); the AMMs included in the SBA (Mountain Valley 2020); and Mountain Valley’s supplemental comment response documents (e.g., all blasting activities within close proximity to known and assumed occupied hibernacula will occur outside of the bat hibernating season, and site-specific blasting plans will be developed for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula to avoid adverse overpressure or vibration impacts to any bats occupying the features and to ensure the structural integrity of both the aboveground and subsurface features of a cave or portal during blasting events), we do not expect hibernating NLEBs in any known or assumed occupied hibernacula to be exposed to the stressors associated with MVP construction (e.g., noise, vibration, feature collapse/modification, etc.). We also expect no impacts to the hibernacula themselves that would render them unsuitable for future use by NLEBs.

Estimating the number of NLEB at hibernacula and within spring staging/fall swarming habitat

Hibernacula surveys are not good indicators of total number of NLEBs hibernating because NLEB are found in small crevices or cracks in the walls or ceiling, often only their noses and ears are visible, and they are easily overlooked (78 FR 61046-61080). While we acknowledge hibernacula surveys likely underestimate winter abundance, we do not have an estimate of how the counts might correlate to the number of bats hibernating in that particular hibernaculum. Therefore, we cannot precisely estimate the number of hibernating NLEB within the action area and such information cannot be readily obtained during consultation. WNS was first detected in VA and WV during the 2008/2009 winter hibernacula surveys (Stihler 2012, Powers et al. 2015). Since that time, WNS has been confirmed in all areas of VA and WV where NLEB hibernacula are known to occur (Stihler 2012, Powers et al. 2015). Given the continued declines associated with WNS, there may be as few as 0 NLEB in these areas or there could be several NLEB hibernating in each feature. For example, 17 NLEB were captured exiting Cudjo's Cave in VA when 0 were observed in winter (R. Reynolds, VDGIF, email to S. Hoskin, Service, October 30, 2017). For the purposes of our analyses we assume up to 17 NLEB are hibernating in these 3 hibernacula. As all of the acreage has already been cleared, it is not possible to verify what percentage, if any, was in fact utilized by NLEB for spring staging or fall swarming prior to clearing.

Summer Habitat

As mentioned in the Ibat section, to determine the presence or probable absence of potential Ibat maternity colonies, summer mist-net surveys were conducted following the Range-wide Indiana Bat Summer Survey Guidance (Service 2017a). Mist-net surveys were conducted between May 15 and August 15, 2015, and May 15 and May 26, 2016 (FERC 2017b) along approximately 140.8 miles (64.6 miles in WV and 76.3 miles in VA) of the construction ROW and 79.6 miles (43.0 miles in WV and 36.7 miles in VA) of ARs (ESI 2015c, 2015d; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). A total of 1,398 bats of 9 species were captured at the 441 mist-net sites (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). Seventy-four NLEBs were captured during these surveys (FERC 2017b). One was captured in Montgomery County, VA, and the rest in WV. Radio transmitters were placed on 56 NLEB and 43 were successfully tracked to roost trees. Two known, occupied NLEB maternity roosts occur within the project's construction workspace. One of the occupied maternity roosts (Roost 499-1) occurs on private land and has since been removed due to logging events by the landowner. Mountain Valley has agreed to avoid the remaining occupied maternity roost (Roost 423-1) by shifting an AR and fencing off the tree to avoid any direct impacts (Mountain Valley 2020). Mountain Valley is implementing conservation measures outlined in the 4(d) rule, avoiding the removal of documented roosts and trees within 150 ft around roosts within June and July. In addition, no new NLEB roosts have been documented within the action area since the 2017 BiOp was written (Mountain Valley 2020).

However, there is overlap of the likely home range of a juvenile male tracked to Roost 791-1 with the 0.25-mile buffer around PS-WV3-Y-1. NLEB maternity colonies range widely in size, although 30-60 adult females may be most common (Service 2014). We have no information about this colony besides the 1 juvenile male, and such information cannot be readily obtained during consultation for similar reasons as discussed above for Ibats. However, we would expect that the status of the known colony within the action area is the same as the current rangewide status of the species (declining[19]). It is likely that some maternity colonies have been extirpated, while other colonies may have fragmented resulting in reduced colony size (although we expect that they will continue to occupy their prior home ranges because of their high site fidelity). Since we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 5-40 adult female bats per colony and 1 pup per female. This range is reasonable given that the pre-WNS average was 30-60 adult females per colony, and that winter counts have declined significantly since the onset of WNS. This range is also consistent with post-WNS studies conducted at WV artificial roosts containing 3-38 individuals (average of 12.24 adult females per capture event) (T. Lennon, Service, email to R. Niver, Service, July 22, 2020). Adult males are not included in this estimate because they typically stay close to hibernacula and do not coalesce with adult females and pups during the summer months. As all of the acreage has already been cleared, it is not possible to verify what percentage, if any, was in fact utilized by NLEB for summer habitat prior to clearing.

Status of Proposed Critical Habitat within the Action Area

Candy darter (CD) proposed critical habitat

Two CD proposed critical habitat units are included in the action area, the Upper Gauley River unit (unit 5) and Middle New River unit (unit 2). The Upper Gauley unit contains 182 stream miles, or almost half, of the total stream miles of proposed critical habitat. The impact area in the Upper Gauley River system (2 km = 1.24 mi), assumed to support CD, represents approximately 4.56% of the CD occupied habitat within the Upper Gauley population and 0.68% of potential habitat within the Upper Gauley River system metapopulation. There are a total of 6 critical habitat subunits within the Upper Gauley unit. Subunits 5c, 5d, 5e, and 5f are not part of the action area. The Gauley River is designated as critical habitat subunits 5a and 5b. Subunit 5a is not part of the action area. The Upper Gauley River, Nicholas and Webster Counties, WV, is designated as subunit 5b and is within the action area and will be affected by the proposed action.

The Middle New unit contains 27 stream miles, 7.3% of the total stream miles proposed as critical habitat. There are a total of 3 critical habitat subunits within the Middle New unit. Subunits 2a and 2c are not part of the action area. Stony Creek, Giles County, VA, is designated as critical habitat subunit 2b and is within the action area and will be affected by the proposed action.

Subunit 5b is comprised of the Gauley River from the confluence of the Gauley and Williams Rivers at Donaldson, WV, downstream to a point approximately 1.6 skm (1.0 smi) upstream of the Big Beaver Creek confluence. Subunit 5b of the Gauley River comprises 27.2 smi, or approximately 15.0% of the total stream miles of critical habitat proposed in unit 5 and 7.4% of the total stream miles of critical habitat proposed for the species. The Upper Gauley River serves as proposed critical habitat for the CD in all stages of its life cycle, and is occupied year-round by the species. The Upper Gauley River subunit is noted as being important to the redundancy of the Upper Gauley CD metapopulation, and may serve as a connection among the 6 CD-occupied

[19] While we have no absolute numbers from winter or summer data, the trends are declining.

streams in the Upper Gauley watershed (Service 2018b).

Generally, the Upper Gauley subunit is in good condition. The CD metapopulation in this subunit has the highest overall condition score of the species' 5 extant metapopulations and has 6 populations of CDs. Throughout the watershed, the habitat condition is considered to be moderately conducive to the species; there is generally high forest cover (over 90%), which is an indicator of higher quality habitat conditions specific to the CD (lower water temperature, and lower instream sedimentation and substrate embeddedness). There is a high percentage of public land ownership for some of the subpopulations, but a mix of private and public landownership in other parts of the watershed. The water conditions throughout the Upper Gauley watershed are cold waters, with some degree of water quality impairment. Most of the streams within the watershed have some degree of impairment by aluminum, iron, or high water acidity. The Upper Gauley watershed has some stocking of brown and rainbow trout, which are known predators of darters; trout are reproducing in some of the rivers. However, the Upper Gauley CD metapopulation is the only one that is currently secure from hybridization with the variegate darter. As this is considered the greatest threat to the species' continued existence, the importance of the pure CD genetics in the Upper Gauley watershed is likely to increase in time, with the expected increase in hybridization in other watersheds. Finally, the Upper Gauley watershed exhibits good connectivity among populations and subpopulations, such that darters can migrate between different populations. Good connectivity is especially important in watersheds with limited habitat availability, such as with the Upper Gauley River unit, where 4 of the 11 occupied streams and rivers have 10 or more miles of habitat (Service 2018a).

Generally, the Middle New watershed is in moderate to poor condition, however, the Stony Creek subunit is in considerably better condition than any other CD streams in VA (which includes both the Middle New and Upper New units). The Stony Creek watershed has habitat conducive to the species, with a high percentage of forest cover (97%) and a high percentage of public land ownership. Stony Creek is listed as "fully supporting" aquatic life use criteria in the 2018 integrated report from VDEQ (2018); however it is listed as impaired under the fish consumption criteria due to PCB contamination from unknown sources. The water conditions throughout Stony Creek are reflective of the forested landscape, with generally cold, fast-flowing waters, high water quality, and low substrate embeddedness. The portion of the action area where proposed critical habitat will be affected is comprised of two tributaries within the Stony Creek watershed and a 1 km area within Stony Creek where the pipeline crossing will occur (200 m upstream through 800 m downstream of the crossing). The scope of potential effects to CD proposed critical habitat is limited to approximately the lowest 4.15 stream miles (smi) of Stony Creek, from the confluence of Stony Creek with the New River up to the confluence of the unnamed tributary to Stony Creek at smi 4.15. All project activities potentially affecting the Stony Creek subunit will be limited to this lower 4.15 smi. Within the Stony Creek watershed, sediment from project activities west of Stony Creek will primarily enter the watershed via the unnamed tributary at Stony Creek smi 4.15 and Kimballton Branch, while sediment from activities east of Stony Creek will enter directly to Stony Creek. Upland sediment from east of Stony Creek will enter the watershed within the 1 km area surrounding the crossing and is accounted for based on elevated sediment calculations for the area within 800 m downstream of the crossing. This sediment from east of Stony Creek will not be carried via tributary streams. The area below the end of the 800 m zone downstream of the crossing occurs in an area that is regularly dry during low summer flows, therefore sediment is not anticipated to be carried beyond this zone. Sediment entering via the unnamed tributary at smi 4.15 is expected to be at levels that are insignificant and/or discountable, and will not be addressed further in this Opinion. The remainder of effects discussed in Stony Creek are within the mixing zone 200 m upstream and 800 m downstream of the confluence with Kimballton Branch.

The role of critical habitat in the action area with regards to conservation/recovery of the species is that the project area provides habitat for feeding, breeding, and sheltering of CD in two metapopulations. The Gauley River above Summersville Lake provides feeding, breeding, and sheltering habitat for CDs as well as important connectivity between the other populations in the Upper Gauley metapopulation, including Panther Creek, Williams River, Cranberry River, and Cherry River. These areas within the Upper Gauley metapopulation represent the majority of extant CD populations with a “good” population condition score. Thus, their continued existence and connectivity within the watershed is critical to the recovery of the species. Within the Middle New and Upper New CD metapopulations, Stony Creek is the only CD population with a “good” population condition score (Service 2018a). The Upper Gauley and Middle New metapopulations are relatively free from hybridization, making them essential to the recovery of the species.

EFFECTS OF THE ACTION

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see § 402.17).

The Service clarified the factors that must be considered in making the determination of reasonably certain to occur, which must be followed after October 28, 2019, the effective date of new regulations under 50 CFR 402. After determining that the “activity is reasonably certain to occur,” based on clear and substantial information[20], using the best scientific and commercial data available, there must be another conclusion that the consequences of that activity (but not part of the proposed action or activities reviewed under cumulative effects) are reasonably certain to occur. In this context, conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available after consideration of three factors in 402.17(b)(1-3).

There is no intent that the 2019 regulatory changes alter how we will analyze the effects of a proposed action or the scope of effects. We will continue to review all relevant effects of a proposed action as we have in past decades, but the Service determined it was not necessary to

[20] By clear and substantial, we mean that there must be a firm basis to support a conclusion that a consequence of an action is reasonably certain to occur. This term is not intended to require a certain numerical amount of data; rather, it is simply to illustrate that the determination of a consequence to be reasonably certain to occur must be based on solid information. This added term also does not mean the nature of the information must support that a consequence is guaranteed to occur, but must have a degree of certitude.

attach labels to various types of effects through regulatory text. That is, we intend to capture all of those effects (now "consequences") previously listed in the regulatory definition of effects of the action— direct, indirect, and the effects from interrelated and interdependent activities—in the new definition. These effects are captured in the new regulatory definition by the term ''all consequences'' to listed species and critical habitat.

The test for determining effects includes the consequences resulting from actions previously referred to as ''interrelated or interdependent'' activities. In order for consequences of other activities caused by the proposed action, but not part of the proposed action, to be considered effects of the action, both those activities and the consequences of those activities must satisfy the two-part test: they would not occur but for the proposed action and are reasonably certain to occur. As a result, when we discuss effects or effects of the action throughout the Opinion, we are referring only to those effects that satisfy the two-part test. Requiring evaluation of all consequences caused by the proposed action allows the Services to focus on the impact of the proposed action to the listed species and critical habitat, while being less concerned about parsing what label to apply to each consequence.

Prior to analyzing the effects of the action on listed species, we must determine whether there are activities that are not part of the proposed action itself, but are nevertheless consequences of the proposed action (i.e., activities that would not occur but for the proposed action and are reasonably certain to occur) (50 CFR 402.02, 402.17).

Non-jurisdictional facilities (NJF) – FERC, under Section 7 of the Natural Gas Act, is required to consider, as part of its decision to authorize interstate gas facilities, all factors bearing on the public convenience and necessity. This includes any NJF that do not come under the jurisdiction of FERC but may be integral to the project objective. The NJF associated with this project are summarized in Appendix W of the FEIS and further discussed below. These NJF and their effects may be considered effects of the proposed action because these facilities likely would not exist but for the proposed action and are reasonably certain to occur.

The NJF are not part of the proposed MVP but will occur as a result of the project. These facilities are short, aboveground utility lines that provide power and/or telecommunication service to the project's MLVs, compressor stations, taps, and measuring stations and utility service required for the project's cathodic protection sites (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020; M. Hoover, Mountain Valley, email to C. Schulz, August 25, 2020). All of the NJF are within the action area.

For each of these NJF, Mountain Valley has requested or will request service from a local utility company, and that company plans, designs, and constructs the facility without Mountain Valley's involvement. Thus, Mountain Valley does not have precise engineering specifications or information about any AMMs the utility providers will implement. Mountain Valley is also unable to determine whether any of these NJF will have a federal nexus because the utility companies will decide on the final pole location in relation to waters of the U.S. That said, the utility companies will likely strive to avoid pole placement in waters of the U.S. and thus avoid a federal nexus. Mountain Valley assumes the utility provider would likely collocate the line with existing disturbance, where feasible.

The list of NJF and their potential impacts to listed species are provided in Appendix G. Appendix G identifies each NJF's location, estimated length and width, estimated tree-felling acreage, Information for Planning and Consultation (IPaC) tool results, bat habitat type (if applicable), potential for listed plant habitat, distance to the nearest known or presumed occupied portal, and status of tree felling.

The NJF will require clearing of the following Ibat habitat (see tree felling not complete column in Appendix G), which totals 6.09 acres:

- 0.35 acre of known use spring staging/fall swarming habitat
- 4.41 acres of unknown use spring staging/fall swarming habitat
- 1.33 acres of unknown use summer habitat

The remaining NJF require no tree clearing, and thus the habitat type is listed as N/A in Appendix G. No impacts to listed aquatic species are anticipated due to the minimal surface disturbance associated with these facilities and utility providers' standard practice of spanning aquatic resources. Impacts to listed plant species are not anticipated. Based on previous field surveys and a desktop survey/aerial review of existing conditions, listed plants are unlikely to be present in all but 1 location. One site, MLV 28, may have potential habitat to support the smooth coneflower (*Echinacea laevigata*) along an AR. However, it is likely the utility can span and thus avoid the potential habitat. No critical habitat was identified in any of the IPaC results.

Take of NLEBs associated with clearing for these NJF is not prohibited under the 4(d) rule for the NLEB and these facilities will not be discussed further, as any impacts that are not prohibited by the 4(d) rule are accounted for in the BiOp on the 4(d) rule. The impacts to Ibats from tree clearing for these NJF are analyzed below and further considered in the Jeopardy Analysis section.

To standardize the effects analysis, the proposed action was divided into discrete actions described as subactivities. Defining subactivities allows for easier interpretation and consideration of complex activities. The project subactivities are defined in the species effects tables (Appendix B Tables 1-6).

<u>Virginia spiraea (VASP)</u>

The potential effects of the proposed action are described in Appendix B Table 1. The project subactivities of the proposed action determined to result in NE or NLAA are described in Appendix B Table 1 and will not be further discussed in this Opinion.

Subactivities of the project that are LAA VASP that are assumed to occur on 0.05 acres within parcel WV-SU-046 (Figure 12) are listed in Appendix B Table 1 and include:

- Vehicle operation and foot traffic
- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – grading and graveling
- Stream equipment crossing structures

- Crossings, wetlands and other water bodies (non-riparian) – clearing

For some components of the proposed action that may affect VASP, AMMs have been incorporated to ameliorate those effects and those are also noted below. These subactivities are LAA VASP by physically impacting individual plants and/or altering or degrading its habitat.

Subactivities in the 0.05-acre area related to vehicle operation, clearing, and grading and graveling will kill VASP stems, bury seeds, and alter/degrade VASP habitat. Vehicle operation, foot traffic and herbaceous vegetation and shrub/tree clearing will cause individual VASP to experience decreased fitness (e.g., from competition with introduced invasive species), decreased reproductive success (e.g., from physical damage, competition with introduced invasive species, habitat disturbance), and crushing or death (e.g., from cutting, digging up, burying, soil compaction). Clearing for stream and wetland crossings and stream equipment crossing structures will cause soil compaction and sedimentation and hydrological changes that will degrade and alter habitat. As a result, plants and seeds will be buried and reestablishment of VASP in the construction ROW, ARs, or ATWS post-construction is not expected. Grading and graveling for ARs will cause habitat loss in all permanently maintained areas, preventing reestablishment of VASP post-construction. The combined effects from these subactivities will result in the permanent removal of all VASP plants, seeds, and habitat in the 0.05 acre.

AMMs have been included in the proposed action that will minimize the extent and significance of adverse effects on VASP. These AMMs include: implementing sediment and erosion control measures during and after construction; ensuring restoration of pre-existing topographic contours after any ground disturbance; restoring native vegetation (where possible); developing plans and procedures for invasive species management; expediting construction within any waterbody, effectively reducing disturbance to the streambed and adjacent soils and the quantity of suspended sediments; prohibiting construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, stored, or serviced within a 100 ft radius of any wetland or waterbody; and avoiding the use of herbicides and pesticides to maintain any portion of the construction ROW. While these AMMs may initially minimize the extent and significance of adverse effects on VASP, effects from the subactivities described above will result in the permanent removal of all plants and habitat in the 0.05 acre.

In summary, on parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). All proposed AMMs are being implemented (Mountain Valley 2020). The combined effects from the subactivities listed above will result in the permanent removal of all VASP plants, seeds, and habitat in the 2.3-acre portion of the action area and reestablishment of VASP in that area is not expected.

Roanoke logperch (RLP)

The potential effects of the proposed action are described in Appendix B Table 2. The project subactivities of the proposed action determined to result in NE or NLAA are described in Appendix B Table 2 and will not be further discussed in this Opinion.

Subactivities of the project that are LAA RLP are listed in Appendix B Table 2 and include:

- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temp and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal
- Stream Crossing, dam and pump
- Stream Crossing, cofferdam
- ROW repair, regrading, revegetation (upland) – hand, mechanical
- ROW repair, regrading, revegetation – instream stabilization and/or fill
- AR maintenance – grading, graveling

For some components of the proposed action that are anticipated to affect RLP, AMMs have been incorporated to ameliorate those effects and those are also noted below. These subactivities are anticipated to result in a loss of prey items and/or an ability to see the prey, temporarily remove habitat, or result in habitat degradation and loss due to vegetation removal, pump around, placement of cofferdams, and/or altering water quality.

Subactivities related to clearing, ARs, and stream crossings will harm or kill RLP and alter/degrade RLP habitat. The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation, increased embeddedness, increased water temperature, decreased dissolved oxygen, and impoundments.

Increased sedimentation/turbidity – Increased sedimentation/turbidity is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. Excessive sedimentation and suspended sediments in aquatic systems can cause multiple adverse effects on all life stages of benthic fish, including loss of stream habitat essential for sheltering, foraging, and spawning; increased mortality of eggs, YOY, juveniles, and adults; increased predation on eggs by sediment-dwelling invertebrates; avoidance of previously occupied habitat; increased vulnerability of adults to predation; reduced reproductive success; increased physiological stress; reduced feeding and subsequent weight loss; reduced prey availability; increased parasitism; reduced disease resistance; and clogging, abrasion, and necrosis of gills (Kundell and Rasmussen 1995, Newcombe and Jensen 1996).

Excessive sedimentation/turbidity increases sublethal impacts such as growth rate and gill health. Studies have found signs of physiological stress, such as increased oxygen consumption and loss of equilibrium, in remaining fish downstream of disturbed areas, as well as decreased abundance of fish downstream of instream work sites (Reid and Anderson 1999, Levesque and Dube 2007). Sutherland and Meyer (2007) found growth rate of YOY spotfin chub, (*Erimonax monachus*, federally listed threatened) was significantly and inversely related to increasing suspended sediment concentrations. They hypothesized that stress inhibited normal feeding behavior. Gill damage in spotfin chubs was noted with increased suspended sediment concentrations. There is no similar study for RLP, but we expect similar impacts would occur to YOY RLP when sediment enters small tributaries. Although this study focused on YOY we expect similar increased sedimentation would also impact the gills of adult RLP and stress might inhibit their normal feeding behavior.

Studies have shown negative effects of increases in sedimentation/turbidity on prey consumption and foraging behavior of darters (Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017). RLP are sight feeders and flip rocks to expose invertebrates (Rosenberger and Angermeier 2002). Sediment deposited on the waterbody bottom will interfere with the ability of RLP to feed (Robertson et al. 2006). Increased sedimentation is anticipated to result in a loss of prey items and/or an ability to see the prey. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for 12.4 hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short-term time period (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7 hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed. As discussed below, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP will persist for up to 4 years.

Fish species that require clean cobble and gravel for spawning had decreased abundance in sediment-impaired streams (Sutherland et al. 2002) and typical riffle-dwelling fish species declined with increased siltation (Berkman and Rabeni 1987), indicating that RLPs numbers may be reduced by increased suspended sediment concentrations in areas heavily affected by sediment. Increased sediment deposition and substrate compaction from instream construction can degrade fish spawning habitat, resulting in the production of fewer and smaller fish eggs, impaired egg and larvae development, and limited food availability for YOY (Reid and Anderson 1999, Levesque and Dube 2007). Burkhead and Jelks (2001) reported a decrease in spawning of the tricolored shiner (*Cyprinella trichroistia*) as suspended sediment concentration increased (0 [control], 100, 300, and 600 mg/L) for 6 days. When fish spawned, fewer eggs were laid as sediment concentrations increased, and spawning activity was delayed at higher levels of suspended sediment. Egg and larval mortality was negligible. Increased sedimentation is anticipated to result in similar effects to RLP when sediment entering a waterbody prior to the start of the TOYR is resuspended during the TOYR and reaches levels that would degrade spawning habitat.

The duration and severity of the effects of increased suspended sediment on individuals and populations depends on factors such as the duration of disturbance, the amount of sediment loading, the length of stream segment directly affected by construction, and whether there were repeated disturbances (Newcombe and Jensen 1996, Yount and Niemi 1990, Vondracek et al. 2003). Most studies documented recovery of the affected stream reach within 1 to 3 years after construction (Reid and Anderson 1999, Yount and Niemi 1990).

The effects to RLP will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background suspended sediment concentrations in the waterbody. At crossing locations, cofferdam placement/removal and effluent pumped from within cofferdams and through filter bags will generate a temporary sediment plume. The size of the sediment plume generated from placement/removal of cofferdams will differ depending on the particular conditions of the streambed. If the particular reach is composed of fine sediment we expect the plume will be larger than if the streambed is composed of more gravel substrate. The 2017 BiOp analyzed and expected that the clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands, AR grading, and the trenching would have minimal impacts to RLP based on E&S control measures. However, numerous alleged E&S control violations were documented in part due to 2018 being the wettest year on record in VA (https://www.ncei.noaa.gov/news/national-climate-201812 accessed 8/12/2020) and failure and/or improper installation and maintenance of E&S control measures.

Elevated sediment levels in RLP habitat likely resulted from upland construction and other MVP activities that have occurred. The available information does not provide information about how long the sediment levels were elevated, exactly which reaches of waterbodies were impacted, and details about the elevated levels, and such information cannot practicably be obtained. A list of notices of violations and non-compliances issued to Mountain Valley from WVDEP, VDEQ, and FERC was provided to the Service (M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 11, 2020) and refined to include those notices that either had the potential to impact RLP because the violation/non-compliance was near predicted suitable habitat or where there was not sufficient information to exclude the notice (Table 25).

Table 25. Summary notices of violation issued by VDEQ to Mountain Valley with potential to impact RLP.

Date	Notice of Violation Number	Location	Description of Deficiency	Remedial Action
05/23/2018	CL18006874-00	Franklin, VA (UNTs to Little Creek (S-IJ10))	As noted on 5/23/2018, the VDEQ observed that the release of sediment and sediment laden stormwater off of the ROW onto adjacent private property and into surface waters of the Commonwealth had occurred near stations markers 13476+16 and 13489+10.	MVP Response: Repaired/upgraded controls to provide outlet relief for perimeter controls to release stormwater following treatment, repair of waterbars, end treatments and perimeter controls. Permission to access off-LOD areas was not granted until after 5/31/2018 VDEQ field inspection (noted below). Once access was granted by landowner, sediment was removed from the adjacent property and affected stream channels. (Same incident noted in 5/31/2018 VDEQ

				inspection)
05/31/2018	CL18006874-00	Franklin, VA (UNTs to Little Creek (S-IJ10))	As noted on 5/31/2018, the VDEQ observed sedimentation within two separate unnamed stream channels on property adjacent to the MVP right of way in the vicinity of Cahas Mountain Road in Franklin County.	MVP Response: This incident is the same area as the 5/23/2018 noted above. This follow-up inspection by the VDEQ biologist was conducted following landowner permission. Approximately 2,800LF of 2 streams impacted. Controls were repaired and sediment was retrieved from affected streams. (Same incident noted in 5/23/2018, VDEQ inspection).
06/26/2018	CL18006874-00	Montgomery, VA (UNT to North Fork Roanoke (S-G39))	As noted on 6/26/2018, the VDEQ observed that the release of sediment and sediment laden stormwater off of the right of way onto adjacent private property and into surface waters of the Commonwealth had occurred near stream 39.	MVP Response: Approximately 340LF of stream impacted from sediment. ROW controls had been repaired and maintained as noted in the inspection report on 6/26/2018. Sediment was promptly retrieved from the stream.
06/26/2018	CL18006874-00	Montgomery, VA (UNT to North Fork Roanoke (S-G40))	As noted on 6/26/2018, the VDEQ observed that the release of sediment and sediment laden stormwater off of the right of way onto adjacent private property and into surface waters of the Commonwealth had occurred near stream 40.	MVP Response: Approximately 1,860LF of stream impacted from sediment. ROW controls had been repaired and maintained as noted in the inspection report on 6/26/2018. Sediment was retrieved from the stream.
06/27/2018	CL18006874-00	Montgomery, VA (UNT to Flatwoods Branch (S-MM15))	As noted on 6/27/2018, the VDEQ observed that the release of sediment and sediment laden stormwater off of the right of way onto adjacent private property and into surface waters of the Commonwealth had occurred near stream SMM15.	MVP Response: Notification to VDEQ made on 6/23/2018. MVP conducted maintenance and repair of waterbars, waterbar end treatments and perimeter controls as specified in VDEQ inspection report. Sediment was retrieved from the stream.
06/27/2018	CL18006874-00	Montgomery, VA (UNT to Flatwoods Branch (S-MM13))	As noted on 6/17/2018, the VDEQ observed that the release of sediment and sediment laden stormwater off of the right of way onto adjacent private property and into surface waters of the Commonwealth had occurred near stream MN-513.	MVP Response: Correct stream ID is S-MM13. Repair and maintenance activities completed on waterbars, end treatments and perimeter controls as specified in VDEQ inspection report. Sediment was retrieved from the stream.
6/1/2018 to 11/15/2018	CL18006874-00	Various	From the beginning of June through 11/15/2018, MBP observed 16 additional	See general response.

			instances where sediment was deposited off of the construction right of way into an adjacent stream as a result of erosion and sediment control measures being improperly installed or maintained.	

The benthic macroinvertebrate standard is a metric that corresponds to sediment load in the waterbody. The 2016 Roanoke River Bacteria and Sediment Total Maximum Daily Load (TMDL) Implementation Plan Part 1 (2016 VDEQ) states "During development of the benthic TMDL, a stressor analysis identified sedimentation as the most probable cause of the benthic macroinvertebrate community impairment. Using a reference watershed approach, the numeric TMDL endpoint for the impaired watershed was established based on the sediment loading rate in a similar, but non-impaired reference watershed." It identified portions of the Roanoke River (14 km) that exceed sediment standards for a healthy benthic community and calculated the need for a 75% reduction in sediment loading from all land use sources and instream erosion to meet the TMDL standard. However, the portion of the Roanoke River that is listed as impaired for benthic macroinvertebrates is 33.28 km downstream of the MVP ROW and beyond the limits of the action area. The upper, headwater sections of the Pigg River (7.2 km) are on the list for benthic macroinvertebrate and are approximately 100 km upstream of the ROW, also beyond the limits of the action area. While we do not have detailed information for the sediment level from the violations in Table 25, based on the distances from the project ROW of the benthic macroinvertebrate TMDL river sections in the Roanoke and Pigg Rivers we do not expect the previous MVP ground disturbing activities contributed additional sediment to those areas and would not further impact the benthic macroinvertebrate community in those areas.

Based on past events, sediment modeling conducted by Mountain Valley (2020), and conservative estimates of total suspended sediment (TSS) concentration in waterways (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020), we anticipate that clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands and the other ground-disturbing activities listed above will impact RLP and have incorporated portions of RLP habitat into our impact area, see additional discussion below.

In response to any sediment plume that occurs, RLP may cease feeding and move to clearer water until suspended sediment concentrations return to background levels. Roberts et al. (2016a) indicates that RLP are very mobile and determined that median lifetime dispersal distance is 3.7 to 15 miles. Therefore, we expect that most adult RLP will have the ability to avoid areas of heavy sediment deposition and move to other areas of suitable habitat within the system as sediment moves within the channel. Younger life stages may not be able to move out of the area and will experience loss of habitat for feeding and sheltering. Changing foraging areas will cause decreased fitness to the majority of RLP that move from the pipeline crossing areas. If the RLP move into an already occupied area there is the potential for a decrease in fitness to some of the resident RLP because there will be increased competition for food. However, relocating is not unusual for RLP; Roberts et al. (2008) reported RLP frequently moved between marking and recapture site (15-75 m away) or to another site (2.5-3.2 km away).

Therefore shifting foraging areas or having additional RLP shift into a foraging area is a behavior to which the RLP is accustomed and we expect it would take a large influx of RLP to decrease the fitness of the resident RLP. After the waterbody has returned to background suspended sediment concentrations, we anticipate that RLP will resume use of the waterbody. Therefore, we do not expect that project-related sedimentation will render any currently suitable RLP habitat permanently unsuitable.

As mentioned above, there are no studies on specific suspended sediment concentrations (e.g., thresholds) and their effects on RLP, and the data needed to develop species-specific thresholds is not available or readily obtainable. Obtaining such data would involve conducting novel laboratory research to quantify the effects of increased sedimentation levels on RLP biology and physiology at multiple temporal scales (e.g., immediate short-term effects to physiology as well as longer-term effects to reproductive cycles and population dynamics). Such research would also necessitate sacrifice of numerous RLP as experimental subjects. As such, this data is not readily obtainable for the purposes of this Opinion. To assess the suspended sediment concentrations at which adverse effects will occur and to determine the downstream extent to which these effects may extend as a result of the proposed project (impact area), we used the analytical framework in the Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010) (framework; Appendix C). This framework was developed by the Service's Washington Fish and Wildlife Office (WAFWO) to assist in determining effects for Section 7 consultation for bull trout (*Salvelinus confluentus*). Newcombe and Jensen (1996) provided the basis for analyzing sediment effects to bull trout in Muck (2010) and is being applied in this Opinion as the basis for analyzing sediment effects to RLP and their habitat. We have carefully considered Mountain Valley's concerns regarding the applicability of the framework (Attachment 4 in P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, May 18, 2020). However, for the reasons outlined below and in the accompanying ITS, we have concluded that the framework represents the best available methodology for adequately assessing the likely effects of project-related sedimentation on RLP.

Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids (none of the documents had specific data on bull trout or RLP). They developed multiple models that calculated the "severity-of-effect" (SEV) to salmonids and nonsalmonids based on the suspended sediment dose (exposure duration) and concentration. In particular, they developed an adult freshwater nonsalmonids model (model 6), which might appear to be more appropriate; however, there are drawbacks to this model such as a small sample size (n=22), no juvenile data, and no values for sub-lethal effects. Due to these drawbacks, the Service does not believe it is reasonable to apply model 6 for nonsalmonids in Newcombe and Jensen (1996) to the RLP. The most data rich model is the salmonid SEV model for adults and juveniles (model 1 in Newcombe and Jensen [1996] and Figure 1 in Muck [2010]); it provides sub-lethal levels and is based on a large sample size (n=171) that includes data for both adult and juvenile salmonids in multiple states and Canada in multiple eco-regions. The Service has determined that this salmonid SEV model for adults and juveniles is the most appropriate available model to use for establishing effects thresholds for RLP, based on the above stated reasons and that RLP share physical habitat requirements similar to salmonids, which is habitat that is relatively free of fine sediment for their breeding and feeding. In addition, suspended sediments affect behavior and physiology of both salmonids and nonsalmonids, including reducing their visibility. RLP rely strongly on vision for reproductive activities, including mate selection, recognizing conspecifics, and initiating spawning activities, and therefore might be as vulnerable to increased turbidity as salmonids (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). In addition, although RLP are benthic feeders while salmonids are drift-feeders, RLP are sight feeders (Rosenberger and Angermeier 2002) and depth perception for both RLP and salmonids is necessary for foraging in a three-dimensional benthic environment. Suspended sediment generally occurs throughout the water column, including the bottom layer, and therefore will likely affect RLP. Sediment deposited on the waterbody bottom due to suspended sediment will interfere with the ability of RLP to feed (Robertson et al. 2006). Due to qualitative information on the sensitivity of RLP to suspended sediments, studies on effects of suspended sediment concentrations on other nonsalmonid and darter species (Burkhead and Jelks 2001, Sutherland and Meyer 2007, Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017), and no studies to indicate darters are more or less sensitive to suspended sediment than salmonids, including the bull trout (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020), application of model 1 in Newcombe and Jensen (1996) is the most appropriate available model to use for establishing effects thresholds for RLP.

The framework for evaluating effects to RLP is based on suspended sediment concentration (SSC), duration, and exposure. Factors influencing SSC, exposure, and duration include waterbody size, volume of flow, the nature of the construction activity, construction methods, erosion controls, and substrate and sediment particle size. Factors influencing the SEV include duration and frequency of exposure, concentration, and life stage. Availability and access to refugia are other important considerations.

The framework requires an estimate of SSC (mg/L) and exposure duration. We expect that any measurable increases in turbidity will be short-term and episodic from waterway crossings and from storm events that deliver sediment from construction activities in upland areas into waterways. Using this approach (Figure 1 in Muck [2010]) and an SEV of 5 to include sublethal effects to juveniles, we expect that adverse effects to adult, subadult, and juvenile RLP are likely to occur under any of the following circumstances:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than 1 hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than 3 hours continuously[21].
d. When sediment concentrations exceeded 20 mg/L over background for over 7 hours continuously.

[21] Muck (2010) used the term “cumulatively” instead of “continuously” for items c and d, but used the term “continuously” for item b. “Cumulative” is defined as “summing or integrating overall data or values of a random variable less than or equal to a specified value” or “increasing by successive additions”; “continuous” is defined as “marked by uninterrupted extension in space, time, or sequence” (https://www.merriam-webster.com/dictionary/; accessed 8/31/2020). Newcombe and Jensen (1996), the basis for the framework in Muck (2010), used the term “exposure duration” in hours for their analysis and “duration” is defined as “continuance in time” (https://www.merriam-webster.com/dictionary/; accessed 8/31/2020). To be consistent with the basis for the determination of adverse effects, it is more appropriate to use “continuously.”

The sediment concentration to be measured is SSC, and not as TSS (total suspended sediment or solids), which are 2 different constituents and are not interchangeable (D. Chambers, USGS, email to J. Stanhope, Service, August 12, 2020). As described in Gray et al. (2000), "the method for determining SSC produces relatively reliable results for samples of natural water, regardless of the amount or percentage of sand-size material in the samples" and the method for determining TSS tends to have a bias towards lower concentration values than SSC when sediment dry weight samples have greater than 25% sand-size material. SSC is the method widely used by USGS. In addition, Newcombe and Jensen (1996), the basis for the framework in Muck (2010), uses the terminology of "suspended sediment concentration." Therefore, application of the SSC method is a conservative method to measure sediment concentration.

Because sediment sampling for concentration is labor intensive, the framework in Muck (2010) is based on using turbidity as a surrogate for SSC. To do this, the sediment concentration above background at which adverse effects to the species and/or habitat occurs expressed as mg/L will be converted to nephelometric turbidity units (NTU), based on existing regression relationships, as described in Muck (2010) or Hyer et al. (2015) or based on guidelines developed by USGS (Rasmussen et al. 2009).

To assess the potential extent of these effects due to open-cut crossings, we relied on published literature. Reid et al. (2008) reviewed 27 past monitoring studies of open-cut pipeline crossings (both wet and dry crossing techniques) throughout Canada and the U.S. and found that sediment released from the construction sites was generally limited to a short distance downstream. This review found that biological effects to fish and benthic invertebrates were limited to several hundred meters downstream of the crossings and were temporary (<1 year). Some of the studies reviewed by Reid et al. (2008) found no effects on warmwater fish abundance (including darter species) downstream of pipeline crossings, however fish abundance does not account for sublethal impacts. Roberts et al. (2016c) observed that RLP densities routinely fluctuated by more than 25% per year, and occasionally by as much as 75% per year. This variability suggests difficulty in statistically detecting changes in darter species abundance if there is a 75% or less reduction in abundance. Reid et al. (2008) also reviewed pipeline crossing TSS monitoring data for different crossing methods and found that for dry, open-cut crossings using the dam and pump method, the mean TSS concentration was 22.7 mg/L (standard error [SE]=5.0 mg/L) above background levels, with mean peak TSS concentration of 334.0 mg/L (SE=23.0 mg/L) occurring a mean distance of 52.5 m (SE=6.3 m) downstream of the crossing. Reid et al. (2002a) studied the effects of a pipeline water crossing, using both wet and dry crossing techniques, on fish and benthic invertebrate communities. They reported habitat conditions >500 m downstream of the crossing were unaffected. Specifically, TSS concentrations decreased 500 m downstream of the crossing to 89-96% lower than the levels measured 50 m downstream of the crossing. Additional studies found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of pipeline crossings and TSS concentrations in most of these studies were less than 1,500 mg/L (Reid and Anderson 1999; Reid et al. 2002b, 2004). To be protective of the RLP, we have determined that RLP will be impacted in streams 200 m above and 800 m below each open-cut crossing plus the construction ROW width (23 m [75 ft]).

For RLP, impact areas (stream length) due to open-cut crossing are as follows (Table 26): 2,046 m in the Roanoke River system (1,023 m in the North Fork Roanoke River, 1,023 m in Bradshaw

Creek) and 1,023 m in the Pigg River system (1,023 m in Harpen Creek).

Table 26. Open-cut crossings impacting RLP.

County in VA	River Basin	RLP Stream Impacted	Stream Crossing MP	Total Length (m) of RLP Stream Impacts
Montgomery	Roanoke	North Fork Roanoke River	227.4	1,023
Montgomery	Roanoke	Bradshaw Creek	230.9	1,023
Pittsylvania	Pigg	Harpen Creek	290	1,023

For the mixing zone areas, where sediment in tributaries discharges to occupied streams during storm events (i.e., sediment from construction in upland areas) and contributes increased suspended sediments, the areal extent of impact will vary depending on numerous factors including rainfall duration and the suspended sediment concentrations in the tributary, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (USEPA and Corps 1998). The Service reviewed TSS concentrations in the streams GIS shapefile that Mountain Valley provided, which is based on the screening-level methodology used to define the aquatic action area (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020). As described in the Action Area section and based on expert review, it was determined that utilizing Mountain Valley's sedimentation analysis to develop the aquatic action area was a reasonable and conservative approach (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Mountain Valley indicated that their approach is conservative and overestimates the expected increased sediment concentrations from the project because it assumes all sediment loads from construction activities, in response to a 24-hour design storm, will arrive simultaneously to the stream segments within the watershed. The highest TSS concentration predicted for the MVP in a tributary to a RLP stream was 702 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from pipeline crossing studies that found downstream impacts due to increases in TSS concentrations and sediment deposition that occurred within 500 m of pipeline crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). Because the predicted TSS concentrations provided in the GIS shapefile from Mountain Valley are based on calculations and not actual laboratory methods, the Service thinks they are indicative of SSC values and do not have a bias towards lower values. As discussed above, some of the downstream impacts included short-term changes in abundance and community structure of benthic invertebrates and changes in fish abundance. To be protective of the RLP, the Service anticipates the areas in which the species will be impacted will be similar to open-cut crossings and also occur within 200 m above and 800 m below the point where the tributary enters the RLP-occupied stream (1,000 m total within RLP-occupied stream). The 200 m area in the RLP-occupied stream upstream of the confluence with the tributary is included to address uncertainty of the mixing zone plume extent (i.e., due to the factors described above).

Based on the GIS shapefile, the Service identified:

- the tributaries with $\geq$20 mg/L TSS concentrations above background that discharged to assumed or known RLP-occupied streams and determined these to be mixing zone areas; and
- stream segments with assumed or known RLP-occupied streams that are predicted to have elevated TSS concentrations $\geq$20 mg/L above background beyond the mixing zone.

The mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, and the stream segments with elevated TSS concentrations beyond the mixing zone increases the total length of the impact area as follows (including open-cut crossings) (Appendix D Table 1 and Figures 1 and 2): a total of 17,558 m in the Roanoke River system (6,998 m in the North Fork Roanoke River, 5,830 m in Bradshaw Creek, 1,000 m in the South Fork Roanoke, and 3,730 m in the Roanoke River); and a total of 6,723 m in the Pigg River system (5,700 m in the Pigg River and 1,023 m in Harpen Creek).

The Predicted Suitable Habitat layer (Virginia Natural Heritage Program 2017), covers approximately 2,795 km in VA, and 240 km of those are from the Roanoke River system (Bradshaw Creek and the South Fork, North Fork, and Upper Roanoke Rivers). The impact area in the Roanoke River system (17.6 km), known or assumed to support RLP, represents approximately 7.3% of the RLP potential habitat within the Roanoke River system. As stated earlier, Roberts et al. (2016b) estimated a mean population of 16,875 adult RLP within the known range extent of the Roanoke River population (118 km), yielding an occurrence rate of 143 adult RLP/km. Based on that occurrence rate, approximately 2,517 adult RLP would be present within the Roanoke River system impact area (143 RLP/km x 17.6 km = 2,516.8 = 2,517 RLP), representing approximately 14.9% of the total estimated Roanoke River population (2,517/16,875 = 0.1491).[22]

When estimating population size, Roberts et al. (2016b) focused on RLP 1 year of age or older because younger RLP are difficult to reliably capture (Rosenberger and Angermeier 2003). The Roberts et al. (2016b) study does not estimate the total population of YOY or juvenile RLP within the known range extent of the Roanoke River population, and no data is available or readily obtainable that would allow us to develop such an estimate with any degree of confidence. Attempting to develop such an estimate would require information such as: egg fecundity, hatching success, and natural mortality (FERC 2017b), which is unknown for RLP and it would take extensive studies over numerous years to collect the information. While YOY estimates have been calculated using RLP population growth rates from information compiled from the literature, it is potentially biased (FERC 2017b). Attempting to develop a numeric estimate of juveniles present thus would require us to make multiple assumptions and would inadvertently suggest a level of confidence not justified by the available information. Although adult RLP use habitat differently than YOY or juveniles, we do not have detailed habitat assessments that identify the habitats used by the different life stages. Nor is there any data indicating that the distribution of juveniles in the Roanoke River system differs significantly from the distribution of adults. Therefore, although we cannot estimate the number of YOY or juveniles that may be present in the impact area, it is reasonable to assume that the proportion of YOY or juveniles present corresponds to the proportion of adults present, i.e., 14.9% of the total number of YOY or juvenile RLP in the Roanoke River population are likely present in the impact area.

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[22] This calculation is conservative and slightly overstates the percentage of the Roanoke River population that is likely to be present in the impact area because the population estimate is for the 118 km known range extent of the Roanoke River population, which includes the Roanoke River, the North Fork Roanoke River, and the South Fork Roanoke River (see Roberts et al. (2016b) and studies cited therein), and our impact area includes a 5.8 km stretch in Bradshaw Creek in which RLP presence is assumed. Because any overestimate would overstate the effects of the action, it would not alter our jeopardy analysis for this species set forth below.

Approximately 139.6 km of the Predicted Suitable Habitat layer (Virginia Natural Heritage Program 2017) covers Harpen Creek and the mainstem of the Pigg River from the Pigg River system. The impact area in the Pigg River system (6.7 km), known or assumed to support RLP, represents approximately 4.8 % of the RLP potential habitat within the Pigg River system. As stated earlier, Roberts et al. (2016b) estimated a mean population of 9,281 adult RLP within the known range extent of the Pigg River population (100 km), yielding an occurrence rate of 93 adult RLP/km. Based on that occurrence rate, approximately 622 adult RLP would be present within the Pigg River system impact area (93 RLP/km x 6.7 km = 621.8 = 622 RLP), representing approximately 6.7% of the total estimated Pigg River population (622/9,281 = 0.0670).[23] Although the number of YOY and juveniles present in the impact area cannot practicably be estimated for the reasons stated above, assuming the proportion of YOY and juveniles present corresponds to the proportion of adults present, roughly 6.7% of YOY and juveniles in the Pigg River system would be present in the impact area.

The total impact area for the project is 24.3 km, which represents 0.9 % of the Predicted Suitable Habitat layer in VA (2,795 km) (Virginia Natural Heritage Program 2017) and a total of 3,139 adult RLP would be present in the impact area (2,517 RLP + 622 RLP). We expect this over estimates the number of adult RLP in the impact area because for two reasons. First, as noted in the Status of the Species in the Action Area, due to the size of Bradshaw and Harpen Creeks we do not anticipate large numbers of adult RLP will use these areas on a regular basis. Second, as noted above, Roberts et al. (2016a) indicates that RLP are very mobile, and so we expect that most adult RLP will have the ability to avoid the impact areas and move to other areas of suitable habitat within the system as sediment moves within the channel.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above although the magnitude and duration will vary depending on the specific subactivity. A commonly documented effect of instream work includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the area where the instream work in occurring, as well as in areas downstream of the disturbance; the resulting increase in substrate embeddedness is expected to reduce habitat heterogeneity and primary productivity; increases fish egg and larval mortality; alters, degrades, and entombs microbenthic communities that RLP depend on as a food source (Burkhead and Jenkins 1991). Sutherland (2001) reported marginally significant negative relationship difference between both embeddedness and foraging time and feeding strikes of the gilt darter (*Percina evides*), where mean substrate embeddedness ranged from 40-70%. Sutherland (2001) also observed increased resting time with increased percent embeddedness although this relationship was not as strong. Overall, the study found embeddedness and foraging behavior was correlated but the author did not determine if it was a function of increased turbidity, increased physiological stress, or possibly decreased prey abundance.

[23] This calculation is conservative and slightly overstates the percentage of the Pigg River population that is likely to be present in the impact area because the population estimate is for the 100 km known range extent of the Pigg River population referenced in Roberts et al. (2016b), which is based on surveys in the Pigg River, Big Chestnut Creek, Doe Run, and Snow Creek (see Roberts et al. [2016b], Lahey and Angermeier [2007]), and our impact area includes 1 km in Harpen Creek in which RLP presence is assumed. Because any overestimate would overstate the effects of the action, it would not alter our jeopardy analysis for this species set forth below.

Rosenberger and Angermeier (2002) compared the habitat of RLP in the Roanoke, Pigg, and Nottoway Rivers. The following is a summary of their findings pertaining to embeddedness: RLP were observed using less embedded substrate in the winter than in the summer; they were consistently observed over loosely embedded substrate with little to no silt cover; RLP in the Roanoke River inhabit areas that are more embedded than those in the Pigg or Nottoway rivers; and RLP subadults were not observed selecting for embeddedness or silt in the Roanoke River although none of the age classes were observed in severely embedded or heavily silted substrate.

Because embeddedness is correlated with increased sedimentation we anticipate effects to RLP from embeddedness will be similar to those discussed in the increased sedimentation/turbidity section above. Moreover, the reaches likely impacted by sediment deposition and increased embeddedness would also be those that will exhibit the highest levels of project-related turbidity (Mountain Valley 2020). Because 20 mg/L is a relatively low TSS concentration (Mountain Valley 2020), the conservatively-defined mixing zones associated with tributaries with ≥20 mg/L TSS above background concentrations, and the stream segments with assumed or known RLP-occupied streams that are predicted to have elevated TSS concentrations of ≥20 mg/L above background beyond the mixing zone, encompass the areas in which project-related increases in embeddedness are reasonably likely to harm RLP. For the mixing zones, this conclusion is supported by the studies of pipeline crossings referenced above, which found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of the crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). As previously noted, the highest TSS concentration predicted for the MVP in a tributary to a RLP stream was 702 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from the pipeline crossings analyzed in those studies.

Mountain Valley used a different methodology to identify deposition/embeddedness zones, a portion of which fall outside the impact area derived under our methodology. Because we are not relying on Mountain Valley's methodology for the reasons discussed above and in the incidental take statement for RLP section, it would be inappropriate to use that methodology to identify areas where deposition is likely to harm RLP. Furthermore, under our approach, deposition posing a risk to the species will occur across 24.3 km of suitable RLP habitat where suspended sediment is expected to be elevated, whereas Mountain Valley's approach predicts that increased embeddedness will only occur over 10.5 km, regardless of any project-related increase in suspended sediment concentrations. Our approach is therefore more conservative and better accounts for the relationship between increases in suspended sediment concentrations and deposition. In short, the impact area defined above encompasses the stream reaches in which harm to RLP from increased sedimentation/turbidity and from increased embeddedness is reasonably certain to occur.

Increased water temperature – Increased water temperature is anticipated from the following subactivities: clearing – herbaceous vegetation and ground cover, clearing – trees and shrubs, and ARs -upgrading. Streambank vegetation clearing/trimming will alter RLP habitat. Decreased riparian vegetation is expected to result in increased sunlight at the stream, resulting in increased instream water temperatures. Changes in light regime and water temperature may affect the RLP prey base and make the habitat less suitable for RLP foraging. We expect all RLP will move from cleared streambank areas to areas with streambank vegetative cover and we do not expect RLP to return to the cleared areas to forage. The construction ROW is 75 ft at streams and removal of vegetative cover is permanent along a 10 ft corridor of the ROW centered over the pipeline, which is a small fraction of the area in which RLP typically move. As a result of this temporary and permanent habitat loss, we anticipate the majority of RLP in the crossings will experience a decrease in individual fitness. If the RLP move into an already occupied area during construction until the majority of the ROW is restored there is the potential that there may be a decrease in fitness to some of the resident RLP if either a large number of RLP move or if they move to an area with an abundance of RLP. If either of these situations occurs, there will be increased competition for food. However, relocating is not unusual for RLP; Roberts et al. (2008) reported RLP frequently moved between marking and recapture site (15-75 m away) or to another site (2.5-3.2 km away). Therefore, shifting foraging areas or having additional RLP shift into a foraging area is a behavior to which the RLP is accustomed. Once the ROW is restored and is maintained as a 10-ft opening we expect the RLP will move back to the general area.

Decreased dissolved oxygen – Decreased dissolved oxygen (DO) is anticipated from the following subactivities: clearing – herbaceous vegetation and ground cover, clearing – trees and shrubs, and ARs -upgrading. Darters and shiners in the Roanoke River exhibited sensitivity to abrupt changes in DO levels (Matthews and Styron 1978, 1981). We expect RLP to move to areas with cleaner substrate/less turbid water and higher DO levels to allow for foraging. After a return to baseline turbidity conditions, we anticipate that RLP will resume use of crossing areas. As a result of this habitat shift, we anticipate the majority of RLP in the crossings will experience a decrease in fitness. If the RLP move into an already occupied area there is the potential that there may be a decrease in fitness to some of the resident RLP if either a large number of RLP move or if they move to an area with an abundance of RLP. If either of these situations occurs, there will be increased competition for food. However, relocating is not unusual for RLP; Roberts et al. (2008) reported RLP frequently moved between marking and recapture site (15-75m away) or to another site (2.5-3.2 km away). Therefore, shifting foraging areas or having additional RLP shift into a foraging area is a behavior to which the RLP is accustomed. Once the ROW is restored and maintained as a 10-ft opening we expect RLP will move back to the general area because a 10-ft ROW is not expected to appreciably decrease the DO levels in the waterbody.

Impoundments – Impoundments are anticipated from the following subactivities: dam and pump or cofferdams. Immediately prior to instream work at each crossing, RLP will be removed by approved and permitted biologists via electrofishing techniques and seining and released approximately 50 ft downstream of the construction area. Once cofferdams are in place, fish depletion surveys will be conducted within the area isolated by cofferdams until no fishes are collected for several consecutive passes. Relocating RLP will minimize effects from instream work (e.g., stream diversion, cofferdam placement) on RLP that will occur immediately after fish relocation. The fish removal/relocation portion of the action will be conducted by individuals with state (VDGIF) permits that are issued as part of the Cooperative Agreement for Management of Endangered Species between the Service and VDGIF, thus no additional effects analysis is required for that portion of the action. If RLP remain in the crossing area after removal/relocation efforts we anticipate they will be entrained. Instream structure placement will result in temporary impoundments which might result in a decrease in feeding activity if RLP are in the impounded area and are no longer able to see their prey if water conditions are turbid. Because we anticipate that the majority of RLP will be removed from the area, we expect at most there is the potential for 1 individual per crossing to remain in the impounded area. This individual may either experience a reduction in fitness due to a decrease in feeding or might be entrained.

Summary – In summary, the duration of all project-related effects on RLP depend on the AMMs (e.g., TOYRs, fish removal and relocation, FERC Plan [FERC 2013a], and Restoration and Rehabilitation Plan [Mountain Valley 2017]), which are anticipated to protect RLP when they are spawning, and reduce surface water runoff and sedimentation, but not to insignificant levels (Mountain Valley 2020). The Restoration and Rehabilitation Plan states that herbaceous and woody seed mixes native to the area will be applied to the temporary construction ROW. Herbaceous seeds are assumed to take approximately 4 weeks to establish, 6 months to develop, and 1 year to become a maturing crop. A minimum of 6 tree species (bare-root saplings) and 4 shrub species will be planted at each stream crossing. We expect the effects from sedimentation and turbidity on food sources (benthic invertebrate community) within the impact areas will last up to 4 years (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). However, we do not expect that project-related sedimentation will render any currently suitable RLP habitat permanently unsuitable. The effects of removal of streambank vegetation on sedimentation rates are expected to continue for 3-5 years as streamside vegetation develops to provide streambank stabilization (FERC 2017b). We expect effects from increased light to be minimized in 3-5 years. While implementation of AMMs is expected to significantly reduce the likelihood of injury or mortality and reduce adverse effects from habitat alteration, all impacts to RLP will not be avoided or minimized.

<u>Candy darter (CD)</u>

The potential effects of the proposed action are described in Appendix B Table 3. The project subactivities of the proposed action determined to result in NE or NLAA are described in Appendix B Table 3 and will not be further discussed in this Opinion.

Subactivities of the project that are LAA CD are listed in Appendix B Table 3 and include:

- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal
- ROW repair, regrading, revegetation (upland) – hand, mechanical
- AR maintenance – grading, graveling

For some components of the proposed action that are anticipated to affect CD, AMMs have been incorporated to ameliorate those effects and those are also noted below. Subactivities related to clearing, grading, trenching, ARs, and ROW repair will harm or kill CD and alter/degrade CD habitat. The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation/turbidity and increased embeddedness.

Increased sedimentation/turbidity – Increased sedimentation/turbidity is anticipated from all of the subactivities listed above although the magnitude and duration will vary depending on the specific subactivity. Excessive sedimentation and suspended sediments in aquatic systems can cause multiple adverse effects on all life stages of benthic fish, including loss of stream habitat essential for sheltering, foraging, and spawning; increased mortality of eggs, YOY, juveniles, and adults; increased predation on eggs by sediment-dwelling invertebrates; avoidance of previously occupied habitat; increased vulnerability of adults to predation; reduced reproductive success; induced physiological stress; reduced feeding and weight loss; reduced prey availability; increased parasitism; reduced disease resistance; and clogging, abrasion, and necrosis of gills (Kundell and Rasmussen 1995, Newcombe and Jensen 1996).

Excessive sedimentation/turbidity increases sublethal impacts such as growth rate and gill health. Studies have found signs of physiological stress, such as increased oxygen consumption and loss of equilibrium, in remaining fish downstream of disturbed areas, as well as decreased abundance of fish downstream of instream work sites (Reid and Anderson 1999, Levesque and Dube 2007). Sutherland and Meyer (2007) found growth rate of YOY spotfin chub was significantly and inversely related to increasing suspended sediment concentrations. They hypothesized that stress inhibited normal feeding behavior. Gill damage in spotfin chubs was noted with increased suspended sediment concentrations. We expect similar impacts would occur to YOY CD if sediment were to enter small tributaries or stream margins and settle. Although this study focused on YOY we expect similar increased sedimentation would also impact the gills of adult CDs and stress might inhibit their normal feeding behavior.

Studies have shown negative effects of increases in sedimentation/turbidity on prey consumption and foraging behavior of darters (Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017). CD are opportunistic invertivores, feeding almost exclusively on benthic macroinvertebrates (in particular, mayflies and caddisflies) (Schoolcraft et al. 2007). Sediment deposited on the waterbody bottom will interfere with the ability of CD to feed (Robertson et al. 2006). Increased sedimentation is anticipated to result in a loss of prey items and/or an ability to see the prey. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for 12.4 hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short-term time period (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7 hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed. As discussed below, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP will persist for up to 4 years.

Fish species that require clean cobble and gravel for spawning had decreased abundance in sediment-impaired streams (Sutherland et al. 2002) and typical riffle-dwelling fish species declined in the presence of increased siltation (Berkman and Rabeni 1987), indicating that CD numbers may be reduced by increased sedimentation in the sediment affected areas. Increased sediment deposition and substrate compaction from instream construction can degrade spawning habitat, resulting in the production of fewer and smaller fish eggs, impaired egg and larvae development, and limited food availability for YOY (Reid and Anderson 1999, Levesque and Dube 2007). As brood-hiding, benthic spawners that deposit eggs between unembedded pebble and gravel substrates within larger cobbles and boulders, CD are particularly sensitive to changes resulting from increased sedimentation. Burkhead and Jelks (2001) reported a decrease in spawning of the tricolored shiner as suspended sediment concentration increased (0 [control], 100, 300, and 600 mg/L) for 6 days. When fish spawned, fewer eggs were laid as sediment concentrations increased, and spawning activity was delayed at higher levels of suspended sediment. Egg and larval mortality was negligible. Increased sedimentation is anticipated to potentially result in similar effects to CD if the sediment entering a waterbody via tributaries rises to similar levels.

The duration and severity of the effects of increased sedimentation on individuals and populations depends on factors such as the duration of disturbance, the amount of sediment loading, the length of stream segment directly affected by construction, and whether there were repeated disturbances (Newcombe and Jensen 1996, Yount and Niemi 1990, Vondracek et al. 2003); however most studies documented recovery of the affected stream reach within 1 to 3 years after construction (Reid and Anderson 1999, Yount and Niemi 1990).

The effects to CD will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background turbidity/TSS concentrations. The clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands, AR grading, and the trenching is expected to have impacts to CD. Based on past events, sediment modeling conducted by Mountain Valley (2020), and conservative estimates of TSS concentration in waterways (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020), we anticipate these activities will impact CD and have incorporated portions of CD habitat into our impact area, see additional discussion below.

In response to any sediment plume that occurs, CD may cease feeding until sediment levels return to background levels. McBaine and Hallerman (2020) indicates that CD are potentially somewhat mobile (i.e., capable of movements >4 km), but are generally expected to move only within adjacent riffle complexes. Therefore we expect that most adult CD will likely not avoid areas of heavy sediment deposition by moving to other areas of suitable habitat within the system as the sediment moves within the channel. However, if CDs were to undertake such movements to avoid areas of increased sedimentation, the physiological toll from such efforts may have negative consequences to individuals. Further, we expect a significant increase in the risk of predation if CDs were to move upstream across run/pool habitats, as they are primarily a benthic species that shelters within interstitial spaces in shallow riffles. Younger life stages are likely incapable of moving out of an area and will experience loss of habitat for feeding and sheltering.

As mentioned above, there are no studies on specific suspended sediment concentrations (e.g., thresholds) and their effects on CD, and the data needed to develop such thresholds is not available or readily obtainable. Obtaining such data would involve conducting novel laboratory research to quantify the effects of increased sedimentation levels on CD biology and physiology at multiple temporal scales (e.g., immediate short-term effects to physiology as well as longer-term effects to reproductive cycles and population dynamics). Such research would also necessitate sacrifice of numerous CDs as experimental subjects. As such, this data is not readily obtainable for the purposes of this Opinion. To assess the suspended sediment concentrations at which adverse effects will occur and to determine the downstream extent to which these effects may extend as a result of the proposed project, we used the analytical framework in Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010) (framework; Appendix C). This framework was developed by the WAFWO to assist in determining effects for Section 7 consultation for bull trout. Newcombe and Jensen (1996) provided the basis for analyzing sediment effects to bull trout in Muck (2010) and is being applied in this Opinion as the basis for analyzing sediment effects to CD and their habitat. As discussed in the Effects of the Action section for the RLP, we have carefully considered Mountain Valley's concerns regarding the applicability of the framework (Attachment 4 in P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, May 18, 2020). For the reasons outlined below and in the accompanying ITS, we have concluded that the framework represents the best available methodology for adequately assessing the likely effects of project-related sedimentation on CD.

Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids (none of the documents had specific data on bull trout or CD). They developed multiple models that calculated the SEV to salmonids and nonsalmonids based on the suspended sediment dose (exposure duration) and concentration. In particular, they developed an adult freshwater nonsalmonids (model 6), which might appear to be more appropriate; however, there are drawbacks to this model such as a small sample size (n=22), no juvenile data, and no values for sublethal effects. Due to these drawbacks, the Service does not believe it is reasonable to apply model 6 for nonsalmonids in Newcombe and Jensen (1996) to CD. The most data rich model is the salmonid SEV model for adults and juveniles (model 1 in Newcombe and Jensen [1996] and Figure 1 in Muck [2010]); it provides sublethal levels and is based on a large sample size (n=171) that includes data for both adult and juvenile salmonids in multiple states and Canada in multiple eco-regions. The Service has determined that this salmonid SEV model for adults and juveniles is the most appropriate available model to use for establishing effects thresholds for CD, based on the above stated reasons and that CD share physical habitat requirements similar to salmonids, which is habitat that is relatively free of fine sediment for their breeding and feeding. In addition, suspended sediments affect behavior and physiology of both salmonids and nonsalmonids, including reducing their visibility. Darters, including the CD, rely strongly on vision for reproductive activities, including mate selection, recognizing conspecifics, and initiating spawning activities, and therefore might be just as vulnerable to increased turbidity as salmonids (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). In addition, although CD are benthic feeders while salmonids are drift-feeders and depth perception for both CD and salmonids is necessary for foraging in a three-dimensional benthic environment. Suspended sediment generally occurs throughout the water column, including the bottom layer, and therefore will likely affect CD. Sediment deposited on the waterbody bottom due to suspended sediment will likely interfere with the ability of CD to feed. Due to qualitative information on the sensitivity of CD to suspended sediments, studies on effects of suspended sediment concentrations on other nonsalmonid and darter species (Burkhead and Jelks 2001, Sutherland and Meyer 2007, Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017), and no studies to indicate darters are more or less sensitive to suspended sediment than salmonids, including the bull trout (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020), application of model 1 in Newcombe and Jensen (1996) is the most appropriate available model to use for establishing effects thresholds for CD.

The framework for evaluating effects to CD is based on SSC, duration, and exposure. Factors influencing suspended sediment concentration, exposure, and duration include waterbody size, volume of flow, the nature of the construction activity, construction methods, erosion controls, and substrate and sediment particle size. Factors influencing the SEV include duration and frequency of exposure, concentration, and life stage. Availability and access to refugia are other important considerations.

The framework requires an estimate of SSC (mg/L) and exposure duration. We expect that any measurable increases in turbidity will be short-term and episodic from waterway crossings and from storm events that deliver sediment from construction activities in upland areas into waterways. Using this approach (Figure 1 in Muck [2010]) and an SEV of 5 to include sublethal effects to juveniles, we expect that adverse effects to adult, subadult, and juvenile CD are likely to occur under any of the following circumstances:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than 1 hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than 3 hours continuously.
d. When sediment concentrations exceeded 20 mg/L over background for over 7 hours continuously.

The sediment concentration to be measured is SSC, and not as TSS (total suspended sediment or solids), which are 2 different constituents and are not interchangeable (D. Chambers, USGS, email to J. Stanhope, Service, August 12, 2020). As described in Gray et al. (2000), "the method for determining SSC produces relatively reliable results for samples of natural water, regardless of the amount or percentage of sand-size material in the samples" and the method for determining TSS tends to have a bias towards lower concentration values than SSC when sediment dry weight samples have greater than 25% sand-size material. SSC is the method widely used by USGS. In addition, Newcombe and Jensen (1996), the basis for the framework in Muck (2010), uses the terminology of "suspended sediment concentration." Therefore, application of the SSC method is a conservative measure of sediment concentration.

Because sediment sampling for concentration is labor intensive, the framework in Muck (2010) is based on using turbidity as a surrogate for SSC. To do this, the sediment concentration above background at which adverse effects to the species and/or habitat occurs expressed as mg/L will be converted to NTUs, based on existing regression relationships, as described in Muck (2010) or Hyer et al. (2015) or based on guidelines developed by USGS (Rasmussen et al. 2009).

For the mixing zone areas, where sediment in tributaries discharges to occupied streams during storm events (i.e., sediment from construction in upland areas) and contributes increased TSS, the areal extent of impact will vary depending on numerous factors including rainfall duration and the suspended sediment concentrations in the tributary, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (USEPA and Corps 1998). The Service reviewed TSS concentrations in the streams GIS shapefile that Mountain Valley provided, which is based on the screening-level methodology used to define the aquatic action area (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020). As described in the Action Area section and based on expert review, it was determined that utilizing Mountain Valley's sedimentation analysis to develop the aquatic action area was a reasonable and conservative approach (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Mountain Valley indicated that their approach is conservative and overestimates the expected increased sediment concentrations from the project because it assumes all sediment loads from construction activities, in response to a 24-hour design storm, will arrive simultaneously to the stream segments within the watershed. The highest TSS concentration predicted for the MVP in a tributary to a CD stream was 159 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from pipeline crossing studies that found downstream impacts due to increases in TSS concentrations and sediment deposition that occurred within 500 m of pipeline crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). Because the predicted TSS concentrations provided in the GIS shapefile from Mountain Valley are based on calculations and not actual laboratory methods, the Service believes they are indicative of SSC values and do not have a bias towards lower values. As discussed above, some of the downstream impacts included short-term changes in abundance and community structure of benthic invertebrates and changes in fish abundance. To be protective of the CD, the Service anticipates the areas in which the species will be impacted will be similar to open-cut crossings and also occur within 200 m above and 800 m below the point where the tributary enters the CD-occupied stream (1,000 m total within CD-occupied stream). The 200 m area in the CD-occupied stream upstream of the confluence with the tributary is included to address uncertainty of the mixing zone plume extent (i.e., due to the factors described above).

Based on the GIS shapefile, the Service identified the tributaries with ≥20 mg/L TSS concentrations above background that discharged to assumed or known CD-occupied streams and determined these to be mixing zone areas. The GIS shapefile did not indicate any stream segments within assumed or known CD-occupied streams that are predicted to have elevated TSS concentrations ≥20 mg/L above background beyond the mixing zone.

The mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, results in the total impact lengths as follows (Appendix D Table 2 and Figures 3, 4, and 5): a total of 2,000 m in the Gauley River system (1,000 m of the Gauley River from each of Coon Creek and Little Laurel Creek); and a total of 1,000 m in the Stony Creek system (1,000 m in Stony Creek from Kimballton Branch).

The Upper Gauley River metapopulation contains 6 populations within close proximity to each other (182 smi total) (Service 2018a), of which the Upper Gauley River population (within proposed critical habitat unit 5b) constitutes 27.2 smi. The impact area in the Upper Gauley River system (2 km = 1.24 mi), assumed to support CD, represents approximately 4.56% of the CD occupied habitat within the Upper Gauley population and 0.68% of potential habitat within the Upper Gauley River system metapopulation. CD abundance was considered "good" in the Upper Gauley River during the SSA (Service 2018a), but no specific population estimates are available to estimate the number of CD in the impact area.

All sections of Stony Creek have also not been surveyed for CDs, but the lower 21.2 smi of Stony Creek contain habitat that is suitable for the species and CD presence is assumed. The impact area in Stony Creek (1 km = 0.62 mi), assumed to support CD, represents approximately 2.92% of potential habitat within Stony Creek. CD CPUE (catch per unit effort) is highest in the midpoint of the watershed in Stony Creek, with lower abundances within the impact area, closer to the confluence with the New River (McBaine and Hallerman 2020). No recent population density estimates are available to estimate the number of CD in the impact area.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. A commonly documented effect of upland deforestation/clearing includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the areas downstream of the disturbance. The resulting increase in substrate embeddedness is expected to reduce habitat heterogeneity and primary productivity, increase egg and larval mortality, and alter, degrade, and entomb benthic macroinvertebrate communities that CD depend on as a food source (Burkhead and Jenkins 1991). Sutherland (2001) reported marginally significant negative relationship difference between both embeddedness and foraging time and feeding strikes of the gilt darter, mean substrate embeddedness ranged from 40-70%. Sutherland (2001) also observed increased resting time with increased percent embeddedness although this relationship was not as strong. Overall, the study found embeddedness and foraging behavior was correlated, but the author did not determine if it was a function of increased turbidity, increased physiological stress, or possibly decreased prey abundance.

Because embeddedness is correlated with increased sedimentation we anticipate effects to CD from embeddedness will be similar to those discussed in the increased sedimentation/turbidity section above. Moreover, as discussed in the Effects of the Action section for RLP, the reaches likely impacted by sediment deposition and increased embeddedness would also be those that will exhibit the highest levels of Project-related turbidity (Mountain Valley 2020). Because 20 mg/L is a relatively low TSS concentration (Mountain Valley 2020), the mixing zones associated with tributaries with $\geq$20 mg/L TSS concentrations above background encompass the areas in which project-related increases in embeddedness are reasonably likely to harm CD. This conclusion is supported by the studies of pipeline crossings referenced above, which found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of the crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). As previously noted, the highest TSS concentration predicted for the MVP in a tributary to a CD stream was

159 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from the pipeline crossings analyzed in those studies. In short, the impact area defined above encompasses the stream reaches in which harm to CD from increased sedimentation/turbidity and from increased embeddedness is reasonably certain to occur.

Summary – The duration of all project-related effects on CD depend on the AMMs (e.g., FERC Plan [FERC 2013a], and Restoration and Rehabilitation Plan [Mountain Valley 2017]), which are anticipated to reduce surface water runoff and sedimentation, but not to insignificant levels (Mountain Valley 2020). The Restoration and Rehabilitation Plan states that herbaceous and woody seed mixes native to the area will be applied to the temporary construction ROW. Herbaceous seeds are assumed to take approximately 4 weeks to establish, 6 months to develop, and 1 year to become a maturing crop. A minimum of 6 tree species (bare-root saplings) and 4 shrub species will be planted at each stream crossing. We expect the effects from sedimentation and turbidity on food sources (benthic invertebrate community) will last up to 4 years (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). However, we do not expect that project-related sedimentation will render any currently suitable CD habitat permanently unsuitable. The effects of removal of streambank vegetation on sedimentation rates are expected to continue for 3-5 years as streamside vegetation develops to provide streambank stabilization (FERC 2017b). While implementation of AMMs is expected to significantly reduce the likelihood of injury or mortality and reduce adverse effects from habitat alteration, all impacts to CD will not be avoided or minimized.

In the short-term, the CD population within the action area will likely persist, but with decreased survival and reproductive rates due to increased physiological stress, decreased foraging efficiency, and decreased spawning success. In the long-term, these CD populations are expected to recover to previous abundances as stream conditions return to previous baseline levels following restoration of the action area.

Indiana bat (Ibat)

The potential effects of the proposed action are described in Appendix B Table 4. We did not reach a NE determination for Ibat for any of the subactivities. The subactivities determined to result in NLAA are listed in Appendix B Table 4 and will not be further discussed in this Opinion beyond the paragraphs set forth below.

Several subactivities had the potential to result in impacts to bats or alter their habitat through changes to baseline noise, lighting, air quality, and water quality conditions or alteration of hibernacula. As discussed in the Environmental Baseline section, for those subactivities, we anticipate no impacts to hibernating bats or hibernacula given the description of the proposed action and conservation measures. In addition, we have determined that impacts from project components that are completed after tree removal are unlikely to result in any discernible impacts to the Ibat (i.e., are not likely to adversely affect the Ibat). This is because the tree removal in areas of known or assumed use is already anticipated to result in changes in individual Ibat foraging, roosting, and travel behavior. Due to this displacement, bats are not likely to be exposed to consequences as a result of increased noise, lighting or dust within the areas of habitat removal. Additionally, conservation measures will further avoid and minimize potential impacts from noise, lighting, and dust. For example, during the active season, the project's construction hours do not overlap with the periods of highest bat activity.

Mountain Valley has committed to the following bat AMMs:

- If burning brush piles within 0.25 mile of known or assumed occupied hibernacula from August 15 to May 15, the brush piles would be no more than 25 ft by 25 ft, spaced at least 100 ft apart, and located at least 100 ft from known hibernacula entrances and associated sinkholes, fissures, or other karst features;
- No woody vegetation or spoil (e.g., soil, rock, etc.) disposal would occur within 100 ft of known or assumed occupied hibernacula entrances and associated sinkholes, fissures, or other karst features;
- Potential recharge areas of cave streams and other karst features that are hydrologically connected to known or assumed occupied hibernacula would be protected by employing relevant erosion control standards for stream and wetland crossings, as well as spill prevention, containment and control;
- Blasting within 0.5 mile of known or assumed occupied hibernacula would be conducted in a manner that would not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., maximum charge of 2 inches per second ground acceleration would avoid impact to nearby structures);
- Equipment servicing and maintenance areas would be sited at least 100 ft away from streambeds, sinkholes, fissures, or other karst features;
- Tree removal, limb trimming, or pruning will be conducted between November 15 and March 31 to avoid disturbance to bats, except in cases of human safety. If the seasonal restriction cannot be met, a qualified bat biologist will investigate the trees for presence of bats to avoid adverse effects (coordination with the Service will occur prior to this effort). In accordance with FERC's Upland Erosion Control, Revegetation, and Maintenance Plan, vegetation maintenance/removal will not be done more frequently than every 3 years (FERC 2013a);
- Instituting a 7:00 a.m. to 7:00 p.m. work day and utilizing "full cut-off" lighting fixtures to maximize shielding to prevent unintentional lighting of surrounding areas;
- Operators, employees, and contractors working in areas of known or presumed Ibat habitat would be educated on the biology of the Ibat, activities that may affect bat behavior, and ways to avoid and minimize these effects;
- Herbicides would not be used for vegetation management to maintain any portion of the MVP ROW or aboveground facilities, except as requested by a landowner and in the Jefferson National Forest as requested by the USFS;
- Aerial spraying will not be utilized for invasive species control along the ROW; and
- E&S control measures would be strictly implemented, any ground disturbance would be restored to pre-existing topographic contours, and restoration would use native vegetation (where possible), as specified in the Mountain Valley's Restoration and Rehabilitation Plan, upon completion of work within known or assumed occupied spring staging and fall swarming habitat.

No significant changes in water quality or invertebrate prey that would adversely affect Ibats are anticipated from earth work or wetland/stream crossings because erosion control measures will be applied throughout the project area to protect water quality and reduce sedimentation associated with wetland/stream crossings. Despite the E&S control measures, as detailed in the discussion of the Effects of the Action section on aquatic species, there have been and will be erosion and increased sedimentation from wetland/stream crossings and from upland sedimentation that have caused or will cause increased embeddedness as well as short-term declines in water quality and in aquatic insect populations in adjacent wetlands, ponds, and other waterbodies. However, since potential impacts from turbidity associated with sedimentation are expected to be localized, foraging bats are expected to have alternative adequate drinking water and foraging locations. The surrounding landscape will continue to provide an abundant prey base for both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential effects to Ibats from a reduction in water quality are anticipated to be insignificant.

Additionally, Mountain Valley (SBA Appendix G, Mountain Valley 2020) assessed the effects of noise and vibration impacts on known and assumed occupied Ibat hibernacula and concluded that adverse effects are not likely to occur, as described above in the Environmental Baseline section. The Service has reviewed the information included in the SBA related to noise and vibration impacts and we concur with Mountain Valley's determination.

Subactivities of the project that are LAA Ibat are listed in Appendix B Table 4 and include:

- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- Crossings, wetlands and other water bodies (non-riparian) – clearing
- Vegetation management – chainsaw, tree clearing, and tree side trimming
- General appurtenance and cathodic protection construction – off ROW clearing

For some components of the proposed action that are likely to affect Ibats, AMMs have been incorporated to reduce those effects to some degree and those are also noted below. The above subactivities, all of which involve tree removal, will temporarily or permanently remove a total of 3,462.76 acres of suitable known or unknown use habitat within 4 habitat categories. We expect the TOYRs (Table 27) to limit the amount of lethal impacts to Ibats from these subactivities, but will not eliminate the effects of habitat loss.

Table 27. Tree clearing by Ibat habitat category.

Habitat Category	TOYRs	Season/Months when Tree Clearing Occurred or will Occur
Known use summer habitat	Trees will be removed between November 15 and March 31, when Ibats will not be present, and potentially in April, August, and September	winter, April, August, September
Unknown use summer habitat	Trees will not be removed between June 1 and July 31, when young cannot fly	winter, April, May[a], August, September
Unknown use spring staging/fall swarming habitat	Trees will be removed between November 15 and March 31, and potentially in April, May, August, and September	winter, April, May, August, September
Known use spring staging/fall swarming habitat	Trees will be removed between November 15 and March 31, when Ibats will not be present	winter

[a]Approximately 0.31 acres of tree removal occurred in June 2018; no future tree removal is proposed during this time period.

Known and unknown use summer habitat – We expect effects to Ibats from tree clearing will occur in known and unknown use summer habitat. Approximately 2,325.14 acres (along 107.8 miles of construction ROW and 66.7 miles of AR) of known use summer habitat (390.18 acres) in WV and unknown use summer habitat (1,934.96 acres) in VA and WV has been or will be cleared. We anticipate tree clearing will impact individuals associated with 1 known and 3 unknown Ibat home ranges. However, not all 2,325.14 acres are expected to be occupied because, as discussed above, a maximum of 3 additional colonies are anticipated to occur within the action area; therefore, much of the "unknown use" habitat is unlikely to be occupied. In addition, Ibat home ranges are not linear, so it is likely that the 125-ft wide construction ROW may only displace Ibats from a portion of their home range, not their entire home range.

Tree removal in known use summer habitat (during the active season) – Effects from the loss of 390.18 acres of known use summer habitat within the 5-mile buffer of a documented maternity colony in Wetzel County, WV (Figure 14) are anticipated. Of the 390.18 acres, approximately 166.37 acres are associated with future tree removal to remediate existing slips (9.55 acres), trees down due to existing slips (10.14 acres), anticipated tree removal due to future slips (144.2 acres), acres already cleared through emergency Section 7 consultation (2.47 acres). The 2.47 acres for emergency Section 7 consultation were cleared during the active season. Mountain Valley has committed to avoid conducting any remaining tree removal (153.75 acres) activities, associated with future tree removal to remediate existing slips (9.55 acres) and anticipated tree removal due to future slips (144.2 acres) in this known use summer habitat, during the period of time when Ibat colonies are most concentrated and any pups are anticipated to be nonvolant (May – July). The majority of future tree removal activities within this known use area is expected to be conducted during the winter months while bats are in hibernation, which further reduces the likelihood of lethal impacts to bats.

Maternity colonies use a minimum of 10 to 20 trees per season, but only 1 to 3 of these are primary roosts used by the majority of bats for some or all of the summer (Callahan et al. 1997, Miller et al. 2002). Ibats have primary and secondary roosts and will shift between roosts every few days throughout the season (Humphrey et al. 1977, Gardner et al. 1991, Callahan 1993, Kurta et al. 1993, Romme et al. 1995). The MVP will not result in the removal of any known, documented maternity roosts, as none have been located within the action area. However, based on previous mist-net survey results (capture of a pregnant female in 2010) and potential roost tree surveys within these areas (ESI 2018c, ESI 2018d), we anticipate that there are undocumented roosting and foraging areas present within this known maternity colony (e.g., 5 potential roost trees were located within the 2.47 acres that were cleared for the emergency slip repair, all of which were potential secondary roost trees) (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 10, 2020). If an occupied roost tree is cut down, bats are known to either stay in the tree and be injured or killed (non-volant pups) upon felling, or will fly out (adults or volant pups) during felling (e.g., Belwood 2002). Daytime flights may make bats more susceptible to predation (e.g., by raptors). The risk of injury or death is greater for adults during cooler weather when bats periodically enter torpor and will be unable to arouse quickly enough to respond if the tree they are roosting in is felled. The likelihood of potential roost trees containing large number of tree roosting bats is greatest during pregnancy and lactation (April-July) (Barclay and Kurta 2007). Some tree removal (1.92 acres) occurred during a portion of this period (April), which may have included the felling of occupied roost trees. The remainder of the tree removal occurred when Ibat colonies were beginning to break up (smaller colony counts) and migrate back to their hibernacula (August). Moreover, no future tree removal within this habitat category (153.75 acres) will occur between May 1 and July 31.

Home ranges include roosting and foraging habitat, as well as travel areas between these habitats. Observed home ranges for individual Ibats associated with maternity colonies vary widely (205.1 to 827.8 acres) (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Jachowski et al. 2014, Kniowski and Gehrt 2014). Colonies have larger home ranges than individual bats with areas of overlapping core roosting/foraging areas and areas that do not overlap. A long-term study at the Indianapolis Airport estimated much larger home ranges (over 2,000 acres) for individual Ibats, with the overall home range (roosting and foraging) of the entire maternity colony being over 9,900 acres (Divoll and O'Keefe 2018). The colony in the Airport study occurs in a heavily fragmented landscape dominated by agriculture and development.

While home ranges are thousands of acres in size, core roosting areas are smaller than foraging areas, with roosts often clustered in space. Size of both foraging and core roosting areas likely varies depending on habitat quality. At a site in Michigan with a superabundance of suitable roosts, Kurta and Murray (2002) observed bats moving an average of 74 m between roosts. At a site with less abundant potential roosts, Kurta et al. (1996) observed bats moving an average of 686 m between roosts, ranging from 4 m to 5.8 km. On Fort Drum Military Installation, most roosts are found within approximately 2,200 acres (U.S. Army 2011). Two KY colonies with long-term tracking have roosting areas of approximately 2,400 to 3,200 acres (M. Armstrong, Service, email to R. Niver, Service, April 4, 2019). In most cases, the Service does not have sufficient information to map core roosting and foraging areas or documented travel routes for known maternity colonies. Therefore, the Service developed standard protocols[24] for mapping potential home ranges based on varying levels of existing data. The larger the individual project or the higher the frequency of smaller projects in a given area, the greater the likelihood of projects intersecting with home range components (e.g., roosting, foraging, or travel habitat), resulting in exposure of individual or multiple bats to stressors associated with the project.

The assumed home range for the known colony in Wetzel County, WV, consists of 50,248 acres, over 80% of which is currently forested. We lack information about where roosts or foraging areas are located for this colony. However, given that only 4 small areas were cleared (ranging in size from 0.04-1.40 acres), and the lack of potential primary roost trees within these areas (ESI 2018c, ESI 2018d), it is unreasonable to assume that the clearing (2.47 acres) associated with the emergency Section 7 consultation resulted in the loss of an undocumented maternity roost. However, the prior clearing in April and August, and all future tree removal conducted in April or August associated with slip repair, is expected to have resulted, or will result, in death of individuals and temporary reduced reproductive success for some females.

Tree removal and construction activities within this known use summer area during the active season may have resulted or will result in removal of portions of roosting and foraging areas. Clearing of the ROW results in new forest openings of 125-ft in width. Ibats can easily and routinely cross this size opening and continue to forage and roost in alternative suitable locations if they occur within their home ranges. However, the past/future tree clearing may have resulted,

[24] https://www.fws.gov/midwest/endangered/mammals/inba/pdf/inbaS7and10WindGuidanceFinal26Oct2011.pdf.

or will result, in actual removal of preferred roosts. In certain circumstances, pregnant females displaced from portions of preferred roosting/foraging areas may have to expend additional energy to search for alternative habitat, which would likely result in reduced reproductive success (failure to carry to full term or failure to raise pup to volancy) for some females. Females that do give birth may have pups with lower birth weights, and given the already increased energy demands associated with longer flights, some of these pups are likely to experience delayed development. These longer flights would also be experienced by pups once they become volant, which will likely affect the survival of some of these pups as they enter hibernation with potentially reduced fat reserves. Therefore, regardless of the timing of tree removal, impacts may occur to returning Ibats the following active season from the loss of preferred roosts and foraging areas. However, these kinds of effects are anticipated primarily in areas that are already fragmented or with limited suitable forest available. Given that the potential home range associated with this colony will remain more than 80% forested after tree clearing associated with this project has been completed, we anticipate that Ibats will locate new roosting/foraging areas with no effects or minimal effects to individuals.

In areas with WNS, there are additional energetic demands for Ibats. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Meteyer et al. 2009, Reichard and Kunz 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing. The effects described above will be greatest to WNS-affected bats returning to maternity areas while tree removal is occurring.

Thus far, the months of active season tree removal have been limited to April and August and only 2.47 acres of habitat has been removed during these months, and no tree clearing activities occurred from May 1 – July 31. Furthermore, MVP has committed to avoid conducting any remaining tree removal activities associated with future slip repair work in this known use summer habitat (153.75 acres total) during the May – July period. This significantly reduces the likelihood of lethal impacts to bats by avoiding the period when Ibat colonies are most concentrated (largest colony counts in fewer trees) and young bats cannot fly (May 1 – July 31).

In summary**,** it is possible that individual Ibats have been or will be injured or killed from active season clearing in this known maternity colony. We have no precise way to estimate how many individuals have been or will be injured or killed. If no Ibats are using the roosts at the time they are felled, then none will be injured or killed. If some Ibats are using the roosts at the time they are felled, then a portion of those bats may be injured or killed. The Service compiled a summary of accounts documenting the removal of occupied maternity roosts and used any relevant information to roughly estimate the number of individuals that have been or will be injured or killed from the felling of undocumented occupied roost trees within this habitat category. Each event had slightly different long-term impacts on the affected bats, but all resulted in mortality of adults and juveniles due to trauma from the fallen tree.

The first account led to the discovery of the first Ibat maternity colony in Indiana in 1971 when a dead elm (*Ulmus* sp.) tree containing a maternity colony was bulldozed on August 3 during a hedgerow clearing (Cope et al. 1973). Approximately 50 Ibats flew from the tree; 8 (16%) of these were either killed or injured allowing them to be captured (J. Whitaker, Indiana State University, pers. comm., 2005 from Service 2007). The 8 individuals were comprised of 2 adult females and 6 immature individuals (2 males, 4 females). Subsequent surveys in the vicinity of the lost roost indicated that the reproductive females were still foraging in the area, but a roost tree could not be located.

The second account occurred around September 8, 1984 in Knox County, IN (J. Whitaker, pers. comm., 2005). Eleven dead adult female Ibats were retrieved by a landowner when their roost, a shagbark hickory (*Carya ovata*), was felled in a pastured woodlot containing multiple dead trees. The 11 individuals were submitted for rabies testing to the state health department and subsequently sent to Indiana State University for positive identification by J. Whitaker. This event occurred outside the time when we anticipate colonies will be largest and overlaps with migration periods. In addition, there is no information available to assess the overall colony size and what proportion of the colony may have been impacted. Therefore, this study is not relevant to this project and was not considered further.

The third account occurred in OH. The first maternity colony of Ibats in OH was accidentally discovered on July 8, 1996, when a tree was felled to keep it from falling on a residence in a subdivision (Belwood 2002). Homeowners retrieved 34 individuals, 1 dead adult female, 3 dead non-volant juveniles, and 30 live non-volant juveniles. J. Belwood assisted the homeowners and placed live juveniles on the downed tree and in a nearby bat house. Overnight, adults retrieved the live juveniles; 2 additional non-volant juveniles died overnight. One adult female died out of a presumed 33 adult females based on 33 non-volant pups and 5 of the 33 observed non-volant pups died (total of 18% of Ibats were killed). A portion of the maternity colony (approximately 15 individuals) used a nearby tree later that same maternity season. However, the colony abandoned their maternity area for 3 years following the loss of their roost tree. Surveys during the fourth year after loss of the roost documented a low number of females (i.e., 2) present in the neighborhood.

Based on the accounts summarized above, an estimate of 7 to 15 individuals[25] (i.e., 16 to 18%[26]), depending on the size of the known maternity colony present during the active season (as noted above, we assume 20-40 adult females per colony and 1 pup per female), have been or will be injured or killed from the felling of undocumented occupied roost trees. However, as discussed above, there may be no bats roosting in the trees that are removed.

[25] Including all adult females and juveniles.
[26] This range is based on the numbers of total Ibats killed during occupied roost tree felling referenced in the accounts above for IN (16%) and OH (18%).

For the purposes of this analysis we will utilize the average of all of the values discussed above[27] and assume that 1 adult female and 9 pups (for a total of 10 individuals) have been or will be injured or killed from the felling of undocumented occupied roost trees (Table 28). This assumption represents an appropriate synthesis of the best available data and allows for an adequate assessment of the effects of the project for purposes of the jeopardy analysis.

Tree removal in known use summer habitat (outside of the active season) – Effects to Ibats from the loss of 223.82 acres of suitable habitat (all of which has already been cleared) spread across 10.3 miles of pipeline, ARs and ATWS are anticipated, plus an additional 153.75 acres that may need to be removed to address future repair work associated with landslides, and that is likely to removed outside of the active season based on Mountain Valley's commitment to do so whenever possible. However, the potential injury or death of Ibats from the removal of the additional 153.75 acres is discussed in the preceding section (*Tree removal in known use summer habitat - during the active season*) as it could happen during the active season (excluding May-July). Tree removal in known use summer habitat during the winter is likely to alter roosting, foraging, and travel habitat. This will result in displaced Ibats expending additional energy seeking alternate roosts, foraging areas, and travel corridors when they return the following season. The MVP will not result in the removal of any known documented maternity roosts. However, based on previous mist-net survey results (capture of a pregnant female in 2010), we anticipate that there are undocumented roost trees within this known use area. In the previously-disturbed areas within this habitat category, 413 potential roost trees were located, of which 74 were potential primary trees and 339 were potential secondary trees.

As discussed, one area of known use summer habitat in WV will be crossed by the MVP. Therefore, primary roosts or multiple alternate roosts have been or may be removed. Ibats have primary and secondary roosts and will shift between sites during a season (Humphrey et al. 1977, Gardner et al. 1991, Callahan 1993, Kurta et al. 1993, Romme et al. 1995). Roost trees, although ephemeral in nature, are known to be occupied by a colony for a number of years until the roost trees are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Although loss of a roost (e.g., blowdown, bark loss) is a natural phenomenon that Ibats have adapted to, the loss of multiple roosts may stress individual bats, affect reproductive success, or impact the social structure of a colony (Service 2007b). Removal of an Ibat primary roost tree (that is still suitable for roosting) in winter can result in disruption of maternity colony cohesion and temporary or permanent colony fragmentation. Smaller colonies may be expected to provide less thermoregulatory benefits for adults and non-volant pups in cool spring temperatures. Also, removal of a primary roost may result in increased energy expenditures for affected bats. Female bats have tight energy budgets, and in the spring

[27] As explained in the Environmental Baseline section, because we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 20-40 adult female bats per colony and 1 pup per female. For purposes of this analysis we are utilizing the average (i.e., 30 adults + 30 pups = 60 total bats per colony). We then used the average (i.e., 17%) of the number of total Ibats killed during occupied roost tree felling referenced in the accounts for IN (16%) and OH (18%). 60 total bats x 17% = 10.2 total bats. Rounded to the nearest whole individual = 10 total bats. In the summary of accounts documenting the removal of occupied maternity roosts, at least 1 adult female bat was killed or injured in each instance. Therefore, we are assuming the total of 10 bats is comprised of 1 adult female and 9 pups.

need to have sufficient energy to keep warm, forage, and sustain pregnancies. Increased flight distances or smaller colonies may result in a portion of bats present within the colony having reduced breeding success. Removal of multiple alternate roost trees in winter may also result in similar effects.

For the MVP, there is no way to verify whether any of the previously-documented potential roost trees in the previously-cleared areas were in fact used by Ibats prior to clearing. However, even if some of those roost trees were so utilized, because there is substantial roosting habitat remaining in the action area, we expect the majority of Ibats that previously used the roost trees will relocate roosting areas with no effects or minimal effects to individuals.

In addition to impacts to roosting habitat, we anticipate some areas in this habitat category cleared during the winter are currently used as travel corridors, and/or foraging areas and that effects will be greatest to pregnant females that expend additional energy to seek alternate travel corridors or foraging areas as a result of tree clearing. However, as discussed above, this kind of effect is anticipated primarily in areas that are already fragmented or with limited suitable forest available. Given that the potential home range associated with this colony will remain more than 80% forested after tree clearing associated with this project has been completed, we anticipate that Ibats will locate new travel corridors/foraging areas with no effects or minimal effects to individuals. We expect the extent of effects from the removal of travel corridors and foraging areas may range from no effect to temporary reduced reproductive fitness.

In summary, it is likely that individual Ibats have been or will be harmed from inactive season clearing of roosting habitat in this known colony. We anticipate that effects of tree removal in known use summer habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We have no precise way to estimate how many individuals have been or will be harmed. Above, we discussed that lethal effects from tree-clearing during the active season are anticipated to up to 1 adult female and 9 pups. Comparatively, the effects from the removal of trees while bats are hibernating is lower in magnitude (nonlethal) than those experienced by bats present during the active season, and these effects will only be experienced by adult females. Because we expect the impacts to be less, we assume that no more than 1 adult female will be harmed as a result of this clearing in this known use summer habitat outside of the active season (Table 28). Adverse effects that occur to this individual are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until the individual acclimates to the altered landscape and establishes new foraging and roosting areas.

Tree removal in unknown use summer habitat (during the active season) – Tree removal in unknown use summer habitat during the active season (April, May, August, and September) is expected to affect Ibats using undocumented occupied roosts and Ibat foraging areas within 3 unknown maternity colony home ranges. We expect the same types and extent of effects will occur from tree removal during the active season in unknown use summer habitat as those described above for known use summer habitat. Of the 1,559.29 acres that were previously cleared during the active season no trees were removed between June 1 and July 31, when young cannot fly.

Mountain Valley has committed to avoid all future tree removal associated with slip repairs in unknown use summer habitat (106.38 acres) during the time when bat colonies are most concentrated (May – July). These AMMs are expected to minimize effects from loss of undocumented occupied roosts. In summary, as discussed above, an estimate of 17% of individuals of the known maternity colony present during the active season (we assume 30 adult females per colony and 1 pup per female), have been or will be injured or killed from the felling of undocumented occupied roost trees during the active season. However, as discussed above, there may be no bats roosting in the trees that are removed.

For the purposes of this analysis, and consistent with our analysis of active tree clearing in known summer use habitat, we utilize the average of all of the values discussed above and assume that 1 adult female and 9 pups (for a total of 10 individuals per colony) have been or will be injured or killed from the felling of undocumented occupied roost trees during the active season (Table 28).

Nonjurisdictional facilities – An additional 1.33 acres of unknown use summer habitat will be removed for NJF. These acres represent 6 facilities in WV and range from 0.06 - 0.58 acres removed per facility (Appendix G). A reasonable worst case scenario is the trees will be removed during the active season. The additional 1.33 acres added to the total acreage to be cleared for MVP (1,934.96 acres) results in a total of 1,936.29 acres cleared in this habitat category. The estimated number of Ibats to be affected does not change when the additional acreage is incorporated into the calculations, as detailed below. Therefore, the estimated number of maternity colonies (3) to be affected does not change. We do not anticipate any additional adverse effects other than those described above for known use summer habitat.

The calculations are as follows:

- Acres removed/average tree removal per projects tracked by the Service = number of surveys MVP would have represented
- Capture ratio x number of surveys MVP would have represented = estimated number of Ibats.
- Colony ratio x estimated number of Ibats = number of colonies affected
- Calculation of total acreage to be cleared for MVP: 1,934.93/16.93 = 114.29
- 0.299 x 114.29 = 34 Ibats
- Calculation with NJF acreage added: 1,936.29/16.93 = 114.37
- 0.299 x 114.37 = 34.2, rounded to 34 Ibats
- 0.09 x 34 = 3.06, rounded to 3 colonies

Tree removal in unknown use summer habitat (outside of the active season) – Approximately 269.29 acres of unknown use summer habitat were removed during the winter. We expect the same types and extent of effects will occur from tree removal outside the active season in unknown use summer habitat as those described above for known use summer habitat. We assume 20-40 adult females make up each of the unknown maternity colonies. Above, we discussed that lethal effects are anticipated to up to 1 adult female and 9 pups. Comparatively, the effects from the removal of trees while bats are hibernating is lower in magnitude (nonlethal) than those experienced by bats present during the active season, and these effects will only be experienced by adult females. Because we expect the impacts to be less, we conclude that no more than 1 adult female[28] per colony (as discussed above), and thus 3 total, may be harmed as a result of tree removal in these areas (Table 28). The adverse effects to individuals are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until Ibats acclimate to the altered landscape and establish new foraging and roosting areas.

Known and unknown use spring staging/fall swarming habitat – We expect effects to Ibats from tree clearing will occur in known and unknown use spring staging/fall swarming habitat. Approximately 1,137.62 acres (59.8 miles of construction ROW and 39.7 miles of AR) of known use spring staging/fall swarming habitat (308.97 acres) and unknown use spring staging/fall swarming habitat (828.65 acres) in VA and WV have been or will be cleared. We anticipate tree clearing will impact individuals associated with 2 known and 10 assumed occupied Ibat hibernacula; however, not all 1,137.62 acres are likely to be occupied because this acreage is based on 69 potential hibernacula and we only estimate 10 of these are actually occupied. In addition, Ibat foraging areas are not linear, so it is likely that the 125-ft wide construction ROW will only displace Ibats from a small portion of their spring staging/fall swarming habitat.

Tree removal in known use spring staging/fall swarming habitat (outside of the active season)[29] – Effects to Ibats from the loss of 308.97 acres of suitable habitat are anticipated. Approximately 131.43 acres of suitable habitat was removed around Tawney's Cave in VA and 176.76 acres was removed around Greenville Saltpeter Cave in WV. The maximum amount of habitat available within 5 miles of any given hibernacula is 50,265.6 acres. Approximately 36,512.5 acres surrounding Tawney's Cave, and 38,653.79 acres surrounding Greenville Saltpeter Cave, is considered suitable spring staging/fall swarming habitat. These habitat impacts represent 0.36% and 0.46% of available spring staging/fall swarming habitat for Tawney's Cave and Greenville Saltpeter Cave, respectively. Tree removal in known use spring staging/fall swarming habitat during the winter will remove foraging and roosting areas for a concentrated number of Ibats during spring emergence or fall swarming. Bats use the area around hibernacula to build fat reserves prior to hibernation and to socialize and mate in the fall. In the spring, bats spend a few hours or days around hibernacula or migrate immediately to summer habitat. Clearing trees around hibernacula may decrease foraging and roosting habitat. Depending on the amount and location of removal, this may require bats to spend more time searching for food, which could result in bats entering hibernation with less fat reserves resulting in decreased overwinter survival or poorer spring body condition or result in less time on social interactions, which could result in decreased breeding success.

The spring emergence period (April through May) is also a sensitive time period for bats in general, but increasingly so for WNS-affected bats that do not die during hibernation and may be weakened by the effects of the disease and may have reduced fat reserves and damage to wing membranes. WNS-affected bats may have difficulty flying and may be less likely to survive long-distance migrations to summer areas. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer time period following

[28] No pups are present during this time of year.
[29] No tree removal in known use spring staging/fall swarming habitat has occurred or is expected to occur during the active spring staging or fall swarming seasons.

spring emergence. We anticipate that any effects incurred will be greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred.

All tree removal activities within this habitat category have been/will be completed during the winter months (when bats were not present) and no impacts to Ibat hibernacula or hibernating bats were documented or are anticipated to have occurred for the reasons stated in the Environmental Baseline section. However, tree clearing within these areas resulted in temporary and permanent habitat loss. As stated above, depending on the amount and location of removal, bats may need to spend more time searching for food, which could result in bats entering hibernation with less fat reserves resulting in decreased overwinter survival or poorer spring body condition or result in less time on social interactions, which could result in decreased breeding success. In this case, however, the tree removal is linear in nature with a maximum width of 125-ft of clearing and represents 0.36% - 0.45% of available spring staging/fall swarming habitat around the known hibernacula. The closest clearing is approximately 0.04 miles from the entrance of Tawney's Cave in VA. Therefore we do not expect reduced overwinter survival and only anticipate temporary, sublethal effects to WNS-affected bats emerging in the spring.

In summary, it is likely that individual Ibats have been or will be harmed from inactive season clearing in these known use spring staging/fall swarming areas. We anticipate that effects of tree removal in known use spring staging/fall swarming habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We anticipate that any effects incurred will be greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred. We have no precise way to estimate how many individuals have been or will be harmed. However, using the information discussed above in the Environmental Baseline section, we estimate that 0-8 adults associated with each known hibernacula may be harmed as a result of tree removal in these areas. If we assume a 50:50 sex ratio, then there are up to 4 adult females within each hibernacula. If all 4 adult females are reproductively active, they will disperse to their associated maternity colonies and experience temporary sublethal impacts (i.e., temporary reduced breeding success) (Table 28). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Nonjurisdictional facilities – An additional 0.35 acre of known use spring staging/fall swarming habitat will be removed for NJF. These acres represent 1 NJF in Giles County, VA (Appendix G). Because tree removal will occur around a documented hibernaculum and the Service typically recommends a TOYR in these buffers, a reasonable worst case scenario is the trees will be removed during the inactive season. The additional 0.35 acres added to the total acreage to be cleared for MVP (308.97 acres) results in a total of 309.32 acres in this habitat category and represents the same known hibernacula in VA (Tawney's Cave), which increases the acres removed around Tawney's Cave from 131.43 to 131.78. The total habitat impacts still represent 0.36% of available spring staging/fall swarming habitat for Tawney's Cave, which is the same amount as described above for only MVP. We do not anticipate additional adverse effects from tree clearing for NJF other than those described above for known use spring staging/fall swarming habitat.

Tree removal in unknown use spring staging/fall swarming habitat (during the active season) – Effects from the loss of 828.65 acres of suitable habitat are anticipated. Tree removal in unknown use spring staging/fall swarming habitat during the active season (April, May, and September) will disrupt bats engaging in fall swarming, spring staging, and roosting behavior. Bats could be killed, injured, or forced to flee if an occupied roost tree is cut. During spring staging/fall swarming, bats often roost individually rather than in groups, typically have numerous suitable day-roosts available, and frequently roost-switch. Therefore, there is less potential to affect a tree being used by multiple bats or a large bat colony, and effects are likely restricted to smaller groups of bats or individual bats. We expect the same types and extent of effects will occur from tree removal during the active season in unknown use spring staging/fall swarming habitat as those described for known use summer habitat above.

Approximately 0.31 acres was removed in June 2018 (emergence surveys were performed on all suitable roosts within this area prior to removal and no bats were documented). The emergence surveys are expected to have minimized effects from loss of undocumented occupied roosts.

In this habitat category, 580.43 acres may be removed during the active season, however no future tree removal will occur between May 1 and July 31. As discussed above, we anticipate tree clearing will impact individuals associated with 10 assumed occupied Ibat hibernacula; however, not all 580.43 acres are likely to be occupied because this acreage is based on 69 potential hibernacula and we only estimate 10 of these are actually occupied. We estimate 0 to 8 individual Ibats are using each of the 10 assumed occupied hibernacula and the surrounding spring staging/fall swarming habitat. It is possible that individual Ibats have been or will be injured or killed from active season clearing in these areas. We have no precise way to estimate how many individuals have been or will be injured or killed. If no Ibats are using the roosts at the time they are felled, then none will be injured or killed. If some Ibats are using the roosts at the time they are felled, then a portion of those bats may be injured or killed. As discussed above (see footnote 27), we are assuming that 1 adult female bat present in roosts that are felled has been or will be killed. For the purposes of our analyses, we will assume that 1 individual will be injured or killed per hibernacula (Table 28).

Nonjurisdictional facilities – An additional 4.41 acres of unknown use spring staging/fall swarming habitat will be removed for NJF. These acres represent 6 facilities in 4 counties in WV and VA and range from 0.01 - 1.30 acres removed per facility (Appendix G). Because tree removal will occur around unknown hibernacula, a reasonable worst case scenario is the trees will be removed during the active season. The additional 4.41 acres added to the total acreage to be cleared for MVP (580.43 acres) results in a total of 584.84 acres in this habitat category. The amount of tree clearing for this habitat category from NJF is a 0.75% increase and therefore we maintain our assumptions stated above and do not anticipate any additional adverse effects other than those described above.

Tree removal in unknown use spring staging/fall swarming habitat (outside of the active season) – Approximately 248.20 acres of unknown use spring staging/fall swarming habitat was removed during the winter. We expect the same types and extent of effects will occur from tree removal outside the active season in unknown use spring staging/fall swarming habitat as those described above for known use spring staging/fall swarming habitat. We have no precise way to estimate how many individuals were harmed as a result of this tree clearing. However, using the information discussed above in the Environmental Baseline section, we estimate that 0-8 adults associated with each assumed occupied hibernacula may be harmed as a result of tree removal in these areas. If we assume a 50:50 sex ratio, then there are up to 4 adult females within each hibernacula. If all 4 adult females are reproductively active, they will disperse to their associated maternity colonies and experience sublethal impacts (i.e., reduced breeding success) (Table 28). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Table 28 identifies the acreage of each habitat type that will be cleared and the corresponding number of individual bats that have been or will be affected by the project.

Table 28. Acreage of each Ibat habitat type that has been or will be cleared for MVP and NJF and the corresponding number of individual bats that have been or will be affected.

Habitat Type	Acreage Cleared MVP	Acreage Cleared NJF	Associated Colonies or Hibernacula	Number of Adult Female Ibats Affected	Number of Ibat Pups Affected	Types of Effects Anticipated
Known use summer (active season)	166.36	0	1 known maternity colony	1	9	Injury or death
Known use summer (inactive season)	223.82	0	(Same colony as above)	1	N/A	Reduced breeding success
Known use summer (total)	390.18	0	1 known maternity colony	2	9	See above
Unknown use summer (active season)	1,665.67	1.33	3 unknown maternity colonies	3 (1 per colony)	27 (9 per colony)	Injury or death
Unknown use summer (inactive season)	269.29	0	(Same 3 colonies as above)	3 (1 per colony)	N/A	Reduced breeding success
Unknown use summer (total)	1,934.96	1.33	3 unknown maternity colonies	6	27	See above
Known use spring staging/fall swarming (inactive season)	308.97	.35	2 known hibernacula	8 (4 per hibernacula)	N/A	Reduced breeding success
Known use spring staging/fall swarming (total)	309.32	.35	2 known hibernacula	8	N/A	See above
Unknown use spring staging/fall swarming (active)	580.43	4.41	10 assumed occupied hibernacula	10 (1 per hibernacula)	N/A	Injury or death
Unknown use spring staging/fall swarming (inactive)	248.20	0	(Same 10 hibernacula as above)	40 (4 per hibernacula)	N/A	Reduced breeding success
Unknown use spring staging/fall swarming (total)	828.63	4.41	10 assumed occupied hibernacula	50	N/A	See above

Conservation Action – To ameliorate effects to Ibats within unknown use spring staging/fall swarming habitat, a 121-acre property was acquired by Mountain Valley in Braxton County, WV. The parcel contains mature, upland deciduous forest dominated by mostly oak, hickory, and red maple (*Acer rubrum*). There are numerous travel/foraging corridors and snags for bats throughout the property. Approximately 860 ft of the construction ROW crosses the eastern portion of the property. After project completion, approximately 106 acres will remain as interior forest and will be maintained as such in perpetuity. Protection of this property may provide habitat, immediately adjacent to the project area, for bats displaced during construction activities. Due to the property's proximity to the construction ROW, displaced bats will only need to travel a short distance to locate alternative spring staging/fall swarming habitat. It is anticipated that the availability and protection of this property may reduce adverse effects on returning bats; however, bats have not been detected on this property as of the date of this Opinion.

As Table 28, indicates, the majority of tree removal activities associated with the MVP, as well as the effects associated with those activities, have been completed and/or already occurred. However, tree removal activities associated with future slip repairs, existing slip remediation, and variance requests remains (Table 29). The associated tree removal is incorporated in the effects discussion and subsequent analysis above and is included in the acreage figures in Table 28.

Table 29. Ibat forested habitat categories with remaining tree removal (M. Hoover, Mountain Valley, email to T. Lennon, Service, June 30, 2020).

Habitat Category	Acres of Tree Removal			
	Future Slips	**Variance Requests**	**Existing Slip Remediation**	**Total**
Known use spring staging/fall swarming habitat	0	0.78	0	0.78
Unknown use spring staging/fall swarming habitat	0	1.50	0.12	1.62[a]
Known us summer habitat	144.20	0	9.55	153.75
Unknown use summer habitat	90.48	4.85	11.05	106.38

[a]An additional 1.50 acres and 0.24 acres in unknown use spring staging/fall swarming habitat remains to be cleared due to occupancy by protestors and vacatur of Mountain Valley's Corps authorization, respectively.

Northern long-eared bat (NLEB)

The potential effects of the proposed action are described in Appendix B Table 5. The only effects analyzed are: (1) those that have the potential to result in the incidental take of NLEBs in hibernacula; (2) those that have the potential to result in the incidental take of NLEBs by altering a known hibernaculum's entrance or interior environment if the alteration impairs an essential behavioral pattern, including sheltering NLEBs; or (3) tree-removal activities that have the potential to result in the incidental take of NLEBs when the activity either occurs within 0.25 mile (0.4 km) of a known hibernaculum, or cuts or destroys known, occupied maternity roost trees or any other trees within a 150-ft (45-m) radius from the maternity roost tree during the pup season (June 1 through July 31). We did not reach a NE determination for NLEB for any of the subactivities. As discussed above in the Status of the Species within the Action Area section, other forms of adverse effects to individual NLEB are accounted for in the BiOp on the Section 4(d) rule.

The subactivities that we determined are NLAA NLEB are described in Appendix B Table 5 and will not be further discussed in this Opinion beyond the paragraphs set forth below.

Several subactivities had the potential to result in impacts to bats or alter their habitat through changes to baseline noise, lighting, air quality, and water quality conditions or alteration of hibernacula. As discussed in the Environmental Baseline section, for those subactivities we anticipate no impacts to hibernating bats or hibernacula given the description of the proposed action and AMMs. In addition, we have determined that impacts from project components that are completed after tree removal are unlikely to result in any discernible impacts to the NLEB (i.e., are NLAA the NLEB). This is because the tree removal in areas of known use is already anticipated to result in changes in individual NLEB foraging, roosting, and travel behavior. Due to this displacement, bats are not likely to be exposed to consequences as a result of increased noise, lighting, or dust within the areas of habitat removal. In addition, AMMs will further avoid and minimize potential impacts from noise, lighting, and dust. For example, during the active season, the project's construction hours do not overlap with the periods of highest bat activity.

Mountain Valley has committed to the following impact AMMs:

- If burning brush piles within 0.25 mile of known or presumed occupied hibernacula from August 15 to May 15, the brush piles would be no more than 25 ft by 25 ft, spaced at least 100 ft apart, and located at least 100 ft from known hibernacula entrances and associated sinkholes, fissures, or other karst features;
- No woody vegetation or spoil (e.g., soil, rock, etc.) disposal would occur within 100 ft of known or presumed occupied hibernacula entrances and associated sinkholes, fissures, or other karst features;
- Potential recharge areas of cave streams and other karst features that are hydrologically connected to known or presumed occupied hibernacula would be protected by employing relevant erosion control standards for stream and wetland crossings, as well as spill prevention, containment and control;
- Blasting within 0.5 mile of known or presumed occupied hibernacula would be conducted in a manner that would not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., maximum charge of 2 inches per second ground acceleration would avoid impact to nearby structures);
- Equipment servicing and maintenance areas would be sited at least 100 ft away from streambeds, sinkholes, fissures, or other karst features;
- Operators, employees, and contractors working in areas of known or presumed Ibat habitat would be educated on the biology of the Ibat, activities that may affect bat behavior, and ways to avoid and minimize these effects;
- Herbicides would not be used for vegetation management to maintain any portion of the MVP ROW or aboveground facilities, except as requested by a landowner and in the Jefferson National Forest as requested by the USFS; and
- E&S control measures would be strictly implemented, any ground disturbance would be restored to pre-existing topographic contours, and restoration would use native vegetation (where possible), as specified in the Mountain Valley's Restoration and Rehabilitation Plan, upon completion of work within known or presumed occupied spring staging and fall swarming habitat.

No significant changes in water quality or invertebrate prey that would adversely affect NLEB are anticipated from earth work or wetland/stream crossings because E&S control measures will be applied throughout the project area to protect water quality and reduce sedimentation associated with wetland/stream crossings. Despite the E&S control measures, and as detailed in the discussion of the effects of the action on aquatic species, there have been and will be erosion and sedimentation from stream crossing and from upland sedimentation that have caused or will cause increased embeddedness as well as short-term declines in water quality and in aquatic insect populations in adjacent wetlands, ponds, and other water bodies. However, since potential impacts from turbidity associated with sedimentation are expected to be localized, foraging bats are expected to have alternative adequate drinking water and foraging locations. The surrounding landscape will continue to provide an abundant prey base for both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential effects to NLEB from a reduction in water quality are anticipated to be insignificant.

Additionally, Mountain Valley assessed the effects of noise and vibration impacts on Ibats hibernacula which would also be applicable to NLEB and came to the conclusion that adverse effects are not likely (Mountain Valley 2020 SBA Appendix G). The Service has independently reviewed the information included in the SBA related to noise and vibration impacts and we concur with Mountain Valley's determination.

There are other subactivities of the project that are LAA NLEB and have not been addressed in the Service's January 5, 2016 programmatic BiOp implementing the 4(d) rule. These LAA subactivities are listed in Appendix B Table 5 and include:

- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- Crossings, wetlands and other water bodies (non-riparian) – clearing
- Vegetation management – chainsaw, tree clearing, and tree side trimming
- General appurtenance and cathodic protection construction – off ROW clearing

Each of these subactivities involves tree clearing within 0.25 mile of hibernacula: Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1. For some components of the proposed action that are likely to affect NLEB, AMMs have been incorporated to reduce those effects to some degree and those are also noted below.

For context, 429.95 acres of tree removal has occurred or is proposed within 5 miles (anticipated spring staging/fall swarming range) of Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1 (Table 30). Any impacts within the 5 miles but outside of the 0.25 mile-buffers around these hibernacula are not prohibited and are covered by the BiOp on the 4(d) rule.

Table 30. Tree removal within 5 miles of NLEB hibernacula[a].

Feature	Acres of Tree Removal	
	Within 5 miles	Within 0.25 mile[30]
Canoe Cave	63.38[b]	0.51
Overlap area within both Canoe and Tawney's Caves	92.73	N/A
Tawney's Cave	38.68[b]	2.70
PS-WV3-Y-P1	235.15	12.43
Total	429.95c	15.64

[a]M. Stahl, EQT, email to S. Hoskin, Service, October 30, 2017; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, August 17, 2020.
[b]Minus 97.4 acres of overlap within 5 miles of both Canoe and Tawney's Caves.
cThe total acreage in this column is 0.01 acre larger than the sum of the individual acreages due to rounding.

Hibernating Bats/Hibernacula – All tree removal within 0.25 miles of the known hibernacula occurred in March 2018 (Mountain Valley 2020). No impacts to NLEB hibernacula or hibernating bats were documented and none are expected to have occurred for the reasons outlined in Mountain Valley's SBA (Mountain Valley 2020, pp. 108-110, 111-112). The Service has independently reviewed the information included in the SBA related to tree removal within 0.25 miles of the known hibernacula and we concur with Mountain Valley's determination.

Spring Staging/Fall Swarming – Based on 2016 NLCD, within 0.25 miles of Canoe Cave, Tawney's Cave, and portal PS-WV3-Y-1, there are approximately 91.1, 80.6, and 104.5 acres of forest, respectively. The project has resulted in the removal of 0.51, 2.70, and 12.43 acres or forest within 0.25 miles of Canoe Cave, Tawney's Cave, and PO-WV3-Y-P1, or 0.56%, 3.3%, and 11.9% of available forest within this buffer, respectively. Although this tree-clearing has occurred outside of the active spring staging season (April-May), tree removal in known use spring staging/fall swarming habitat during the winter removes foraging and roosting areas for a concentrated number of NLEBs during spring emergence or fall swarming. Bats use the area around hibernacula to build fat reserves prior to hibernation and to socialize and mate in the fall. In the spring, bats spend a few hours or days around hibernacula or migrate immediately to summer habitat. Clearing trees around hibernacula may decrease foraging and roosting habitat. The spring emergence period (April through May) is also a sensitive time period for bats in general, but increasingly so for WNS-affected bats that do not die during hibernation and may be weakened by the effects of the disease and may have reduced fat reserves and damage to wing membranes. WNS-affected bats may have difficulty flying and may be less likely to survive long-distance migrations to summer areas. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer time period following spring emergence.

Tree clearing within these areas results in temporary and permanent habitat loss. In certain circumstances, depending on the amount and location of removal, bats may need to spend more time searching for food, which could result in bats entering hibernation with less fat reserves

[30] Mountain Valley 2020.

resulting in decreased overwinter survival or poorer spring body condition or result in less time on social interactions, which could result in decreased breeding success. In this case, tree removal represents 0.5-11.9% of the 0.25-mile buffer habitat around each of the 3 hibernacula. However, we are focusing our analysis on a small area directly located around the hibernacula, while in reality, NLEB are anticipated to be using a much larger area as part of their spring staging and fall swarming habitat (up to 5 miles around the hibernaculum). For example, there are approximately 36,512.5 acres of forest within 5 miles of Tawney's Cave and the removal of 2.70 acres represents 0.007% loss of available spring staging/fall swarming habitat. In addition, the tree removal is linear in nature with a maximum width of 125-ft of clearing. Therefore we do not expect reduced overwinter survival and only anticipate temporary, sublethal effects to WNS-affected bats emerging in the spring.

In summary, therefore, it is possible that individual NLEBs have been harmed from inactive season clearing in these known use spring staging/fall swarming areas. This is most likely around PS-WV3-Y-P1, with the greatest amount of tree clearing. We anticipate that effects of tree removal in known use spring staging/fall swarming habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We anticipate that any effects incurred were greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred. We have no precise way to estimate how many individuals have been harmed. The maximum amount of clearing within 0.25 miles of these hibernacula is 12.43 acres with the other hibernacula each having 0.51 acres and 2.70 acres of removal. As discussed in the Environmental Baseline section, up to 17 NLEB may be overwintering in each hibernacula. Given the relatively small quantity of tree removal around each hibernacula, we expect that for individuals that are affected, the likely effects will be temporary and sublethal. If we assume a 50:50 sex ratio of hibernating NLEB (Whitaker and Rissler 1992), then there are up to 9 adult females within each hibernacula. If all 9 adult females are reproductively active, they will disperse to their associated maternity colonies and experience sublethal impacts (i.e., temporary reduced pregnancy success). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Summer Habitat within 0.25 Miles of Hibernacula – NLEBs may have summer maternity colonies around Canoe Cave, Tawney's Cave, or PS-WV3-Y-P1. This is unlikely around Canoe Cave and Tawney's Cave in VA given that only 1 NLEB was captured during the entire netting effort in that state for the project. However, this is likely around PS-WV3-Y-P1, as a juvenile male (Bat 791) was captured near this hibernaculum in 2015. Consequently, the discussion below addresses the effects of clearing 12.43 acres of summer habitat (which has already been cleared) within 0.25 miles of PS-WV3-Y-P1.

Tree removal in known use summer habitat during the winter may alter roosting, foraging, and travel habitat. The MVP will not result in the removal of any known documented maternity roosts or foraging areas. However, we anticipate that there are undocumented roost trees or foraging habitat within this known use area. NLEBs will avoid the permanently cleared areas and start exploring undisturbed areas for future roost sites. Any direct effects to NLEBs from tree removal were avoided because of winter tree removal. However, similar to Ibats, effects to

NLEBs may occur even if maternity roost trees are cleared during the hibernation period. Johnson et al. (2012) found that NLEBs form social groups among networks of roost trees that are often centered around a central-node roost. Central-node roost trees may be similar to Ibat primary roost trees (locations for information exchange, thermal buffering) but they were identified by the degree of connectivity with other roost trees rather than by the number of individuals using the tree (Johnson et al. 2012). NLEBs form smaller social groups within a maternity colony and exhibit nonrandom roosting behaviors, with some female NLEBs roosting more frequently together than with others (Garroway and Broders 2007, Patriquin et al. 2010, Johnson et al. 2012).

Similar to Ibats, NLEBs exhibit fidelity to the general summer maternity area (Foster and Kurta 1999, Jackson 2004, Johnson et al. 2009, Patriquin et al. 2010, Perry 2011, Broders et al. 2013). Roost trees, although ephemeral in nature, may be used by a colony for a number of years until they are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Some trees have shorter life expectancy as a roost than others (e.g., living shagbark hickories can provide suitable roosts for Ibat for decades while elm snags may lose their bark within a few years). Although loss of a roost (e.g., blow down, bark loss) is a natural phenomenon that NLEBs must deal with regularly, the loss of multiple roosts, which could comprise most or all of a home range, likely stresses individual bats, affects reproductive success, and impacts the social structure of a colony.

NLEBs are flexible in their tree species roost selection and roost trees are an ephemeral resource; therefore, the species would be expected to tolerate some loss of roosts provided suitable alternative roosts are available. Silvis et al. (2014) modeled the effects of roost-loss on NLEBs and then Silvis et al. (2015) actually removed known NLEB roosts during the winter to investigate the effects. Once removals exceeded 20–30% of documented roosts (ample similar roosts remained), a single maternity colony network started showing patterns of break-up. Sociality is believed to increase reproductive success (Silvis et al. 2014) and smaller colonies would be expected to have reduced reproductive success. Similar to the Ibat discussion, smaller colonies would be expected to provide less thermoregulatory benefits for adults in cool spring temperatures and for non-volant pups. Female bats have tight energy budgets, and in the spring need to have sufficient energy to keep warm, forage, and sustain pregnancies. Increased flight distances or smaller colonies are expected to result in a portion of bats present within the colony having reduced breeding success. In this case, removal of multiple alternate roost trees in winter could result in similar effects. However, 89% of the forested acres within 0.25 miles of PS-WV3-P1 will remain after tree-clearing. Because there is substantial roosting habitat remaining in the area, and we expect the majority of NLEBs will relocate roosting areas with no to minimal effects to individuals.

In addition to potential disruption of colony networks (Silvis et al. 2015), removal of roosting and/or foraging habitat can result in longer flights for NLEBs to find alternative suitable habitat. NLEBs emerge from hibernation with their lowest fat reserves and return to their summer home ranges where they are familiar with roosting and foraging areas. Since NLEBs have summer home range fidelity (Foster and Kurta 1999, Patriquin et al. 2010, Broders et al. 2013), loss or alteration of forest habitat, depending upon the extent and proximity to roosting trees, can put additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy). Hibernation and reproduction are the most energy-demanding periods for temperate-zone bats like the NLEB (Broders et al. 2013). Further, flight is an energy-demanding mode of transportation (particularly for pregnant females). Bats may reduce costs of searching for food by concentrating their foraging in areas of known high profitability, a benefit that could result from local knowledge and site fidelity (Broders et al. 2013). Cool spring temperatures provide an additional energetic demand as bats need to stay sufficiently warm or enter torpor. Entering torpor comes at a cost with delayed parturition; bats born earlier have a greater chance of surviving their first winter and breeding their first year (Frick et al. 2009). Delayed parturition may be costly because young of the year and adult females would have less time to prepare for hibernation (Broders et al. 2013). NLEB females roost colonially with their largest counts in spring (Foster and Kurta 1999), presumably this is one way to reduce thermal costs for individual bats (Foster and Kurta 1999). In summary, NLEBs have multiple energetic demands (particularly in spring) and must have sufficient suitable roosting and foraging habitat available in close enough proximity to allow for successful reproduction. In this case, there will be sufficient habitat remaining in close proximity (directly adjacent) to the cleared areas that should lessen the additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy).

In areas with WNS, there are additional energy demands for NLEBs. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing.

Mean NLEB home range sizes for individual females have been minimally estimated at 60.2-72.3 hectares (148.8-173.7 acres) (Owen et al. 2003, Lacki et al. 2009). Carter and Feldhamer (2005) estimated roosting area size for NLEB at 186.3 hectares (460.4 acres). The home range for colonies are likely much larger with some overlapping home ranges of individuals. This project is removing 12.43 acres of suitable habitat within 0.25 miles of a hibernaculum that is also summer maternity habitat. This represents up to 8% of the home range of an individual NLEB associated with the colony. Given the highly forested nature of this area, we anticipate that NLEBs will locate new travel corridors/foraging areas with no effects or minimal effects to individuals.

In summary, it is likely that individual NLEBs have been or will be harmed from inactive season clearing of roosting or foraging habitat in one known colony. We anticipate that effects of tree removal will vary with some individuals experiencing no effects to others experiencing temporary reduced pregnancy success. As discussed in the Environmental Baseline section, NLEB maternity colonies are anticipated to range in size from 5-40 adult females and 5-40 juveniles. We have no precise way to estimate how many individuals have been or will be harmed; however we used a similar analysis as done for the Ibat above. NLEBs have similar life history strategies as Ibats and similar colony sizes. Given the small acreage (12.43) of tree removal that has already occurred within the range of the one known NLEB colony, we anticipate effects of a similar magnitude to those described for Ibats from the loss of summer habitat during the winter and we assume that no more than 1 adult female will be harmed (temporary reduced breeding success). Adverse effects that occur to this individual are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until the individual acclimates to the altered landscape and establish new foraging and roosting areas.

Conservation Action – To compensate for effects to NLEB within known use spring staging/fall swarming habitat, Mountain Valley acquired a 121-acre property in Braxton County, WV. Five NLEBs were captured 4 miles north of the property and 1 NLEB was captured about 3 miles south of the property. The parcel contains mature, upland deciduous forest dominated by mostly oak, hickory, and red maple. There are numerous travel/foraging corridors and snags for bats throughout the property. Approximately 860 ft of the construction ROW crosses the eastern portion of the property. After project completion, approximately 106 acres will remain as interior forest and will be maintained as such in perpetuity. Protection of this property provides habitat, immediately adjacent to the project area, for bats that may be displaced during construction activities. Due to the property's proximity to the construction ROW, displaced bats will only need to travel a short distance to locate alternative spring staging/fall swarming habitat. It is anticipated that the availability and protection of this property may reduce adverse effects on returning bats; however, bats have not been detected on this property as of the date of this Opinion.

Candy darter (CD) proposed critical habitat

The potential effects of the proposed action are described in Appendix B Table 6. The project subactivities of the proposed action determined to result in NE or NLAA are described in Appendix B Table 6 and will not be further discussed in this Opinion.

Subactivities of the project that are LAA CD proposed critical habitat are listed in Appendix B Table 6 and include:
- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- ROW repair, regrading, revegetation (upland) – hand, mechanical
- AR maintenance – grading, graveling

Subactivities related to clearing, grading, trenching, ARs, and ROW repair will affect PBFs of both critical habitat subunit 2b (Stony Creek) and 5b (Upper Gauley River). The effects to PBFs described below will be limited to the impact areas within those subunits (see Appendix D Table 2 and Figures 3, 4, and 5). The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation/turbidity and increased embeddedness.

Increased sedimentation/turbidity – Increased sedimentation/turbidity is anticipated from all of the subactivities listed above although the magnitude and duration will vary depending on the specific subactivity. The effects to the PBFs will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background turbidity/TSS concentrations.

Increased sedimentation will affect PBF 2 (a blend of unembedded gravel and cobble that allows for normal breeding, feeding, and sheltering behavior) by introducing increased silt and fine particles to the unembedded gravel and cobble substrate characteristic of CD streams. This PBF will still function as required by the species, but at a reduced level. The reduced function of this PBF within the impact areas is expected to occur during construction and restoration activities and remain until after restoration is completed and fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities. Following restoration, this PBF is expected to return to background levels.

Increased sedimentation/turbidity will affect PBF 3 (adequate water quality characterized by seasonally moderated temperatures and physical and chemical parameters (e.g., pH, dissolved oxygen levels, turbidity) that support normal behavior, growth, and viability of all life stages of the CD) by altering water quality parameters via reduced light levels and visibility, decreased DO levels, and altered pH. This PBF will still function as required by the species within the impact areas, but at a reduced level. These changes are expected to be limited in duration to the length of time that construction and restoration activities are actively contributing excess sediment to the watershed. Following restoration, this PBF is expected to return to background levels.

Increased suspended and deposited sediment is anticipated to affect PBF 4 (an abundant, diverse benthic macroinvertebrate community (e.g., mayfly nymphs, midge larvae, caddisfly larvae) that allows for normal feeding behavior) through loss of prey items. This PBF will still function as required by the species, but at a reduced level. The reduced function of this PBF within the impact areas is expected to occur during construction and restoration activities and will remain until after restoration is completed. Once fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities and macroinvertebrate populations have recovered via recolonization and new reproductive cycles, this PBF is expected to return to background levels. These effects on the benthic invertebrate community can persist after construction has been completed. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for 12.4 hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short-term time period (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7 hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed. As discussed below, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP will persist for up to 4 years.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. Increased embeddedness is anticipated to reduce the quality of PBF 2 within the impact areas. A commonly documented effect of instream work and upland deforestation/clearing includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the area where instream work is occurring, as well as in areas downstream of the disturbance. This PBF will still function as required by the species, but at a reduced level. These changes are expected to occur during construction and restoration activities and will remain until after restoration is completed and fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities. Following restoration, this PBF is expected to return to background levels.

The resulting increase in substrate embeddedness is expected to reduce habitat heterogeneity and primary productivity, and alter, degrade, and entomb benthic macroinvertebrate communities that CD depend on as a food source, per PBF 4 (Burkhead and Jenkins 1991). In the short-term, PBF 4 will experience increased sediment deposition and filling of interstitial spaces. This PBF will still function as required by the species within the impact areas, but at a reduced level. These changes are expected to occur during construction and restoration activities and will remain until after restoration is completed. Once fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities and macroinvertebrate populations have recovered via recolonization and new reproductive cycles, this PBF is expected to return to background levels.

In summary, in the short-term, the quality of PBFs 2, 3, and 4 are anticipated to continue to function for CD within the impact areas, but will be temporarily reduced in quality. In the long-term, these PBFs are expected to return to their previous quality as stream conditions return to previous baseline levels following restoration of the action area. Project subactivities in critical habitat subunit 2b and 5b are not anticipated to affect PBF 1 or PBF 5 as no part of the proposed action is predicted to introduce nonnative species or meaningfully alter water quantity or velocity within proposed critical habitat.

CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area" considered in this Opinion (50 CFR 402.02). While there are numerous state and private activities currently occurring within the action area, these activities are ongoing and the effects created by those activities are considered in the Status of the Species and Status of Critical Habitat and Environmental Baseline sections of this Opinion.

Mountain Valley (2020) provided non-federal actions in the SBA (SBA Table 17). They noted (Mountain Valley 2020) that these actions included "some activities for which the available information is insufficient to determine whether it is in fact non-federal." Mountain Valley completed additional review of publicly available information regarding each of the projects listed in Table 17 of the SBA (P. Moore, Beveridge & Diamond PC, email to J. Martin FERC, August 11, 2020).

Based on the additional review, Mountain Valley determined the list of projects from Table 17 of the SBA is now limited to 3 projects in VA (Route 40 Development Phase II, Sanctuary Bay Townhouse Complex, Midway Estates). Mountain Valley's review also identified 3 additional non-federal projects in the action area in WV (Glade View Townhomes, AW9477, Crupperneck Road). The Service reviewed each of the 6 projects and determined the following (T. Andersen, Service, email to C. Schulz, Service, August 14, 2020):

- Route 40 Development Phase II – project is ongoing or completed per VDEQ permit database.
- Sanctuary Bay Townhouse Complex Section II – project is ongoing or completed per VDEQ permit database.
- Midway Estates – project is ongoing or completed per VDEQ permit database.
- Glade View Townhomes – the Service could find no available information to determine if this project is ongoing, completed, or some other status.
- AW9477 – based on information available in the Service's Tracking and Integrated Logging System, there are no anticipated impacts on listed species.
- Crupperneck Road – project is ongoing or completed.

In summary, the Service is not aware of any future State, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, no cumulative effects are anticipated.

JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

Jeopardy Analysis Framework

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on 4 components: (1) Status of the Species, which evaluates the species' rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) Environmental Baseline, which evaluates the status of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species, (3) Effects of the Action, which determines impacts of the proposed action, and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species. The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination (see 50 CFR 402.14(g)).

In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat and to the environmental baseline to formulate our opinion as to whether the proposed action is likely to appreciably: (1) reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the RND of that species; or (2) appreciably diminish the value of critical habitat for both the survival and recovery of a listed species.

Per the Service's consultation handbook (Service and NMFS 1998), survival is defined as "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Per the Service's consultation handbook (Service and NMFS 1998), recovery is defined as "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the ESA." The "criteria set out in Section 4(a)(1)" means determining when a species no longer meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

- (A) present or threatened destruction, modification, or curtailment of habitat or range;
- (B) overutilization for commercial, recreational, scientific, or educational purposes;
- (C) disease or predation;
- (D) inadequate existing regulatory mechanisms; and
- (E) other natural or manmade factors affecting the species continued existence.

An endangered species is "in danger of extinction throughout all or a significant portion of its range" (see ESA Section 3(6)). A threatened species is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (see ESA Section 3(20)).

To conduct this analysis, we begin by assessing whether there are effects to any individuals of the species of interest (as discussed in the effects analysis section above). If all effects are insignificant, discountable, or wholly beneficial, no further consultation is required. In other words, if we conclude that individuals are *not* likely to experience reductions in reproductive success or survival likelihood, fitness consequences for the species rangewide would not be expected as well. In this case, the agency has ensured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed. Conversely, if we are unable to show that individuals are unlikely to experience reductions in their reproductive success or survival likelihood, we are required to assess how those effects are or are not anticipated to result in an appreciable reduction in the likelihood of both the survival and recovery <u>of the species</u>. We do not assess appreciable reduction of reproduction, numbers or distribution at an individual level because we do not assess appreciable reduction of <u>survival and recovery</u> at an individual level.

Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) to the overall species survival and recovery, it is a logical intermediate step to evaluate the effects of impacts to individuals on the population(s) they are associated with. If our analyses indicate that reductions in the fitness of the population(s) are not likely to occur then there can be no appreciable reductions in reproduction, numbers, or distribution at a species level and we conclude that the agency has ensured that their action is not likely to jeopardize the continued existence of the species. If there are reductions in the fitness of the population(s) impacted, we then assess whether those changes affect the overall species survival and recovery rangewide based on the importance of the population(s) for species level representation, resiliency and redundancy, the level of impact, and the status of the species.

Analysis for Jeopardy

<u>Virginia spiraea (VASP)</u>

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[31] upon exposure to the stressors and

[31] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our BiOps. For our jeopardy

beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes vehicle operation and foot traffic, herbaceous vegetation and shrub/tree clearing, AR grading and graveling, stream equipment crossing structures, and stream and wetland crossings subactivities. As discussed in the Effects of the Action, effects of the action include effects to VASP assumed to be present within parcel WV-SU-046 year-round. Effects generally include decreased fitness, decreased reproductive success, or death of individual VASP due to physical damage, competition with introduced invasive species, habitat disturbance, crushing, cutting, digging up, burying, or soil compaction. Additionally, these activities are expected to permanently alter and degrade habitat such that conditions are no longer favorable for VASP re-establishment post-construction. The AMMs will initially minimize some of these adverse effects, but we expect that all VASP individuals in the 0.05 acre will be killed. On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). This will result in the permanent removal of all VASP plants, seeds, and habitat in the 2.3 acre parcel and reestablishment of VASP in that area is not expected.

In summary, we anticipate impacts to individual VASP in either their survival or reproductive rates.

Impacts to Populations – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual VASP are likely to experience reductions in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population(s) to which these individuals belong.

We expect that the population level impacts from decreased fitness, decreased reproductive success, death of individual VASP, and habitat degradation and loss will be relatively minor because the proposed action only affects 1 assumed occurrence of VASP. This occurrence is 1 of 4 that comprise the Greenbrier River population. The other 3 occurrences will not be affected by the proposed action and based on 2019 survey information these 3 occurrences appear healthy.

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analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

Therefore, the loss of this 1 occurrence will not affect the stability and recovery of the Greenbrier River population as a whole.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a biologically meaningful and consequentially negative way. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of maintaining or progressing towards one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As we have concluded that the Greenbrier River population of VASP is unlikely to experience any meaningful reductions in fitness, there will be no reduction in RND on the species as a whole and therefore, the continued existence of VASP will not be jeopardized.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1992. Primary actions to address recovery include: (1) Protect existing populations and essential habitat. (2) Conduct rangewide searches in areas of suitable habitat for additional populations. (3) Conduct site-specific habitat manipulation to maintain existing populations. (4) Distinguish between N (the number of genetically different plants) and n (the number of genetically identifiable nodules or clones that are in reality a single plant) individuals and identify genetically different populations. (5) Maintain representative material from each known genotype in permanent cultivation. (6) Investigate the species' environmental tolerances and habitat characteristics. (7) As appropriate, reintroduce VASP in additional drainage systems within the species' historical range. (8) Develop an information packet for landowners and land managers. (9) Evaluate the effectiveness of protection and management programs and redirect efforts as necessary. The Service outlined the following conditions that would result in the species no longer meeting the definition of a threatened species (Service 1992a): (1) 3 stable populations are permanently protected in each drainage where populations are currently known, (2) stable populations are established on protected sites in each drainage where documented specimens have been collected, (3) potential habitat in the states with present or past collections has been searched for additional populations, and (4) representatives of each genotype are cultivated in a permanent collection.

As discussed in the Status of the Species section, there are multiple (redundancy) populations in each state and these populations are spread across the geographic range of the species in multiple states (GA, KY, NC, OH, TN, VA, and WV) (representation). Information about the size/abundance and health of these populations (resiliency) across the range is limited due to lack of consistent monitoring approaches and survey efforts. Prior to the MVP, the status of the species rangewide species appears to be stable, with some populations improving and some declining (Ogle 2008, Service 2008).

This project is anticipated to result in impacts to VASP assumed to be present within parcel WV-SU-046 year-round. These impacts are expected to permanently alter and degrade the VASP habitat such that conditions are no longer favorable for VASP re-establishment post-construction. We expect that all VASP individuals in the 0.05 acre will be killed. On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). All proposed AMMs will be implemented (Mountain Valley 2020). This will result in the permanent removal of all VASP plants, seeds, and habitat in the 2.3 acre parcel and reestablishment of VASP in that area is not expected.

This occurrence is 1 of 4 that comprise the Greenbrier River population. The other 3 occurrences will not be affected by the proposed action and based on 2019 survey information these 3 occurrences appear healthy. The loss of one assumed VASP occurrence within the Greenbrier River population is not likely to appreciably reduce the species' ability to attain any of the four recovery criteria outlined in the recovery plan. Therefore, the loss of this 1 occurrence will not affect the recovery of the Greenbrier River population as a whole. The overall status of the species appears to be stable and the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

<u>Roanoke logperch (RLP)</u>

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[32] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

[32] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our BiOps. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temp and permanent – grading, graveling, tree trimming and tree removal; stream crossing – dam and pump, cofferdam; ROW repair, regrading, revegetation (upland) – hand, mechanical; ROW repair, regrading, revegetation – instream stabilization and/or fill; and AR maintenance – grading, graveling. As discussed in the Effects of the Action, effects of the action include effects to RLP present within the impact area year-round. Temporary reductions in RLP foraging are expected as a result of cofferdams preventing access to foraging areas and individuals moving to new habitat to avoid sedimentation. As previously mentioned, sediment deposited on the waterbody bottom will interfere with the ability of RLP to feed (Robertson et al. 2006). Sediment plumes and increased turbidity will also temporarily lower DO levels. In response to sediment plumes, most RLP are anticipated to cease feeding and move to clearer water until sediment levels return to background levels. Individuals will expend more energy to seek out different foraging areas. A TOYR (March 15 - June 30) to protect RLP during their spawning season will be implemented, which will minimize the potential for effects from sedimentation to spawning adults and larvae. Permanent removal of riparian vegetation in a 10 ft corridor centered over the pipeline is expected to decrease fitness of individual RLP.

In summary, we anticipate impacts to individual RLP in either their survival or reproductive rates.

Impacts to Populations – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual RLP are likely to experience impacts in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the populations to which these individuals belong.

We expect that the population level impacts from habitat alteration, foraging disruption, injury, and death, to the RLP will be relatively small because the proposed action affects a small number of individuals relative to the overall population numbers and most of the effects of sedimentation on individual RLPs are expected to be sublethal. In some cases the combined effects of increased sedimentation, decreased dissolved oxygen, and increased temperature could result in the death of a small portion of the RLP present in the impact areas. In recent years RLP population analyses have combined the upper and lower Roanoke River systems into a single Roanoke River population. As stated above, approximately 2,517 adult RLP (14.9% of the total estimated adult population), and approximately 14.9% of the total YOY and juvenile population would be present within the Roanoke River system impact area, which represents 7.3% of the RLP potential habitat within the Roanoke River system. Approximately 622 adult RLP (6.7% of the total estimated adult Pigg River population), and approximately 6.7% of the total YOY and juvenile population, would be present within the Pigg River system impact area, which represent 4.8% of the RLP potential habitat within the Pigg River system. None of the affected habitat in the Roanoke River or Pigg River systems will be rendered permanently unsuitable as a result of the project. The Roanoke and Pigg River populations had the largest estimated populations of all the RLP populations. For several reasons we do not anticipate a long-term reduction in fitness in these populations: (1) sufficient numbers of adult, YOY, and juvenile RLP are likely to be present in suitable habitat outside of the impact area such that individuals are available to repopulate the impact area as project effects dissipate; (2) following completion of each subactivity that results in adverse effects to RLP, we expect that the RLP population, given no other new major stressors above baseline conditions, will recover to baseline levels within 3-5 years; (3) the amount of habitat to be impacted is minor (0.9%) compared to the overall amount of RLP habitat available rangewide; (4) the effects of the proposed action are expected to be primarily temporary; (5) in general, RLP habitat will recover to a suitable condition following temporary impacts; (6) and RLP are expected to continue to occupy waterways within the impact areas during and after the project, as most of the project-related effects are expect to be sublethal. As mentioned earlier, Roberts et al. (2016b) calculated all populations had a greater than 95% probability of persisting for the next 100 years under a less severe catastrophe scenario. Even under a severe catastrophe scenario, such as a total fish kill in a stretch of the Roanoke or Pigg Rivers, the authors determined that the Roanoke and Pigg River populations would remain viable. We do not expect that the MVP will cause significant reductions in short-term fitness or any reduction in long-term fitness of these RLP populations, let alone rise to the level that would be categorized as a catastrophe. Therefore, we conclude that the effects from the proposed action do not pose a significant risk to the RLP Roanoke or Pigg River populations and will not result in permanent population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than “background” noise of the species’ population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species’ conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As we have concluded that the Roanoke and Pigg River populations of RLP are unlikely to experience meaningful reductions in in fitness, there will be no reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1992 (Service 1992b). A 5-year review (Service 2007a) provides primary actions to address recovery: (1) Maintain and increase the health and vigor of present populations through a watershed-level conservation approach that addresses sediment loading and preserves ecological processes that provide ephemeral, seasonal, and persistent types of habitat required over RLP ontogeny; (2) Evaluate the feasibility of propagating RLP and determine whether a controlled propagation and reintroduction/augmentation plan should be developed; (3) Increase connectivity of RLP populations by identifying major and minor artificial movement barriers and eliminating them when feasible; (4) Prevent and reduce the risk of catastrophic extirpation from toxic spills through identification, evaluation, and improvement of present and proposed road crossings, agricultural, and industrial facilities; (5) Survey streams with suitable habitat and continue to identify habitat that is potentially suitable for RLP reintroduction/augmentation; (6) Revise the recovery plan to include measurable criteria that specifically address each of the relevant listing factors and incorporate currently available information about population abundance and distribution.

The recovery objectives for RLP are to downlist to threatened then, once achieved, delist the species. The Service outlined the following conditions that we believed would result in the species no longer meeting the definition of an endangered species (Service 1992b): protecting and enhancing habitat containing RLP populations, and expanding populations within river corridors that either now support this species or supported it historically. While the recovery criteria have not yet been achieved, some of the identified threats have been reduced.

As discussed in the Status of the Species section, there are multiple (i.e., 7) (redundancy) populations spread across the geographic range of the species (representation); however, the health (resiliency) of those populations varies across the range. The RLP populations in VA appear to be stable or increasing (Service 2007a; J. Roberts, Georgia Southern University, email to S. Hoskin, Service, June 4, 2019). Prior to the MVP, as a whole, the rangewide status of the species was improving.

As discussed above, this project is anticipated to affect a small number of individuals in the Roanoke River and Pigg River RLP populations relative to the overall population numbers and most of the effects are expected to be sublethal. None of the affected habitat in the Roanoke River or Pigg River systems will be rendered permanently unsuitable as a result of the project.

The amount of habitat to be impacted is minor (0.9%) compared to the overall amount of RLP habitat available in VA; the effects of the proposed action are expected to be primarily temporary; in general, RLP habitat will recover to a suitable condition following temporary impacts; and RLP are expected to continue to occupy waterways within the impact area during and after the project. The MVP will not increase threats listed in the RLP recovery plan (Service 1992b) such as building dams or other impediments to movement; increase channelization; remove woody debris; or create a long-term water withdrawal project. The overall status of the species is improving and the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Candy darter (CD)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[33] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temp and permanent – grading, graveling; ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal; ROW repair, regrading, revegetation (upland) – hand, mechanical; and AR maintenance – grading, graveling. As discussed in the Effects of the Action, effects of the action include effects to CD present within the impact area year-round. Temporary reductions in CD foraging are expected as a result of increased sedimentation reducing visibility, decreasing available prey, and preventing access to foraging areas (interstitial spaces) filled in by sediment. CD may move to new habitat to avoid sedimentation, resulting in increased energy expenditures and stress, as well as increased risk of predation while moving to new area. In response to sediment plumes, most CD are anticipated to temporarily cease feeding and/or move to clearer water until sediment levels return to background levels. In the event of prolonged exposure to elevated sediment plumes, individuals may resume attempts to feed, but at reduced efficiency (requiring increased effort) due to the combination of reduced visibility and reduced prey availability. Individuals will expend more energy to seek out different foraging areas. Decreased visibility is expected to reduce spawning efficiency via increased effort to find suitable spawning partners. Increased sediment deposition is expected to reduce spawning efficiency by reducing the availability of suitable substrates for egg-laying.

[33] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our BiOps. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

In summary, we anticipate impacts to individual CD in either their survival or reproductive rates.

Impacts to Populations – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual CD are likely to experience some reductions in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population(s) to which these individuals belong.

We expect that the population level impacts from habitat alteration, foraging disruption, injury, and death to the CD will be relatively small because most of the effects of sedimentation on individual CDs are expected to be sublethal and because the impact areas in which CD will be affected comprise a relatively small portion of the species' range within these populations. Robust population estimates are not available for CD populations in the Gauley River and Stony Creek. The Upper Gauley River metapopulation contains 6 populations within close proximity to each other (182 smi total) (Service 2018a), of which the Upper Gauley River population constitutes 27.2 smi. The impact area includes approximately 1.24 smi of the Upper Gauley River known to support CD, which represents approximately 4.56% of the CD occupied habitat within the Upper Gauley River and 0.68% of the occupied habitat within the Upper Gauley River metapopulation. CD abundance was considered "good" in the Upper Gauley River during the SSA (Service 2018a), but no specific population estimates are available or can be readily obtained. The Middle New River metapopulation (27.0 smi) contains 3 disjunct populations, of which the Stony Creek population constitutes 21.2 smi. The impact area includes approximately 0.62 mi of Stony Creek known to support CD, which represents approximately 2.92% of the CD occupied habitat within Stony Creek and 2.30% of the occupied habitat within the Middle New River metapopulation. Within Stony Creek, CD CPUE is highest in the midpoint of the watershed, with lower abundances within the impact area, closer to the confluence with the New River (McBaine and Hallerman 2020).

For several reasons we do not anticipate a long-term reduction in fitness in these populations: (1) CD are likely to be present in suitable habitat outside of the impact area such that individuals are available to repopulate the impact area as project effects dissipate; (2) habitat quality within the Gauley River and Stony Creek is rated as "moderate" and "good" respectively, and is not expected to be permanently altered; (3) effects are expected to occur for a short duration and are expected to be primarily temporary; (4) following completion of each action that results in adverse effects to CD, we expect that the CD population, given no other major stressors, will recover to baseline levels within 3-5 years; (5) the amount of habitat to be temporarily impacted is minor (0.50%) compared to the overall amount of CD habitat available rangewide (370 smi total); (6) in general, CD habitat will recover to a suitable condition following temporary impacts; and (7) CD are expected to continue to occupy waterways within the impact area during and after the project. The CD SSA (Service 2018a) predicted future condition scenarios based on negative impacts to habitat, increased hybridization with variegate darters, and a combination of both. In the predicted future scenarios resulting from negative impacts to CD habitats, the Gauley River population condition changed from "high" to "moderate" while the Stony Creek population remained "high" even under degraded habitat conditions. Population extirpations in the Upper Gauley River and Stony Creek were only predicted to occur in modeled scenarios where introduction and hybridization of variegate darters occurred. Therefore, we conclude that the effects from the proposed action do not pose a significant risk to the CD Gauley River or Stony Creek populations and will not result in permanent population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As we have concluded that the Stony Creek and Gauley River populations of CD are unlikely to experience meaningful reductions in fitness, there will be no reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service developed a recovery outline for the species in 2018 (Service 2018b). The primary actions to address CD conservation needs include: maintain extant populations by conserving the genetic diversity and PBFs on the landscape that are essential for the species' conservation; minimize the risk of variegate darter introductions or spread in areas with little evidence of introgression; investigate factors that would minimize and control hybridization, and implement those measures in currently occupied areas that are affected by ongoing hybridization; repatriate CDs to historically occupied areas where variegate darters are not present; and investigate feasible methods to remove variegate darters and repatriate CDs.

As described in the recovery outline (Service 2018b), CD conservation needs include: an absence of nonnative fish species (particularly, the variegate darter); unembedded gravel and cobble substrates with minimal sedimentation; adequate water quality; an abundant, diverse benthic macroinvertebrate community; and sufficient water quantity and velocities. Absence or degradation of these features could limit populations of the CD. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term.

As discussed in the Status of the Species section, of the 18 extant populations, 5 currently have high or moderate to high resiliency. These populations are located in the Upper Gauley, Greenbrier, and Middle New metapopulations. The remaining 2 extant metapopulations (Lower Gauley and the Upper New River) maintain populations with moderate and low resiliency. Therefore, the CD currently maintains moderate resiliency (Service 2018a). The loss of CD populations and the areas they represented within the species' historical range, as well as the fragmentation of extant populations, has compromised the species' ability to repatriate those areas or avoid species level effects from a catastrophic event. Therefore, the CD's current redundancy is moderate to low (Service 2018a). The best available data for the CD indicate that there is a high level of genetic differentiation between the Greenbrier River and Upper and Lower Gauley River metapopulations. These metapopulations currently have moderate resiliency, however the loss of either would represent a substantial reduction in the species' genetic representation. Although the CD retains representation in both of the Appalachian Plateaus and Valley and Ridge physiographic provinces, the species has a different distribution than it had historically, and likely a different ability to respond to stochastic and catastrophic events, thereby putting the species at increased risk of extinction from any such events. Therefore, we conclude that the species' representation is currently moderate to low (Service 2018a). Prior to the MVP, the rangewide status of the species was declining.

As discussed above, the project impacts are anticipated to be relatively small because most of the effects of sedimentation are expected to be sublethal and occur within a relatively small portion of the species range within each affected population. The Upper Gauley River metapopulation contains 6 populations (182 smi total) (Service 2018a), of which the Upper Gauley River population constitutes 27.2 smi. The impact area includes approximately 1.24 smi of the Upper Gauley River known to support CD, which represents approximately 4.56% of the CD occupied habitat within the Upper Gauley River and 0.68% of the occupied habitat within the Upper Gauley River metapopulation. The Middle New River metapopulation (27.0 smi) contains 3 disjunct populations, of which the Stony Creek population constitutes 21.2 smi. The impact area includes approximately 0.62 mi of Stony Creek known to support CD, which represents approximately 2.92% of the CD occupied habitat within Stony Creek and 2.30% of the occupied habitat within the Middle New River metapopulation.

The amount of habitat to be temporarily impacted is minor (0.50%) compared to the overall amount of CD habitat available rangewide (370 smi total); in general, CD habitat will recover to a suitable condition following temporary impacts; and CD are expected to continue to occupy waterways within the impact area during and after the project. The CD SSA (Service 2018a) predicted future condition scenarios based on negative impacts to habitat, increased hybridization with variegate darters, and a combination of both. In the predicted future scenarios resulting from negative impacts to CD habitats, the Gauley River population condition changed from "high" to "moderate" while the Stony Creek population remained "high" even under degraded habitat conditions.

Consistent with the conservation needs in the recovery outline, the affected populations will be maintained; the PBFs of the affected area that are essential for species conservation will only be temporarily affected in the impact areas; there will be no increase in the risk of variegate darter introductions or spread; and the ability to repatriate CDs to historically occupied areas will not be diminished. Although the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Indiana bat (Ibat)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[34] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes removal of a total of 3,462.76 acres of known or unknown use Ibat habitat (Table 21 and 23). As discussed in the Effects of the Action (Table 28), effects of the MVP (3,462.76 acres) and the NJF (6.09 acres) include effects to Ibats present within the action area year-round. Tree removal in known use and unknown use summer habitat during winter will alter roosting, foraging, and travel habitat.

Displaced Ibats will expend additional energy seeking out alternate roosts and travel corridors when they return the following season. Tree removal during winter in known use and unknown use summer habitat will result in temporary reduced pregnancy success for 1 adult female per colony (1 known maternity colony and 3 unknown maternity colonies). These effects will be greatest the first season after tree removal has occurred.

Tree removal in April, May, August, and September in unknown use summer habitat and in April and August in known use summer habitat is expected to affect Ibats using undocumented occupied roosts and foraging areas. Approximately 269.29 acres of unknown use summer habitat was removed during the winter and no trees were removed between June 1 and July 31, when young cannot fly. MVP has also committed to avoid conducting any future tree removal

[34] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our BiOps. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

activities associated with slip repair in known (153.75 acres) and unknown use summer habitat (106.38 acres) during the period of time when bat colonies are most concentrated (May – July), unless presence/probable absence surveys (in accordance with the Service's current Ibat Range-wide Survey Guidelines) indicate the probable absence of Ibat.

As discussed in the Effects of the Action section, we anticipate 1 adult female and 9 pups present within each of the known and unknown maternity colony home ranges will be injured or killed from the felling of undocumented occupied roost trees. We expect that some individuals experienced reduced pregnancy success associated with increased energy expenditure from the loss of roosting/foraging habitat. Furthermore, bats impacted by WNS have additional energetic demands and reduction in flight ability. This compounds the stress of having to find new roosting and/or foraging habitat. Some individuals may have also expended additional energy finding prey, experienced higher predation risk, and/or experienced complications with pregnancy and rearing young, resulting in reduced reproductive potential. However, the AMMs (including TOYRs) will minimize reductions in the number of individuals and the reproductive rates in affected maternity colonies, and the preservation of 121 acres of suitable Ibat habitat within Braxton County, WV may provide immediate roosting habitat for displaced bats.

Tree removal in known use and unknown use spring staging/fall swarming habitat during winter will remove foraging and roosting areas for a concentrated number of Ibats during spring emergence or fall swarming. The majority of tree removal activities within known use spring staging/fall swarming habitat (308.19 acres) and 248.20 acres within unknown use spring staging/fall swarming habitat was completed during the winter months (when bats were not present) and no impacts to Ibat hibernacula or hibernating bats were documented or are expected to have occurred for the reasons stated in the Environmental Baseline section. However, tree clearing within these areas resulted in temporary and permanent habitat loss, which we expect caused decreased breeding success. We anticipate 4 adult females per hibernacula (2 known hibernacula and 10 assumed occupied hibernacula) were harmed from the loss of suitable spring staging/fall swarming habitat during the winter months.

Tree removal in unknown use spring staging/fall swarming habitat during the active season will disrupt bats engaging in fall swarming, spring staging, and roosting behavior. As discussed in the Effects of the Action, we anticipate 1 adult Ibat per hibernacula (10 assumed occupied hibernacula) will be injured or killed (adults and volant young) from the felling of undocumented occupied roost trees within unknown use spring staging/fall swarming habitat. We expect that some individuals will experience temporary reduced pregnancy success and/or reduced pup survival associated with increased energy expenditure from the loss of roosting/foraging habitat. Some individuals may also temporarily expend additional energy finding prey, experienced higher predation risk, and/or experience complications with pregnancy and rearing young, resulting in temporary reduced reproductive potential. To minimize impacts to individual Ibats, 121 acres of suitable Ibat habitat within Braxton County, WV, will be permanently protected. While this property will likely provide habitat for Ibats, it does not eliminate or offset all impacts to individual bats.

In summary, we anticipate impacts to individual Ibats in either their survival or reproductive rates. As explained in the Effects of the Action section, these impacts are not expected to increase due to the additional NJF acres.

Impacts to Populations – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual Ibats are likely to experience some reductions in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population(s) to which these individuals belong.

The affected Ibats fall within the AMRU. As noted in the Environmental Baseline section, at present, few healthy winter populations (and likely associated maternity colonies) remain in the AMRU, primarily as a result of WNS. The AMRU population has declined from 32,465 Ibats in 2011 to 1,996 Ibats in 2019, and WNS impacts are expected to continue across the range for years to come as are other ongoing threats (e.g., climate change, wind turbines) to the bats and their habitats. The Service (2019a) estimates the 2019 hibernating Ibat population is 648 in VA and 620 in WV; these numbers indicate a 30.9% increase in VA and a 42.4% decline in WV since the 2017 census. Overall, however, the status of the Ibat populations in VA and WV remain degraded. Taking into account the degraded status of the species in the action area, we must assess whether the proposed action will appreciably reduce the likelihood of the continued survival of those populations, and ultimately, of the species as a whole. See 84 FR 44,976, 44,987 (August 2019).

As noted in the Status of the Species section, high Ibat adult female survival is required for stable or increasing growth rates, and given the significant declines in populations across much of the range, it is essential to minimize impacts to reproductive potential for surviving Ibats. Individuals associated with 1 known and 3 unknown maternity colonies, including adult females, will be or have been affected by the MVP in the form of injury, temporary reduced reproductive success, or, potentially, lethal harm in some cases. These effects are not expected to measurably decrease the fitness of these colonies overall, however, for several reasons. The majority of tree removal activities within known use summer habitat were, or likely will be, completed in the winter when bats were not present (November 15 - March 31), which is expected to significantly reduce the potential for death of Ibats in this known maternity colony during tree felling. Additionally, the removal of potential roost trees within unknown use summer habitat during the period of time when lactating females and non-volant pups are present (June – July) was avoided, which is expected to have significantly avoided reductions in population numbers and reproductive rates in affected maternity colonies overall because it reduces the likelihood of lethal impacts to bats. Further, not every bat from the 4 colonies is expected to have been exposed to stressors associated with the proposed action as they occur within a small portion of each colony's potential home range.

All impacts associated with the loss of any roosting or foraging habitat are anticipated to be short-term in nature, lasting up to two seasons post-construction. We do not anticipate a long-term reduction in any maternity colony fitness in this situation, because the Ibats are expected to acclimate to changes in the landscape given the amount of suitable habitat remaining within their anticipated home ranges. In addition, given the linear nature of the MVP, we do not anticipate that significant areas of habitat (roosting, foraging, and travel) associated with these maternity colonies has been/will be affected by the MVP. We expect that there will be suitable habitat adjacent to the LOD available to Ibats after future hibernation events.

Therefore, despite the degraded status of the species in the action area, we conclude that adequate habitat will remain to maintain numbers, reproduction, and viability for any given maternity colony in the action area.

There are 2 known hibernacula and we have estimated that 10 additional hibernacula occur within the action area, all of which have associated spring staging/fall swarming habitat. No impacts to hibernating bats are expected, however, we anticipate impacts to individual Ibats present within known and unknown use spring staging/fall swarming habitat from tree clearing activities. These impacts are primarily expected in unknown use spring staging/fall swarming habitat during the active season, with more limited impacts at known use spring staging/fall swarming habitat outside of the active season. As a result of TOYRs, most tree removal activities occurred when Ibats were not present. Most effects occurred during the first fall swarm after tree clearing. Ibats are expected to have acclimated to this change and shifted to alternative habitat within the known and unknown use spring staging/fall swarming areas. We do not expect a long-term reduction in any hibernating populations because a significant portion of the known and unknown use spring staging/fall swarming habitat will remain. Additionally, winter hibernacula counts were conducted in 2019 (post-tree removal activities) and Ibat numbers within Greenville Saltpeter Cave in WV were reported to have increased by 71.4% since 2018. The Ibat counts in Tawney's Cave in VA remain the same (0) however, the overall winter population estimates for the entire state of VA increased by 30.9%, indicating that known hibernating bat populations within the action area are stable and/or increasing. Therefore, we do not anticipate a long-term reduction in fitness because Ibats are expected to have acclimated to changes in the landscape given the amount of suitable habitat present within the AMRU in VA and WV (18,889,053 acres). Given the linear nature of the MVP, we do not anticipate significant areas of habitat (roosting, foraging, and travel) associated with these spring staging/fall swarming areas has been/will be affected. We expect that there will be suitable habitat adjacent to the LOD available to Ibats after future hibernation events.

Therefore, notwithstanding the degraded baseline conditions in the action area, we conclude that the overall long-term health and viability of spring staging/fall swarming populations will not be negatively impacted.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare 1) what the species needs, 2) what it has, and 3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a biologically meaningful and consequentially negative way. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of maintaining or progressing towards one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As discussed above, currently, the rangewide status of the species is declining (Figure 8, Service 2019a). Declines are associated with the onset of WNS which has spread from NY south and west across the range. Impacts to Ibats to date are most severe in areas with the longest exposure to WNS (e.g., 75-99% declines in NY, WV, and PA) but declines have been observed in all RUs. Although we acknowledge those range-wide declines, the effects of the proposed action itself are limited to largely non-lethal and short-term impacts to 4 Ibat maternity populations and 12 hibernating Ibat populations. As we have concluded that the affected maternity and hibernating populations are unlikely to experience long-term reductions in fitness due to the limited magnitude, duration, and nature of the impacts of the action, there will be no appreciable reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1983 (Service 1983) and drafted a revised recovery plan that was made available for public comment in 2007 (Service 2007b). In addition, 5-year reviews (Service 2009; 2019b) provide current summaries of the status of the species rangewide. Priority actions include: incorporating WNS into the recovery plan; monitoring status of hibernacula; monitoring status of maternity colonies; implementing the North American Bat Monitoring Program; providing for continual recruitment of high quality roosting habitat; securing permanent/long-term protection of Priority 1 and Priority 2 hibernacula; conducting additional research to understand the causes and potential spread of WNS; researching management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach); continuing public education/outreach efforts about WNS; and continuing to refine survey protocols.

Criteria for reclassification and delisting from the 2007 draft Recovery Plan are as follows:

Reclassification:
1. Permanent protection of a minimum of 80% of Priority 1 hibernacula in each RU, with a minimum of one Priority 1 hibernaculum protected in each unit.
2. A minimum overall population estimate equal to the 2005 population estimate of 457,000.
3. Documentation that shows important hibernacula within each RU have a positive annual population growth rate over the next 10-year period (i.e., 5 survey periods).

Delisting:

1. Permanent protection of a minimum of 50% of Priority 2 hibernacula in each RU.
2. A minimum overall population estimate equal to the 2005 population estimate of 457,000.
3. Documentation that shows a positive population growth rate within each RU over an additional 5 sequential survey periods (i.e., 10 years).

As discussed in the Status of the Species section, the Ibat draft recovery plan (Service 2007b) delineates RUs based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats. To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all 4 RUs. Prior to the MVP, the status of the species within the AMRU was considered declining.

This project is anticipated to result in impacts (primarily nonlethal) to individual bats associated with 1 known and 3 unknown maternity colonies, 2 known (one Priority 3 and one Priority 4), and 10 unknown hibernacula. There are no known Priority 1 or 2 hibernacula within the action area. Given that the persistence of the affected populations is not anticipated to be changed by this project, those populations will retain the ability to contribute to the recovery of the species as a whole if they are not lost from WNS. While we anticipate that some adult females will be injured or killed or experience decreased reproductive success, these impacts will be to few individuals within a given colony, and the nonlethal impacts will be temporary. Additionally, we anticipate the number of females that will be killed is a subset of those few individuals that are injured, which further reduces the effects on recovery. Therefore, they will not have a significant effect on recovery potential of the affected colonies as a whole. In addition, we considered the potential impacts to recovery from the overall project including the loss of suitable surveyed habitat where no Ibats were captured. The entire Ibat range includes approximately 157,702,200 acres of potential habitat based on 2011 NLCD data. Because NLCD cover classes are coarse categories, it is difficult to assess how much of this potential habitat is truly suitable without additional field work. However, assuming all potential habitat is suitable allows for a conservative analysis. If all of this habitat was cleared, there is no likelihood of recovery of Ibats. If all documented currently occupied habitat was cleared, which is a subset of the larger potential habitat category, the likelihood of recovery would be significantly reduced given the high site fidelity of the species. If all unoccupied habitat (areas where presence/probable absence surveys were conducted and results were negative) was cleared, an argument could be made that the likelihood of recovery would be decreased; however, this may or may not be the case depending on numerous factors. There may still be sufficient habitat for a long-term increase in Ibat population size if maternity colony sizes rebound and expand in size in existing colony locations (known and unknown). Regardless, we are only analyzing the impacts associated with this project which is clearing 4,714.87 acres overall, 699.15 acres of occupied, 2,763.61 acres of unknown, and 1,252.11 acres of unoccupied habitat.

The AMRU is highly forested. For example, the Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat, based on NLCD 2016 land cover data. This project removes 3,890.80 acres in WV and VA within the AMRU and is linear in nature. Therefore, the habitat impacts associated with the MVP represent 0.03% of available Ibat habitat within the AMRU.

As discussed in the Environmental Baseline section, we do not anticipate the status of Ibat populations to rapidly improve and fill in previously unoccupied suitable habitat. The closest summer location is approximately 9 miles from unoccupied previously surveyed habitat. While the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Northern long-eared bat (NLEB)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[35] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The majority of impacts to NLEBs have been previously addressed in the Service's January 5, 2016 programmatic BiOp implementing the 4(d) rule, which concludes that those effects are not likely to jeopardize the continued existence of the species. Some effects to NLEBs associated with impacts to habitat surrounding Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1 have not previously been addressed. The proposed action includes the permanent removal of 15.64 acres within 0.25 miles around these hibernacula, all of which has already been cleared. This area is likely to be used as roosting/foraging habitat in the fall or spring and the 12.43 acres around PS-WV3-Y-P1 is likely to be used by 1 maternity colony in summer.

No direct effects are anticipated to have occurred but individual NLEBs may be temporarily affected by loss of fall swarming, spring staging, and summer habitat resulting in reduced reproductive success. Displaced NLEBs will expend additional energy seeking out alternate roosts and foraging habitat when they return the following season. Tree removal during winter in known use summer habitat will result in reduced pregnancy success for 1 adult female. These temporary effects will be greatest the first season after tree removal has occurred.

Tree removal in known use spring staging/fall swarming habitat during winter will remove foraging and roosting areas for a concentrated number of NLEBs during spring emergence or fall

[35] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our BiOps. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

swarming. All tree removal activities within known use spring staging/fall swarming habitat was completed during the winter months (when bats were not present) and no impacts to NLEB hibernacula or hibernating bats were documented or expected to have occurred. However, tree clearing within these areas resulted in temporary and permanent habitat loss, which we expect caused temporary decreased breeding success. We anticipate up to 9 adult females per hibernacula (3 known hibernacula) were harmed from the loss of suitable spring staging/fall swarming habitat during the winter months.

To minimize impacts to individual NLEBs, 121 acres of suitable NLEB habitat within Braxton County, WV, will be permanently protected. While this property will likely provide habitat for NLEBs, it does not avoid all impacts to individual bats.

In summary, we anticipate temporary impacts to individual NLEBs in their reproductive rates.

Impacts to Populations – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population’s abundance, reproduction, or growth rates to make inferences about the population’s future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual NLEBs are likely to have experienced some temporary reductions in their annual reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population(s) to which these individuals belong.

As noted in the Environmental Baseline section, the status of the NLEB populations in VA and WV is degraded from impacts due to WNS. Taking into account the degraded status of the species in the action area, we must assess whether the proposed action will appreciably reduce the likelihood of the continued survival of those populations, and ultimately, of the species as a whole. See 84 FR 44,976, 44,987 (August 2019).

Individuals associated with 1 known maternity colony will be or have been affected by the MVP. These effects are not expected to measurably decrease the fitness of this colony, however, for several reasons. The tree removal activities within known use summer habitat were completed in the winter when bats were not present (November 15 - March 31), which is expected to avoid the potential for death of NLEBs in this known maternity colony. Further, not every bat from the colony is expected to have been exposed to stressors associated with the proposed action as they occur within a small portion of the colony’s potential home range.

All impacts associated with the loss of any roosting or foraging habitat are anticipated to be short-term in nature, lasting up to two seasons post-construction. We do not anticipate a long-term reduction in maternity colony fitness because in this situation, the NLEBs are expected to acclimate to changes in the landscape given the amount of suitable habitat remaining within their anticipated home ranges. In addition, given the linear nature of the MVP, we do not anticipate that significant areas of habitat (roosting, foraging, and travel) associated with this maternity colony have been/will be affected by the MVP. We expect that there will be suitable habitat adjacent to the LOD available to NLEBs after future hibernation events.

Therefore, despite the degraded status of the species in the action area, we conclude that adequate habitat will remain to maintain numbers, reproduction, and viability for any given maternity colony in the action area.

There are 3 known hibernacula within the action area, all of which have associated spring staging/fall swarming habitat. No impacts to hibernating bats were documented or are anticipated to have occurred; however, we anticipate impacts to individual NLEBs present within spring staging/fall swarming habitat from tree clearing activities. As a result of TOYRs, all tree removal activities occurred when NLEBs were not present. Most effects occurred during the first fall swarm after tree clearing. NLEBs are expected to have acclimated to this change and shifted to alternative habitat within the spring staging/fall swarming areas. We do not expect a long-term reduction in any hibernating populations because a significant portion of the spring staging/fall swarming habitat will remain. Given the linear nature of the MVP, we do not anticipate significant areas of habitat (roosting, foraging, and travel) associated with these spring staging/fall swarming areas has been/will be affected. We expect that there will be suitable habitat adjacent to the LOD available to NLEBs after future hibernation events.

Therefore, notwithstanding the degraded baseline conditions in the action area, we conclude that the overall long-term health and viability of spring staging/fall swarming populations will not be negatively impacted.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As discussed above, currently, the rangewide status of the species is declining. Declines are associated with the onset of WNS which has spread from NY south and west across the range.

Although we acknowledge those rangewide declines, the temporary, sublethal effects of the proposed action itself are limited to individuals within 1 NLEB maternity colony and 3 hibernating NLEB populations. As we have concluded that the affected maternity and hibernating populations are unlikely to experience long-term reductions in fitness, there will be no appreciable reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, there is no recovery plan for the NLEB. However, our current focus addresses the following conservation needs similar to the Ibat:

- Managing the effects of WNS;
- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating bats.

This project is anticipated to result in nonlethal impacts to individual bats associated with 3 known hibernacula. Given that the populations are likely to persist, they will retain the ability to contribute to the recovery of the species as a whole. While we anticipate decreased reproductive success of some adult females, these impacts will be to few individuals within a given colony and will be temporary. Therefore, they will not have a significant effect on recovery potential. We do not have recovery units to conduct analyses similar to the Ibat to assess potential impacts but the discussion for the Ibat holds true for the NLEB. Because the availability of suitable habitat is not currently a limiting factor and most of the available suitable habitat (both in the vicinity of the 3 known hibernacula and elsewhere in the species' range) will remain after project completion, the project will not appreciably reduce the quantity of suitable habitat available for species recovery.

As discussed in the Environmental Baseline section, we do not anticipate the status of NLEB populations to rapidly improve and fill in previously unoccupied suitable habitat. While the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably recovery potential for the species.

Adverse Modification Analysis Framework

In accordance with 50 CFR 402.02, "destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

The following analysis relies on 4 components: (1) Status of Critical Habitat, (2) Environmental Baseline, (3) Effects of the Action, and (4) Cumulative Effects. For purposes of making the destruction or adverse modification determination, the effects of the proposed federal action, together with any cumulative effects, are evaluated to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PBFs to be functionally re-established in areas of currently unsuitable but capable habitat) to serve its intended conservation/recovery role for the species.

The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that result in a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of the species. Such alterations may include, but are not limited to, those that alter the PBFs essential to the conservation of these species or that preclude or significantly delay development of such features. The role of critical habitat is to support PBFs essential to the conservation of a listed species and provide for the conservation of the species.

Analysis for Adverse Modification

<u>Candy darter (CD) proposed critical habitat</u>

The proposed critical habitat rule for the CD (83 FR 59232) includes a brief evaluation and description of activities involving a Federal action that may destroy or adversely modify the proposed critical habitat. The list of activities includes the following: "Actions that would significantly increase water temperature or sedimentation and stream bottom embeddedness. Such activities could include, but are not limited to, land use changes that result in an increase in sedimentation, erosion, and bankside destruction or the loss of the protection of riparian corridors and leaving insufficient canopy cover along banks." The impact area includes approximately 1.86 smi of CD proposed critical habitat, 0.50% of the total proposed critical habitat area for the species (370 smi total). Within the Gauley River, the 1.24 smi impact area represents approximately 4.56% of the proposed critical habitat within the 27.2 smi of unit 5b (Upper Gauley River, Nicholas and Webster Counties, WV) and 0.68% of unit 5 (Upper Gauley) as a whole (182 smi total). Within Stony Creek, the 0.62 smi impact area represents approximately 2.92% of the proposed critical habitat within the 21.2 smi of unit 2b (Stony Creek, Giles County, VA) and 2.30% of unit 2 (Middle New) as a whole (27.0 smi total).

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temp and permanent – grading, graveling; ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal; ROW repair, regrading, revegetation (upland) – hand, mechanical; and AR maintenance – grading, graveling. As discussed in the Effects of the Action, effects of the action include effects to PBFs of both critical habitat subunit 2b (Stony Creek) and 5b (Upper Gauley River) within the impact areas. Temporary reductions in water quality and habitat quality are expected as a result of increased sedimentation reducing visibility, decreasing available prey, increasing embeddedness, and filling interstitial spaces with fine sediment. These effects are expected to be limited in relative severity and duration. Some short-term and immediate changes in the conditions of PBFs 2, 3, and 4 in the impact areas in both critical habitat subunits 2b and 5b are anticipated due to increased sedimentation from upland project activities and due to suspension and re-deposition of substrate sediments disturbed during storm events. However, these impacts are expected to be relatively minor and occur within a small portion of the proposed critical habitat area (i.e., subunits 2b and 5b). Within Stony Creek (subunit 2b), the impact area occurs in the lower reaches of the stream before its confluence with the New River; therefore anticipated impacts will leave the PBFs in the upper 97.08% of proposed critical habitat within Stony Creek unaffected. In the Gauley River (subunit 5b), the amount of proposed critical habitat within the impact area is also small (4.56%), and as a result a large proportion of the PBFs in the subunit will be unaffected and available for the CD. None of the affected habitat in the Gauley River or Stony Creek systems will be rendered permanently unsuitable as a result of the project.

As we have concluded that the PBFs are unlikely to experience significant alterations, there will be no reduction in the conservation role of individual critical habitat subunits or the conservation role of critical habitat as a whole.

CONCLUSION

Virginia spiraea (VASP)

We considered the current overall stable rangewide status of VASP and the similar condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the VASP. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the VASP.

Roanoke logperch (RLP)

We considered the current overall improving rangewide status of RLP and the stable condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the RLP. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the RLP.

Candy darter (CD)

We considered the current overall declining rangewide status of CD and the similar condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, the species as a whole, and proposed critical habitat. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the CD. As stated in the Adverse Modification Analysis, we concluded that the PBFs are unlikely to experience significant alterations and, as a result, there will be no reduction in the conservation role of individual critical habitat subunits or the conservation role of critical habitat as a whole. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the CD. It is the Service's conference opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to destroy or adversely modify proposed critical habitat.

Indiana bat (Ibat)

We considered the current overall declining status of the Ibat and the anticipated similar condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. These types of effects of the proposed action are not currently considered primary factors influencing the status of the species. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the Ibat. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the Ibat.

Northern long-eared bat (NLEB)

We considered the current overall declining rangewide status of NLEB and the anticipated similar condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. These types of effects of the proposed action are not currently considered primary factors influencing the status of the species. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the NLEB. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the NLEB.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this ITS.

The measures described below are nondiscretionary, and must be undertaken by FERC so that they become binding conditions of any grant or permit issued to Mountain Valley, as appropriate, for the exemption in Section 7(o)(2) to apply. FERC has a continuing duty to regulate the activity covered by this ITS. If FERC: (1) fails to assume and implement the terms and conditions or (2) fails to require Mountain Valley to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, FERC or Mountain Valley must report the progress of the action and its impact on the species to the Service as specified in the ITS [50 CFR 402.14(i)(3)].

The NJF described and analyzed above in the Effects of the Action and Jeopardy Analysis sections likely would not exist but for the proposed action and are reasonably certain to occur. However, these NJF do not come under the jurisdiction of FERC. Additionally, these NJF are not part of Mountain Valley's proposed MVP. For each of these NJF, Mountain Valley has requested or will request service from a local utility company, and that company plans, designs, and constructs the facility without Mountain Valley's involvement. Because FERC and Mountain Valley do not have discretion or control over these NJF, any incidental take resulting from these NJF is not included in the ITS below. The project proponent for each NJF will need to obtain incidental take coverage by coordinating with the Service (and any associated federal agency) to receive a separate ITS or ESA Section 10 incidental take permit.

On January 14, 2016, the Service published a final species-specific rule pursuant to Section 4(d) of the ESA for the NLEB (50 CFR §17.40(o)), which became effective February 16, 2016. The Section 4(d) rule defines prohibited take of the NLEB, which is limited to certain circumstances and activities. The majority of incidental take of the NLEB that may occur from the proposed action is not considered prohibited take under the NLEB 4(d) rule. Therefore, that incidental take does not require exemption from the Service. However, any incidental take associated with 15.64 acres of habitat removal within 0.25 mile of 3 known hibernacula and an overlapping maternity colony is addressed below.

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service analyzed the effects to the species above.

Roanoke logperch (RLP)

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of adult RLP. This numerical estimate provides a clear limit on the incidental take of adult RLP anticipated and authorized in this Opinion. However, because the anticipated incidental take of YOY and juvenile RLP cannot practicably be expressed in terms of a specific number of individuals for the reasons stated in the Effects of the Action section, and based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional, alternative means of monitoring take of RLP. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of adult RLP specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

The numerical estimate of incidental take of adult RLP was calculated based on an estimate of 3,139 RLP within the impact areas outside of the impoundment areas created for specific river crossings (see calculations in Effects of the Action section). In the Effects of the Action section, we explained why the number of YOY and juvenile RLP within the impact area cannot practicably be estimated, and that discussion is incorporated here by reference. All 3,139 adult RLP within the impact areas and any YOY or juveniles within the impact areas (estimated to be 14.9% of the YOY and juveniles present in the Roanoke River system and 6.7% of the YOY and juveniles present in the Pigg River system), are expected to be affected by the proposed action and at most, 3 RLP are expected to be entrained in impoundments associated with specific river crossings. For those crossings, we anticipate the majority of RLP will be removed and relocated downstream of cofferdam placement, as described in the Effects of the Action section for RLP. Within the Roanoke and Pigg River systems 24.3 km are expected to be impacted through water quality and habitat degradation. Incidental take of adult RLP accounts for the take for any subsequent egg production. The incidental take is expected to be in the form of harm, including lethal harm in some instances. The anticipated take is described in Table 31. In the preceding Opinion, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the RLP.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual RLP for the following reasons: the RLP has a small body size making it difficult to locate, which makes encountering dead or injured individuals unlikely; scavengers may consume the carcass or the carcass may be swept downstream; losses may be masked by annual fluctuations in numbers; take may occur offsite (e.g., a RLP may die outside of the impact area) and would not be detected; and most of the anticipated take including non-lethal injury of individual RLP is not directly observable.

We expect incidental take of RLP in the form of harm or kill resulting from entrainment due to cofferdam dewatering and stream diversion for the open-cut crossings of North Fork Roanoke River, Bradshaw Creek, and Harpen Creek. River bottom disturbance is being used as a surrogate to monitor the extent of authorized take related to installing and removing cofferdams because it is not practical to monitor take-related impacts in terms of individuals. We calculated the area impacted (i.e., wetted width of the waterbody by the construction ROW width) for cofferdam placement and removal: North Fork Roanoke River 1 (22 m x 22.86 m) = 502.92 m^2; Bradshaw Creek 1 (6 m x 22.86 m) = 137.16 m^2; Harpen Creek 1 (5 m x 22.86 m) = 114.3 m^2; Total = 754.38 m^2. The 754 m^2 of river bottom disturbance sets a clear, enforceable standard, and river bottom disturbance related to installing and removing cofferdams outside of that specific area exceeds take. The surrogate for monitoring anticipated take is described in Table 31.

We expect incidental take of RLP in the form of harm (including lethal harm in some instances) resulting from exposure to degraded surface water quality and elevated turbidity and sedimentation during construction. The impact areas in which project-related SSC/turbidity levels are expected to exceed one or more of the take thresholds described below are being used as a surrogate to express and monitor the extent of authorized take for the RLP related to clearing trees, shrubs, and herbaceous vegetation, grading, trenching, regrading, graveling, installing and removing cofferdams, crossing RLP waterbodies, constructing, upgrading, and maintaining ARs, and ROW repair, regrading because it is not practical to express the number of affected YOY and juveniles numerically or to monitor take-related impacts in terms of individuals. These impact areas are described in the Effects of the Action section and depicted in Appendix D Figures 1 and 2. The level of anticipated, authorized take of RLP expressed using this surrogate will be exceeded if implementation of the procedures set forth in the monitoring plan (Appendix F) indicates that project-related SSC/turbidity levels cause an exceedance of any of the following thresholds described in Figure 1 of Muck (2010) at the downstream limit of any of the impact areas depicted in Appendix D Figures 1 and 2:

- 148 mg/L sediment concentration above background at any time; or
- 99 mg/L sediment concentration above background for more than 1 hour, continuously; or
- 40 mg/L sediment concentration above background for more than 3 hours, continuously; or
- 20 mg/L sediment concentration above background for more than 7 hours, continuously

Because the SSC/turbidity levels measure the conditions that result in take, a clear causal link exists between the surrogate and take of the listed species.

SSC and embeddedness are different parameters to assess the habitat quality for fish although both impact fish health in slightly different ways. However, measuring SSC due to sedimentation can be measured in real-time, while embeddedness is more of a delayed response. Moreover, measuring SSC is a standard monitoring approach, and can be correlated to impacts to fish. Furthermore, as discussed in the Effects of the Action section above, the impact area defined based on open-cut crossings or using the TSS concentration threshold of $\geq$20 mg/L above background (e.g., mixing zone and additional stream segments downstream of mixing zones) encompasses the stream reaches in which harm to RLP from project-related increases in embeddedness is reasonably certain to occur.

Furthermore, although several studies have measured embeddedness, a standard technique to measure embeddedness does not yet exist, see Sylte and Fischenich (2002) for a summary of different methods. That study also listed additional limitations to using embeddedness as a comparison measure such as:

- "Cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes (Potyondy 1988 [*in* Sylte and Fischenich 2002]);
- Repeat monitoring must be conducted at the same site because of high instream variability (Munther and Frank 1986, Potyondy 1988 [*in* Sylte and Fischenich 2002]); and
- Application of the method in streams <6.1 m (20 ft) wide may destroy sites for future monitoring (Potyondy 1988 [*in* Sylte and Fischenich 2002])."

Kramer (1989 *in* Sylte and Fischenich 2002) identified limitations to the embeddedness measuring methods developed by Burns (1984 *in* Sylte and Fischenich 2002) and Skille and King (1989 *in* Sylte and Fischenich 2002) and pointed out that after a certain point embeddedness does not accurately reflect stream bottom conditions. Kramer (1989 *in* Sylte and Fischenich 2002) found that the percent embeddedness decreased with increasing fines when rocks became 100% embedded because they were then excluded from being measured. Similar to this concept is that the rate of substrate embeddedness will depend not only on new inputs, but also on the amount of existing fine sediment in the interstitial spaces, thus an already embedded habitat has less capacity to accept new sediment deposits, which complicates estimation of project impacts (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Another confounding issue is unlike suspended sediments, which is generally homogenous throughout the water column, embeddedness may be unpredictably heterogeneous due to depth and variation in velocity. This unpredictably may make establishing a pre-project baseline condition difficult to establish and statistical changes difficult to detect (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Similar to the limitations Potyondy (1988 *in* Sylte and Fischenich 2002) identified regarding sampling intensity, surveying small areas for a dam operation change did not seem sufficient to adequately reflect the overall conditions of the stream (P. Shute, retired Service employee, email to C. Schulz, Service, May 11, 2020). Due to these limitations, USFS does not routinely use embeddedness to monitor streambed conditions (Potyondy and Sylte 2008, Sylte and Fischenich 2002). While Rosenberger and Angermeier (2003) reported microhabitat data, including embeddedness, in RLP habitat in the Roanoke and Nottoway rivers, we cannot correlate it to impact thresholds. Absent standard methodologies to measure increases in embeddedness in real time and the ability to correlate those measures to impacts to darters, measuring SSC/turbidity is the most feasible approach to monitor take.

The anticipated take is described in Table 31 below.

Table 31. RLP amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (Surrogate)	Amount of Take Anticipated (Individuals)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
RLP	754 m^2 of river bottom disturbance	3	All	Harm	Entrainment due to cofferdams or stream diversion
RLP	The impact areas in which project-related SSC/ turbidity is expected to exceed one of the thresholds described above. See Appendix D Figures 1 and 2.	3,138 adult RLP and 14.9% of YOY/juvenile RLP present in the Roanoke River system and 6.7% of YOY/ juvenile RLP present in the Pigg River system.	All	Harm	Habitat alteration from instream structure placement and removal, streambank vegetation clearing/trimming, and upland vegetation clearing, trenching, and grading during construction and O&M subactivities. Exposure to degraded surface water quality and elevated turbidity and sedimentation from construction activities.

Candy darter (CD)

The Service has reviewed available data and is unable to quantify and numerically express anticipated incidental take of CD. For Stony Creek, Leftwich et al. (1996) calculated densities ranging 0-30 CD per 100 m^2 with the highest densities found in riffles, with an average of 10 CD/100 m^2. With a lack of data on specific habitat types throughout Stony Creek, the density estimates are not suitable for generating reliable estimates of absolute abundance. Further, data from Leftwich et al. (1996) is based on collections from 1995, which is not recent enough to reliably use for an assessment of current condition. More recently, McBaine and Hallerman (2020) attempted to calculate CD population abundances in Stony Creek using mark recapture data, but found that low recapture rates for CD resulted in low precision for abundance and survival estimates. The estimates for abundance within the survey reach at the Lower Stony Creek site by McBaine and Hallerman (2020) are based on Cormack Jolly-Seber mark-recapture models and indicate abundance estimates with 95% confidence intervals (CI) (the 95% CI defines a range of values with a 95% probability of containing the true population mean). The Lower Stony Creek population estimate was approximately 800 individuals (95% CI = 0 – 1,850 individuals) for summer 2016, 800 individuals (95% CI = 0 – 1,850 individuals) for spring 2017, and <20 individuals (no CI provided) for summer 2017. The wide variability in these successive population estimates, taken together with the caveats from the authors about low precision resulting from low recapture rates, indicate that this data should not be used to estimate population abundances for CD in Stony Creek for this Opinion. While recent CPUE-based measures are available for CD populations in Stony Creek from both McBaine and Hallerman (2020) and Dunn (2013), these are measures of relative abundance and are not suitable for generating reliable estimates of absolute abundance. Similar surveys have not been conducted for the Gauley River. Therefore, there is no data available for generating reliable abundance estimates for CDs within the Gauley River, and such data cannot be readily obtained. Because impacts to the CD from project activities are expected to occur via water quality degradation (e.g., sedimentation, turbidity, and impacts to prey), they are expected to affect all CDs present within the impact area. Thus, quantifying the specific number of individuals affected is not practicable. Therefore, the Service uses a surrogate to provide an alternative means of expressing and monitoring take of CD. Reinitiation of consultation will be triggered if the incidental take from the project exceeds the surrogates specified below.

The Service has conducted 1 formal consultation for the CD and also did not calculate number of individuals for incidental take from "habitat degradation stemming from the effects of sedimentation during in-water project repairs in the Williams River and from in-stream rock placement in the Williams River and sandbag placement during channel diversions" (D. Carlson Bremer, Service, letter to K. Rose, Federal Highway Administration, August 9, 2019). In these cases, a surrogate for take, in terms of amount of habitat affected, was used.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

As discussed above, a numerical estimate of incidental take of CD was not calculated because data is either unavailable (Gauley River) or lacks the precision needed to generate meaningful take estimates (Stony Creek), and such data cannot be readily obtained. The wide range of population estimate CIs (0 – 1,850 individuals as described above) found by McBaine and Hallerman (2020) indicates that even with targeted efforts to estimate population size within a given reach, sufficient precision cannot be achieved. Further, considerable harm could come to CD populations if an extensive set of repeated surveys were conducted in all CD stream reaches downstream of affected areas in order to generate precise population estimates. Such methods would include repeated depletion sampling with electrofishing in all affected project reaches. The tradeoff of less numerical precision in favor of avoiding the harm of such repeated electrofishing efforts in multiple locations of the Gauley River and Stony Creek populations is in the best interest of the species. All CD within the impact area are expected to be affected by the proposed action. Within the Stony Creek and Gauley River systems 3.0 km are expected to be impacted through water quality and habitat degradation.

Surrogate for Estimating and Monitoring Anticipated Incidental Take

Use of a habitat surrogate is also appropriate for a second, independent reason: it is not practical to monitor take-related impacts in terms of individual CD for the following reasons: available data for generating quantitative estimates and incidental take limits are either unavailable or vary by orders of magnitude (making the estimates unusable), the CD has a small body size making it difficult to locate, which makes encountering dead or injured individuals unlikely; scavengers may consume the carcass or the carcass may be swept downstream; losses may be masked by annual fluctuations in numbers; take may occur offsite (e.g., a CD may die outside of the impact area) and would not be detected; and most of the anticipated take including non-lethal injury of individual CD is not directly observable.

We expect incidental take of CD in the form of harm (including lethal harm in some instances) resulting from exposure to degraded surface water quality and elevated turbidity and sedimentation during construction. The impact areas in which project-related SSC/turbidity levels are expected to exceed one or more of the take thresholds described below are being used as a surrogate to express and monitor the extent of authorized take for the CD related to clearing trees, shrubs, and herbaceous vegetation, trenching, constructing or upgrading ARs and ROW repair and regrading because it is not practical to monitor take-related impacts in terms of individuals. _These impact areas are described in the Effects of the Action section and depicted in Appendix D Figures 3, 4, and 5. The level of anticipated, authorized take of CD expressed using this surrogate will be exceeded if implementation of the procedures set forth in the monitoring plan (Appendix F) indicates that project-related SSC/turbidity levels cause an exceedance of any of the following thresholds described in Figure 1 of Muck (2010) at the downstream limit of any of the impact areas depicted in Appendix D Figures 3, 4, and 5:

- 148 mg/L sediment concentration above background at any time; or
- 99 mg/L sediment concentration above background for more than 1 hour, continuously; or
- 40 mg/L sediment concentration above background for more than 3 hours, continuously; or
- 20 mg/L sediment concentration above background for more than 7 hours, continuously

Because the SSC/turbidity levels measure the conditions that result in take, a clear causal link exists between the surrogate and take of the listed species.

SSC and embeddedness are different parameters to assess the habitat quality for fish. While both impact fish health in slightly different ways. However, measuring SSC due to sedimentation can be measured in real-time, while embeddedness is more of a delayed response. Moreover, measuring SSC is a standard monitoring approach, and can be correlated to impacts to fish. Furthermore, as discussed in the Effects of the Action section above, the impact area defined using the TSS concentration threshold of $\geq$20 mg/L above background (e.g., mixing zone and additional stream segments downstream of mixing zones) encompasses the stream reaches in which harm to CD from project-related increases in embeddedness is reasonably certain to occur.

Furthermore, although several studies have measured embeddedness, a standard technique to measure embeddedness does not yet exist, see Sylte and Fischenich (2002) for a summary of different methods. That study also listed additional limitations to using embeddedness as a comparison measure such as:

- "Cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes (Potyondy 1988 [*in* Sylte and Fischenich 2002]);
- Repeat monitoring must be conducted at the same site because of high instream

variability (Munther and Frank 1986, Potyondy 1988 [*in* Sylte and Fischenich 2002]); and

- Application of the method in streams <6.1 m (20 ft) wide may destroy sites for future monitoring (Potyondy 1988 [*in* Sylte and Fischenich 2002])."

Kramer (1989 *in* Sylte and Fischenich 2002) identified limitations to the embeddedness measuring methods developed by Burns (1984 *in* Sylte and Fischenich 2002) and Skille and King (1989 *in* Sylte and Fischenich 2002) and pointed out that after a certain point embeddedness does not accurately reflect stream bottom conditions. Kramer (1989 *in* Sylte and Fischenich 2002) found that the percent embeddedness decreased with increasing fines when rocks became 100% embedded because they were then excluded from being measured. Similar to this concept is that the rate of substrate embeddedness will depend not only on new inputs, but also on the amount of existing fine sediment in the interstitial spaces, thus an already embedded habitat has less capacity to accept new sediment deposits, which complicates estimation of project impacts (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Another confounding issue is unlike suspended sediments, which is generally homogenous throughout the water column, embeddedness may be unpredictably heterogeneous due to depth and variation in velocity. This unpredictably may make establishing a pre-project baseline condition difficult to establish and statistical changes difficult to detect (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Similar to the limitations Potyondy (1988 *in* Sylte and Fischenich 2002) identified regarding sampling intensity, surveying small areas for a dam operation change did not seem sufficient to adequately reflect the overall conditions of the stream (P. Shute, retired Service employee, email to C. Schulz, Service, May 11, 2020). Due to these limitations, USFS does not routinely use embeddedness to monitor streambed conditions (Potyondy and Sylte 2008, Sylte and Fischenich 2002). Absent standard methodologies to measure increases in embeddedness in real time and the ability to correlate those measures to impacts to darters, measuring SSC/turbidity is the most feasible approach to assess and monitor take.

The anticipated take is described in Table 32 below.

Table 32. CD amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (Surrogate)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
CD	The impact areas in which project-related SSC/turbidity is expected to exceed one of the thresholds described above. See Appendix D Figures 3, 4, and 5.	All	Harm	Habitat alteration from upland vegetation clearing, trenching, and grading during construction and O&M subactivities. Exposure to degraded surface water quality and elevated turbidity and sedimentation from construction activities.

Indiana bat (Ibat)

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of Ibat. This numerical estimate provides a clear limit on the incidental take anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional, alternative means of monitoring take of Ibat. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of Ibat specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

To conduct our jeopardy analysis, we estimated the number of Ibats harmed or killed by tree-clearing in the affected habitat categories using the best available data (see Effects of the Action section). Based on our analysis of the environmental baseline and effects of the proposed action, individuals from 4 Ibat maternity colonies and spring staging/fall swarming habitat associated with 12 Ibat hibernacula, will be impacted as a result of the MVP. The incidental take is expected to be in the form of harm or death. The anticipated take is described in Table 33. In the preceding Opinion, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the Ibat.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual Ibats for the following reasons: (1) the Ibat has a small body size, is drab in color, which makes encountering dead or injured individuals unlikely; (2) any dead or injured Ibats may be eaten or scavenged; (3) Ibats occupy summer habitats (heavily forested) where they are difficult to locate (multiple roosts located within and outside of the action area); (4) Ibats spend a substantial portion of their lifespan hibernating underground; (5) take may occur offsite (e.g., the bat dies outside of the action area); (6) starvation or failure to reproduce cannot be detected; (7) losses may be masked by fluctuations in numbers associated with WNS; and (8) the majority of tree removal has already occurred. Moreover, for several habitat categories in which tree-clearing occurs during the inactive season, take would occur only when the bats return to the area in the active season and, as a result, it is impossible to track or monitor take in real time. Furthermore, as discussed in the Environmental Baseline section, there are challenges with being able to locate and monitor individuals. Therefore, even when tree clearing occurs in the active season, available survey techniques are effective only for determining bat presence/probable absence in a particular area; they cannot be used to track in real time the number of bats that may experience lethal or sublethal take from ongoing activities. For all of these reasons, it is not practicable to monitor take-related impacts in terms of individuals of the species, requiring the use of a surrogate.

Because tree-clearing is the cause of all forms of take that are reasonably certain to result from the project, there is a clear causal link between the acres of habitat impacted and take of the Ibats. In addition, because the location, timing, and acreage of habitat impacts can be readily identified, measured, and monitored, this surrogate is the most reasonable means for monitoring the anticipated take, and for detecting when the anticipated level of take may be exceeded, thereby providing a clear trigger for reinitiating consultation. The Service therefore will use the acreage of affected habitat as a surrogate for monitoring the amount and extent of anticipate take.

The anticipated take is described in Table 33 below.

Table 33. Ibat amount and type of anticipated incidental take.

Habitat Type	Acreage Cleared	Associated Colonies or Hibernacula	Life Stage when Take is Anticipated	Type of Take	Number of Adult Female Ibats Affected	Number of Ibat Pups Affected	Types of Effects Anticipated
Known use summer (active season)	166.36[36]	1 known maternity colony	Adults/pups	Harm or Kill	1	9	Reduced survivorship or direct mortality of individuals (adults and pups) associated with occupied roost tree removal.
Known use summer (inactive season)	223.82	(Same colony as above)	Adults	Harm	1	N/A	Temporary reduced breeding success of individuals associated with loss of (and relocating) roosting, travel, and foraging habitat.
Known use summer (totals)	390.18	1 known maternity colony	N/A	N/A	2	9	See above
Unknown use summer (active season)	1,665.67[37]	3 unknown maternity colonies	Adults/pups	Harm or Kill	3 (1 per colony)	27 (9 per colony)	Reduced survivorship or direct mortality of individuals (adults and pups) associated with occupied roost tree removal.
Unknown use	269.29	(Same 3 colonies as	Adults	Harm	3 (1 per colony)	N/A	Temporary reduced breeding success of

[36] This total includes the 2.47 acres that was removed as part of the emergency Section 7 consultation and the 10.14 acres of downed trees associated with reported slips.
[37] This total includes the 4.82 acres of downed trees associated with reported slips.

summer (inactive season)		above)					individuals associated with loss of (and relocating) roosting, travel, and foraging habitat.
Unknown use summer (totals)	1,934.96	3 unknown maternity colonies	N/A	N/A	6	27	See above
Known use spring staging/fall swarming[38] (inactive season)	308.97	2 known hibernacula	Adults	Harm	8 (4 per hibernacula)	N/A	Temporary or permanent habitat loss will cause decreased breeding success (adults).
Known use spring staging/fall swarming (totals)	308.97	2 known hibernacula	N/A	N/A	8	N/A	See above
Unknown use spring staging/fall swarming (active)	580.43	10 assumed occupied hibernacula	Adults	Harm or Kill	10 (1 per hibernacula)	N/A	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal.
Unknown use spring staging/fall swarming (inactive season)	248.20	(Same 10 hibernacula as above)	Adults	Harm	40 (4 per hibernacula)	N/A	Temporary or permanent habitat loss will cause decreased breeding success (adults).
Unknown use spring staging/fall swarming (totals)	828.63	10 assumed occupied hibernacula	N/A	N/A	50	N/A	See above

<u>Northern long-eared bat (NLEB)</u>

The majority of effects have been previously addressed in the Service's January 5, 2016 programmatic BiOp implementing the 4(d) rule and any incidental take further than 0.25 mile from Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1 is not prohibited under the 4(d) rule (50 CFR §17.40(o)).

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of NLEB. This numerical estimate provides a clear limit on the incidental take anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional,

[38] Pups are not present during these timeframes.

alternative means of monitoring take of NLEB. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of NLEB specified below or exceeds, in any amount or manner, the surrogates specified below.

As explained in the preceding Opinion, take prohibited by the 4(d) rule is anticipated to have occurred as a result of the clearing of 15.64 acres within 0.25 miles of three known hibernacula. All of this tree clearing has already been completed. Therefore, clearing of any additional areas within 0.25 miles of any of the hibernacula, or any other modification of the proposed action that is likely to result in take prohibited by the 4(d) rule, will be considered to have exceeded the surrogate level of take expressed below and will require reinitiation of consultation.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

To conduct our jeopardy analysis, we estimated the number of NLEB harmed by tree-clearing (see Effects of the Action section). The anticipated take within 0.25 mile of the 3 known hibernacula and an overlapping maternity colony is described in Table 34 below. The incidental take is expected to be in the form of harm. In the preceding Opinion, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the NLEB.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual NLEB for the following reasons: (1) the NLEB has a small body size, is drab in color, which makes encountering dead or injured individuals unlikely; (2) any dead or injured NLEB may be eaten or scavenged; (3) NLEB occupy summer habitats (heavily forested) where they are difficult to locate (multiple roosts located within and outside of the action area); (4) NLEB spend a substantial portion of their lifespan hibernating underground; (5) take may occur offsite (e.g., the bat dies outside of the action area); (6) starvation or failure to reproduce cannot be detected; (7) losses may be masked by fluctuations in numbers associated with WNS; and (8) the majority of tree removal has already occurred. Moreover, take would occur only when the bats return to the area in the active season and, as a result, it is impossible to track or monitor take in real time. Furthermore, available survey techniques are effective only for determining bat presence/probable absence in a particular area; they cannot be used to track in real time the number of bats that may experience lethal or sublethal take from ongoing activities. For all of these reasons, it is not practicable to monitor take-related impacts in terms of individuals of the species, requiring the use of a surrogate.

Because tree-clearing is the cause of all forms of take that are reasonably certain to result from the project, there is a clear causal link between the acres of habitat impacted and take of the NLEB. In addition, because the location, timing, and acreage of habitat impacts can be readily identified, measured, and monitored, this surrogate is the most reasonable means for monitoring the anticipated take and for detecting when the anticipated level of take may be exceeded, thereby providing a clear trigger for reinitiating consultation. The Service therefore will use the acreage of affected habitat as a surrogate for monitoring the amount and extent of anticipated take.

The anticipated take within 0.25 mile of the 3 known hibernacula and an overlapping maternity colony is described in Table 34 below.

Table 34. NLEB amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (Individuals)	Amount of Take Anticipated (Surrogate)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
NLEB	28 adults (1 adult female within maternity colony and 9 adults per hibernacula [27 adults])	15.64 acres	Adults	Harm	Temporary reduced reproduction (reduced breeding success) of individuals (within spring staging/fall swarming habitat surrounding 3 known hibernacula and an overlapping maternity colony) associated with loss of (and relocating) roosting and foraging habitat. Temporary or permanent habitat loss will cause temporary decreased breeding success.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impact of the take.

Roanoke logperch (RLP)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the RLP.
- Conduct construction in a manner that minimizes disturbance to RLP.
- Minimize and monitor incidental take caused by elevated SSC/turbidity and sedimentation due to construction activities.

Candy darter (CD)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the CD.
- Minimize and monitor incidental take caused by elevated SSC/turbidity and sedimentation due to construction activities.

Indiana bat (Ibat)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the Ibat.
- Finalize the Braxton County conservation property preservation.
- Finalize the Memorandum of Understanding regarding federally listed bat mitigation.
- Submit site-specific plans for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula.
- Conduct future tree removal activities outside of critical spring staging/fall swarming periods in unknown use spring staging/fall swarming habitat.

Northern long-eared bat (NLEB)

- Finalize the Braxton County conservation property preservation and the Memorandum of Understanding regarding federally listed bat mitigation.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, FERC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

Roanoke logperch (RLP)

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the RLP, special provisions necessary to protect the RLP, activities that may affect the RLP, and ways to avoid and minimize these effects. This information can be obtained by reading RLP-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. Use the most non-lethal technique first when removing fish from the instream workspaces.
3. Construct cofferdams (North Fork Roanoke River 1, Bradshaw Creek, and Harpen Creek) using non-erodible materials. Remove cofferdams in their entirety upon project completion.
4. Fill any sandbags used in cofferdams with clean sand and no other materials. All sandbags must be new with no prior use and must be removed at the time of cofferdam removal.

5. Build cofferdams to a height, strength, and configuration to resist no less than normal peak daily flows. All construction within suitable habitat for the species must take place outside of the RLP TOYR.
6. Minimize instream (North Fork Roanoke River, Bradshaw Creek, and Harpen Creek) foot traffic during construction.
7. Vehicles or construction equipment may not enter North Fork Roanoke River, Bradshaw Creek, and Harpen Creek, except within cofferdams.
8. Inspect all vehicles for leaks immediately prior to instream or cofferdam work (North Fork Roanoke River, Bradshaw Creek, and Harpen Creek). Repair any leaks and clean construction vehicles thoroughly to remove any residual dirt, mud, debris, grease, motor oil, hydraulic fluid, coolant, or other hazardous substances from construction vehicles. Inspections, repairs, cleaning, and/or servicing will be conducted either before the vehicle, equipment, or machinery is transported into the field or at the work site within the staging area. All wash-water runoff and/or harmful materials will be appropriately controlled to prevent entry into the waterbody, including the riparian zone.
9. Adhere to the monitoring and reporting requirements for the RLP detailed below.

<u>Candy darter (CD)</u>

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the CD, special provisions necessary to protect the CD, activities that may affect the CD, and ways to avoid and minimize these effects. This information can be obtained by reading CD-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. Construct cofferdams in CD watersheds (Stony Creek and Gauley River) using non-erodible materials. Remove cofferdams in their entirety upon project completion.
3. Fill any sandbags used in cofferdams with clean sand and no other materials. All sandbags must be new with no prior use and must be removed at the time of cofferdam removal.
4. Build cofferdams to a height, strength, and configuration to resist no less than normal peak daily flows.
5. Inspect all vehicles for leaks immediately prior to instream work in CD watersheds (Stony Creek and Gauley River). Repair any leaks and clean construction vehicles thoroughly to remove any residual dirt, mud, debris, grease, motor oil, hydraulic fluid, coolant, or other hazardous substances from construction vehicles. Inspections, repairs, cleaning, and/or servicing will be conducted either before the vehicle, equipment, or machinery is transported into the field or at the work site within the staging area. All wash-water runoff and/or harmful materials will be appropriately controlled to prevent entry into the waterbody, including the riparian zone.
6. Adhere to the monitoring and reporting requirements for the CD detailed below.

<u>Indiana bat (Ibat)</u>

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the Ibat, special provisions necessary to protect the Ibat, activities that may affect the Ibat, and ways to avoid and minimize

these effects. This information can be obtained by reading Ibat-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. A mechanism for preservation of the Braxton County conservation property must be in place prior to completion of project construction or on a date mutually agreed upon with the Service. Contact the WVFO (tiernan_lennon@fws.gov) regarding Service approval.
3. Finalize the Memorandum of Understanding regarding federally listed bat mitigation prior to the completion of project construction. Contact the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov) regarding Service review and approval.
4. Prior to initiation of any blasting activities within 0.5 mile of any known or assumed occupied hibernacula, Mountain Valley will provide site-specific blasting plans to the Service and FERC for review and approval.
5. Avoid conducting future tree removal activities within unknown use spring staging/fall swarming habitat during April and October.
6. Adhere to the monitoring and reporting requirements for the Ibat detailed below.

Northern long-eared bat (NLEB)

1. A mechanism for preservation of the Braxton County conservation property must be in place prior to completion of project construction or on a date mutually agreed upon with the Service. Contact the WVFO (tiernan_lennon@fws.gov) regarding Service review and approval.
2. Finalize the Memorandum of Understanding regarding federally listed bat mitigation prior to the completion of project construction. Contact the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov) regarding Service review and approval.
3. Adhere to the monitoring and reporting requirements for the NLEB detailed below.

MONITORING AND REPORTING REQUIREMENTS

Care must be taken in handling any dead specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead specimen, notify the Service's VA Law Enforcement Office at 804-771-2883 and VAFO at the phone number provided below or at 804-693-6694.

Roanoke logperch (RLP)

1. Any high water event that disturbs the construction site that introduces sediment or other materials, including failure or overtopping of cofferdams or disturbance of a bridge over RLP occupied streams, must be reported to the Service at the contact phone number/email address below within 24 hours.

2. Any spills of motor oil, hydraulic fluid, coolant, or similar fluids, not contained before entry into the action area, must be reported to the Service at the contact number/email provided below and National Response Center (800-424-8802) immediately.
3. Conduct a RLP habitat assessment at North Fork Roanoke River, Bradshaw Creek and Harpen Creek crossings 6 months after construction activities related to the crossing are completed to assess the status of the RLP habitat. If the habitat assessment indicates RLP habitat has not been restored, conduct an additional habitat assessment in 6 months. Habitat assessments will be conducted within the ROW and 200 m upstream and 800 m downstream of each crossing site by a qualified surveyor(s). Provide a report containing raw data and summarized information from the habitat assessments at each site to the VAFO (sumalee_hoskin@fws.gov) within 30 days of completion of each habitat assessment.
4. Implement and adhere to the provisions of the monitoring plan detailed in Appendix F.
5. FERC or the applicant shall notify the Service regarding the projected and actual start dates, progress, and completion of instream construction and verify that 754 m^2 of river bottom disturbance was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the VAFO at sumalee_hoskin@fws.gov.
6. After review and approval by FERC and the Service, Mountain Valley may discontinue monitoring, detailed in Appendix F, when sufficient vegetation has been re-established along the ROW within RLP watersheds to prevent any likelihood of adverse effects on RLP from turbidity/sedimentation (e.g., during the first growing season in the next calendar year after re-establishment of vegetation).
7. In addition to complying with the notification requirements detailed in the monitoring plan (Appendix F), FERC or the applicant shall submit a monthly report to the VAFO at sumalee_hoskin@fws.gov, on or before the 15th of each month until the month after monitoring has been terminated, summarizing the prior month's activities under the monitoring plan and providing any monitoring data that has not previously been provided. The report shall document any refinements to the NTU conversions that will initially be based on Hyer et al. (2015), and shall identify the site-specific SSC data that form the basis for those refinements.
8. Within 6 months of the termination of monitoring (Appendix F), Mountain Valley shall submit a draft report to FERC and the Service summarizing the monitoring data, with statistical analysis of the monitoring data. FERC, Mountain Valley, and the Service will agree to the contents of this report prior to submission of the draft report. A final report will be submitted within 3 months following receipt of comments on the draft report.

<u>Candy darter (CD)</u>

1. Any high water event that disturbs the construction site that introduces sediment or other materials, including failure or overtopping of cofferdams, within the CD watershed must be reported to the Service at the contact phone number/email address below within 24 hours.
2. Any spills of motor oil, hydraulic fluid, coolant, or similar fluids, not contained before entry into the action area, must be reported to the Service at the contact number/email provided below and National Response Center (800-424-8802) immediately.

3. Implement and adhere to the provisions of the monitoring plan detailed in Appendix F.
4. FERC or the applicant shall notify the Service regarding the projected and actual start dates, progress, and completion of instream construction and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the VAFO at jordan_richard@fws.gov.
5. After review and approval by FERC and the Service, Mountain Valley may discontinue monitoring, detailed in Appendix F, when sufficient vegetation has been re-established along the ROW within CD watersheds to prevent any likelihood of adverse effects on CD from turbidity/sedimentation (e.g., during the first growing season in the next calendar year after re-establishment of vegetation).
   In addition to complying with the notification requirements detailed in the monitoring plan (Appendix F), FERC or the applicant shall submit a monthly report to the VAFO at jordan_richard@fws.gov, on or before the 15th of each month until the month after monitoring has been terminated, summarizing the prior month's activities under the monitoring plan and providing any monitoring data that has not previously been provided. The report shall document any refinements to the NTU conversions that will initially be based on Hyer et al. (2015), and shall identify the site-specific SSC data that form the basis for those refinements.
6. Within 6 months of the termination of monitoring (Appendix F), Mountain Valley shall submit a draft report to FERC and the Service summarizing the monitoring data, with statistical analysis of the monitoring data. FERC, Mountain Valley, and the Service will agree to the contents of this report prior to submission of the draft report. A final report will be submitted within 3 months following receipt of comments on the draft report.

Indiana bat (Ibat)

1. FERC or the applicant shall notify the Service regarding the projected and actual re-start dates, progress, and completion of the project and verify that the acres of clearing identified in Table 33 was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov).
2. Monitor Ibat activity around Greenville Saltpeter Cave and Tawney's Cave to determine effects to Ibats in the fall swarming/spring staging areas. Two weeks prior to the start of tree clearing place acoustic monitors outside the entrance of each cave. Monitors will remain in place until completion of 2 hibernating seasons post-construction. Provide a report including the raw acoustic data every year on January 30 to the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov).

Northern long-eared bat (NLEB)

1. FERC or the applicant shall notify the Service regarding the projected and actual re-start dates, progress, and completion of the project and verify that the 15.64 acres of clearing was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov).
2. Monitor NLEB activity around Canoe Cave, Tawney's Cave, and PS-WV3-Y-1 to

determine effects to NLEBs in the fall swarming/spring staging areas. Two weeks prior to the start of tree clearing place acoustic monitors outside the entrance of each cave. Monitors will remain in place until completion of 2 hibernating seasons post-construction. Provide a report including the raw acoustic data every year on January 30 to the WVFO (tiernan_lennon@fws.gov) and VAFO (sumalee_hoskin@fws.gov).

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Virginia spiraea (VASP)

- Permanently protect habitat for the Greenbrier River VASP population.
- Assist with breeding ecology (seed viability/pollinators/compatibility) and genetic diversity research efforts.

Roanoke logperch (RLP)

- Fund or conduct projects to identify and remove manmade barriers to fish passage that will benefit RLP.
- Continue to work with the VAFO (sumalee_hoskin@fws.gov) to identify appropriate restoration efforts.

Candy darter (CD)

- Conduct activities to reduce sedimentation:
    - Utilizing enhanced BMPs designed to reduce sedimentation, erosion, and bankside destruction when implementing construction and forestry projects.
    - Avoiding or reducing other watershed activities that release sediments, pollutants, or nutrients into the water or that result in instream disturbances.
- Conduct activities to reduce potential spills and discharges including:
    - Rerouting roads away from riparian corridors.
    - Constructing or reconstructing guard rails in areas adjacent to streams.
    - Modifying drainage systems at stream crossings or impervious cover so that discharges or spills are directed away from streams.
    - Locating or relocating facilities that could result in spills away from CD streams.
    - Developing spill prevention and response plans.
- Additional landscape level conservation planning will help refine and effectively implement the overall recovery strategy. Activities include:
    - Encouraging voluntary stewardship such as through watershed group, stream monitoring, etc.
    - Working with project proponents through ESA Section 7 consultations, to avoid,

minimize, and mitigate for potential adverse effects to CD and its habitat.

Indiana bat (Ibat)

- Fund research on understanding/controlling and mitigating the effects of WNS.
- Fund research to improve knowledge of Ibat use of suitable habitat in VA and WV.
- Plant native trees with exfoliating bark in the temporary construction ROW to replace those that were cleared. Contact the VAFO (sumalee_hoskin@fws.gov) and WVFO (tiernan_lennon@fws.gov) for area-specific recommendations.
- Conduct mist-net surveys and telemetry studies within 5 miles of the location of the pregnant female Ibat captured in Wetzel County, WV to identify occupied roost trees.
- Conduct surveys and telemetry studies within the action area to determine if unknown maternity colonies are present.
- Coordinate with the WVDNR to purchase and protect critical entrances of Greenville Saltpeter Cave.
- Implement habitat enhancement measures (e.g., erect artificial roost structures, create vernal pools, girdle trees, etc.) on the Braxton County conservation property. Develop a site specific plan for the conservation property that includes: a description of the quality of the habitat; extent and location of on-site enhancements; and a long-term management plan. Conduct bat monitoring on the property to document use by bats. Contact the WVFO (tiernan_lennon@fws.gov) for specific recommendations.

Northern long-eared bat (NLEB)

- Fund research on understanding/controlling and mitigating the effects of WNS.
- Permanently protect parcels with documented roosts or hibernacula.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the reinitiation request. As provided in 50 CFR 402.16, reinitiation of consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the ITS is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

You may ask the Service to confirm the CnOp as a BiOp issued through formal consultation if the CD critical habitat is designated. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the CnOp as the BiOp on the project and no further Section 7 consultation will be necessary.

After designation of critical habitat for CD and any subsequent adoption of this CnOp, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this CnOp; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this CnOp; or (4) a new species is listed or critical habitat designated that may be affected by the action.

Any information provided to the Service on or after July 9, 2020, was not considered in this Opinion. The Service strongly recommends that any changes or modifications to construction or restoration plans and/or any other information that may affect listed species or their critical habitat provided to the Service on or after July 9, 2020, be summarized and provided to the Service to ensure reinitiation of consultation is not necessary prior to commencing work.

If you have any questions regarding this Opinion or our shared responsibilities under the ESA, please contact me at (804) 824-2426 or via email at cindy_schulz@fws.gov.

Sincerely,

Cynthia A Schulz

Date: 2020.09.04 11:01:52 -04'00'

Cindy Schulz
Field Supervisor
Virginia Ecological Services

Enclosures

cc: Corps, Norfolk, VA (Attn: William Walker)
FERC, Washington, DC (Attn: James Martin)
NPS, Spruce Pine, NC (Attn: Lillian McElrath)
USFS, Roanoke, VA (Attn: Joby Timm)
VDACS, Richmond, VA (Attn: Keith Tignor)
VDCR-DNH, Richmond, VA (Attn: Jason Bulluck)
VDGIF, Richmond, VA (Attn: Becky Gwynn)
WVDNR, Elkins, WV (Attn: Cliff Brown)
MVP, Canonsburg, PA (Attn: Megan Neylon)

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NLEB
N/A

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CD Proposed Critical Habitat
N/A

Conclusion
N/A

Amount or Extent of Take Anticipated

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<u>Ibat</u>
N/A

<u>NLEB</u>
N/A

<u>Terms and Conditions</u>
N/A

Monitoring and Reporting Requirements
N/A

Conservation Recommendations
N/A

Appendix A. Consultation History.

10-13-14	Mountain Valley sent the Service an introductory letter regarding MVP.
04-03-15	VAFO sent a letter to ESI providing comments on MVP VA segments.
04-17-15	FERC issued a Notice of Intent to prepare an EIS for the planned MVP.
10-23-15	FERC provided notification that Mountain Valley filed its certificate application and attached an EIS schedule.
11-13-15	Mountain Valley sent a letter to the Service submitting notification of intent to initiate formal consultation.
02-01-16	Mountain Valley submitted the draft BA to the Service.
03-08-16	VAFO sent a letter to ESI providing recommendations for MVP and surveys in VA.
04-07-16	The Service met with Mountain Valley and ESI to discuss the draft BA.
04-20-16	ESI sent a letter to VAFO responding to the Service’s March 8, 2016 letter.
06-24-16	Mountain Valley submitted the updated BA to the Service.
06-28-16	FERC issued a Notice of Schedule for Environmental Review of MVP.
09-27-16	FERC published a Notice of Availability of the Draft EIS for the proposed MVP.
09-28-16	FERC issued the Draft EIS for the projects proposed by Mountain Valley and Equitrans LP.
10-25-16	Mountain Valley submitted the updated BA to the Service.
03-31-17	FERC issued a Notice of Revised Schedule for Environmental Review of MVP.
05-18-17	Mountain Valley filed responses to data requests and comments on the draft BA.
06-23-17	FERC issued a Notice of Availability of the FEIS for MVP.
07-10-17	FERC sent a letter to the Service requesting initiation of formal consultation and submitting the BA.
07-27-17	Mountain Valley sent a letter to FERC filing Supplemental Information to the BA.
08-04-17	The Service sent a letter to FERC initiating formal consultation.

09-01-17 Mountain Valley provided their Upland Forest Impact Assessment and Voluntary Mitigation Plan.

09-08-17 The Service sent a letter to FERC regarding Mountain Valley's final Migratory Bird Conservation Plan.

11-08-17 Mountain Valley sent a letter to the Service providing avoidance and minimization measures for SWP and VASP.

11-21-17 The Service issued a non-jeopardy BiOp to FERC for MVP.

05-21-18 SELC sent a letter to FERC stating that FERC must enforce the terms of its order and prohibit pipeline construction until the Service approves of the pipeline route by completing Section 7 consultation and issuing a statement concerning incidental take.

05-22-18 Sierra Club sent a letter to FERC requesting reinitiation of formal consultation on MVP.

06-06-18 The Service sent a letter to FERC regarding Mountain Valley's May 30, 2018 requested approval to clear trees in 2 areas of the Jefferson National Forest between June 1 and July 31, 2018.

03-29-19 Mountain Valley sent a letter to FERC providing information about landslide conditions along MVP corridor so that FERC may consider initiating emergency consultation with the Service under Section 7 of the ESA.

03-29-19 FERC sent a letter to the Service requesting expedited consultation under the ESA using the emergency consultation procedures specified at 50 CFR §402.05.

04-03-19 FERC posted correspondence to the FERC docket regarding MVP and emergency Section 7 consultation.

04-12-19 The Service sent a letter to FERC providing a list of questions and information/data needs to assist FERC and the Service in determining how best to proceed under the ESA regarding certain activities related to MVP.

05-01-19 Sierra Club sent a letter to the Service stating that "the Service must reinitiate consultation; update its analysis to account for new information regarding the manner and extent of impacts on imperiled species; and remedy its defective ITS."

05-22-19 The Service sent a letter to Sierra Club indicating that the Service is currently engaging with FERC to determine whether reinitiation of our consultation under the ESA may be appropriate and that we do not believe yellow lance are present in the area affected by MVP such that consultation is required.

07-02-19	Mountain Valley emailed the Service providing a response to the Service's April 12, 2019 data request.
08-12-19	Sierra Club sent a letter to the Service requesting the Service stay its November 21, 2017 BiOp and ITS for MVP.
08-13-19	Wild Virginia et al. petitioned the U.S. Court of Appeals for the 4th Circuit for review of the Service's November 21, 2017 BiOp and ITS to FERC for MVP.
08-15-19	Mountain Valley sent FERC and the Service a letter indicating voluntary suspension of certain activities for MVP.
08-15-19	The Service sent Sierra Club a letter indicating that an administrative stay of the 2017 BiOp and ITS is not necessary at this time to avoid adverse effects to listed species.
08-21-19	Sierra Club filed a motion for stay of the Service's 2017 BiOp and ITS in the U.S. Court of Appeals for the 4th Circuit.
08-28-19	FERC sent a letter to the Service requesting to reinitiate consultation.
09-11-19	The Service sent FERC a letter accepting FERC's August 28, 2019 letter requesting reinitiation of Section 7 consultation, pursuant to the ESA on MVP.
10-01-19	Sierra Club sent a letter to FERC requesting that FERC enforce Environmental Conditions 9 and 28 by issuing a stop work order halting all construction activities, and by suspending all notices to proceed for MVP.
10-15-19	FERC issued a letter to Mountain Valley notifying them that that construction activity along all portions of MVP and in all work areas must cease immediately, with the exception of restoration and stabilization of the ROW and work areas.
10-16-19	The Service sent FERC a letter requesting additional data/information.
11-19-19	The Service, FERC, USGS, and Mountain Valley met to discuss technical issues.
11-27-19	Mountain Valley sent a letter to FERC responding to the Service's October 16, 2019 request for information.
12-10-19	The Service sent a letter to FERC documenting the agreement between the Service and FERC to extend the consultation period by 60 days to February 10, 2020.

12-18-19	Mountain Valley sent a letter to FERC and the Service responding to SELC's October 18, 2019 regarding the Atlantic Coast Pipeline project and several assertions about MVP.
12-31-19	Mountain Valley sent a letter to FERC submitting a supplemental answer to the Motion for Revised Peak Stormwater Discharge Analysis filed on September 4, 2019.
02-07-20	The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 45 days until March 26, 2020.
03-25-20	The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 32 days until April 27, 2020.
04-03-20	FERC sent a letter to the Service providing an updated effects determination for SWP.
04-27-20	The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 30 days until May 27, 2020.
04-27-20	Mountain Valley submitted a SBA to the Service.
05-04-20	Mountain Valley submitted a revised SBA to the Service.
05-07-20	FERC sent a letter to the Service confirming FERC's agreement with the action area in the SBA.
05-11-20	The Service sent a letter to Mountain Valley and FERC providing comments on SBA.
05-28-20	Mountain Valley submitted a second revised SBA to the Service.
07-08-20	FERC sent a letter to the Service providing updated Section 7 determinations.
07-09-20	The Service sent a letter to FERC concurring with FERC's Section 7 determinations.
07-22-20	The Service sent a letter to FERC transmitting the Service's preliminary draft non-jeopardy/adverse modification Opinion.
08-27-20	The Service sent a letter to FERC transmitting the Service's revised draft non-jeopardy/adverse modification Opinion.

Appendix B. Species-Specific Effects Tables.

Tables 1-6 are color coded as follows:

- NE rows are green
- NLAA rows are yellow
- LAA are blue

Table 1. Analysis of effects on Virginia spiraea.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle operation and foot traffic	physical impacts to individuals, habitat alteration and/or degradation	crushing, soil compaction	vehicles	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will crush and possibly kill VASP plants and bury seeds in the construction ROW and ATWS. These activities will alter/degrade suitable habitat (changing hydrology, compacting soil, sedimentation), preventing reestablishment of VASP in the construction ROW and ATWS. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Exotic and Invasive Species Control Plan [Mountain Valley 2016], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce exposure from sedimentation and invasive plants due to vehicle operation. We anticipate that a portion of VASP stems will be crushed and VASP seeds will be buried in the construction ROW and ATWS. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	physical impacts to individuals, habitat alteration and/or degradation	burying, soil compaction, introduction of invasive species, cutting, digging up, and crushing	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will cut, dig up, bury, and/or crush VASP plants and seeds in the construction ROW and ATWS. These activities will alter/degrade suitable habitat (compacting soil, introducing invasive species, changing hydrology, sedimentation) preventing reestablishment of VASP in the construction ROW and ATWS post-construction. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. We anticipate that a portion of VASP stems will be killed and VASP seeds will be buried in the construction ROW and ATWS. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Clearing - trees and shrubs	physical impacts to individuals, habitat alteration and/or degradation	crushing, burying, digging up, cutting	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will cut, dig up, bury, and/or crush VASP plants and seeds within the construction ROW and ATWS. These activities will alter/degrade suitable habitat (compacting soil, introducing invasive species, changing hydrology, sedimentation) preventing reestablishment of VASP in the construction ROW and ATWS post-construction. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation. We anticipate that a portion of VASP stems will be killed and VASP seeds will be buried in the construction ROW and ATWS. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	habitat alteration and/or degradation	altered sunlight	NA	NA	discountable - beneficial	NA	NA	NLAA	This subactivity will occur in the construction ROW and ATWS. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. VASP is not a shade tolerant species; overtopping from arboreal species will eventually eliminate VASP. Effects from side trimming along the ROW will range from discountable to beneficial over an extended period of time.
New Disturbance - Construction	Grading, erosion control devices	physical impacts to individuals, habitat alteration and/or degradation, temporary loss of habitat	crushing, burying, cutting roots	NA	NA	NA	NA	NA	NLAA	This subactivity will occur in the construction ROW and ATWS. Soil compaction and ground disturbance will increase surface water flow and erosion rates and alter surface and subsurface hydrology in the watershed, further degrading VASP habitat. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation; therefore, all effects are anticipated to be insignificant.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	physical impacts to individuals, habitat alteration and/or degradation, temporary loss of habitat	crushing, burying, cutting roots	NA	NA	NA	NA	NA	NLAA	This subactivity will occur in the construction ROW. Digging, blasting, dewatering, open trench, and sedimentation will increase surface water flow and erosion rates and alter surface and subsurface hydrology in the watershed, further degrading VASP habitat. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation; therefore, all effects are anticipated to be insignificant.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	neutral	none	NA	NA	NA	NA	NA	NE	The water used during hydrostatic testing will be stored, if necessary, at the discharge location. The discharge location is on the other side of the river, in an upland area not suitable for VASP.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
New Disturbance - Construction	Facilities - noise, lights	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent - grading, graveling	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	crushing, changes in hydrology, contaminants, burying, digging up	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will cut, dig up, bury, and/or crush VASP plants and seeds in the access road footprint. These activities will alter/degrade suitable habitat (compacting soil, introducing invasive species, changing hydrology, sedimentation) preventing reestablishment of VASP in the access road footprint post-construction. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. We anticipate that a portion of VASP stems will be killed and VASP seeds will be buried in the access road footprint. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent - culvert installation	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent- tree trimming and tree removal	habitat alteration and/or degradation	altered sunlight	NA	NA	discountable - beneficial	NA	NA	NLAA	This subactivity will occur along ARs. VASP is not a shade tolerant species; overtopping from arboreal species will eventually eliminate VASP. Effects from side trimming along ARs will range from discountable to beneficial over an extended period of time.
New Disturbance - Construction	Stream Crossings, flume	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Crossings, dam & pump	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossings, cofferdam	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Equipment Crossing Structures	habitat alteration and/or degradation	sedimentation, soil compaction	NA	limited to some habitat, population, few to some individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will alter/degrade suitable habitat (compacting soil, introducing invasive species, changing hydrology, sedimentation) preventing reestablishment of VASP in the access road footprint and ATWS post-construction. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. We anticipate that a portion of VASP stems will be killed and VASP seeds will be buried in the access road footprint and ATWS. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	physical impacts to individuals, habitat alteration and/or degradation	burying, soil compaction, introduction of invasive species, cutting and crushing	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	This subactivity will alter/degrade suitable habitat (compacting soil, introducing invasive species, changing hydrology, sedimentation) preventing reestablishment of VASP in the construction ROW, access road footprint, and ATWS post-construction. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. We anticipate that any remaining VASP stems will be killed and VASP seeds will be buried in the construction ROW, access road footprint, and ATWS. All proposed AMMs will be implemented (Mountain Valley 2020). On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond, email, to J. Martin, FERC, August 12, 2020).
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, access road footprint, and ATWS, which have already been disturbed by previous activities and no longer provide suitable habitat for VASP.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	physical impacts to individuals, habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, access road footprint, and ATWS, which have already been disturbed by previous activities and no longer provide suitable habitat for VASP.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
Operation & Maintenance	Vegetation Management - mowing	physical impact to individuals	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - herbicides - hand, vehicle mounted, aerial applications	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	physical impacts to individuals, habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	Access Road Maintenance - grading, graveling	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur along access roads, which have already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	Access Road Maintenance - culvert replacement	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur along access roads, which have already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	Inspection Activities - ground and aerial	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.

Table 1. Analysis of effects on Virginia spiraea.

Table 2. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, stress on individuals, reduction in prey population	Sedimentation, increase in water temperatures, decrease of dissolved oxygen	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides stormwater filter or shade to stream	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, stress on individuals, reduction in prey population	Sedimentation, increase in water temperatures, decrease of dissolved oxygen	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland)- dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland)- brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing- tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in water temperatures, decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	Temperature increases from vegetation removal will be slight. The construction ROW at waterbody crossings is narrowed to 75 ft to minimize clearing of trees and riparian vegetation. Post construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Therefore, effects from this habitat change are expected to be insignificant.
New Disturbance - Construction	Grading, erosion control devices	Temporary loss of habitat, habitat degradation, physical impacts to individuals, reduction of prey population	Sedimentation	Stormwater erosion	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, upland, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in stream and tributary, noise from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in stream and tributary, noise from in water work	NA	NA	NA	NA	NLAA	This subactivity occurs after the stream crossing has been isolated behind cofferdams and impacts to RLP from the placement and removal of cofferdams are discussed below. Effects from any sediment that may leak through the cofferdam or noise generated from behind the cofferdam are expected to be insignificant. These activities may take place along some RLP habitat, while E&S control measures should be in place to minimize impacts those measures were insufficient and excess sedimentation entered waterways. Instream structure placement and removal will result in temporary change in water flow. Based on one steam crossing that was completed in the North Fork Roanoke River we expect flow will be altered for 5 days (M. Neylon, EQT, email to S. Hoskin, Service June 10, 2020). Altered flow may increase the stream velocity at a particular location thereby making the area too swift for some YOY RLP to navigate; however, the crossing sites are in typical adult habitat. Adult and juvenile RLP are found in swift moving water so we anticipate altered flow would have minimal affects. The spill prevention and response plan takes all reasonable precautions to prevent a spill. Additionally, there will be no permanent structures such as parking lots that would be a source point for introduction of contaminants. Because of the spill plan and lack of permanent parking lots we expect impacts from contaminants would be unlikely. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g. Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NA	NLAA	Municipal water sources will be used for this subactivity. Discharge water will be discharged through sediment filters in vegetated uplands away from waterbodies and wetlands. Therefore, we expect any effects to be discountable.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Loss of prey, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation , Stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen,	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants, Loss of prey, Disruption of spawning, Crushing or removal of eggs	Near, in-stream, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in stream and tributary, noise from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Table 2. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow,	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from inwater work, minor noise from construction activities in water. water work, minor	NA	NA	NA	NA	NE	This is not proposed at RLP crossings.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from inwater work, minor noise from construction activities in water	NA	NA	NA	NA	NE	This is not proposed at RLP crossings. Mountain Valley is using the dam and pump approach for its open cut crossings of the streams of interest (M. Neylon, EQT, email to S. Hoskin, Service June 10, 2020)
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Table 2. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in water work, minor noise from construction activities in water.	NA	NA	NA	NA	NE	This is not proposed at RLP crossings.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, & human presence	NA	NA	NA	NA	NE	This trenchless crossing method minimized impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed strea (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching was performed, the stream channel itself was not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. The Pigg River crossing (MP 289.2) was completed in 2019 via HDD. No inadvertent returns occurred and riparian zone impacts were minimized.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noi se	Vegetation removal; instream drilling fluids; noise, & human presence	NA	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed strea (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities.Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures a compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management- mowing	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 2. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management- chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	Post-construction, a 10 ft wide ROW will be maintained, which will further lesse impacts from vegetation removal. Effects from this habitat change are expected t be insignificant.
Operation & Maintenance	Vegetation Management- herbicides - hand, vehicle mounted, aerial applications	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NA	NLAA	Herbicides use will be on a local scale after a request from the landowner or land management agencies. Effects from this subactivity are expected to be insignificant.
Operation & Maintenance	Vegetation Disposal (upland)- dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	Vegetation Disposal (upland)- brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	ROW repair, regrading, revegetation (upland)- hand, mechanical	Habitat degradation, Water quality degradation	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation , Stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland)- hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation , Stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen, Equipment located in connected wetland can increase chance of spills	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. Therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Sedimentation, Contaminants	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance- grading, graveling	Temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation	Tributary and in stream earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Table 2. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Access Road Maintenance- culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity , Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in water work, minor noise from construction activities in water.	NA	NA	NA	NA	NE	Culvert placement will not occur at RLP crossings.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this subactivity occurs on a minimal amount of land (3.4 acres) throughout the project in VA (FERC 2017b). Two cathodic areas are near RLP waterbodies but they are in cleared fields. Therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation , Stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this subactivity occurs on a minimal amount of land (3.4 acres) throughout the project in VA (FERC 2017b). Therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Inspection Activities- ground and aerial	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 2. Analysis of effects on Roanoke logperch.

Table 3. Analysis of effects on candy darter.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides stormwater filter	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland)- dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland)- brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing- tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in Water Temperatures, Decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	No instream and bank work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts would be insignificant and discountable.
New Disturbance - Construction	Grading, erosion control devices	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, tributary, and upland earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in stream and tributary, noise from in water work	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g. Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NA	NLAA	Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD are anticipated from water withdrawals.
New Disturbance - Construction	Regrading and Stabilization- restoration of corridor	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance may result in increased sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from inwater work, minor noise from construction activities in water. water work, minor	NA	NA	NA	NA	NE	This is not proposed at CD crossings.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Grubbing with heavy equipment, disturbing soil	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water. water work, minor	NA	NA	NA	NA	NE	This is not proposed at CD crossings. MVP is using the dam and pump approach for its open cut crossings of the streams of interest (M. Neylon, EQT, email to J. Richard, Service June 16, 2020)
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries to CD occupied streams. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity , Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water.	NA	NA	NA	NA	NE	This is not proposed at CD crossings.

Table 3. Analysis of effects on candy darter.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, & human presence	NA	NA	NA	NA	NE	This is not proposed at CD crossings.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed strear (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities.Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures a compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Habitat degradation, Water quality degradation	Sedimentation, Contaminants	Stormwater runoff from pollution generating pavement, Stormwater erosion	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management-mowing	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
Operation & Maintenance	Vegetation Management-chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	No instream and bank work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts would be insignificant and discountable.
Operation & Maintenance	Vegetation Management-herbicides - hand, vehicle mounted, aerial applications	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NA	NLAA	Herbicides use will be on a local scale after a request from the landowner or land management agencies. Effects from this subactivity are expected to be insignificant.
Operation & Maintenance	Vegetation Disposal (upland)- dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.

Table 3. Analysis of effects on candy darter.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Disposal (upland)- brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	ROW repair, regrading, revegetation (upland)- hand, mechanical	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland)- hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen, Equipment located in connected wetland can increase chance of spills	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. We do not anticipate this activity occurring in wetland areas adjacent to CD-occupied streams, therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in water work	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
Operation & Maintenance	Access Road Maintenance- grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance- culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity , Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in water work, minor noise from construction activities in water.	NA	NA	NA	NA	NE	Culvert placement will not occur at CD crossings.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	grubbing with heavy equipment, disturbing soil	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this subactivity occurs on a minimal amount of land (3.4 acres and 6.2 acres, respectively) throughout the project in VA and WV and are not located near CD occupied streams (FERC 2017b). Therefore, effects from this habitat change are expected to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Disturbance in upland areas may result in increased sedimentation, contaminant spills from equipment located in upland areas.	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this subactivity occurs on a minimal amount of land (3.4 acres and 6.2 acres, respectively) throughout the project in VA and WV and are not located near CD occupied streams (FERC 2017b). Therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Inspection Activities- ground and aerial	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 3. Analysis of effects on candy darter.

Table 4. Analysis of effects on Indiana bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Vegetation removal, human activity and disturbance	alteration of summer roosting/foraging habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs - this is associated with multiple other subactivities and all tree removal for new construction is addressed here unless otherwise specifically called out in its own subactivity below	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Alteration of forested habitat, human disturbance	daytime arousal, tree damage	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Grading, erosion control devices	Alteration of water flow, vegetation removal, human activity	alteration of hibernacula conditions	alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Human activity, ground disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	loss or alteration of hibernacula, alteration of water or air flow in/out of hibernacula, instream sedimentation & water flow disruption, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Withdrawal/discharge of water into aquatic habitats, human activity	decreased aquatic invertebrates, daytime arousal, alteration of hibernacula conditions	water alterations, human presence & noise, alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Human activity and disturbance	daytime arousal, altered foraging behavior	human presence and noise, lighting	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Alteration of surface water flow, vegetation removal, human activity	alteration of hibernacula conditions, alteration of foraging habitat, daytime arousal	removal of vegetation, alteration of surface water flow into hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent- tree trimming and tree removal	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, flume	human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, dam & pump	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, cofferdam	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Equipment Crossing Structures	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal; contamination of drinking water; human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Alteration of forested habitat, human activity and disturbance	daytime arousal, tree damage	vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Alteration of surface water flow, vegetation removal, human activity and disturbance, wetland disturbance	alteration of hibernacula conditions, decreased aquatic invertebrates, alteration of foraging habitat, daytime arousal	removal of wetland vegetation, water disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring - fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - mowing	Vegetation removal, human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 4. Analysis of effects on Indiana bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, and tree side trimming	Tree removal, loss or alteration of forested habitat, human activity disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - herbicides - hand, vehicle mounted, aerial applications	Chemical contamination, vegetation loss	lethal or sublethal exposure to toxins	contamination of water & vegetation, loss of herbaceous vegetation	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	human activity and disturbance, instream and riparian disturbance	daytime arousal, decreased aquatic invertebrates	human presence & noise, instream sedimentation	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - grading, graveling	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - culvert replacement	human activity and disturbance, instream and riparian disturbance, temporary dewatering	decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	breeding, feeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Inspection Activities - ground and aerial	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 4. Analysis of effects on Indiana bat.

Table 5. Analysis of effects on Northern long-eared bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Vegetation removal, human activity and disturbance	alteration of summer roosting/foraging habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs - this is associated with multiple other subactivities and all tree removal for new construction is addressed here unless otherwise specifically called out in its own subactivity below	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Alteration of forested habitat, human disturbance	daytime arousal, tree damage	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Grading, erosion control devices	Alteration of water flow, vegetation removal, human activity	alteration of hibernacula conditions	alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Human activity, ground disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	loss or alteration of hibernacula, alteration of water or air flow in/out of hibernacula, instream sedimentation & water flow disruption, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Withdrawal/discharge of water into aquatic habitats, human activity	decreased aquatic invertebrates, daytime arousal, alteration of hibernacula conditions	water alterations, human presence & noise, alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Human activity and disturbance	daytime arousal, altered foraging behavior	human presence and noise, lighting	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Alteration of surface water flow, vegetation removal, human activity	alteration of hibernacula conditions, alteration of foraging habitat, daytime arousal	removal of vegetation, alteration of surface water flow into hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent- tree trimming and tree removal	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, flume	human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, dam & pump	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, cofferdam	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Equipment Crossing Structures	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal; contamination of drinking water; human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Alteration of forested habitat, human activity and disturbance	daytime arousal, tree damage	vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Alteration of surface water flow, vegetation removal, human activity and disturbance, wetland disturbance	alteration of hibernacula conditions, decreased aquatic invertebrates, alteration of foraging habitat, daytime arousal	removal of wetland vegetation, water disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring - fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - mowing	Vegetation removal, human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 5. Analysis of effects on Northern long-eared bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, and tree side trimming	Tree removal, loss or alteration of forested habitat, human activity disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - herbicides - hand, vehicle mounted, aerial applications	Chemical contamination, vegetation loss	lethal or sublethal exposure to toxins	contamination of water & vegetation, loss of herbaceous vegetation	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	human activity and disturbance, instream and riparian disturbance	daytime arousal, decreased aquatic invertebrates	human presence & noise, instream sedimentation	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - grading, graveling	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - culvert replacement	human activity and disturbance, instream and riparian disturbance, temporary dewatering	decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	breeding, feeding, sheltering	numbers, reproduction	LAA	See relevant sections of Opinion.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Inspection Activities - ground and aerial	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 5. Analysis of effects on Northern long-eared bat.

Table 6. Analysis of effects on candy darter proposed critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD proposed critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides stormwater filter	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD proposed critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD proposed critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in Water Temperatures, Decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NLAA	Temperature increases from vegetation removal will be slight and occur at tributaries to CD proposed critical habitat. The construction ROW at waterbody crossings is narrowed to 75 ft to minimize clearing of trees and riparian vegetation. Post-construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Therefore, effects from this habitat change are expected to be insignificant to CD proposed critical habitat.
New Disturbance - Construction	Grading, erosion control devices	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, instream, tributary, and upland earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located instream and tributary, noise from in water work	NA	NA	NA	NLAA	No instream work will occur in CD proposed critical habitat. Due to the distance of the crossings in the tributaries to CD proposed critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g. Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NLAA	Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD proposed critical habitat are anticipated from water withdrawals.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD proposed critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance may result in increased sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water. water work, minor	NA	NA	NA	NE	This is not proposed in CD proposed critical habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Grubbing with heavy equipment, disturbing soil	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.

Table 6. Analysis of effects on candy darter proposed critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity, Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water. water work, minor	NA	NA	NA	NE	This is not proposed at CD proposed critical habitat.
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	NA	NA	NA	NLAA	No instream work will occur in CD proposed critical habitat. Due to the distance of the crossings from proposed critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in water work	NA	NA	NA	NLAA	No instream work will occur in CD proposed critical habitat. Due to the distance of the crossings from proposed critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity , Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities	NA	NA	NA	NE	This is not proposed at CD proposed critical habitat.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, & human presence	NA	NA	NA	NE	This is not proposed in CD proposed critical habitat.

Table 6. Analysis of effects on candy darter proposed critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to proposed critical habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to proposed critical habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to proposed critical habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Habitat degradation, Water quality degradation	Sedimentation, Contaminants	Stormwater runoff from pollution generating pavement, Stormwater erosion	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management - mowing	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD proposed critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NLAA	Post-construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Vegetation Management - herbicides - hand, vehicle mounted, aerial applications	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NLAA	Herbicides use will be on a local scale after a request from the landowner or land management agencies. Effects from this subactivity are expected to be insignificant.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.

Table 6. Analysis of effects on candy darter proposed critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff, fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen, Equipment located in connected wetland can increase chance of spills	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. We do not anticipate this activity occurring in wetland areas adjacent to CD proposed critical habitat, therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work	NA	NA	NA	NLAA	No instream work will occur at CD proposed critical habitat. Due to the distance of the crossings in the tributaries to CD proposed critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
Operation & Maintenance	Access Road Maintenance - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity , Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water.	NA	NA	NA	NE	Culvert placement will not occur at CD proposed critical habitat.
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - Off ROW Clearing	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	grubbing with heavy equipment, disturbing soil	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this sub-activity occurs on a minimal amount of land (3.4 acres and 6.2 acres, respectively) throughout the project in VA and WV and are not located near CD occupied streams (FERC 2017b). Therefore, effects from this habitat change are expected to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	General Appurtenance and Cathodic Protection Construction - trenching, anode, bell hole	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Disturbance in upland areas may result in increased sedimentation, contaminant spills from equipment located in upland areas.	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. In addition, this subactivity occurs on a minimal amount of land (3.4 acres and 6.2 acres, respectively) throughout the project in VA and WV and are not located near CD proposed critical habitat (FERC 2017b). Therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Inspection Activities - ground and aerial	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 6. Analysis of effects on candy darter proposed critical habitat.

Appendix C. Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010).

BIOLOGICAL EFFECTS OF SEDIMENT ON BULL TROUT AND THEIR HABITAT –

GUIDANCE FOR EVALUATING EFFECTS

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July 13, 2010

BIOLOGICAL EFFECTS OF SEDIMENT ON BULL TROUT AND THEIR HABITAT

Anthropogenic sediment input into water bodies can have a variety of impacts to fish species from behavioral effects such as avoidance or abandonment of cover to lethal effects. The Washington Fish and Wildlife Office reviews numerous projects where sediment is generated during construction. A scientific approach was needed to determine the concentration and duration of sediment input where adverse effects of project-related sediment would occur.

The following document addresses the biological effects of sediment on bull trout and their habitat. The document is divided into two sections:

1. A literature review on the biological effect of sediment on fish (Page 3).
2. Effects analysis for project related sediment input (Page 23).

The literature review addresses the different types of sediment and the biological effects on bull trout. Direct effects include gill trauma and impacts to spawning, redds, eggs, and alevins. Indirect effects include impacts to macroinvertebrates, feeding efficiency, habitat, physiological stress, and behavioral changes.

The effects analysis section provides a step-by-step process to determine the concentration and duration of sediment input to a stream where adverse affects occur. Newcombe and Jensen (1996) and Anderson et al (1996) provide the basis for the analyzing sediment effects to bull trout and their habitat.

Introduction

As a stream or river flows downslope, it transports sediment and dissolved matter (Skinner and Porter 2000, p. 252). A stream has a natural amount of sediment that is transported through the system that varies throughout the year in response to natural hydrological changes (Galbraith et al. 2006, p. 2488). The amount of sediment that a stream can transport annually is based on numerous factors: precipitation, surface water transport, erosion, topography, geology, streamflow, riparian vegetation, stream geomorphologic characteristic, human disturbance, atmospheric deposition, etc. (Bash et al. 2001o, p. 7;Berry et al. 2003, p. 7). Therefore, different watersheds will have different levels or concentrations of turbidity and suspended sediment. A glaciated stream will have higher sediment levels than a spring fed stream (Uehlinger et al. 2002, p. 1;Ahearn 2002, p. 2).

Many watersheds are subject to anthropogenic disturbances that can produce substantial inputs of sediments into streams (Barrett et al. 1992, p. 437). Turbidity, suspended solids, sediment, and siltation have been consistently listed as impairments in the U.S. Environmental Protection Agency's (EPA) 305(b) water quality reports in rivers and streams, lakes, reservoirs, ponds, wetlands, and oceans shoreline waters (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). The EPA's 305(b) list provides the U.S. Congress and the public a means of determining or assessing the current condition of water quality within each individual state. Excessive sedimentation, natural and anthropogenic, has been estimated to occur in 46 percent of all streams and rivers in the U.S. and is considered the most important factor limiting fish habitat and causing water quality impairment (Judy et al. 1984 as cited in Henley et al. 2000, p. 126;Berry, Rubinstein, Melzian, and Hill 2003, pp. 4, 7). One of the most pervasive influences of land-use activities on stream ecosystems is an increase in sediment yield resulting from point source discharges associated with in-stream activities (Suren and Jowett 2001, p. 725).

Aquatic organisms have adapted to the natural variation in sediment load that occurs seasonally within the stream (ACMRR/IABO Working Party on Ecological Indices of Stress to Fishery Resources 1976, pp. 13, 15;Birtwell 1999, p. 7). Field experiments have found a thirty-fold increase in salmonids' (coho salmon) tolerance to suspended solids between August and November when naturally occurring concentrations are expected to be high (Cederholm and Reid 1987, p. 388).

The introduction of sediment in excess of natural amounts can have multiple adverse effects on bull trout and their habitat (Rhodes et al. 1994, pp. 16-21;Berry, Rubinstein, Melzian, and Hill 2003, p. 7). The effect of sediment beyond natural background conditions can be fatal at high levels. Embryo survival and subsequent fry emergence success have been highly correlated to percentage of fine material within the streambed (Shepard et al. 1984, pp. 146, 152). Low levels of sediment may result in sublethal and behavioral effects such as increased activity, stress, and emigration rates; loss or reduction of foraging capability; reduced growth and resistance to disease; physical abrasion; clogging of gills; and interference with orientation in homing and migration (McLeay et al. 1987a, p. 671;Newcombe and MacDonald 1991, pp. 72, 76, 77;Barrett, Grossman, and Rosenfeld 1992, p. 437;Lake and Hinch 1999, p. 865;Bash et al. 2001n, p. 9;Watts et al. 2003, p. 551;Vondracek et al. 2003, p. 1005;Berry, Rubinstein, Melzian, and Hill

2003, p. 33). The effects of increased suspended sediments can cause changes in the abundance and/or type of food organisms, alterations in fish habitat, and long-term impacts to fish populations (Anderson et al. 1996, pp. 1, 9, 12, 14, 15;Reid and Anderson 1999, pp. 1, 7-15). No threshold has been determined in which fine-sediment addition to a stream is harmless (Suttle et al. 2004, p. 973). Even at low concentrations, fine-sediment deposition can decrease growth and survival of juvenile salmonids.

Aquatic systems are complex interactive systems, and isolating the effects of sediment to fish is difficult (Castro and Reckendorf 1995d, pp. 2-3). The effects of sediment on receiving water ecosystems are complex and multi-dimensional, and further compounded by the fact that sediment flux is a natural and vital process for aquatic systems (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). Environmental factors that affect the magnitude of sediment impacts on salmonids include duration of exposure, frequency of exposure, toxicity, temperature, life stage of fish, angularity and size of particle, severity/magnitude of pulse, time of occurrence, general condition of biota, and availability of and access to refugia (Bash et al. 2001m, p. 11). Potential impacts caused by excessive suspended sediments are varied and complex and are often masked by other concurrent activities (Newcombe 2003, p. 530). The difficulty in determining which environmental variables act as limiting factors has made it difficult to establish the specific effects of sediment impacts on fish (Chapman 1988, p. 2). For example, excess fines in spawning gravels may not lead to smaller populations of adults if the amount of juvenile winter habitat limits the number of juveniles that reach adulthood. Often there are multiple independent variables with complex inter-relationships that can influence population size.

The ecological dominance of a given species is often determined by environmental variables. A chronic input of sediment could tip the ecological balance in favor of one species in mixed salmonid populations or in species communities composed of salmonids and nonsalmonids (Everest et al. 1987, p. 120). Bull trout have more spatially restrictive biological requirements at the individual and population levels than other salmonids (USFWS (U.S. Fish and Wildlife Service) 1998, p. 5). Therefore, they are especially vulnerable to environmental changes such as sediment deposition.

Bull trout are apex predators that prey on a variety of species including terrestrial and aquatic insects and fish (Rieman and McIntyre 1993, p. 3). Fish are common in the diet of individual bull trout that are over 110 millimeters or longer. Large bull trout may feed almost exclusively on fish. Therefore, when analyzing impacts of sediment on bull trout, it is very important to consider other fish species that are part of their prey base. While sediment may not directly impact bull trout, the increased sediment input may affect the spawning and population levels of Chinook and coho salmon, cutthroat trout, and steelhead, or other species that are potential prey for bull trout. The following effects of sediment are not specific to bull trout alone. All salmonids can be affected similarly.

This document identifies the biological effects of sediment on fish and their habitat including the different life stage(s) affected by sediment input. It also provides an analysis to determine the level of sediment concentrations and duration that results in adverse effects to bull trout (and all salmonids) and their habitat.

Sediment Classifications and Definitions

Sediment within a stream can be classified into a variety of categories: turbidity, suspended sediment, bedload, deposited sediment, and wash load (Waters 1995, pp. 13-14;Bash et al. 2001l, pp. 3-4). Sediment category definitions include:

- Turbidity - Optical property of water which results from the suspended and dissolved materials in the water. This causes light to be scattered rather than transmitted in straight lines. Turbidity is measured in nephelometric turbidity units (NTUs). Measurements of turbidity can quickly estimate the amount of sediment within a sample of water.
- Suspended sediment - Represents the actual measure of mineral and organic particles transported in the water column. Suspended sediment is measured in mg/L and is an important measure of erosion, and is linked to the transport of nutrients, metals, and industrial and agricultural chemicals through the river system.
- Bedload - Consists of larger particles on the stream bottom that move by sliding, rolling, or saltating along the substrate surface. Bedload is measured in tons/day, or tons/year.
- Deposited sediment - The intermediate sized sediment particles that settle out of the water column in slack or slower moving water. Based on water velocity and turbulence, these intermediate size particles may be suspended sediment or bedload.
- Wash load - Finest particles in the suspended load that are continuously maintained in suspension by the flow turbulence. Therefore significant quantities are not deposited in the bed.

Suspended sediment, turbidity, and deposited sediment are not associated with specific particle sizes, as there will be considerable overlap depending on velocity, turbulence, and gradient (MacDonald et al. 1991, p. 98;Waters 1995, p. 14). Turbidity cannot always be correlated with suspended solid concentrations due to the effects of size, shape and refractive index of particles (Bash et al. 2001k, p. 5). Turbidity and suspended sediment affect the light available for photosynthesis, visual capability of aquatic animals, gill abrasion, and physiology of fish. Suspended and deposited sediment affect the habitat available for macroinvertebrates, the quality of gravel for fish spawning, and the amount of habitat for fish rearing (Waters 1995, p. 14).

The size of particles within the stream is also important. The quantity of "fines" within a stream ecosystem is usually associated with the degree of fish population declines (Castro and Reckendorf 1995c, p. 2). Particle diameters less than 6.4 mm are generally defined as "fines" (Bjornn et al. 1977c, p. 1;Shepard, Leathe, Waver, and Enk 1984, p. 148;Hillman et al. 1987, p. 185;Chapman 1988, p. 14;Bjornn and Reiser 1991, p. 103;Rieman and McIntyre 1993, p. 6;Castro and Reckendorf 1995b, p. 2;MBTSG (The Montana Bull Trout Scientific Group) 1998a, p. 8).

Biological Effects of Sediment on Bull Trout

<u>Classification of Sediment Effects</u>

In the absence of detailed local information on population dynamics and habitat use, any increase in the proportion of fines in substrates should be considered a risk to the productivity of an environment and to the persistence of associated bull trout populations (Rieman and McIntyre 1993, p. 6). Specific effects of sediment on fish and their habitat can be put into three classes that include (Newcombe and MacDonald 1991, pp. 72-73;Waters 1995, pp. 81-82;Bash et al. 2001j, p. 10):

Lethal: Direct mortality to any life stage, reduction in egg-to-fry survival, and loss of spawning or rearing habitat. These effects damage the capacity of the bull trout to produce fish and sustain populations.

Sublethal: Reduction in feeding and growth rates, decrease in habitat quality, reduced tolerance to disease and toxicants, respiratory impairment, and physiological stress. While not leading to immediate death, may produce mortalities and population decline over time.

Behavioral: Avoidance and distribution, homing and migration, and foraging and predation. Behavioral effects change the activity patterns or alter the kinds of activity usually associated with an unperturbed environment. Behavior effects may lead to immediate death or population decline or mortality over time.

<u>Direct Effects</u>

Gill trauma

High levels of suspended sediment and turbidity can result in direct mortality of fish by damaging and clogging gills (Curry and MacNeill 2004, p. 140). Fish gills are delicate and easily damaged by abrasive silt particles (Bash et al. 2001i, p. 15). As sediment begins to accumulate in the gill filaments, fish excessively open and close their gills to expunge the silt. If irritation continues, mucus is produced to protect the gill surface, which may impede the circulation of water over the gills and interfere with fish respiration (Bash et al. 2001h, p. 15). Gill flaring or coughing abruptly changes buccal cavity pressure and is a means of clearing the buccal cavity of sediment. Gill sediment accumulation may result when fish become too fatigued to continue clearing particles via the cough reflex (Servizi and Martens 1991a, p. 495).

Fish are more susceptible to increased suspended sediment concentrations at different times of the year or in watersheds with naturally high sediment such as glaciated streams. Fish secrete protective mucous to clean the gills (Erman and Ligon 1985, p. 18). In glaciated systems or during winter and spring high flow conditions when sediment concentrations are naturally high, the secretion of mucous can keep gills clean of sediment. Protective mucous secretions are inadequate during the summer months, when natural sediment levels are low in a stream system. Consequently, sediment introduction at this time may increase the vulnerability of fish to stress and disease (Bash et al. 2001g, p. 12).

Spawning, redds, eggs, and alevins

The effects of suspended sediment, deposited in a redd and potentially reducing water flow and smothering eggs or alevins or impeding fry emergence, are related to sediment particle sizes of the spawning habitat (Bjornn and Reiser 1991, p. 98). Sediment particle size determines the pore openings in the redd gravel. With small pore openings, more suspended sediments are deposited and water flow is reduced compared to large pore openings.

Survival of eggs is dependent on a continuous supply of well oxygenated water through the streambed gravels (Cederholm and Reid 1987, p. 384;Anderson, Taylor, and Balch 1996, p. 13). Eggs and alevins are generally more susceptible to stress by suspended solids than are adults. Accelerated sedimentation can reduce the flow of water and, therefore, oxygen to eggs and alevins. This can decrease egg survival, decrease fry emergence rates (Cederholm and Reid 1987, p. 384;Chapman 1988, pp. 12-16;Bash et al. 2001f, pp. 17-18), delay development of alevins (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm 1987, p. 113), reduce growth and cause premature hatching and emergence (Birtwell 1999, p. 19). Fry delayed in their emergence are also less able to compete for environmental resources than fish that have undergone normal development and emergence (intra- or interspecific competition) (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm 1987, p. 113). Sedimentation fills the interstitial spaces and can prevent alevins from emerging from the gravel (Anderson, Taylor, and Balch 1996, p. 13;Suttle, Power, Levine, and McNeely 2004, pp. 971-972).

Several studies have documented that fine sediment can reduce the reproductive success of salmonids. Natural egg-to-fry survival of coho salmon, sockeye and kokanee has been measured at 23 percent, 23 percent and 12 percent, respectively (Slaney et al. 1977, p. 33). Substrates containing 20 percent fines can reduce emergence success by 30-40 percent (MacDonald, Smart, and Wissmar 1991, p. 99). A decreases of 30 percent in mean egg-to-fry survival can be expected to reduce salmonid fry production to extremely low levels (Slaney, Halsey, and Tautz 1977, p. 33).

Indirect Effects

Macroinvertebrates

Sedimentation can have an effect on bull trout and fish populations through impacts or alterations to the macroinvertebrate communities or populations (Anderson, Taylor, and Balch 1996, pp. 14-15). Increased turbidity and suspended sediment can reduce primary productivity by decreasing light intensity and periphytic (attached) algal and other plant communities (Anderson, Taylor, and Balch 1996, p. 14;Henley, Patterson, Neves, and Lemly 2000, p. 129;Suren and Jowett 2001, p. 726). This results in decreased macroinvertebrates that graze on the periphyton.

Sedimentation also alters the habitat for macroinvertebrates, changing the species density, diversity and structure of the area (Waters 1995, pp. 61-78;Anderson, Taylor, and Balch 1996, pp. 14-15;Reid and Anderson 1999, pp. 10-12;Shaw and Richardson 2001, p. 2220). Certain groups of macroinvertebrates are favored by salmonids as food items. These include mayflies, caddisflies, and stoneflies. These species prefer large substrate particles in riffles and are negatively affected by fine sediment (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm

1987, p. 115;Waters 1995, p. 63). Increased sediment can affect macroinvertebrate habitat by filling of interstitial space and rendering attachment sites unsuitable. This may cause invertebrates to seek more favorable habitat (Rosenberg and Snow 1975, p. 70). With increasing fine sediment, invertebrate composition and density changes from available, preferred species (i.e., mayflies, caddisflies, and stoneflies) to non-preferred, more unavailable species (i.e., aquatic worms and other burrowing species) (Reid and Anderson 1999, p. 10;Henley, Patterson, Neves, and Lemly 2000, pp. 126, 130;Shaw and Richardson 2001, p. 2219;Suren and Jowett 2001, p. 726;Suttle, Power, Levine, and McNeely 2004, p. 971). The degree to which substrate particles are surrounded by fine material was found to have a strong correlation with macroinvertebrate abundance and composition (Birtwell 1999, p. 23). At an embeddedness of one-third, insect abundance can decline by about 50 percent, especially for riffle-inhabiting taxa (Waters 1995, p. 66).

Increased turbidity and suspended solids can affect macroinvertebrates in multiple ways through increased invertebrate drift, feeding impacts, and respiratory problems (Cederholm and Reid 1987, p. 384;Shaw and Richardson 2001, p. 2218;Berry, Rubinstein, Melzian, and Hill 2003, pp. 8, 11). The effect of turbidity on light transmission has been well documented and results in increased invertebrate drift (Waters 1995, p. 58;Birtwell 1999, pp. 21, 22). This may be a behavioral response associated with the night-active diel drift patterns of macroinvertebrates. While increased turbidity results in increased macroinvertebrate drift, it is thought that the overall invertebrate populations would not fall below the point of severe depletion (Waters 1995, p. 59). Invertebrate drift is also an important mechanism in the repopulation, recolonization, or recovery of a macroinvertebrate community after a localized disturbance (Anderson, Taylor, and Balch 1996, p. 15;Reid and Anderson 1999, pp. 11-12).

Increased suspended sediment can affect macroinvertebrates by abrasion of respiratory surface and interference with food uptake for filter-feeders (Anderson, Taylor, and Balch 1996, p. 14;Birtwell 1999, p. 21;Shaw and Richardson 2001, p. 2213;Suren and Jowett 2001, pp. 725-726;Berry, Rubinstein, Melzian, and Hill 2003, p. 11). Increased suspended sediment levels tend to clog feeding structures and reduce feeding efficiencies, which results in reduced growth rates, increased stress, or death of the invertebrates (Newcombe and MacDonald 1991, p. 73). Invertebrates living in the substrate are also subject to scouring or abrasion which can damage respiratory organs (Bash et al. 2001e, p. 25).

Feeding Efficiency

Increased turbidity and suspended sediment can affect a number of factors related to feeding for salmonids, including feeding rates, reaction distance, prey selection, and prey abundance (Barrett, Grossman, and Rosenfeld 1992, pp. 437, 440;Henley, Patterson, Neves, and Lemly 2000, p. 133;Bash et al. 2001d, p. 21). Changes in feeding behavior are primarily related to the reduction in visibility that occurs in turbid water. Effects on feeding ability are important as salmonids must meet energy demands to compete with other fishes for resources and to avoid predators. Reduced feeding efficiency would result in lower growth and fitness of bull trout and other salmonids (Barrett, Grossman, and Rosenfeld 1992, p. 442;Sweka and Hartman 2001, p. 138).

Distance of prey capture and prey capture success both were found to decrease significantly when turbidity was increased (Berg and Northcote 1985, pp. 1414-1415;Sweka and Hartman 2001, p. 141;Zamor and Grossman 2007, pp. 168, 170, 174). Waters (1995, p. 83) states that loss of visual capability, leading to reduced feeding, is one of the major sublethal effects of high suspended sediment. Increases in turbidity were reported to decrease reactive distance and the percentage of prey captured (Sweka and Hartman 2001, p. 141;Bash et al. 2001c, pp. 21-23;Klein 2003, pp. 1, 21). At 0 NTUs, 100 percent of the prey items were consumed; at 10 NTUs, fish frequently were unable to capture prey species; at 60 NTUs, only 35 percent of the prey items were captured. At 20 to 60 NTUs, significant delay in the response of fish to prey was observed (Bash et al. 2001b, p. 22). Loss of visual capability and capture of prey leads to depressed growth and reproductive capability.

To compensate for reduced encounter rates with prey under turbid conditions, prey density must increase substantially or salmonids must increase their active searches for prey (Sweka and Hartman 2001, p. 144). Such an increase in activity and feeding rates under turbid conditions reduces net energy gain from each prey item consumed (Sweka and Hartman 2001, p. 144).

Sigler et al. (1984, p. 150) found that a reduction in growth occurred in steelhead and coho salmon when turbidity was as little as 25 NTUs. The slower growth was presumed to be from a reduced ability to feed; however, more complex mechanisms such as the quality of light may also affect feeding success rates. Redding et al. (1987, p. 742) found that suspended sediment may inhibit normal feeding activity, as a result of a loss of visual ability or as an indirect consequence of increased stress.

Habitat Effects

Compared to other salmonids, bull trout have more specific habitat requirements that appear to influence their distribution and abundance (Rieman and McIntyre 1993, p. 7). All life history stages are associated with complex forms of cover including large woody debris, undercut banks, boulders, and pools. Other habitat characteristic important to bull trout include channel and hydrologic stability, substrate composition, temperature, and the presence of migration corridors (Rieman and McIntyre 1993, p. 5).

Increases in sediment can alter fish habitat or the utilization of habitats by fish (Anderson, Taylor, and Balch 1996, p. 12). The physical implications of sediment in streams include changes in water quality, degradation of spawning and rearing habitat, simplification and damage to habitat structure and complexity, loss of habitat, and decreased connectivity between habitat (Anderson, Taylor, and Balch 1996, pp. 11-15;Bash et al. 2001a, pp. 1, 12, 18, 30). Biological implications of this habitat damage include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their preferred habitat, and avoidance of habitat (Newcombe and Jensen 1996, p. 695).

As sediment enters a stream it is transported downstream under normal fluvial processes and deposited in areas of low shear stress (MacDonald and Ritland 1989, p. 21). These areas are usually behind obstructions, near banks (shallow water) or within interstitial spaces. This episodic filling of successive storage compartments continues in a cascading fashion downstream until the flow drops below the threshold required for movement or all pools have reached their storage capacities (MacDonald and Ritland 1989, p. 21). As sediment load increases, the stream compensates by geomorphologic changes in increased slope, increased channel width, decreased depths, and decreased flows (Castro and Reckendorf 1995a, p. 21). These processes contribute to increased erosion and sediment deposition that further degrade salmonid habitat.

Loss of acceptable habitat and refugia, as well as decreased connectivity between habitats, reduces the carrying capacity of streams for salmonids (Bash et al. 2001p, p. 30). This loss of habitat or exclusion of fish from their habitat, if timed inappropriately, could impact a fish population if the habitat within the affected stream reach is critical to the population during the period of the sediment release (Anderson, Taylor, and Balch 1996, p. 12;Reid and Anderson 1999, p. 13). For example, if summer pool habitat used by adults as holding habitat prior to spawning is a limiting factor within a stream, increased sediment and reduced pool habitat during the summer can decrease the carrying capacity of the stream reach and decrease the fish population. In systems lacking adequate connectivity of habitats, fish may travel longer distances or use less desirable habitats, increasing biological demands and reducing their fitness.

The addition of fine sediment (less than 6.4 mm) to natural streams during summer decreased abundance of juvenile Chinook salmon in almost direct proportion to the amount of pool volume lost to fine sediment (Bjornn et al. 1977b, p. 31). Similarly, the inverse relationship between fine sediment and densities of rearing Chinook salmon indicates the importance of winter habitat and high sediment loads (Bjornn et al. 1977a, pp. 26, 38, 40). As fine sediments fill the interstitial spaces between the cobble substrate, juvenile Chinook salmon were forced to leave preferred habitat and to utilize cover that may be more susceptible to ice scouring, predation, and decreased food availability (Hillman, Griffith, and Platts 1987, p. 194). Deposition of sediment on substrate may lower winter carrying capacity for bull trout (Shepard, Leathe, Waver, and Enk 1984, p. 153). Food production in the form of aquatic invertebrates may also be reduced.

Juvenile bull trout densities are highly influenced by substrate composition (Shepard, Leathe, Waver, and Enk 1984, p. 153;Rieman and McIntyre 1993, p. 6;MBTSG (The Montana Bull Trout Scientific Group) 1998b, p. 9). During the summer, juvenile bull trout hold positions close to the stream bottom and often seek cover within the substrate itself. When streambed substrate contains more than 30 percent fine materials, juvenile bull trout densities drop off sharply (Shepard, Leathe, Waver, and Enk 1984, p. 152). Any loss of interstitial space or streambed complexity through the deposition of sediment would result in a loss of summer and winter habitats (MBTSG (The Montana Bull Trout Scientific Group) 1998c, p. 9). The reduction of rearing habitat will ultimately reduce the potential number of recruited juveniles and therefore reducing population numbers (Shepard, Leathe, Waver, and Enk 1984, pp. 153-154). In fact, Johnston et al. (2007, p. 125) found that density-dependent survival during the earliest of the juvenile stages (between egg and age-1) regulated recruitment of adult bull trout in the population.

Although an avoidance response by fish to increased sediment may be an initial adaptive survival strategy, displacement from cover could be detrimental. It is possible that the consequences of fish moving from preferred habitat, to avoid increasing levels of suspended sediment, may not be beneficial if displacement is to sub-optimal habitat, because they may be stressed and more vulnerable to predation (Birtwell 1999, p. 12).

In addition to altering stream bed composition, anthropogenic input of sediment into a stream can change channel hydrology and geometry (Owens et al. 2005, pp. 694-695). Sediment release can reduce the depth of pools and riffle areas (Anderson, Taylor, and Balch 1996, p. 12). This can reduce available fish habitat, decrease fish holding capacity, and decrease fish populations (Anderson, Taylor, and Balch 1996, pp. 12, 14).

Physiological Effects

Sublethal levels of suspended sediment may cause undue physiological stress on fish, which may reduce the ability of the fish to perform vital functions (Cederholm and Reid 1987, p. 388, 390). Stress is defined as a condition perceived by an organism which threatens a biological function of the organism, and a set of physiological and behavioral responses is mounted to counteract the condition (Overli 2001, p. 7). A stressor is any anthropogenic or natural environmental change severe enough to require a physiological response on the part of a fish, population, or ecosystem (Anderson, Taylor, and Balch 1996, pp. 5-6;EPA (U.S. Environmental Protection Agency) 2001a, pp. 1-2;Jacobson et al. 2003, p. 2). At the individual level, stress may affect physiological systems, reduce growth, increase disease, and reduce the individual's ability to tolerate additional stress (Anderson, Taylor, and Balch 1996, p. 7;Bash et al. 2001q, p. 17). At the population level, the effects of stress may include reduced spawning success, increased larval mortality, reduced recruitment to succeeding life stages and, therefore, overall population declines (Bash et al. 2001r, p. 17).

Upon encountering a stressor, the fish responds through a series of chemical releases in its body. These primary chemical and hormonal releases include catecholamine (e.g. epinephrine, norepinehprine) in the circulatory system, corticosteroids (e.g. cortisol) from the interregnal tissue, and hypothalamic activation of the pituitary gland (Gregory and Wood 1999, p. 286;Schreck et al. 2001, p. 5;Barton 2002, p. 517;Davis 2006, p. 116). Primary chemical releases result in secondary releases or changes in plasma, glucose, tissue ion, metabolite levels, and hematological features. These secondary responses relate to physiological adjustments in metabolism, respiration, immune and cellular function (Mazeaud et al. 1977, p. 201;Barton 2002, p. 517;Haukenes and Buck 2006, p. 385). After secondary responses, continued stress results in tertiary stress responses which affect whole-animal performance such as changes in growth, condition, resistance to disease, metabolic scope for activity, behavior, and ultimately survival (Pickering et al. 1982, p. 229;Barton 2002, p. 517;Portz et al. 2006, pp. 126-127).

Stress in a fish occurs when the homeostatic or stabilizing process in the organism exceed the capability of the organism to compensate for the biotic or abiotic challenge (Anderson, Taylor, and Balch 1996, p. 5). The response to a stressor is an adaptive mechanism that allows the fish to cope with the real or perceived stressor in order to maintain its normal or homeostatic state (Barton 2002, p. 517). Acclimation to a stressor can occur if compensatory physiological responses by the fish are able to re-establish a satisfactory relationship between the changed environment and the organism (Anderson, Taylor, and Balch 1996, p. 5). The ability of an individual fish to acclimate or tolerate the stress will depend on the severity of the stress and the physiological limits of the organism (Anderson, Taylor, and Balch 1996, p. 5). In a natural system, fish are exposed to multiple chemical and physical stressors which can combine to cause adverse effects (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). The chemical releases from each stressor results in a cumulative or additive response (Barton et al. 1986, pp. 245, 247;EPA (U.S. Environmental Protection Agency) 2001b, pp. 3, 25;Cobleigh 2003, pp. 16, 39, 55;Milston et al. 2006, p. 1172).

Stress in fish results in extra cost and energy demands. Elevated oxygen consumption and increased metabolic rate result from the reallocation of energy to cope with the stress (Barton and Schreck 1987, pp. 259-260;Contreras-Sanchez et al. 1998, pp. 439, 444;McCormick et al. 1998, pp. 222, 231). An approximate 25 percent increase in metabolic cost, over standard metabolism requirements, is needed to compensate for a perceived stress (Barton and Schreck 1987, p. 260;Davis 2006, p. 116). Stressed fish would thus have less energy available for other life functions such as seawater adaptation, disease resistance, reproduction, or swimming stamina (Barton and Schreck 1987, p. 261;Contreras-Sanchez, Schreck, Fitzpatrick, and Pereira 1998, p. 444).

Tolerance to suspended sediment may be the net result of a combination of physical and physiological factors related to oxygen availability and uptake by fish (Servizi and Martens 1991b, p. 497). The energy needed to perform repeated coughing (see Gill trauma section) increases metabolic oxygen demand. Metabolic oxygen demand is related to water temperature. As temperatures increase, so does metabolic oxygen demand, but concentrations of oxygen available in the water decreases. Therefore, a fish’s tolerance to suspended sediment may be primarily related to the capacity of the fish to perform work associated with the cough reflex. However, as sediment increases, fish have less capability to do work, and therefore less tolerance for suspended sediment (Servizi and Martens 1991c, p. 497).

Once exposed to a stressor, the primary chemical releases can take one-half to twenty-four hours to peak (Schreck 1981, p. 298;Barton 2002, p. 520;Quigley and Hinch 2006, p. 437). Recovery or return of the primary chemical release to normal or resting levels can take two hours to two weeks (Mazeaud, Mazeaud, and Donaldson 1977, pp. 205-206;Schreck 1981, p. 313). In a study of handling stress, chemical release of cortisol peaked at two hours and returned to normal in four hours. However, complete recovery took 2 weeks (Pickering, Pottinger, and Christie 1982, pp. 236, 241). Fish exposed to two or more stresses require longer recovery times than fish exposed only to one stressor indicating the cumulative effects of stress (Sigismondi and Weber 1988, pp. 198-199).

Redding el al.(1987, pp. 740-741) observed higher mortality in young steelhead trout exposed to a combination of suspended sediment (2500 mg/L) and a bacteria pathogen, than when exposed to the bacteria alone. Physiological stress in fishes may decrease immunological competence, growth, and reproductive success (Bash et al. 2001s, p. 16).

Behavioral effects

Increased turbidity and suspended sediment may result in behavior changes in salmonids. These changes are the first effects evoked from increased levels of turbidity and suspended sediment

(Anderson, Taylor, and Balch 1996, p. 6). These behavioral changes include avoidance of habitat, reduction in feeding, increased activity, redistribution and migration to other habitats and locations, disruption of territoriality, and altered homing (Anderson, Taylor, and Balch 1996, p. 6;Bash et al. 2001t, pp. 19-25;Suttle, Power, Levine, and McNeely 2004, p. 971). Many behavioral effects result from changes in stream habitat (see Habitat effects section). As suspended sediment concentration increases, habitat may be lost which results in abandonment and avoidance of preferred habitat. Stream reach emigration is a bioenergetic demand that may affect the growth or reproductive success of the individual fish (Bash et al. 2001u, p. 12). Pulses of sediment result in downstream migration of fish, which disrupts social structures, causes downstream displacement of other fish and increases intraspecific aggression (McLeay et al. 1987b, pp. 670-671;Bash et al. 2001v, pp. 12, 20;Suttle, Power, Levine, and McNeely 2004, p. 971). Loss of territoriality and the breakdown of social structure can lead to secondary effects of decreased growth and feeding rates, which may lead to mortality (Berg and Northcote 1985, p. 1416;Bash et al. 2001w, p. 20).

Downstream migration by bull trout provides access to more prey, better protection from avian and terrestrial predators, and alleviates potential intraspecific competition or cannibalism in rearing areas (MBTSG (The Montana Bull Trout Scientific Group) 1998d, p. 13). Benefits of migration from tributary rearing areas to larger rivers or estuaries may be increased growth potential. Increased sedimentation may result in premature or early migration of both juveniles and adults or avoidance of habitat and migration of nonmigratory resident bull trout.

High turbidity may delay migration back to spawning sites, although turbidity alone does not seem to affect homing. Delays in spawning migration and associated energy expenditure may reduce spawning success and therefore population size (Bash et al. 2001x, p. 29).

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DETERMINING EFFECTS FOR SECTION 7 CONSULTATIONS

There are numerous factors that can influence project-specific sediment effects on bull trout and other salmonids. These factors include the concentration and duration of sediment input, existing sediment conditions, stream conditions (velocity, depth, etc.) during construction, weather or climate conditions (precipitation, wind, etc.), fish presence or absence (bull trout plus prey species), and best management practice effectiveness. Many of these factors are unknown.

Newcombe and Jensen (1996) and Anderson et al. (1996) provide the basis for analyzing sediment effects to bull trout and other salmonids and their habitat. Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids. They developed a model that calculated the severity of ill effect (SEV) to fish based on the suspended sediment dose (exposure) and concentration. No data on bull trout were used in this analysis. Anderson et al. (1996), using the methods used by Newcombe and Jensen (1996), developed a model to estimate sediment impacts to salmonid habitat.

A 15-point scale was developed by Newcombe and Jensen (1996, p. 694) to qualitatively rank the effects of sediment on fish (Table 1). Using a similar 15-point scale, Anderson et al. (1996)

Table 1 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonids.

SEV	Description of Effect
	Nil effect
0	No behavioral effects
	Behavioral effects
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
	Sublethal effects
4	Short-term reduction in feeding rates; short-term reduction in feeding success
5	Minor physiological stress; increase in rate of coughing; increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation; impaired homing
8	Indications of major physiological stress; long-term reduction in feeding rate; long-term reduction in feeding success; poor condition
	Lethal and paralethal effects
9	Reduced growth rate; delayed hatching; reduced fish density
10	0-20% mortality; increased predation; moderate to severe habitat degradation
11	> 20 – 40% mortality
12	> 40 – 60% mortality
13	> 60 – 80% mortality
14	> 80 – 100% mortality

ranked the effects of sediment on fish habitat (Table 2).

We analyzed the effects on different bull trout life history stages to determine when adverse effects of project-related sediment would occur. Table 3 shows the different ESA effect calls for bull trout based on severity of ill effect.

The effect determination for a proposed action should consider all SEV values resulting from the action because sediment affects individual fish differently depending on life history stage and site-specific factors. For juvenile bull trout, an SEV of 5 is likely to warrant a "likely to adversely affect" (LAA) determination. However, abandonment of cover (SEV 2), or an avoidance response (SEV 3), may result in increased predation risk and mortality if habitat features are limiting in the project's stream reach. Therefore, a LAA determination may be warranted at an SEV 2 or 3 level in certain situations. For subadult and adult bull trout, however, abandonment of cover and avoidance may not be as important. A higher SEV score is more appropriate for adverse effects to subadult and adult bull trout. In all situations, we assume that SEV scores associated with adverse effects are also sufficient to represent a likelihood of harm or harass[1].

Table 2 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonid habitat.

SEV	Description of Effect
3	Measured change in habitat preference
7	Moderate habitat degradation – measured by a change in invertebrate community
10	Moderately severe habitat degradation – defined by measurable reduction in the productivity of habitat for extended period (months) or over a large area (square kilometers).
12	Severe habitat degradation – measured by long-term (years) alterations in the ability of existing habitats to support fish or invertebrates.
14	Catastrophic or total destruction of habitat in the receiving environment.

When evaluating impacts to habitat as a surrogate for species effects, adverse effects may be anticipated when there is a notable reduction in abundance of aquatic invertebrates, and an alteration in their community structure. These effects represent a reduction in food for bull trout and other salmonids, and correspond to an SEV of 7 – moderate habitat degradation.

Newcombe and Jensen (1996) used six data groups to conduct their analysis. These groups were 1) juvenile and adult salmonids (Figure 1), 2) adult salmonids (Figure 2), 3) juvenile salmonids (Figure 3), 4) eggs and larvae of salmonids and non-salmonids (Figure 4), 5) adult estuarine nonsalmonids (no figure provided), and 6) adult freshwater nonsalmonids (no figure provided). No explanation was provided for why juvenile and adult salmonids were combined

[1] Harm and harass in this context refers to the FWS's regulatory definition at 50 CFR 17.3. E.g., Harm means "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."

for group 1. As juveniles are more adapted to turbid water (Newcombe 1994, p. 5), their SEV levels are generally lower than for adult salmonids given the same concentration and duration of sediment (Figures 1-3).

Table 3 – ESA Effect calls for different bull trout life stages in relation to the duration of effect and severity of ill effect. Effect calls for habitat, specifically, are provided to assist with analysis of effects to individual bull trout.

	SEV	ESA Effect Call
Egg/alevin	1 to 4	Not applicable - alevins are still in gravel and are not feeding.
	5 to 14	LAA - any stress to egg/alevin reduces survival
Juvenile	1 to 4	NLAA
	5 to 14	LAA
Subadult and Adult	1 to 5	NLAA
	6 to 14	LAA
Habitat	1 to 6	NLAA
	7 to 14	LAA due to indirect effects to bull trout

The figures of Newcombe and Jensen (1996) have been modified in this document. In each figure, values (in mg/L) are provided for each duration to determine when adverse effects would occur. Specific values are also given for when harm would be likely to occur. For example:

> Figure 1 – This figure is for both juveniles and adults. From Table 2, bull trout are “likely to be adversely affected” given an SEV of 5. On Figure 1, a sediment concentration of 99 mg/L for one hour is anticipated to be the maximum concentration for an SEV of 4. At 100 mg/L, an SEV of 5 occurs. In addition, one hour of exposure to 5,760 mg/L is the maximum for an SEV of 7. Exposure to 5,761 mg/L for one hour would warrant an SEV of 8. This would be the threshold between harassment and harm. An SEV of 7 would be harassment, and an SEV of 8 would be considered harm.

The following provides some guidance on use of the figures.

Definitions from Newcombe and Jensen (1996, p. 696). These definitions are provided for consultations that may have impacts to bull trout prey such as Chinook and coho salmon.

> Eggs and larvae – eggs, and recently hatched fish, including yolk-sac fry, that have not passed through final metamorphosis.
>
> Juveniles – fry, parr, and smolts that have passed through larval metamorphosis but are sexually immature.

Adults – mature fish.

Bull trout use:

Newcombe and Jensen (1996) conducted their analysis for freshwater, therefore the use of the figures within this document in marine waters should be used with caution.

Figure 1 – Juvenile and Adult Salmonids. This figure should be used in foraging, migration and overwintering (FMO) areas. In FMO areas, downstream of local populations, both subadult and adult bull trout may be found.

Figure 2 – Adult Salmonids. This figure will not be used very often for bull trout. There may be circumstances, downstream of local population spawning areas that may have just adults, but usually this would not be the case. Justification for use of this figure should be stated in your consultation.

Figure 3 – Juvenile Salmonids. This figure should be used in local population spawning and rearing areas outside of the spawning period. During this time, only juveniles and sub-adults should be found in the area. Adults would migrate to larger stream systems or to marine water. If the construction of the project would occur during spawning, then Figure 1 should be used.

Figure 4 – Eggs and Alevins. This figure should be used if eggs or alevins are expected to be in the project area during construction.

Figure 5 – Habitat. This figure should be used for all projects to determine whether alterations to the habitat may occur from the project.

Background and Environmental Baseline

In determining the overall impact of a project on bull trout, and to specifically understand whether increased sediment may adversely affect bull trout, a thorough review of the environmental baseline and limiting factors in the stream and watershed is needed. The following websites and documents will help provide this information.

1. Washington State Conservation Commission's Limiting Factors Analysis. A limiting factors analysis has been conducted on watersheds within the State of Washington. Limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae." These documents will provide information on the current condition of the individual watersheds within the State of Washington. The limiting factors website is http://salmon.scc.wa.gov. Copies of the limiting factors analysis can be found at the Western Washington Fish and Wildlife Library.

2. Washington Department of Fish and Wildlife's (1998) Salmonid Stock Inventory (SaSI). The Washington Department of Fish and Wildlife (WDFW) inventoried bull

trout and Dolly Varden (*S. malma*) stock status throughout the State. The intent of the inventory is to help identify available information and to guide future restoration planning and implementation. SaSI defines the stock within the watershed, life history forms, status and factors affecting production. Spawning distribution and timing for different life stages are provided (migration, spawning, etc.), if known. SaSi documents can be found at http://wdfw.wa.gov/fish/sasi/index.htm.

3. U.S. Fish and Wildlife Service's (USFWS 1998a) Matrix of Diagnostics/Pathways and Indicators (MPI). The MPI was designed to facilitate and standardize determination of project effects on bull trout. The MPI provides a consistent, logical line of reasoning to aid in determining when and where adverse affects occur and why they occur. The MPI provides levels or values for different habitat indicators to assist the biologist in determining the level of effects or impacts to bull trout from a project and how these impacts may cumulatively change habitat within the watershed.

4. Individual Watershed Resources. Other resources may be available within a watershed that will provide information on habitat, fish species, and recovery and restoration activities being conducted. The action agency may cite a publication or identify a local watershed group within the Biological Assessment or Biological Evaluation. These local groups provide valuable information specific to the watershed.

5. Washington State Department of Ecology (WDOE) - The WDOE has long- and short-term water quality data for different streams within the State. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html. Clicking on a stream or entering a stream name will provide information on current and past water quality data (when you get to this website, scroll down to the Washington map). This information will be useful for determining the specific turbidity/suspended sediment relationship for that stream (more information below).

6. Washington State Department of Ecology (WDOE) - The WDOE has also been collecting benthic macroinvertebrates and physical habitat data to describe conditions under natural and anthropogenic disturbed areas. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_benth/index.htm. You can access monitoring sites at the bottom of the website.

7. U.S. Forest Service, Watershed Analysis Documents - The U.S. Forest Service (USFS) is required by the Record of Decision for Amendments to the USFS and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl to conduct a watershed analysis for watersheds located on FS lands. The watershed analysis determines the existing condition of the watershed and makes recommendations for future projects that move the landscape towards desired conditions. Watershed analysis documents are available from individual National Forests or from the Forest Plan Division.

8. U.S. Fish and Wildlife Service - Bull Trout Recovery Plans and Critical Habitat Designations. The draft Bull Trout Recovery Plan for the Columbia River Distinct

Population Segment (DPS) (also the Jarbidge River and the St. Mary-Belly River DPS) and the proposed and final critical habitat designations provide current species status, habitat requirements, and limiting factors for bull trout within specific individual recovery units. These documents are available from the Endangered Species Division as well as the Service's web page (www.fws.gov).

These documents and websites provide baseline and background information on stream and watershed conditions. This information is critical to determining project-specific sediment impacts to the aquatic system. The baseline or background levels need to be analyzed with respect to the limiting factors within the watershed.

Consultation Sediment Analysis

The analysis in this section only applies to construction-related physiological and behavioral impacts, and the direct effects of fine sediment on current habitat conditions. Longer-term effects to habitat from project-induced channel adjustments, post-construction inputs of coarse sediment, and secondary fine sediment effects due to re-mobilization of sediment during the following runoff season, are not included in the quantitative part of this effects determination. Those aspects are only considered qualitatively.

The background or baseline sediment conditions within the project area or watershed will help to determine whether the project will have an adverse effect on bull trout. The following method should be followed to assist in reviewing effects determinations and quantifying take in biological opinions.

1) Determine what life stage(s) of bull trout will be affected by sedimentation from the project. Life history stages include eggs and alevins, juveniles, and sub-adults and adults. If projects adhere to approved work timing windows, very few should be constructed during periods when eggs and alevins are in the gravels. However, streambed or bank adjustments may occur later in time and result in increased sedimentation during the time of the year when eggs and alevins may be in the gravels and thus affected by the project.

2) Table 4 (Page 45) provides concentrations, durations, and SEV levels for different projects. This table will help in analyzing similar projects and to determine sediment level impacts associated with that type of project. Based on what life history stage is in the project area and what SEV levels may result from the project, a determination may be made on effects to bull trout.

3) Once a "likely to adversely affect" determination has been made for a project, the figures in Newcombe and Jensen (1996) or Anderson et al. (1996) are used to determine the concentration (mg/L) at which adverse effects[2] and "take" will occur (see Figures 1-5). For example, if a project is located in FMO habitat, Figure 1 would be used to determine the concentrations at which adverse effects will occur. Since Figure 1 is used for both adults and juveniles, an SEV of 5 (for juveniles) is used (see Table 2). For (a.) the level

[2] For the remainder of the document, references to "adverse effects" also refer to harm and harass under 50 CFR 17.3.

when instantaneous adverse effects occur, find the SEV level of 5 in the one hour column. The corresponding concentration is the instantaneous value where adverse affects occur. In this example, it is 148 mg/L. For (b), (c), and (d), adverse effects will occur when sediment concentrations exceed SEV 4 levels. The exact concentrations for this have been provided. For each category, find the SEV 4 levels and the corresponding concentration levels are the values used.

For impacts to individual bull trout, adverse effects would be anticipated in the following situations:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 20 mg/L over background for over seven hours cumulatively.

For habitat effects, use Figure 5 and the same procedure as above for individual bull trout. For example, adverse effects would be expected to occur in the following situations:

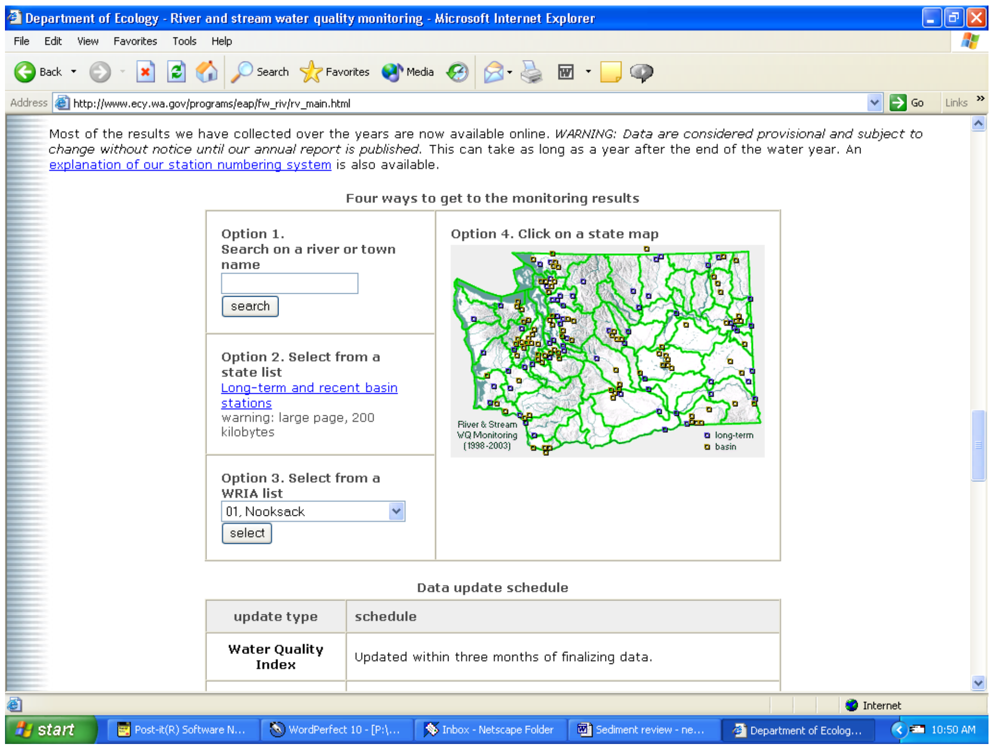
a. Any time sediment concentrations exceed 1,097 mg/L over background.
b. When sediment concentrations exceed 885 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 345 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 167 mg/L over background for over seven hours cumulatively.

4) Because sediment sampling for concentration (mg/L) is labor intensive, many applicants prefer to monitor turbidity as a surrogate. To do this, the sediment concentration at which adverse effects to the species and/or habitat occurs is converted to NTUs. Two methods, regression analysis and turbidity to suspended solid ratio, are available for this conversion. The regression analysis method should be used first. If not enough data are available then the turbidity to suspended solid ratio method should be used.

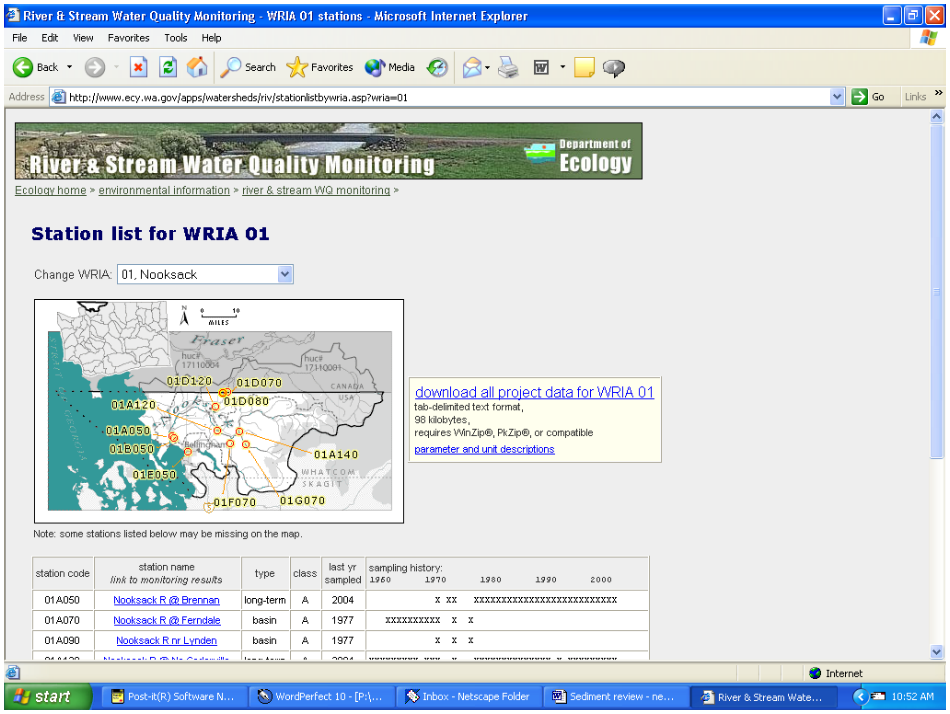
    a. Data – as described above in Background and Environmental Baseline, an attempt should be made to find turbidity and suspended solid information from the project area, action area, or the stream in which the project is being constructed. This information may be available from the Tribes, watershed monitoring groups, etc. Try to obtain information for the months in-water construction will occur, which is usually during the fish timing window (in most cases, July through September). If you are unable to find any data for the action area, use the WDOE water quality monitoring data. The following are the steps you need to go through to locate the information on the web and how to download the data:

i. Go to the WDOE webpage (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html).

ii. When you get to the website, the page will state "River and Stream Water Quality Monitoring." If you scroll down the page, you will see the following text and map.



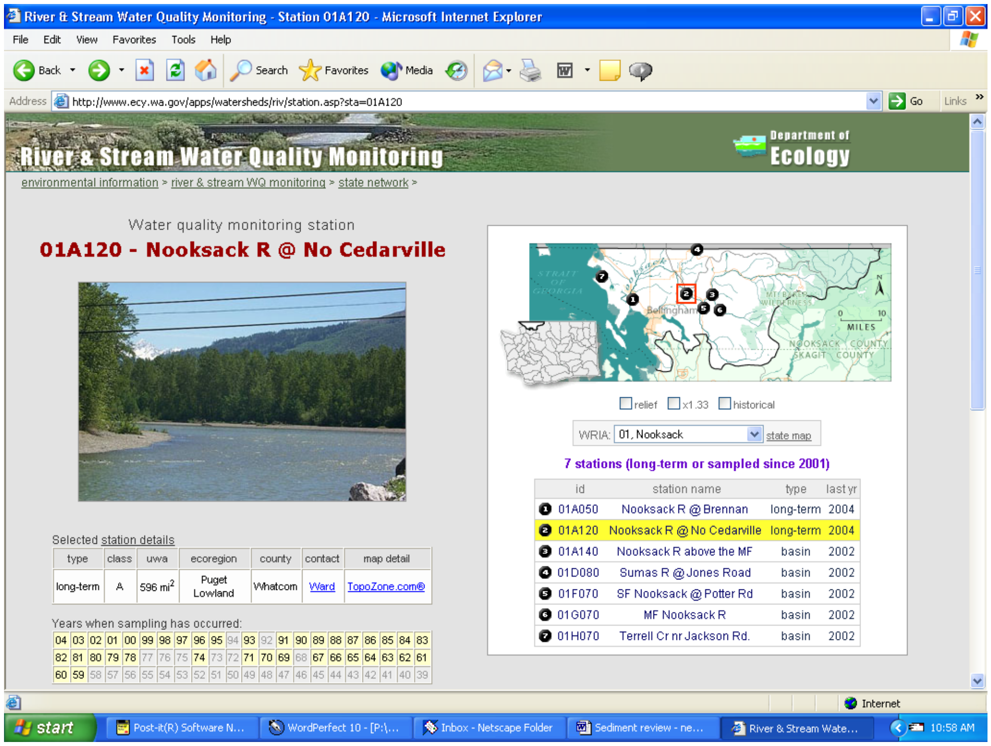
iii. The map shows all the water quality monitoring stations in Washington. You can click on a watershed, or go to Option 3, click on the down arrow and find your watershed. You will then get the following webpage. This is an example for the Nooksack River.



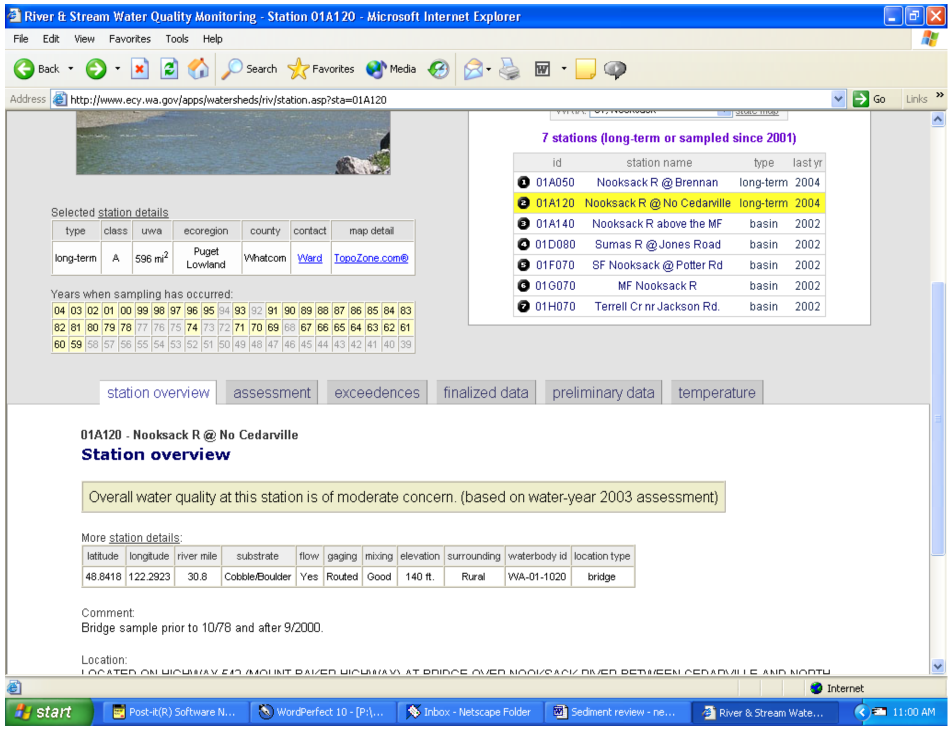
iv. This webpage shows you all the monitoring stations in this watershed. Scrolling down a little on the webpage, you get a list of the monitoring stations and the years that data were collected. The more years in which data were collected the better; however, you want to pick the monitoring station closest to the project site. If a project is located on a tributary, do not use data from the main river in the watershed. Find a monitoring station on a tributary and use that data. **Justification for the use of the data needs to be made in the BO.** The following language was used in the Anthracite Creek Bridge Scour BO. Changes to this paragraph to represent regression analysis are not italicized.

"*The guidance of Newcombe and Jensen (1996) requires a measurement of the existing suspended sediment concentration levels (mg/L) and duration of time that sediment impacts would occur. The Service used data available on the Washington Department of Ecology (WDOE) website to determine a ratio of turbidity (NTU) to suspended solids (mg/L)*(website to find the correlation between turbidity and suspended solids) *in Anthracite Creek. No water quality data was available for Anthracite Creek, so the Service used water quality monitoring data from a different tributary within the Snohomish River watershed. Patterson Creek, which is a tributary to the Snoqualmie River, was used to determine the ratio of turbidity to suspended solids* (correlation between turbidity and suspended solids). *The Service believes that Patterson Creek would have very comparable water quality data as Anthracite Creek. The turbidity to suspended solid ratio for Patterson Creek is 1:2.4 during the proposed months of construction (July through September).*" Delete the last sentence for regression analysis or put in the equation used for analysis and the R^2.

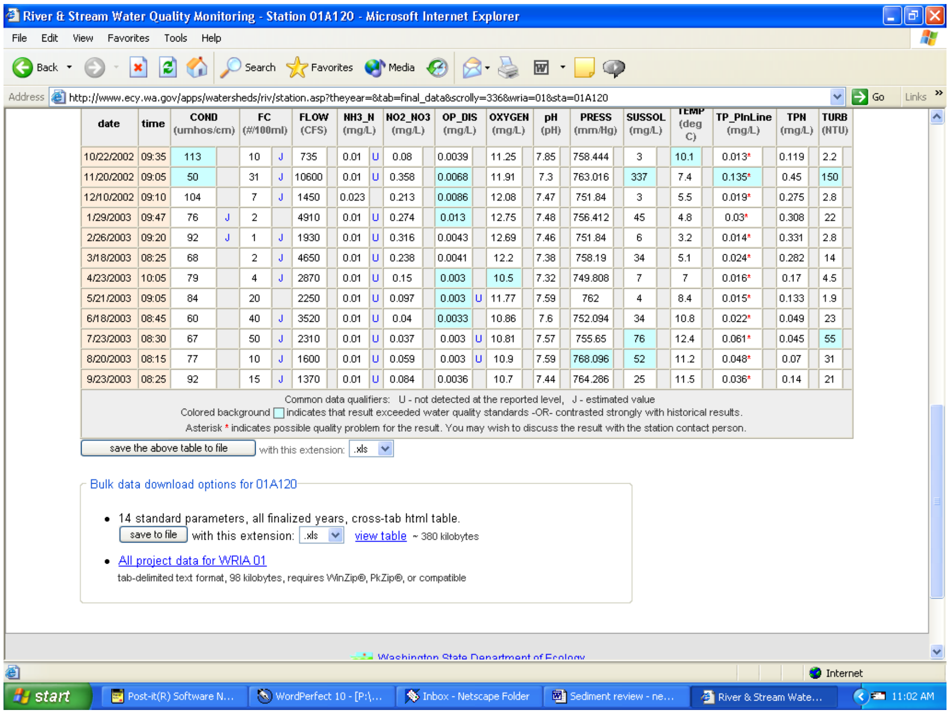
v. When you select the monitoring station, the following webpage appears. This monitoring station is on the Nooksack River at North Cedarville.



vi. Moving down the webpage, you find the following. The page shows the years data were collected and 4 to 6 tabs that provide different information. Click on the finalized data tab.



vii. Selecting the finalized data, a new page comes up; scrolling down that page you see the following. The top part of the page shows the finalized data for the most recent year data were collected. Below the data is a box that says “Bulk data download options...” Click on the “save to file” button for the 14 standardized data parameters. Follow the instructions to save this file. This saves all the data from that monitoring station so the regression analysis can be conducted.



River & Stream Water Quality Monitoring - Station 01A120 - Microsoft Internet Explorer

http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=final_data&scrolly=336&wria=01&sta=01A120

date	time	COND (umhos/cm)	FC (#/100ml)	FLOW (CFS)	NH3_N (mg/L)	NO2_NO3 (mg/L)	OP_DIS (mg/L)	OXYGEN (mg/L)	pH (pH)	PRESS (mm/Hg)	SUSSOL (mg/L)	TEMP (deg C)	TP_PlnLine (mg/L)	TPN (mg/L)	TURB (NTU)
10/22/2002	09:35	113	10 J	735	0.01 U	0.08	0.0039	11.25	7.85	758.444	3	10.1	0.013*	0.119	2.2
11/20/2002	09:05	50	31 J	10600	0.01 U	0.358	0.0068	11.91	7.3	763.016	337	7.4	0.135*	0.45	150
12/10/2002	09:10	104	7 J	1450	0.023	0.213	0.0086	12.08	7.47	751.84	3	5.5	0.019*	0.275	2.8
1/29/2003	09:47	76 J	2	4910	0.01 U	0.274	0.013	12.75	7.48	756.412	45	4.8	0.03*	0.308	22
2/26/2003	09:20	92 J	1 J	1930	0.01 U	0.316	0.0043	12.69	7.46	751.84	6	3.2	0.014*	0.331	2.8
3/18/2003	08:25	68	2 J	4650	0.01 U	0.238	0.0041	12.2	7.38	758.19	34	5.1	0.024*	0.282	14
4/23/2003	10:05	79	4 J	2870	0.01 U	0.15	0.003	10.5	7.32	749.808	7	7	0.016*	0.17	4.5
5/21/2003	09:05	84	20	2250	0.01 U	0.097	0.003 U	11.77	7.59	762	4	8.4	0.015*	0.133	1.9
6/18/2003	08:45	60	40 J	3520	0.01 U	0.04	0.0033	10.86	7.6	752.094	34	10.8	0.022*	0.049	23
7/23/2003	08:30	67	50 J	2310	0.01 U	0.037	0.003 U	10.81	7.57	755.65	76	12.4	0.061*	0.045	55
8/20/2003	08:15	77	10 J	1600	0.01 U	0.059	0.003 U	10.9	7.59	768.096	52	11.2	0.048*	0.07	31
9/23/2003	08:25	92	15 J	1370	0.01 U	0.084	0.0036	10.7	7.44	764.286	25	11.5	0.036*	0.14	21

Common data qualifiers: U - not detected at the reported level, J - estimated value

Colored background indicates that result exceeded water quality standards -OR- contrasted strongly with historical results.

Asterisk * indicates possible quality problem for the result. You may wish to discuss the result with the station contact person.

save the above table to file with this extension: .xls

Bulk data download options for 01A120

- 14 standard parameters, all finalized years, cross-tab html table. save to file with this extension: .xls view table ~ 380 kilobytes
- All project data for WRIA 01 tab-delimited text format, 98 kilobytes, requires WinZip®, PkZip®, or compatible

viii. Open Excel and open the file that was just downloaded. Verify that all data appear to be available. After you have worked with these files, you will get an idea if something appears wrong. If the data looks like something is wrong, verify it by comparing the data to the finalized data on the webpage (look at each year's finalized data). After the file is open, delete all columns except the date, sussol (mg/L) and turb (NTU).

ix. Next delete the rows that do not need to be included. Only save the months in which the project will be constructed. For example, if work will be conducted during the work timing window of July 15 through August 31, delete all rows except those that contain data for July and August. The data consist of one data collection point each month. In addition, delete any values that have a "U" or "J" in the column to the right of the NTU value. This data may not be accurate; data may not be detectable at reported level or is an estimated value. The blue cells indicate the value exceeds water quality standards or contrasted strongly with historical results.

x. After deleting the unnecessary columns and rows, your data should contain 5 columns. You can now delete the columns to the right of the values. This will give you 3 columns. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

b. Regression analysis. Once you have the data reduced to the months construction will occur, you can determine the relationship between turbidity and suspended solids using regression. The following steps will provide the regression equation using the data obtained above. These steps are for Excel 2007.

i. With your mouse, highlight both columns of data (suspended solid and turbidity), but do not include the heading information.

ii. Then click on “Insert”, “Scatter” and then the graph that does not have any lines on it (should be the upper left graph).

iii. The graph is placed on your Excel sheet, so move it over so you can see all the data and the graph.

iv. Now add the trendline to the graph. This is done by clicking (left button) once on any of the points on the graph. Then right click. A window pops open and click on “Add Trendline.” A “Format Trendline” window appears. Make sure Linear is checked, and down on the bottom, check Display Equation on chart and Display R-squared value on chart. Click on close.

    1. The X and Y data are opposite of what you want so you need to swap the values. This is done by left clicking once anywhere on the graph and then right click and click on “select data.” A window pops open and you want to click on Edit. An Edit Series window appears and you want to click on the little red arrow next to Series X values. This allows you to select the data in the table. Upon clicking the red arrow, you will see the column under sussol (mg/L) being selected by a moving line around the cells. Select the data under Turb (NTU) by left clicking and holding the button down and drag all the way down to the last cell in that column. The whole column should have the moving line around all the cells. Click on the little red arrow in the Edit Series window. That will expand out the window and you will do the same for the Series Y values. Click on the red arrow next to that, then left click and hold and select all the cells in the column under Sussol (mg/L), and then click on the red arrow again. When the Edit Series window expands, click on OK, and then click on OK.

v. The equation that you want to use for your conversion from NTUs to suspended solids is now on the graph. Hopefully, your R-squared value is also high. This gives you an indication of how well your data fits the line. A one (1) is perfect. If this number is low (and a ballpark figure is less than 0.60) then you may want to consider using the ratio method to determine your conversion from NTUs to suspended solids.

    1. Outliers – sometimes there will be data that will be far outside the norm. These values can be deleted and that will help increase your R-squared value. If you are good at statistics there are ways of

determining outliers. If not, you will probably just use the data as is, unless you think something is really not right, then you may want to delete those data points.

vi. Using the equation for the regression analysis, convert the sediment concentrations found for when adverse affects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid equation is: $y = 1.6632x - 0.5789$. Adverse effects would then occur at (solve for x):

For impacts to the species adverse effect would occur in the following situations:

a. Any time sediment concentrations exceed 89 NTU over background.
b. When sediment concentrations exceed 60 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 24 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 12 NTU over background for over seven hours cumulatively.

For impacts to habitat

a. Any time sediment concentrations exceed 660 NTU over background.
b. When sediment concentrations exceed 532 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 208 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 101 NTU over background for over seven hours cumulatively.

c. Turbidity:suspended solid ratio: To calculate the turbidity to suspended solid ratio you need to download the same data off the Ecology website as described above. Sometimes the monitoring stations have limited amount of data and by running the regression analysis it is possible to get a negative slope (an increase in turbidity results in a decrease in suspended solids). This is very unlikely to occur in a stream. Other times you have so few data points that the R^2 value shows that the correlation between suspended solid and turbidity is not very good. When R^2 values are below 0.60, determine the turbidity to suspended solid ratio. The following are the steps needed to calculate the turbidity to suspended solid ratio.

i. After you deleted all the columns and rows of data you do not need, you should have 3 columns of data. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

ii. Calculate the average turbidity and suspended solid value for all data. Average the turbidity column and average the suspended solid column.

iii. Calculate the turbidity to suspended solid value for the average turbidity and average suspended solid value obtained in ii. Divide the average suspended solid value by the average turbidity value.

iv. If any outliers are identified, they should be deleted. Recalculate the turbidity:suspended solid ratio if outliers have been removed (should automatically be done when values are deleted).

vii. Using the turbidity to suspended solid ratio, convert the sediment concentrations found for when adverse effects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid ratio is 2.1. Adverse effects to the species would then occur in the following situations:

a. Any time sediment concentrations exceed 70 NTU over background.
b. When sediment concentrations exceed 47 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 19 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 10 NTU over background for over seven hours cumulatively.

Adverse effects to the species through habitat impacts would occur in the following situations:
a. Any time sediment concentrations exceed 522 NTU over background.
b. When sediment concentrations exceed 421 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 164 NTU over background for more than three hours cumulatively.
a. When sediment concentrations exceeded 80 NTU over background for over seven hours cumulatively.

5) Determine how far downstream adverse effects and take will occur. There is no easy answer for determining this. Table 4 provides some sediment monitoring data for a variety of projects. These data can be used to determine the downstream extent of sediment impacts for a project. Note that in Table 4 there is not a single downstream point that can always be used because sediment conveyance and mixing characteristics are different for each stream. **An explanation of how the distance downstream was determined needs to be included in each BO.**

Figure 1 – Severity of ill effect scores for juvenile and adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile and Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours 1	Hours 3	Hours 7	Days 1	Days 2	Days 6	Weeks 2	Weeks 7	Months 4	Months 11	Months 30
162755	10	11	11	12	12	13	14	14	-	-	-
59874	9	10	10	11	12	12	13	13	14	-	-
22026	8	9	10	10	11	11	12	13	13	14	-
8103	8	8	9	10	10	11	11	12	13	13	14
2981	$\boxed{5760}$ 7	8	8	9	9	10	11	11	12	12	13
1097	6	$\boxed{2335}$ 7	$\boxed{1164}$ 7	8	9	9	10	10	11	12	12
403	5	6	7	$\boxed{491}$ 7	8	9	9	10	10	11	12
148	5	5	6	7	$\boxed{214}$ 7	8	8	9	10	10	11
55	$\boxed{99}$ 4	5	5	6	6	$\boxed{95}$ 7	8	8	9	9	10
20	3	$\boxed{40}$ 4	$\boxed{20}$ 4	5	6	6	$\boxed{42}$ 7	8	8	9	9
7	3	3	4	$\boxed{8}$ 4	5	6	6	$\boxed{18}$ 7	$\boxed{8}$ 7	8	9
3	2	2	3	4	$\boxed{4}$ 4	5	5	6	7	$\boxed{4}$ 7	8
1	1	2	2	3	3	$\boxed{2}$ 4	5	5	6	7	$\boxed{2}$ 7

Figure 2 - Severity of ill effect scores for adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 5 and 6 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	11	11	12	12	13	13	14	14	-	-	-
59874	10	10	11	11	12	12	13	13	14	14	-
22026	9	10	10	11	11	12	12	13	13	14	14
8103	8	9	9	10	10	11	11	12	12	13	13
2981	8	8	9	9	10	10	11	11	12	12	13
1097	$\boxed{2190}$ 7	8	8	8	9	9	10	10	11	11	12
403	6	$\boxed{1095}$ 7	$\boxed{642}$ 7	8	8	9	9	10	10	11	11
148	$\boxed{156}$ 5	6	6	$\boxed{331}$ 7	$\boxed{175}$ 7	8	8	9	9	10	10
55	5	$\boxed{78}$ 5	6	6	7	$\boxed{94}$ 7	8	8	9	9	9
20	4	4	$\boxed{46}$ 5	$\boxed{24}$ 5	6	6	$\boxed{50}$ 7	$\boxed{27}$ 7	8	8	9
7	3	4	4	5	$\boxed{12}$ 5	6	6	7	$\boxed{14}$ 7	$\boxed{8}$ 7	8
3	2	3	3	4	4	$\boxed{7}$ 5	$\boxed{4}$ 5	6	6	7	$\boxed{4}$ 7
1	2	2	3	3	4	4	5	$\boxed{2}$ 5	$\boxed{1}$ 5	6	6

Figure 3 - Severity of ill effect scores for juvenile salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	9	10	11	11	12	13	14	14	-	-	-
59874	9	9	10	11	11	12	13	14	14	-	-
22026	8	9	9	10	11	11	12	13	13	14	-
8103	$\boxed{13119}$ 7	8	9	9	10	11	11	12	13	13	14
2981	6	$\boxed{4448}$ 7	8	9	9	10	11	11	12	13	13
1097	6	6	$\boxed{1931}$ 7	8	9	9	10	11	11	12	13
403	5	6	6	$\boxed{687}$ 7	8	9	9	10	11	11	12
148	$\boxed{197}$ 4	5	6	6	$\boxed{254}$ 7	8	9	9	10	11	11
55	4	$\boxed{67}$ 4	5	6	6	$\boxed{96}$ 7	8	8	9	10	11
20	3	4	$\boxed{29}$ 4	5	6	6	$\boxed{36}$ 7	8	8	9	10
7	2	3	4	$\boxed{10}$ 4	5	6	6	$\boxed{13}$ 7	8	8	9
3	1	2	3	4	$\boxed{4}$ 4	5	6	6	$\boxed{5}$ 7	8	8
1	1	1	2	3	4	$\boxed{1}$ 4	5	6	6	8	8

Figure 4 - Severity of ill effect scores for eggs and alevins of salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for both harassment and harm to eggs and alevins.

Eggs and Alevins of Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	7	9	10	11	12	13	14	-	-	-	-
59874	7	8	9	10	12	13	14	-	-	-	-
22026	7	8	9	10	11	12	13	-	-	-	-
8103	7	8	9	10	11	12	13	14	-	-	-
2981	6	7	8	10	11	12	13	14	-	-	-
1097	6	7	8	9	10	11	12	14	-	-	-
403	6	7	8	9	10	11	12	13	14	-	-
148	5	6	7	9	10	11	12	13	14	-	-
55	5	6	7	8	9	10	12	13	14	-	-
20	5	6	7	8	9	10	11	12	13	-	-
7	11 4	5	7	8	9	10	11	12	13	14	-
3	4	5	6	7	8	10	11	12	13	14	-
1	4	5	6	7	8	9	10	11	13	14	-

Figure 5 - Severity of ill effect scores for salmonid habitat. The individual boxes provide the maximum concentration for that SEV. The concentration between 6 and 7 represents the threshold for anticipating adverse effects to bull trout through habitat modifications.

Salmonid Habitat
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	11	12	12	13	14	-	-	-	-	-	-
59874	10	11	12	12	13	14	-	-	-	-	-
22026	9	10	11	11	12	13	14	14	-	-	-
8103	8	9	10	11	11	12	13	14	14	-	-
2981	8	8	9	10	11	11	12	13	13	14	-
1097	7	7	8	9	10	10	11	12	13	13	14
	$\boxed{885}$										
403	6	7	7	8	9	10	10	11	12	12	13
		$\boxed{345}$	$\boxed{167}$								
148	5	6	6	7	8	9	9	10	11	12	12
				$\boxed{68}$							
55	4	5	6	6	7	8	9	9	10	11	11
					$\boxed{29}$						
20	3	4	5	5	6	7	8	8	9	10	11
						$\boxed{12}$					
7	2	3	4	5	5	6	7	7	8	9	10
							$\boxed{5}$				
3	2	2	3	4	5	5	6	7	8	8	9
								$\boxed{2}$			
1	1	1	2	3	4	4	5	6	7	7	8

Reference List

1. Anderson, P. G., B. R. Taylor, and G. C. Balch. 1996. Quantifying the effects of sediment release on fish and their habitats.Canadian Manuscript Report of Fisheries and Aquatic Sciences 2346.

2. Newcombe, C. P. and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4): 693-727.

3. Newcombe, C. P. 1994. Suspended sediment in aquatic ecosystems: ill effects as a function of concentration and duration of exposure.Victoria, British Columbia.

ESA Consultations:

While reviewing a project for sediment related impacts, there are a couple things to think about.

1. Time frame – how does sediment affect feeding, breeding, and sheltering. This is important when thinking about the likelihood of harm (significant impairment of essential behavior…) and/or harassment (significantly disrupt normal behavior…). During ESA consultations this must always be in the back of your mind.

2. Individual fish – Throughout this document, the term bull trout and their habitat are used. Please remember to think about risks to individual bull trout. The ESA is designed to protect individuals as well as populations, but effect determination and analysis or take are both about effects to individuals. For example, on page 4 of the Sediment Template (literature review), under Biological Effects of Sediment on bull trout, the last sentence in the first paragraph states "Specific effects of sediment on fish and their habitat can be put into three classes that include:" The document then defines lethal, sublethal, and behavioral effects. These effects can be to an individual or to multiple individuals within a reach.

3. Habitat – similarly, sediment input into a stream can alter habitat, and this can impact an individual bull trout as well as multiple bull trout within a reach. The preceding discussion addresses fish habitat in general and not necessarily critical habitat or PCE's. An attempt was made to clarify this in the document. It was not possible to relate sediment input to the critical habitat PCE's. The information needed to address sediment input and impacts to the PCEs can be found within the Sediment Template document.

Table 4 - Water quality monitoring data received by the Washington Fish and Wildlife Office. Calculated Values are exact SEV values for juvenile and adult salmonids (Figure 1) based on Newcombe and Jensen (1996), and for habitat (Figure 5) by Anderson et al. (1996).

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data – how sediment data was provided in monitoring report.	Concentration (mg/L) used for determining SEV level. From original sediment data, concentration was either directly used, or was calculated using ratio or regression as stated in comments column.	Duration of elevated sediment concentration levels during project construction.	SEV (Juvenile and Adult Salmonids) Calculated SEV value for impacts to salmonids based on Newcombe and Jensen (1996)	SEV Habitat Calculated SEV value for habitat based on Anderson et al. (1996)	Comments
Culvert Removal or Removal and Replacement								
Siegel Creek Culvert Removal, Siegel Creek – Clark Fork River Watershed (Montana) Culvert removal Channel stabilization Bank reshaping	Lolo National Forest Bankfull width: 12 ft Average discharge: 2.8 CFS Slope: 6.7% Drainage area: 9,245 acres	Grab samples No distance Provided. Assume 150 ft. Automatic sampling - 150 ft downstream	Sediment load Ave: 0.07 tons/day Peak: 0.4 tons/day Sediment load Ave: 0.04 tons/day Peak: 0.3 tons/day	9.4 (average)* 53.7 (peak)* 5.4 (average)* 40.3 (peak)*	24 hrs* > 3 to 7 hrs* 24 hrs* > 3 to 7 hrs*	5 5 at 3 hrs 5 at 7 hrs 4 4 at 3 hrs 5 at 7 hrs	5 5 at 3 hrs 6 at 7 hrs 4 5 at 3 hrs 5 at 7 hrs	Creek dewatered during work. All sediment sampling was in mg/L. Concentration reached baseline at 1.5 miles downstream. Most of sediment appeared to settle within several hundred feet.
Sheep Creek Culvert Replacement Sheep Creek – Selway River Watershed (Idaho) Culvert replacement	Bitterroot National Forest Discharge: 1.5-2.0 CFS baseflow Channel width: 5 feet Slope: 8.9% Rosgen B4 channel	Approximately 100 ft. Distance not given, stated right below work area where water was put back in stream.	Baseline 1.69 mg/L 4.5 mg/L – 25 min 7.5 mg/L – 2 min 7.5 mg/L – 30 min 34.37 mg/L – 30 min 164.19 mg/L – 11 min 15,588.6 mg/L – 30 min 677 mg/L – 30 min 105.31 mg/L – 30 min 29.17 mg/L – 30 min 17.6 mg/L – 30 min 19.74 mg/L – 30 min 15,588.6 mg/L – 30 min	11..8 162.5 2,737.9 (average) 15,586.9 (peak)	1.5 hrs (building diversion dam and diverting stream) 15 min (diversion failure) 6.5 hrs (diversion removed and stream stabilizing, exact duration unknown, stopped monitoring before sediment conc. returned to background. 30 min (peak during diversion removal)	3 4 8 8	3 4 9 8	Creek dewatered during work. All sediment sampling in mg/L.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Culvert Removal or Removal and Replacement, continued								
Graves Creek Road Repair Graves Creek – Quinault River Watershed (Washington) Road widening Culvert installation	Olympic National Park Project located 1.5 and 1.7 miles upstream of Upper Quinault Bridge Discharge: 3,200 – 3,700 cfs Slope: 0.4%	Distance from project site on tributary to the confluence with the Quinault was not provided. Road runs along Quinault River, so assume distance was less then 50 feet. Monitoring data is at confluence.	Baseline: 1.5 NTUs Confluence: 39 NTUs Below new culvert: 5.5 NTUs	52.5	2 hrs Monitoring report stated that construction was limited to less than two hours.	4	5	No diversion Culvert was installed on small trib. to Quinault River. Data indicates concentration and duration of sediment at trib. confluence with Quinault. Data analysis: Used Quinault River data downstream of Quinault Lake. No data available upstream. One year of data available – used July through October (4 months) NTU:SS ratio = 1:1.4 Regression: Negative slope Used ratio in analysis
Sulpher Creek State Route 241 Yakima County Culvert replacement	Project located approximately 1.5 miles of I-82 on SR141, near airport. Slope 3.5%	100 and 200 ft	Data provided in NTUs	100 ft 137.1 36.8 77.6 436.3 94.6 118.7 200 ft 33.8 50.0 55.5 213.0 147.2 141.0	 6 hr# 1 hr# 1 hr# 6 hr# 1 hr# 1 hr# 1 hr# 1 hr# 1 hr# 6 hr# 1 hr# 1 hr#	 6 4 4 7 4 5 4 4 4 6 5 5	 6 4 4 7 5 5 4 4 4 7 5 5	Dewatered stream Data analysis: Sulpher Creek has 2 monitoring stations, each a half mile apart. Both stations only have one year of data. Using individually, there would only be 2 points. Combined data for regression analysis. Used regression Regression: SS = 2.6561*NTU + 14.362 Ratios: Lower site ratio of 1:3.7 upper site has 1:3.3. Combined data 1:3.4.
Everett Vicinity Bridge 2/5N Seismic Retrofit Snohomish River and unnamed side channel Removal of 2 culverts of an existing temporary access road	Culverts removed in side channel Project located at Highway 2 over Snohomish River. Slope: In tidally influenced section of Snohomish River Construction occurred during low tide and channel had very little water running.	Work conducted in side channel of Snohomish River, sample taken 10 ft below confluence with river	Reading of 825 NTUs found, no background on that day, background next day was 15.6 NTUs.	713.4	2.5 hrs	6	7	Side channel not dewatered. Data analysis: Used Snohomish River data at Snohomish. 27 years of data on the lower Shohomish River. Used regression NTU:SS ratio = 1:2.1 Regression: SS = 0.878*NTU + 2.7839

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Culvert Removal or Removal and Replacement, continued								
Judd Creek Vashon Island Culvert replacement stream dewatered during construction. Water quality monitoring data for other Judd Creek project said "another stream simulation culvert replacement"	Judd Creek enters in NW corner of Quartermaster Harbor of Vashon Island. Monitoring report did not state where project was located. Drainage area: 3,292 acres. Discharge: 2.2 cfs Slope: 1.5% - used lower reach	100, 500, 1800 ft.	Data provided in graph format (NTUs). All values were estimated from graph	100 20 379.1 172 18.5 500 11.3 41.4 72.7 16.3 1800 19 41.4 9.2	 6 hrs 7 hrs 5 hrs 13 hrs 6 hrs 7 hrs 6 hrs 14 hrs 4 hrs 7 hrs 12 hrs	 4 7 6 5 4 5 5 5 4 5 4	 5 7 6 5 4 5 6 5 4 5 4	Stream was dewatered. Ecology does not monitor water quality in streams on Vashon Island. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.
Judd Creek Vashon Island Culvert Replacement stream dewatered during construction.	Judd Creek enters in NW corner of Quartermaster Harbor of Vashon Island. Drainage area: 3,292 acres. Discharge: 2.2 cfs Slope: 2.0%	100, 500, 1600 ft.	Data provided in graph format (NTUs). All values were estimated from graph	100 ft 9.6 49.7 20.6 500 ft 12 20.9 22.2 1,600 ft 10 22.5 11	 3 hrs 4 hrs 5.5 hrs 1.5 hrs 6 hrs 3.5 hrs 1 hr 2.5 hrs 2	 3 5 4 3 4 4 3 4 3	 3 5 5 3 5 4 3 4 3	Stream was dewatered. Ecology does not monitor water quality in streams on Vashon Island. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.
Harris Creek Snoqualmie River Culvert Replacement	Harris Cr. located approx. 2 miles north of Carnation, WA. Project in upper reaches of creek. Drainage area: 8,626 acres. Slope: 3.9% Discharge: 1.3 cfs (King County data)	Not provided	Document stated all water quality criteria were met except for one exceedance, 24 NTUs above background.	48	1 hr#	4	4	Stream was dewatered. Ecology does not monitor water quality in Harris Creek. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization								
Swede Heaven Bank Stabilization N.F. Stillaguamish River Project: 300 feet long, placing rock groins, LWD, and plantings	Project located approx. 5.5 miles west of Darrington, WA. Drainage area: 685 sq. miles. Discharge: 1,892 cfs Slope: 0.3% Bankfull width: 210 ft.	300, 600, and 1,200 ft downstream	Data provided in NTUs.	300 ft. 56.7 103.8 191.5 28.4 27.5 16.1 22.8 35.7 42.4 20.0 600 ft. 33.6 38.5 31.6 17.7 24.5 20.4 1,200 ft 47.6	 1 hrs** 3 hrs** 3 hrs** 30 min. 1.5 hrs 30 min 30 min 1.5 hrs 30 min 1 hrs# 2 hrs** 2 hrs** 3 hrs** 1 hrs# 30 min 30 min 1 hrs**	 4 5 6 3 4 3 3 4 3 3 4 4 4 3 3 3 4	 4 5 6 3 4 3 3 4 3 3 4 4 4 3 3 3 4	Construction area was diverted. Streambank was isolated. Data analysis 9 years of data available for the N.F. Stillaguamish River at Darrington, used July and August months when construction occurred. NTU:SS ratio = 1:3.5 Regression: Negative slope Used ratio in analysis
MP 9.2 Oil City Road Hoh River Riprap (170 ft) and LWD placement	No project location given, Oil City Road runs along the north bank of the lower Hoh River. Discharge: 2,541 cfs Drainage area: 253 sq. miles Slope: 0.3%	300 and 600 ft downstream	Monitoring data was only for LWD placement and not riprap installation Data provided in NTUs.	300 ft. 8.4 7.7 9.4 600 ft 7.5	 10 min 10 min 10 min 20 min	 2 1 2 2	 1 1 1 2	No information on how project constructed, dewatered. Project became influenced by WSDOT diversion dam release 5-6 miles upstream. 13 Years of data available for the Hoh River at the DNR Campground near the Hwy 101 Bridge. NTU:SS ratio = 1:1.2 Regression SS = 0.3874*NTU + 5.5385 Used regression analysis
SR 20 – debris jam Skagit River tributary	Project located at milepost 90 on SR20. No exact location, so used tributary just east of Concrete WA. Slope: 8.1%	Data stated sampling points located upstream and downstream of project area on the Skagit River. Two additional points located on two Skagit tributaries that are culverted under SR20.	Turbidity readings taken once a week in absence of any major rainfall and more frequently during a runoff producing rain event.	Met water quality standards.	Met water quality standards.			High turbidity was sampled, but this was due to runoff from rain events and not project. Channel was dewatered during construction.
Emergency Bank Protection Hoh River Rock placed in stream	No information on location of project. Work conducted in December.	Samples drawn 150 - 200 ft downstream of project.	Turbidity readings taken usually after large deposit of rock was placed in the river.	Met water quality standards. NTUs were provided for project, but levels were same as background.				NTU’s read between 10.7 and 17.2. For emergency work, this seems very clear water.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Rivershore Lane Emergency Watershed Project South Fork Stilliguamish River Reconstructed 1,000 ft of riverbank and stabilized the bank with rock vanes, logs, and rootwad structures.	Project located 0.5 miles SE of Robe WA. Discharge: 461 cfs Slope: 0.4%	300, 600 ft, and 3.3 miles		600 ft 130.3 14.2 20.9 12.5 98.1 120.7 3.3 miles 50.1 32.8	 6 hrs 2.5 hrs 2 hrs 1 hr 1 hr 10.5 hrs 4 hrs 4.5 hrs**	 6 4 4 3 4 6 5 5	 6 4 4 3 5 7 5 5	Work area was dewatered by construction of a bypass channel. 9 years of data available for the N.F. Stillaguamish River at Darrington, used July and August months when construction occurred. NTU:SS ratio = 1:3.5 Regression had negative slope, used ratio. No 300 ft readings were taken, data logger not operating correctly.
Boulder Creek Bank Stabilization Montana	No project location was given. Unable to determine any stream characteristics information.	350 and 4,300 ft	Data estimated off of graph of monitoring data – in mg/L	350 ft 77.4 334.5 4,300 ft 13.25 155.6	 3.5 hrs 12.5 hrs 3.5 hrs 12.25 hrs	 5 7 4 6	 5 8 4 7	Project area was dewatered by constructing diversion channel.
Saxon Bank Stabilization Project South Fork Nooksack River Construct tree revetment and 3 rock vanes. Protecting 1,400 ft. of bank.	Project located at town of Saxon, WA. Slope: 0.7% Drainage area: 129 sq. miles Discharge: 748 cfs	300 ft	Summary of data provided in email which gave NTU levels when monitoring was above 5 NTU's, WA water quality standard.	43.0	4 hrs#	5	5	Had constructed an in-channel deflector to move the bulk of the river flow away from construction site. Data analysis. Two years of data for the S.F. Nooksack River at Potter Road. Used July through September data. NTU:SS ratio = 1:1.9 Regression: SS = 1.7249*NTU + 0.5206 Used regression
Lower Hutchinson Creek Project South Fork Nooksack River Installation of ELJs and levee setback	Project located at confluence of Hutchinson Creek and S.F. Nooksack River near Acme, WA. LEJs installed on S.F. Nooksack and Hutchinson Creek. S.F. Nooksack Slope: 0.7% Drainage area: 129 sq. miles Discharge: 748 cfs Hutchinson Creek Slope: 1.1%	300, 1200, 3000 ft.	Daily monitoring was provided in NTU's. Most work occurred either in dewatered section of Hutchinson Creek or outside wetted channel.	300 ft. 14 12	 1 hr 0.5 hr	 3 2	 3 2	Hutchinson Creek was diverted. Unable to tell from data where samples were taken, used estimated average ratio of 1:2.0 from S.F. Nooksack River (see previous entry for Saxon Bank project) NTU:SS ratio = 1:2.0 Project had low turbidity, no monitoring was done at 1200 and 3000 ft.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Green River Fish	Project located at RM	300, 600, 1200, 2500	Data provided in	300				
Restoration Project	60 on the Green River.	ft	NTUS. No	19.0	3.25	4	4	
	2 miles east of Palmer		background values	20.5	11.75#	5	5	Data analysis;
Green River	WA.		provided, so used first	39.9	9.5**	5	5	
			couple readings of the	45.5	5.25	5	5	29 years of data for the Green River at Kanaskat.
Installation of in-	Drainage area:		day as background.	16.6	5.0	4	4	Data collected at Cumberland-Palmer Road
stream gravel	231 sq. miles			63.5	11.25**	6	6	bridge. Used July and August data.
nourishment and				74.6	10.5#	6	6	
construction of 2 ELJs	Discharge 958 cfs			112.3	2.75**	5	5	Ratio: 1:1.7
				27.0	7.75**	5	5	
	Slope: 0.8%			9.0	9.5**	4	4	Regression:
				87.1	11**	6	6	S = 0.0983*NTU + 1.9326
				118.4	8.5#	6	6	
				600				Used ratio, regression data not correlated.
				11.1	3.25	4	4	
				121.9	0.75	4	5	
				28.8	11.75#	5	5	
				31.3	9.5**	5	5	
				35.7	9.0#	5	5	
				9.9	5.0	4	4	
				58.6	11.25**	6	6	
				67.3	10.5#	6	6	
				10.7	2.75**	3	3	
				23.5	7.75**	5	5	
				9.9	9.5**	4	4	
				121.8	11**	6	7	
				100.6	8.5#	6	6	
				1200				
				22.4	4.75	4	4	
				36.7	11.75#	5	6	
				20.6	9**	5	5	
				23.5	11.5#	5	5	
				20.2	2.25**	4	4	
				48.3	11.25**	5	6	
				130.3	6.75#	6	6	
				19.7	7.75**	5	5	
				18.8	11.75#	5	5	
				143.1	11**	6	7	
				75.6	9.0#	6	6	
				2500				
				11.4	4.75	4	4	
				19.1	3.0	4	4	
				13.4	10.0**	4	5	
				26.9	9.5	5	5	
				12.5	2.25**	3	3	
				33.4	11.25**	5	5	
				67.7	2.25#	5	5	
				48.8	4.5	5	5	
				20.9	7.75**	5	5	
				12.7	9.5**	4	4	
				104.1	11**	6	6	
				63.4	10.0#	6	6	

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Maple Creek Channel Reconstruction Thornton Creek 2 culvert removals, 2 bridge installations, channel reconstruction with habitat enhancement, boulder clusters, porous weirs, logjams, etc.	Project located on the S.F. Thornton Creek, just upstream of Hale School, above 30th St. NE bridge. S.F. Thornton Creek Drainage area: 12.1 sq. miles Discharge: 8 cfs Slope: 0.3% Bankful: 8 ft	200, 600, and 1660 ft downstream	Data provided in NTUs in graph. Estimated values from graph. Project site was dewatered, data collected during rewatering site.	200 ft 131.8 600 ft 48.1 1660 ft 40.5	 1.75 hrs 3 hrs 1.5 hrs	 5 5 4	 5 5 4	Site was dewatered and had excessive flows that overtopped diversion dams and flushed system prior to monitoring. Data analysis King County water quality data was used. 30 years of data for Thornton Creek collected at mouth. Used July and August data. Ratio: 1:2.5 Regression: SS = 3.2973*NTU - 3.6295 Used regression.
Bridge Construction and/or Repair								
SR 90 – Wilson Creek Bridge Widening Project Wilson Creek tributary to Yakima River	Project located on Wilson Creek at I-90 Bridge at Ellensburg WA. Slope: 0.6% Drainage area: 13 sq, miles	100 and 200 ft downstream		100 ft. 55.2 21.4 20.6 200 ft. 202.3 28.2 22.5	 1 hr# 6 hrs 1 hr 2 hrs 4.5 hrs 1 hr	 4 4 3 5 4 3	 4 5 3 6 5 3	Data analysis 3 years of data for Wilson Creek at Highway 821. Used July through September data. NTU:SS ratio = 1:3.2 Regression SS = 2.4425NTU + 6.2212 Used regression
SR – 12 Black River Bridge Scour Protection Black River – Tributary to Chehalis River. Placement of riprap to protect bridge column, placement of filter blanket and streambed gravel, installation of temporary work platform.	Project located on Black River, approximately 2 miles SE of Oakville, WA Slope: 0.2% Drainage area: 144 sq. miles Discharge: 162 cfs	300, 500 and 600 ft	Data provided in NTUs.	300 ft 10.6 8.8 9.6 18.8 500 ft 12.0 8.1 19.1 600 ft 12.5 6.4 12.8	 0.5 hr 5 hr 5 hr 1 hr# 4.5 hr 4.5 hr 1 hr# 2.5 hr 4.5 hr 1 hr#	 2 4 4 3 4 4 3 3 3 3	 2 4 4 3 4 4 3 3 3 3	Inwater silt curtain used. Data analysis: Ecology monitoring site at project location did not have turbidity and SS data. Used the data from the Black River at Moon Road Bridge monitoring station approximately 2 miles upstream. Six years of data available, July through September. NTU:SS ratio = 1:1.5 Regression had negative slope. Used ratio.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bridge Construction and/or Repair, continued								
Monroe Trestle Bridge Skykomish River Removal of railroad trestle	Project location is unknown. Project near City of Monroe WA. Discharge: 3,946 cfs Drainage area: 842 sq. miles Slope: 0.2%	300 ft (three locations across stream)	Turbidity was only high on one side of stream, that data is analyzed.	Site 1 6.9	32 hrs	5	5	Used sediment curtain around project. Data analysis 26 years of data for Skykomish River at Monroe. Used July through September data. NTU:SS ratio = 1:1.9 Regression: SS = 0.8453*NTU + 1.9163 Used regression
Humptulips River Bridge Scour Repair Humptulips River Project involved repair and augment riprap and placement of LWD	Project located on Humptulips River at US 101 Bridge. Slope 0.4% Drainage area: 276 sq. miles, 132 Sq. miles at project location Discharge: 1,340 cfs Bankfull at project location: 80-220 ft.	300 ft.	Measurements were recorded throughout the day, 5 to 7 times. Data provided in NTUs. Because time between monitoring sampling was anywhere from one to two hours during sediment generating activities, the peak turbidity values may not have been captured.	7.6 11.0	6.5 hrs** 7 hrs#	4 4	4 4	No stream dewatering occurred. Data analysis. 25 years of data for the Humptulips near Humptulips at the Highway 101 Bridge. Used July through September data. NTU:SS ratio = 1:1.6 SS = 0.6514*NTU + 1.1202 Used regression
Humptulips River Bridge Scour Repair Humptulips River Project involved installation of rock barbs and LWD in stream.	Project located on Humptulips River at US 101 Bridge. Slope 0.4% Drainage area: 276 sq. miles, 132 Sq. miles at project location Discharge: 1,340 cfs Bankfull at project location: 80-220 ft.	300 ft.	Met water quality standards.					

Project and Watershed	Stream Charact. at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concent.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream								
Williams Pipeline, Mt. Vernon Loop North Fork Stillaguamish River Project involved installing a pipeline under the NF. Stillaguamish River	Project located on the NF Stillaguamish approximately 1 mile north of Arlington WA. Drainage area: 262 sq miles Discharge: 1,896 cfs Slope: 0.3%	100, 600, 2000 ft and 1 mile	Monitoring conducted throughout project. Project also took samples for analysis in lab. Regression equation determined from lab analysis: SS = 2.3237*NTU + 3.6702 Equation provides higher total suspended solids then Ecology data.	100 ft				Stream is diverted and dewatered during trenching. Open trench is exposed to river when one side of river is trenched and dredging occurred on opposite side. Data analysis. Used regression from project monitoring determined in lab for both SS and NTUs. Regression SS = 2.3237*NTU + 3.6702
				185.7	1 hr	5	5	
				220.2	1 hr	5	5	
				83.4	4 hr	5	5	
				113.8	9 hrs	6	6	
				95.5	1 hr	4	5	
				312.5	20 hrs	7	8	
				338.9	20 hrs	7	8	
				76.2	4 hrs	5	5	
				145.3	12 hrs	6	7	
				1070.5	29 hrs	8	9	
				676.6	6 hrs	7	8	
				132.0	9.5 hrs	6	7	
				93.5	5 hrs	5	6	
				600 ft				
				25.9	1 hr	3	3	
				16.7	0.5 hr	3	3	
				25.4	8.5 hrs	5	5	
				13.0	3 hrs	4	4	
				37.4	8.5 hrs	5	5	
				73.0	21 hrs	6	7	
				19.8	0.5 hr	3	3	
				135.3	20.5 hrs	7	7	
				23.7	0.5 hr	3	3	
				59.8	1.5 hr	4	4	
				50.7	9.5 hrs	5	6	
				293.1	31.5 hrs	7	8	
				41.7	5.5 hrs	5	5	
				122.4	10 hrs	6	6	
				12.7	9.5 hrs	4	4	
				12.7	9 hrs	4	4	
				2000 ft				
				12.6	3 hrs	4	4	
				25.9	1.5 hrs	4	4	
				14.1	4 hrs	4	4	
				34.7	9 hrs	5	5	
				45.3	2 hrs	4	4	
				212.8	18 hrs	7	7	
				25.3	5 hrs	4	5	
				30.4	10.5 hrs	5	5	
				18.2	4 hrs	4	4	
				185.7	14.5 hrs	7	7	
				22.8	7.5	5	5	
				75.7	5.5 hrs	5	6	
				75.4	9.5 hrs	6	6	
				32.0	1.5 hrs	4	4	
				22.9	1 hrs	3	3	
				1 mile				
				20.5	1.5 hrs	4	4	
				16.5	1.5 hrs	3	3	
				45.5	2.5 hrs	4	5	
				23.1	3.5 hrs	4	4	
				394.6	0.5 hr	5	5	
				232.4	17 hrs	7	7	
				22.3	4.5 hrs	4	4	
				46.6	5.5 hrs	5	5	
				25.3	3.5 hrs	4	4	
				123.2	9.5 hrs	6	6	
				30.5	6.5 hrs	5	5	
				22.9	3.5 hrs	4	4	
				45.4	9 hrs	5	6	

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Williams Pipeline, Mt. Vernon Loop. Pilchuck River Project involved installing a pipeline under the Pilchuck River. Used open trench method.	Exact project location unknown, used location where pipeline crosses the Pilchuck on topo map. Located SW of Machias, WA. Slope: 0.4% Drainage area: 127 sq. miles Discharge: 744 cfs	100, 400, and 1000 ft	Measurements taken every hour throughout construction.	100 ft. 54.9 400 ft. 38.5 1000 ft. 34.8	62 hrs 57 hrs 51 hrs	7 6 6	7 7 7	River was not dewatered or diverted. Open water trenching. Data analysis. 14 years of data for the Pilchuck River at Snohomish at the Highway 2 Bridge. Used July through September data. NTU:SS ratio = 1:2.3 Regression SS = 1.4319*NTU + 2.5223 Used regression
Williams Pipeline – Sumas Loop		Construction method:						
Smith Creek	Trib to mainstem Nooksack River by Lawrence WA Slope: 0.8%	Dam and pump	Met water quality standards.					
Saar Creek (two locations where crossed creeks)	Trib to Frasier River, creek enters Canada, located near Sumas, WA Slope: 0.6%	#1: Open cut #2: Dam and pump	Met water quality standards. Met water quality standards.					
Kenny Creek	Unable to locate creek	Open cut	Met water quality standards.					
Unnamed trib to Sumas River	Located 2 miles SE of Nooksack, WA. Slope: 2.3%	Dam and pump	Met water quality standards.					
Breakenridge Cr.	Trib to Sumas River, located 2 miles east of Nooksack, WA Slope: 1.9%	Dam and pump	Met water quality standards.					
Williams Pipeline – Mt. Vernon Loop		Construction method:						
Armstrong Creek	Trib to mainstem Stillaguamish at Arlington, WA Slope: 0.5%	Dam and pump	Met water quality standards.					
Trib to SF Stillaguamish River	Unable to locate creek	Dam and pump	Met water quality standards.					

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Williams Pipeline – Snohomish Loop Sternoff Crossing Seidel Creek – had Siedel Creek on monitoring form Struve Creek	 Unable to locate creek Trib to Bear Creek, 1.4 miles NE of Avondale, WA, which enters Sammamish River. Slope: 1.0% Trib to Bear Creek, 1.1 miles SE of Cottage Lake, WA, which enters Sammamish River. Slope: 3.0%	Construction method: Flume Dam and pump Dam and pump	 Met water quality standards. Met water quality standards. Met water quality standards.					
Williams Pipeline – Ft. Lewis Loop Muck Creek South Fork Creek	 Trib to the Nisqually River. Site located on Ft. Lewis, 2.7 miles W of Rocky Ridge. Trib to the Nisqually River. Site located on Ft. Lewis, 2.7 miles W of Rocky Ridge. Just South of Muck Creek crossing.	Construction method: Open cut Open cut	 Met water quality standards. Met water quality standards.					
Williams Pipeline Ft. Lewis Loop Nisqually River Project involved installing a pipeline under the Nisqually River Used open trench method.	Project located 0.8 miles SW if McKenna, WA Drainage area: 517 sq. miles Discharge: 1,500 cfs Slope: 0.1%	600, 1250, 2500, 5200 ft, 2 miles, and 4 miles	Samples taken approximately every hour. Samples at 2 miles was only taken once, two samples were taken at 4 miles (4.5 hours apart). These samples were used to determine downstream extent of plume. Data provided in NTUs.	600 ft. 35.1 1,250 ft. 24.4 2500 ft. 16.2 5200 ft. 12.8 2 miles 15.5 4 miles 9.5	 22 hrs 22 hrs 22 hrs 22 hrs 4.5** Used 4 miles time 4.5**	 6 5 5 5 4 4	 6 6 5 5 4 4	Open cut, no diversion or dewatering occurred. Data analysis. 3 years of data for the Nisqually River at McKenna. Used July through September data. NTU:SS ratio = 1:0.8 Regression SS = 0.7159*NTU + 0.5214 Used regression

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Maintenance Dredging and Disposal, Lower Snohomish River Snohomish River Clamshell and hydraulic dredging were used on the Upper and Lower Sediment Basins and the Navigational Channel. Disposal location was at Elliott Bay for clamshell dredging and Port of Everett's Riverside Business Park Disposal Site for the hydraulic dredging.	Downstream settling basin is located immediately west of the Everett Marina. Upstream settling basin is located southeast of the I-5 Bridge.	Background monitoring occurred 300 feet upstream of dredging. Clamshell dredging: samples taken at 600 ft. Three samples taken, surface (2 foot depth), mid, and bottom (2 feet above bottom). Hydraulic dredging: 300 ft for dredging activities – surface, mid and bottom readings, 600 ft for disposal activities. Samples taken twice daily, once during slack tide, once during strong ebb or flood tide. --------- Ebb tide sampling at 300, 600, 1500, 2250, and 2480 ft.		Clamshell dredging Mid and bottom reading: 58.3 Additional samples taken during ebb tide, which exceeded background levels. Not enough information provided to determine concentration and duration. Hydraulic dredging All within water quality standards.	1 hr	4	4	High turbidity readings were in mid to lower samples which may have been in higher salinity waters, not freshwater from river. Sediment analysis: Project location is in tidally influenced area. No sediment monitoring at this time location. Used lowest Snohomish River data, near City of Snohomish. 25 years of data, December through February. NTU:SS ratio = 1:1.9. Regression SS = 1.2748*NTU + 4.8946 Used regression -------- Dredging stopped during strong ebb tides to reduce sediment impacts.
Grays Harbor Dredging.	Exact location with Grays Harbor was not provided. Project was in tidal area	Samples taken at 300 and 600 feet from dredging operation. Samples taken at surface, midwater, and bottom.	Data provided in NTUs	Met water quality standards. Midwater and bottom samples highly variable. When samples were above water quality, resampling both background and at monitoring location, showed in compliance.				
Miscellaneous Activities								
Mount Vernon Wastewater Treatment Plant Outfall Project Skagit River Project involved extending the outfall from the river bank out into the thalwag of the river.	Project located in City of Mount Vernon. Drainage area: 3,093 sq. miles Discharege: 14,000 cfs Slope: 0.1%	Monitoring occurred 100 feet upstream of project and 300 feet downstream	Data provided in NTUs	Met water quality standards for sheet pile driving (cofferdam) and dewatering, no information provided on putting water back into site and removing sheet piles.				

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Miscellaneous Activities, continued								
Silver Creek Dam Removal Tributary to the White River. Project involved removal of 10-year-old log stringer dam about 5 ft high.	Project located approximately 1120 ft upstream of the confluence with the White River, near Silver Springs Campground. Approximately 3.3 miles SE of Snoquera, WA on Highway 410. Drainage area: 8.0 sq. miles Slope: 8.4% Discharege: 8.3 cfs	159, 559, and 1118 ft downstream	Data provided in NTUs in graph. Estimated values from graph. Project site was not dewatered, logs pulled out of stream and sediment released.	159 ft 114.5 559 ft 157.0 1118 ft. 55.2	 1 hr 0.75 0.75	 5 5 4	 5 5 4	No BMPs or conservation measures used to minimize sedimentation. Sediment analysis. No gage located on creek. Paul Bakke monitored project and determined NTU to suspended sediment ratio of 1:1.9789 Used ratio: 1:2

* Values calculated from monitoring report. Concentration calculated using equation tons/day = 0.0027* cfs* mg/L (USACE (U.S. Army Corps of Engineers) 1995). Background concentration 1.5 mg/L (average). Stream velocity 2.76 cfs. Duration: monitoring report stated sediment concentration levels decreased to near pre-removal levels in about 24 hours (used for average values), peak values based on 8 to 10 hour work day.

** Exact duration is unknown as monitoring stopped when work day was over. Unable to determine when concentrations returned to baseline.

Exact duration is unknown as monitoring did not provide start or stop times to be able to make accurate determination.

Appendix D. RLP and CD Mixing Zone Impact Tables and Maps.

Appendix D

Table 1. Mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, and the stream segments with elevated TSS concentrations beyond the mixing zone impacting Roanoke logperch.

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
1	Montgomery	Roanoke	North Fork Roanoke River (NFRR)	Approximately 0.7 km upstream of MP 227.4 crossing of NFRR(37.272224, -80.3086258)	030101010 00799	Dry Run	perennial	700	Mixing zone overlaps with impact length (200 m) upstream of MP 227.4 open-cut crossing (500 m downstream + 200 m upstream = 700 m)
2	Montgomery	Roanoke	NFRR	Approximately 3.5 km downstream of MP 227.4 crossing of NFRR (37.2605419, -80.3406138)	030101010 00892	Mill Creek	perennial	1,810	Includes stream segment predicted to have elevated TSS concentrations ≥20 mg/L beyond the mixing zone; a total of 1.61 km in NFRR, downstream of tributary (1,610 m downstream + 200 m upstream = 1,810 m) (ends at 37.2499406, -80.3511050)
3	Montgomery	Roanoke	NFRR	Approximately 3 km downstream of MP 229.7 crossing of Flatwoods Branch tributary (37.2368939, -80.2677797)	030101010 00783	Flatwoods Branch	perennial	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
4	Montgomery	Roanoke	Bradshaw Creek	Above MP 230.9 crossing of Bradshaw Creek; two tributaries entering Bradshaw Creek (37.2696555, -80.2524871; 37.2535861, -80.2597108)	03010101002185, 03010101002195	no name, Womack Branch	both intermittent	4,807	Includes stream segment predicted to have elevated TSS concentrations ≥20 mg/L beyond the mixing zone; a total of 5.63 km in Bradshaw Creek, downstream of first tributary to confluence with NFRR. This stream segment also overlaps with the open-cut crossing at MP 230.9 (5,630 m downstream + 200 m upstream - 1,023 m crossing = 4,807 m)
5	Montgomery	Roanoke	NFRR	Approximately 2.5 km downstream of MP 230.9 crossing of Bradshaw Creek (37.2328306, -80.2536921)	03010101000317	Bradshaw Creek	perennial	1,000	
6	Montgomery	Roanoke	NFRR	Approximately 4.5 km upstream of MP 235.6 crossing of Roanoke River (RR) (37.2355679, -80.2407927)	03010101002184	no name	intermittent	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
7	Montgomery	Roanoke	South Fork Roanoke River	Approximately 1.5 km upstream of confluence with the RR(37.2258249, -80.2083847)	03010101008530	Indian Run	intermittent	1,000	
8	Montgomery	Roanoke	NFRR & RR	Approximately 2 km upstream of MP 235.6 crossing of RR (37.2397213, -80.2141063)	03010101002183	no name	intermittent	925 (465 in NFRR; 460 in RR)	Mixing zone overlaps with downstream tributary mixing zone. One tributary enters NFRR approximately 265 m above confluence with RR. The next tributary enters RR approximately 460 m downstream of where NFRR and RR join. The tributaries are approximately 725 m apart (NFRR: 265 m downstream + 200 m upstream = 465 m; RR: 460 m downstream)
9	Montgomery	Roanoke	RR	Approximately 1 km upstream of MP 235.6 crossing of RR(37.2371433, -80.2087417)	03010101002182	no name	intermittent	800	Mixing zone overlaps with upstream tributary mixing zone; tributaries enter NFRR and RR and are approximately 725 m apart, as noted in row above (800 m downstream only)
10	Montgomery/ Roanoke	Roanoke	RR	Approximately 0.3 km downstream of MP 235.6 crossing of RR (37.2343550, -80.1946638)	03010101002181	no name	intermittent	670	Mixing zone overlaps with downstream tributary mixing zone; tributaries enter RR approximately 470 m apart (470 m downstream + 200 m upstream = 670 m)

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
11	Roanoke	Roanoke	RR	Approximately 0.8 km downstream of MP 235.6 crossing of RR (37.2334111, -80.1897257)	03010101002349	no name	perennial	800	Mixing zone overlaps with upstream tributary mixing zone; tributaries enter RR approximately 470 m apart (800 m downstream only)
12	Roanoke	Roanoke	RR	Approximately 5.5 km downstream of MP 235.6 crossing of RR (37.2468410, -80.1655845)	03010101002351	no name	perennial	1,000	
13	Franklin	Pigg	Pigg River	Approximately 2 km downstream of MP 280.0 crossing of Little Jacks Creek (36.9676436, -79.6979944)	03010101001376	Jacks Creek	perennial	1,000	
14	Franklin	Pigg	Pigg River	Approximately 3 km downstream of MP 280.7 crossing of Turkey Creek (36.9563534, -79.6906697)	03010101001373	Turkey Creek	perennial	1,000	
15	Franklin	Pigg	Pigg River	Approximately 3 km downstream MP 283.0 crossing of Parrot Branch (36.9481901, -79.6443586)	03010101001359	Parrot Branch	perennial	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
16	Pittsylvania	Pigg	Pigg River	Approximately 2 km downstream of MP 287.2 crossing of unnamed tributary (36.9311212, -79.5753806)	030101010 01349	Rocky Creek	perennial	900	Mixing zone overlaps with downstream tributary mixing zone; tributaries enter Pigg River approximately 700 m apart
17	Pittsylvania	Pigg	Pigg River	Approximately 0.7 km downstream of confluence of Rocky Creek and Pigg River (36.9277414, -79.5691633)	030101010 01348	no name	intermittent	800	Mixing zone overlaps with upstream tributary mixing zone; tributaries enter Pigg River approximately 700 m apart
18	Pittsylvania	Pigg	Pigg River	Approximately 0.6 km downstream of MP 289.2 crossing of Pigg River (36.9380142, -79.5405795)	030101010 01347	no name	perennial	1000	

Table 2. Mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, impacting candy darter.

Impact Area Number	County, State	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)
19	Webster, WV	Gauley	Gauley River	Approximately 1.8 km upstream of Strouds Creek confluence with Gauley River (38.3649504, -80.5979769)	05050005000952	Coon Creek	Perennial	1,000
20	Nicholas, WV	Gauley	Gauley River	Approximately 0.9 km upstream of MP 118.9 crossing of Gauley River (38.2710519, -80.6830283)	05050005000554	Little Laurel Creek	Perennial	1,000
21	Giles, VA	New River	Stony Creek	Approximately 1.1 km upstream from MP 200.3 (37.3678735, -80.6757298)	05050002000869	Kimballton Branch	Perennial	1,000

Figure 1. Map of Roanoke logperch impact areas (mixing zones highlighted by yellow stars and purple stream segments; instream, open-cut crossings highlighted by green stream segments) in the Roanoke River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

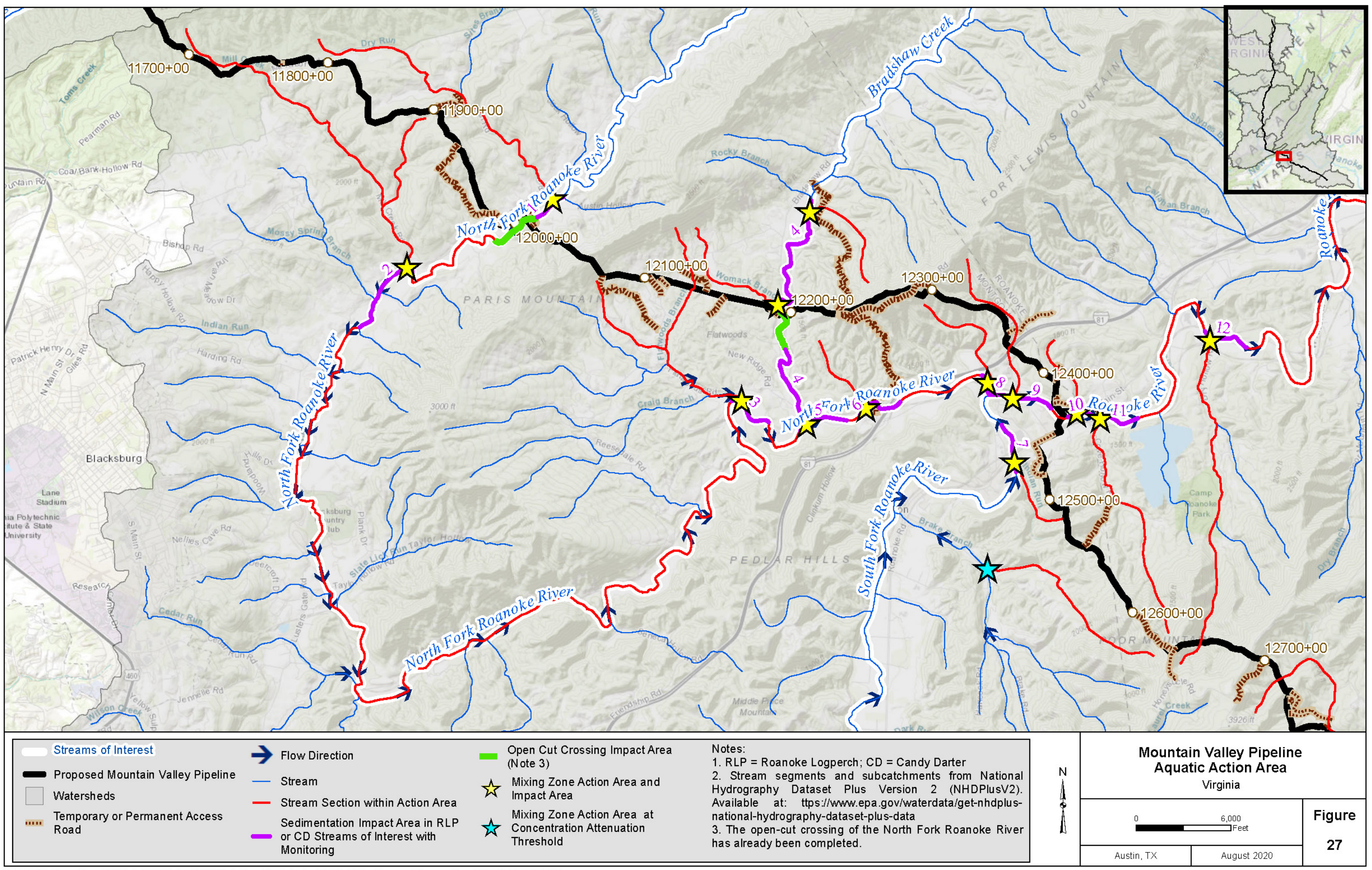


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Figure 2. Map of Roanoke logperch impact areas (mixing zones highlighted by yellow stars and purple stream segments; instream, open-cut crossings highlighted by green stream segments) in the Pigg River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

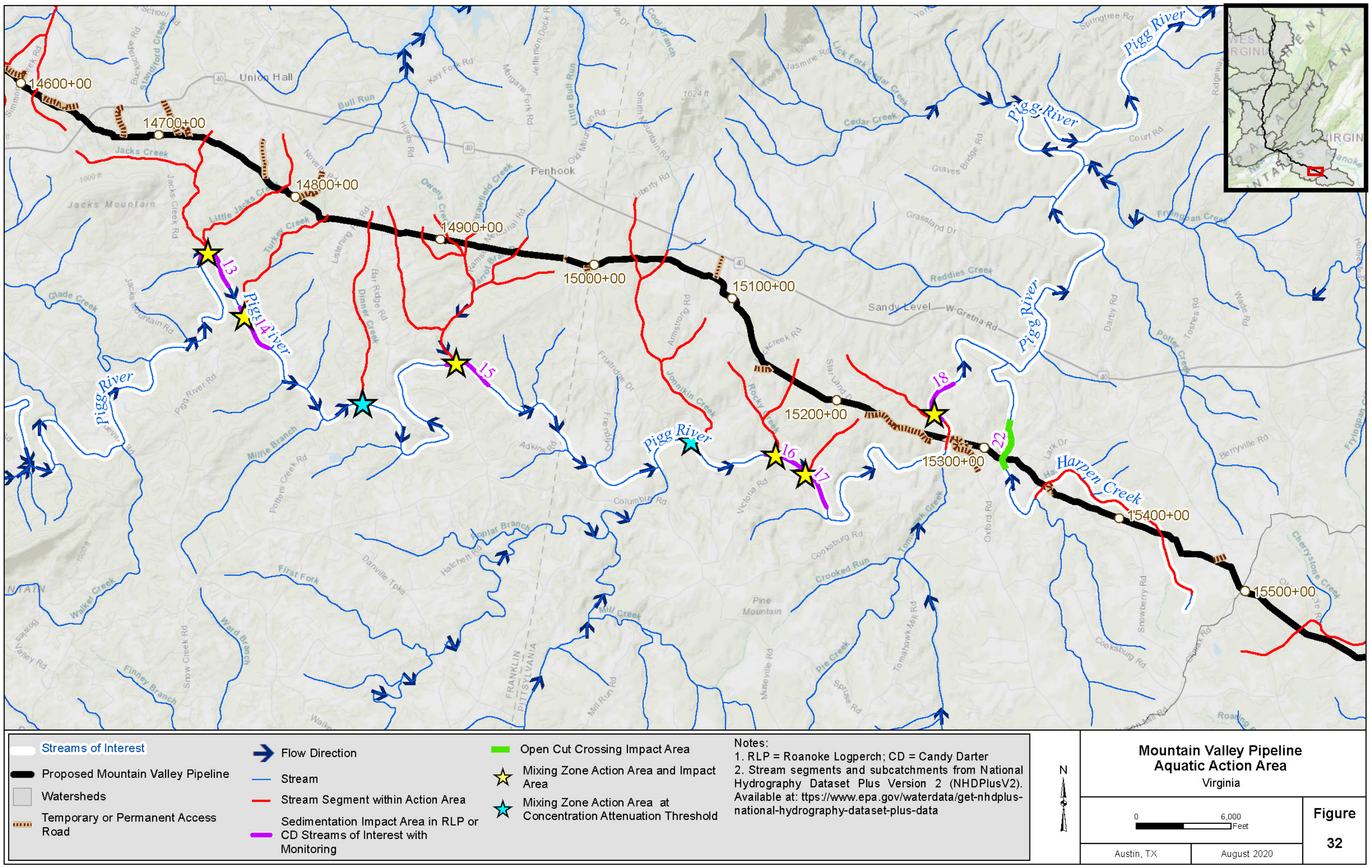

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Figure 3. Map of candy darter impact areas (mixing zones highlighted by yellow stars and purple stream segments) in the Gauley River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

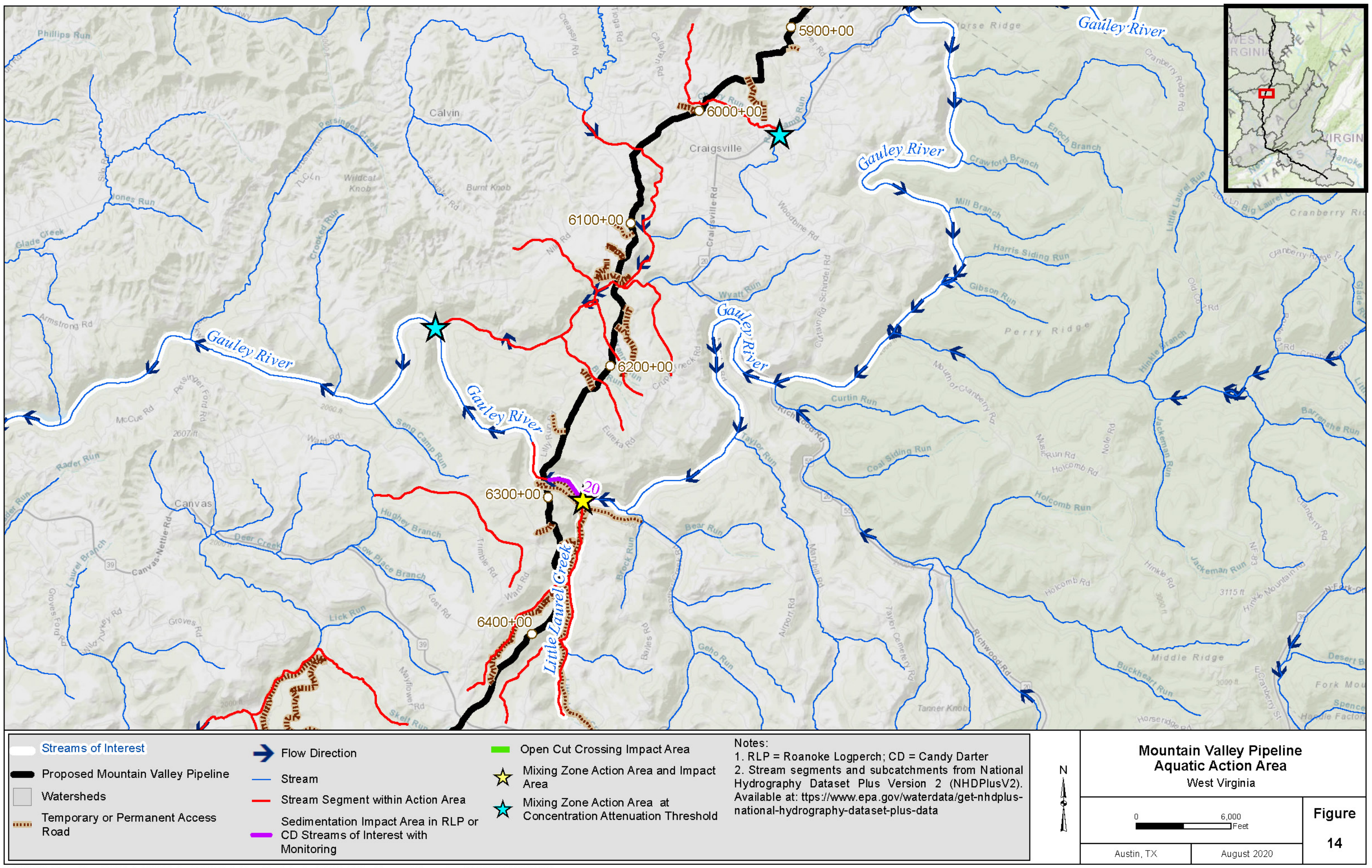

Figure 4. Map of candy darter impact areas (mixing zones highlighted by yellow stars and purple stream segments) in the Gauley River system.

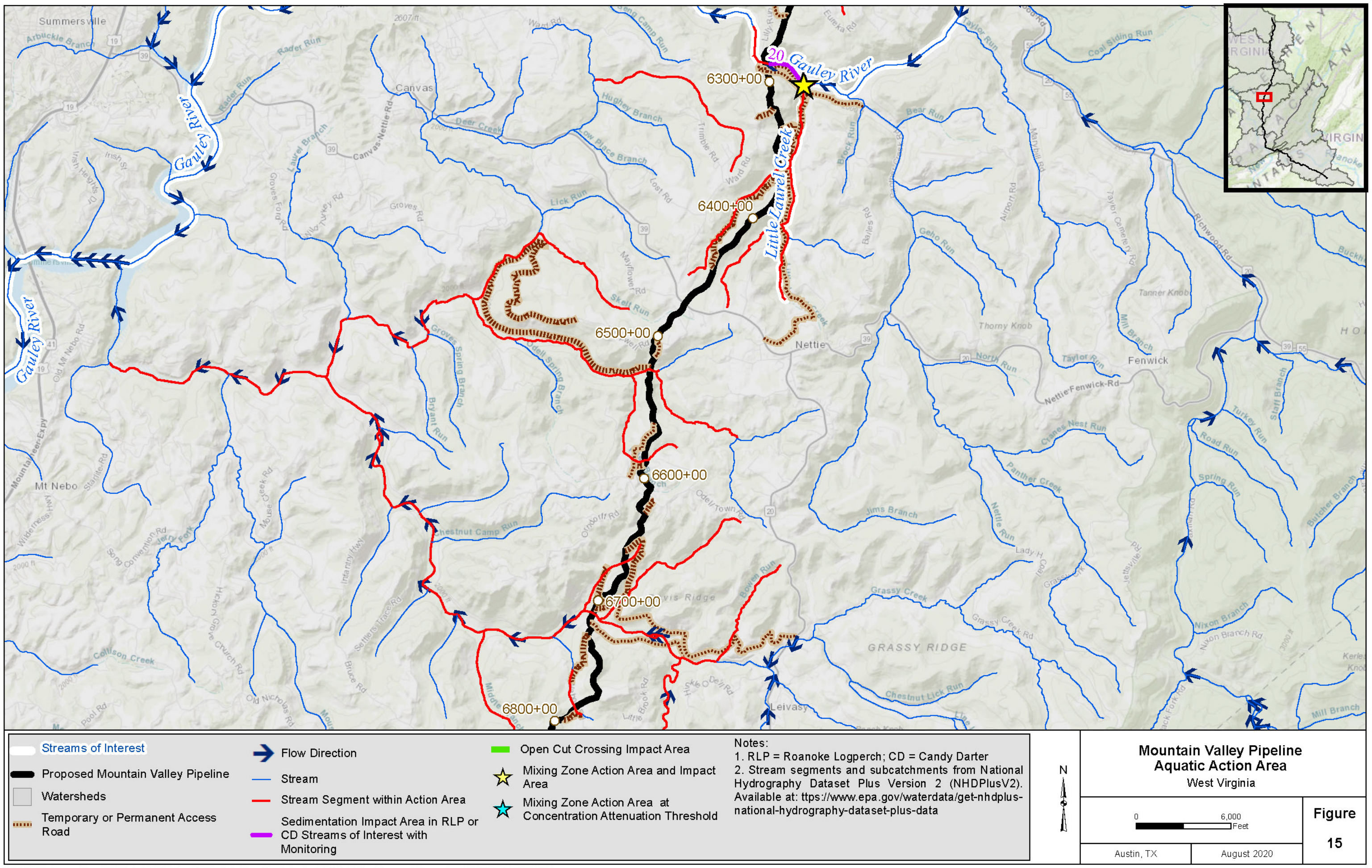

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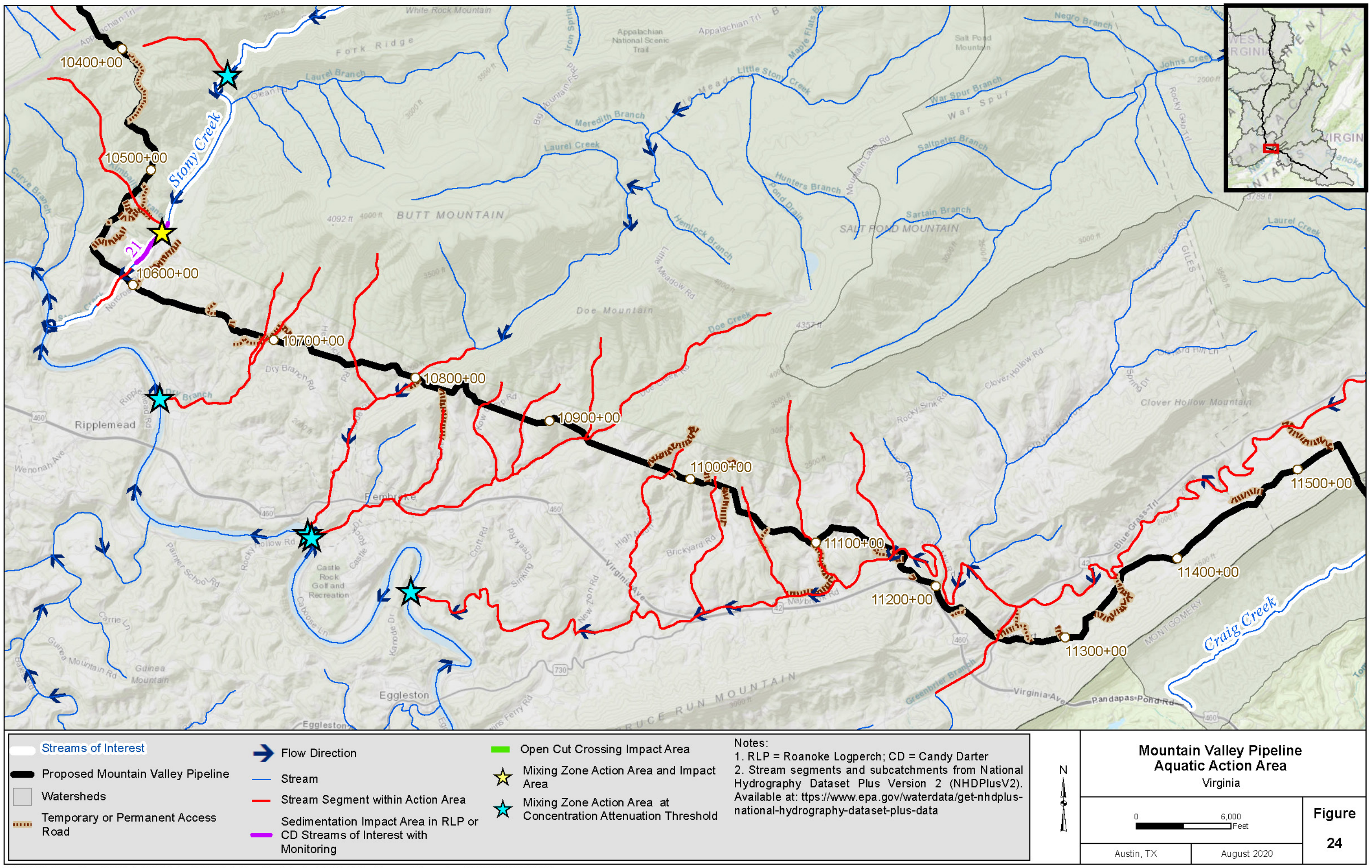
Figure 5. Map of candy darter impact areas (mixing zones highlighted by yellow stars and purple stream segments) in the Stony Creek River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.



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Appendix E. Table 14.

Table 14. MVP FERC-approved variances since 2017 BiOp (M. Neylon, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, November 27, 2019; P. Moore, Beveridge & Diamond, email to C. Schulz, Service, April 10, 2020).

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-3	18.38	22.7	Harrison	WV	Bats-Portals	01/31/2018	No portals documented	4/13/2018	4/17/2018
A-5	1.58	28.97	Harrison	WV	Bats-Portals	11/13/2015 09/15/2015 08/15/2017 12/19/2017	No portals documented	5/18/2018	5/24/2018
A-6	27.75	24.1	Harrison	WV	Bats-Portals	01/31/2018	No portals documented	5/8/2018	5/10/2018
A-9	10.05	7.6	Harrison	WV	Bats-Portals	01/18/2018	No portals documented	7/23/2018	8/23/2018
A-12	2.17	6.80	Wetzel	WV	Bats-Portals	02/12/2015 11/19/2015 08/15/2016 05/03/2018	No portals documented	8/16/2018	8/23/2018
A-13	1.59	22.20	Harrison	WV	Bats-Portals	11/17/2015 06/12/2018	No portals documented	8/17/2018	8/23/2018
A-15	0.19	12	Harrison	WV	Bats-Portals	6/12/2018	No portals documented	8/28/2018	8/30/2018
A-21	5.37	5.7	Wetzel	WV	Bats-Portals	02/12/2015 08/15/2016 02/14/2019 03/13/2019	No portals documented	4/4/2019	4/5/2019
A-22	0.52	0.6	Wetzel	WV	Bats-Portals	08/23/2018	No portals documented	10/15/2018	10/18/2018
A-23	0.87	0.1	Wetzel	WV	Bats-Portals	02/16/2015 10/25/2015	No portals documented	10/18/2018	10/19/2018
A-26	15.14	3.8 - 4.2	Wetzel	WV	Bats-Portals	08/24/2018 10/06/2018 02/14/2019	No portals documented	11/7/2018	2/27/2019
A-27	0.16	3.4	Wetzel	WV	Bats-Portals	02/12/2015 10/05/2018	No portals documented	10/23/2018	10/26/2018
A-29	0.62	0.9	Wetzel	WV	Bats-Portals	02/12/2015 09/25/2018	No portals documented	3/25/2019	3/25/2019
A-30	1.65	3.9	Wetzel	WV	Bats-Portals	10/6/2018	No portals documented	11/7/2018	12/4/2018
A-32	6.24	3.55 - 3.75	Wetzel	WV	Bats-Portals	07/07/2018 09/29/2018	No portals documented	3/28/2019	3/29/2019
A-36	0.22	8.6	Wetzel	WV	Bats-Portals	02/10/2015 10/28/2015	No portals documented	3/12/2019	3/18/2019
A-38	1.4	15.52	Harrison	WV	Bats-Portals	01/19/2015 10/17/2018	No portals documented	5/9/2019	5/13/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-39	0.67	32.4	Doddridge	WV	Bats-Portals	11/15/2015	No portals documented	3/25/2019	3/25/2019
A-40	0.36	32.5	Doddridge	WV	Bats-Portals	04/07/2016 08/24/2016	No portals documented	4/24/2019	4/26/2019
A-41	0.93	1.2	Wetzel	WV	Bats-Portals	02/12/2015 10/12/2018	No portals documented	3/11/2019	3/15/2019
A-42	0.68	3.16	Wetzel	WV	Bats-Portals	02/12/2015	No portals documented	3/20/2019	3/21/2019
A-43	0.13	20.2	Wetzel	WV	Bats-Portals	02/14/2019	No portals documented	6/11/2019	6/14/2019
A-44	0.47	6.62	Wetzel	WV	Bats-Portals	05/03/2018 01/16/2019	No portals documented	3/26/2019	3/28/2019
A-45	0.17	9.1	Wetzel	WV	Bats-Portals	02/10/2015	No portals documented	3/28/2019	3/29/2019
A-46	0.34	2.65	Wetzel	WV	Bats-Portals	02/12/2015 08/24/2018	No portals documented	3/28/2019	3/29/2019
A-47	0.04	5.52	Wetzel	WV	Bats-Portals	02/12/2015 10/27/2015 08/15/2016	No portals documented	4/4/2019	4/5/2019
A-48	0.41	5.05	Wetzel	WV	Bats-Portals	02/12/2015	No portals documented	3/28/2019	3/29/2019
A-49	3.46	4.2	Wetzel	WV	Bats-Portals	02/14/2015 03/12/2019	No portals documented	3/28/2019	3/29/2019
A-50	7.64	3.8 - 4.2	Wetzel	WV	Bats-Portals	02/12/2015 08/24/2018 10/06/2018 02/14/2019 03/12/2019	No portals documented	3/28/2019	3/29/2019
A-51	1.2	2.1	Wetzel	WV	Bats-Portals	10/06/2018 03/12/2019	No portals documented	3/26/2019	3/28/2019
A-52	1.41	20.9	Harrison	WV	Bats-Portals	11/17/2015 01/15/2019	No portals documented	5/22/2019	5/23/2019
A-53	1.86	24.08	Harrison	WV	Bats-Portals	12/12/2014 11/10/2015 01/15/2019 02/15/2019	No portals documented	5/13/2019	5/15/2019
A-54	0.22	6.5	Wetzel	WV	Bats-Portals	02/12/2015 03/13/2019	No portals documented	3/27/2019	3/28/2019
A-55	0.93	1.2	Wetzel	WV	Bats-Portals	02/12/2015 03/27/2019	No portals documented	4/4/2019	4/5/2019
A-56	0.08	6.61	Wetzel	WV	Bats-Portals	06/15/2016	No portals documented	3/29/2019	3/29/2019
A-60	0.03	1.4	Wetzel	WV	Bats-Portals	08/15/2016	No portals documented	7/18/2019	7/23/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-61	0.59	13.5	Harrison	WV	Bats-Portals	01/21/2015 11/12/2015 04/30/2019	No portals documented	5/30/2019	5/30/2019
A-69	0.07	32.55	Doddridge	WV	Bats-Portals	10/16/2014 10/23/2015	No portals documented	5/7/2019	5/9/2019
A-70	0.71	20.3	Harrison	WV	Bats-Portals	11/14/2015 11/16/2015 05/26/2019	No portals documented	5/30/2019	5/31/2019
A-77	1.01	34.3	Doddridge	WV	Bats-Portals	01/19/2015 11/16/2015	No portals documented	9/17/2019	9/18/2019
A-78	0.99	1.51	Wetzel	WV	Bats-Portals	02/16/2015 10/24/2015	No portals documented	7/29/2019	8/13/2019
A-84	0.16	4.2	Wetzel	WV	Bats-Portals	03/12/2019 09/24/2019	No portals documented	10/2/2019	Pending
B-2	1.45	42.7	Lewis	WV	Bats-Portals	08/05/2016 07/29/2017	No portals documented	5/25/2018	5/29/2018
B-3	0.07	60.32	Lewis	WV	Bats-Portals	12/12/2017	No portals documented	5/29/2018	5/31/2018
B-4	9.12	45.5	Lewis	WV	Bats-Portals	09/01/2016	No portals documented	6/12/2018	6/14/2018
B-5	1.72	45.9	Lewis	WV	Bats-Portals	10/12/2015	No portals documented	7/23/2018	8/23/2018
B-6	0.39	38.1	Harrison	WV	Bats-Portals	01/18/2015 01/21/2015 10/23/2015	No portals documented	9/18/2018	9/20/2018
B-7	1.51	60.07	Lewis	WV	Bats-Portals	01/28/2015 12/12/2017 05/23/2018 06/12/2018	No portals documented	8/17/2018	8/23/2018
B-11	0.6	52.6	Lewis	WV	Bats-Portals	01/25/2015 10/12/2018	No portals documented	11/20/2018	11/29/2018
B-13	0.62	50.3	Lewis	WV	Bats-Portals	11/16/2015 09/24/2018	No portals documented	11/20/2018	11/29/2018
B-15	0.02	45.9	Lewis	WV	Bats-Portals	10/12/2015	No portals documented	7/18/2019	7/31/2019
B-16	0.52	47.13	Lewis	WV	Bats-Portals	01/20/2015 11/04/2015	No portals documented	3/15/2019	3/19/2019
B-17	1.16	57.99	Lewis	WV	Bats-Portals	10/12/2015 11/17/2015 10/17/2018	No portals documented	5/13/2019	5/15/2019
B-18	0.4	50.3	Lewis	WV	Bats-Portals	09/24/2018 03/13/2019	No portals documented	5/16/2019	5/17/2019
B-19	0.19	62.4	Lewis	WV	Bats-Portals	10/26/2015	No portals documented	5/2/2019	5/6/2019
B-20	1.62	53.5	Lewis	WV	Bats-Portals	2/28/2019	No portals documented	5/16/2019	5/17/2019
B-21	0.55	51.22	Lewis	WV	Bats-Portals	2/28/2019	No portals documented	5/17/2019	5/21/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
B-22	1.42	46.84	Lewis	WV	Bats-Portals	2/15/2019	No portals documented	4/18/2019	4/23/2019
B-24	0.2	46.89	Lewis	WV	Bats-Portals	01/20/2015 10/14/2015	No portals documented	5/9/2019	5/15/2019
B-27	0.07	46.55	Lewis	WV	Bats-Portals	01/20/2015 01/21/2015 10/14/2015	No portals documented	5/21/2019	5/23/2019
B-29	0.26	44.6	Lewis	WV	Bats-Portals	10/12/2015 04/30/2019	No portals documented	10/7/2019	Pending
B-34	0.11	46.81	Lewis	WV	Bats-Portals	02/15/2019	No portals documented	6/7/2019	6/11/2019
B-35	0.26	52.8	Lewis	WV	Bats-Portals	01/25/2015 11/03/2015	No portals documented	5/30/2019	6/3/2019
B-38	0	52.3	Lewis	WV	Bats-Portals	01/25/2015 08/01/2019	No portals documented	9/4/2019	9/9/2019
Harris-2	1.54	77.3	Braxton	WV	Bats-Portals	11/12/2017	No portals documented	4/5/2018	4/6/2018
C-3	4.78	n/a	Braxton	WV	Bats-Portals	03/04/2018	No portals documented	6/7/2018	6/8/2018
C-4	2.89	90	Braxton	WV	Bats-Portals	05/01/2018	No portals documented	6/12/2018	6/14/2018
C-5	2.45	69.9	Braxton	WV	Bats-Portals	08/18/2016 05/31/2018	No portals documented	9/7/2018	9/17/2018
C-8	0.02	81.72	Webster	WV	Bats-Portals	06/11/2018	No portals documented	9/5/2018	9/10/2018
C-10	2.88	68.4	Braxton	WV	Bats-Portals	07/10/2018	No portals documented	9/24/2018	9/28/2018
C-12	1.45	84.3 - 84.7	Webster	WV	Bats-Portals	01/20/2015 01/21/2015 10/14/2015 10/15/2015	No portals documented	10/23/2018	10/26/2018
C-13	1.6	68.9	Braxton	WV	Bats-Portals	11/15/2015	No portals documented	4/11/2019	4/15/2019
C-14; C-32	0.7	84.4	Webster	WV	Running Buffalo Clover	07/28/2018	Suitable Habitat; No individuals present	11/15/2018; 8/26/2019	11/27/2018; 9/4/2019
					Bats-Portals	10/16/2015 07/26/2018	No portals documented		
C-15	0.99	70.6	Braxton	WV	Bats-Portals	11/22/2015 12/04/2018	No portals documented	5/2/2019	5/6/2019
C-18	2.88	86.65	Webster	WV	Bats-Portals	01/03/2015 11/21/2015 04/22/2019	No portals documented	5/30/2019	5/30/2019
C-19	1.16	82.8	Webster	WV	Bats-Portals	11/19/2015 04/23/2019	No portals documented	5/30/2019	5/31/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
C-22	0.71	87.5	Webster	WV	Bats-Portals	01/14/2015 11/20/2015 05/08/2019	No portals documented	5/30/2019	5/31/2019
					Running Buffalo Clover	05/08/2019	No Suitable Habitat present		
C-23	2.36	94.26	Webster	WV	Running Buffalo Clover	05/08/2019	No Suitable Habitat present	5/30/2019	5/31/2019
					Bats-Portals	11/20/2014 02/15/2019	No portals documented		
C-25	0.22	81.62	Webster	WV	Bats-Portals	11/16/2015 11/17/2015	No portals documented	10/2/2019	Pending
C-26	1.26	92.62	Webster	WV	Bats-Portals	02/15/2015 05/08/2019	No portals documented	6/25/2019	6/26/2019
					Running Buffalo Clover	05/08/2019	No Suitable Habitat present		
C-29	8.56	96.5	Webster	WV	Running Buffalo Clover	05/05/2019	No Suitable Habitat found	6/21/2019	6/26/2019
					Bats-Portals	12/05/2018 05/08/2019	No portals documented		
A-20	0.71	87.5	Webster	WV	Running Buffalo Clover	05/08/2019	No Suitable Habitat present	12/3/2018	12/7/2018
					Bats-Portals	01/14/2015 11/20/2015 05/08/2019	No portals documented		
D-1	15.47	113	Nicholas	WV	Bats-Portals	12/07/2017	No portals documented	5/4/2018, 5/8/2018	5/9/2018
D-2	0.98	111.786	Nicholas	WV	Bats-Portals	8/30/2016 12/13/2017	No portals documented	5/15/2018	5/16/2018
D-6	2.13	115.74	Nicholas	WV	Bats-Portals	03/15/2018	No portals documented	5/29/2018	5/30/2018
D-7	4.78	119	Nicholas	WV	Bats-Portals	11/11/2015 09/15/2017 12/13/2017	No portals documented	5/30/2018	5/31/2018
D-8	0.34	112.67	Nicholas	WV	Bats-Portals	08/30/2016	No portals documented	6/13/2018	6/15/2018
D-9	9.89	n/a	Nicholas	WV	Bats-Portals	05/1/2018	No portals documented	7/16/2018	7/18/2018
D-10	0.95	119.8	Nicholas	WV	Bats-Portals	05/10/2018	No portals documented	7/16/2018	7/18/2018
D-11	8.28	120.35	Nicholas	WV	Bats-Portals	09/11/2017	No portals documented	9/20/2018	9/26/2018
D-14	0.08	111.32	Nicholas	WV	Bats-Portals	11/20/2014	No portals documented	9/19/2018	9/24/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
D-15	3.14	127.16	Nicholas	WV	Bats-Portals	05/12/2018	No portals documented	9/27/2018	9/28/2018
D-17	6.48	108.17	Webster	WV	Bats-Portals	05/30/2018	No portals documented	9/26/2018	9/28/2018
D-18	0.69	102.26	Webster	WV	Bats-Portals	09/16/2016	No portals documented	10/24/2018	10/26/2018
					Running Buffalo Clover	09/16/2016	No Suitable Habitat present		
D-19	2.83	114.75	Nicholas	WV	Bats-Portals	11/13/2015 09/29/2018	No portals documented	2/7/2019	2/8/2019
D-20	3.28	n/a	Nicholas	WV	Bats-Portals	05/01/2018 09/18/2018	No portals documented	11/20/2018	11/29/2018
D-29	0.56	112.3	Nicholas	WV	Bats-Portals	12/07/2017	No portals documented	7/12/2019	7/15/2019
D-31	0.2	122.4	Nicholas	WV	Bats-Portals	11/06/2015	No portals documented	7/12/2019	7/17/2019
D-33	0.84	114	Nicholas	WV	Bats-Portals	10/05/2018	No portals documented	10/7/2019	Pending
E-1	4.36	142	Greenbrier	WV	Bats-Portals	10/27/2017	No portals documented	4/17/2018	4/19/2018
E-2	11.11	165	Raleigh	WV	Bats-Portals	03/21/2018	No portals documented	5/18/2018	5/24/2018
E-3	15.94	n/a	Raleigh	WV	Bats-Portals	04/27/2018	No portals documented	5/23/2018	5/25/2018
E-4	7.41	165	Raleigh	WV	Bats-Portals	03/21/2018	No portals documented	5/30/2018	5/31/2018
E-5	2.1	133.5	Nicholas	WV	Bats-Portals	11/18/2014	No portals documented	5/24/2018	5/25/2018
E-12	0.08	138.4	Greenbrier	WV	Small Whorled Pogonia	08/27/2016 – 08/30/2016	Suitable Habitat; No individuals present	5/15/2019	5/15/2019
					Bats-Portals	10/24/2014 12/09/2014 11/13/2015	No portals documented		
E-13	0.25	150.6	Greenbrier	WV	Bats-Portals	10/23/2015	No portals documented	7/12/2019	7/17/2019
					Running Buffalo Clover	8/18/2015	Suitable Habitat; No individuals present		
F-1	22.71	165	Raleigh	WV	Bats-Portals	05/08/2018	No portals documented	3/27/18, 3/29/18	4/3/2018
F-6	1.41	166.07	Summers	WV	Bats-Portals	12/13/2017	No portals documented	5/29/2018	5/31/2018
F-9	22.71	165	Raleigh	WV	Bats-Portals	05/08/2018	No portals documented	9/20/2018	9/26/2018
F-10	1.63	171.33	Summers	WV	Virginia spiraea	07/29/2017	No suitable habitat present	9/5/2018	9/10/2018
					Bats-Portals	07/29/2017	No portals documented		
F-14	9.22	194.2	Monroe	WV	Bats-Portals	12/18/2017	No portals documented	10/1/2019	10/4/2019
F-15	0.03	188.4	Monroe	WV	Bats-Portals	07/19/2017	No portals documented	10/2/2019	10/4/2019
F-19	1.06	163.5	Summers	WV	Bats-Portals	02/06/2015 11/18/2015	No portals documented	8/8/2019	Pending
G-1	22.66	195.3	Monroe	WV	Bats-Portals	9/11/2017 12/06/2018	No portals documented	3/21/2018, 3/23/18	3/26/2018
G-2	14.84	202.94	Giles	VA	Bats-Portals	12/20/2017	No portals documented	3/27/2018	4/4/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
G-3	8.22	221.14 - 224.3	Montgomery	VA	Bats-Portals	01/29/2018	No portals documented	5/29/2018	5/31/2018
G-5	5.52	200.6	Giles	VA	Bats-Portals	03/30/2016 01/25/2017	No portals documented	6/12/2018	6/14/2018
G-7	0.07	200.62	Giles	VA	Bats-Portals	11/15/2015 03/08/2016 03/30/2016	No portals documented	11/7/2018	12/4/2018
G-10	3.84	n/a	Montgomery	VA	Bats-Portals	01/28/2015 11/10/2015 11/13/2015 07/10/2018 07/20/2018	No portals documented	6/18/2019	6/19/2019
H-2	15.44	240.8 - 241.53	Roanoke	VA	Bats-Portals	04/29/2016 01/25/2017	No portals documented	5/22/2018	5/25/2018
H-3	11.37	234.85 - 235.46	Roanoke / Montgomery	VA	Bats-Portals	09/14/2016 09/28/2016	No portals documented	5/18/2018	5/24/2018
H-4	20.43	235.6	Roanoke	VA	Smooth Coneflower	12/21/2017	No Suitable Habitat present	6/20/2018	6/25/2018
					Bats-Portals	12/21/2017	No portals documented		
H-5	1.92	257.9 - 258.22	Franklin	VA	Bats-Portals	04/05/2016 12/20/2017	No portals documented	5/25/2018	5/29/2018
H-6	20.69	235.58 - 236.26	Montgomery	VA	Bats-Portals	04/28/2016 12/21/2017 12/20/2017	No portals documented	5/29/2018	5/30/2018
H-9	1.47	237.5 - 238.0	Montgomery	VA	Bats-Portals	04/28/2016 06/18/2018	No portals documented	9/21/2018	9/25/2018
H-15	0.28	239.1	Roanoke	VA	Bats-Portals	04/02/2019	No portals documented	8/7/2019	Pending
H-17	0.0	246.7	Franklin	VA	Bats-Portals	10/13/2015 11/06/2015	No portals documented	7/18/2019	7/18/2019
I-1	4.98	267	Franklin	VA	Bats-Portals	12/14/2017	No portals documented	4/20/2018	4/23/2018
I-2	0.36	265.72 - 265.80	Franklin	VA	Bats-Portals	08/30/2016 01/28/2017 01/15/2018	No portals documented	5/22/2018	5/25/2018
I-4	1.36	300.73 - 300.8	Pittsylvania	VA	Bats-Portals	08/20/2015 08/15/2016	No portals documented	5/22/2018	5/25/2018
I-8	0.7	286.16	Pittsylvania	VA	Bats-Portals	04/06/2016	No portals documented	7/11/2018	7/17/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
I-10	0.07	266.3	Franklin	VA	Bats-Portals	09/01/2016 09/13/2016	No portals documented	9/5/2018	9/10/2018
I-11	0.45	289.55	Pittsylvania	VA	Bats-Portals	02/26/2015 04/06/2016 07/26/2018	No portals documented	8/16/2018	8/23/2018
I-12	0.26	286.2	Pittsylvania	VA	Bats-Portals	06/14/2018	No portals documented	9/5/2018	9/10/2018
I-13	0.43	271.1	Franklin	VA	Bats-Portals	02/28/2016 04/05/2016	No portals documented	9/27/2019	9/30/2019
I-14	0.05	272.4	Franklin	VA	Bats-Portals	02/24/2015 04/06/2016	No portals documented	7/15/2019	7/15/2019
I-15	0.3	264 - 264.1	Franklin	VA	Bats-Portals	05/04/2016 09/26/2018	No portals documented	10/1/2019	10/4/2019
Transco-1	0.11	Transco-1	Pittsylvania	VA	Bats-Portals	04/07/2016 08/24/2016	No portals documented	1/16/2019	1/24/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-10	0.43	5.9	Wetzel	WV	No species surveys required – existing graveled parking lot; no earth disturbance required	n/a	n/a	6/15/2018	7/16/2018
A-24	8.82	2.65	Wetzel	WV	Bats – portals	2/12/2015, 8/24/2018	No portals documented	10/18/2018	10/19/2018
A-25	1.2	2.1	Wetzel	WV	Bats – portals	2/12/2015 10/6/2018	No portals documented	10/18/2018	10/19/2018
D-5	1.74	n/a	Nicholas	WV	No species surveys required – existing laydown yard	4/10/2018	n/a	6/7/2018	6/8/2018
F-2	9.22	194.2	Monroe	WV	No species surveys required – agricultural fields	12/18/2017	n/a	5/11/2018	5/15/2018
F-3	1.75	159.27 - 159.45	Summers	WV	Bats – portals	12/20/2017	No portals documented	5/22/2018	5/25/2018
I-7	5.78	303	Pittsylvania	VA	No species surveys required – pre-existing developed area; no habitat available	n/a	n/a	6/12/2018	6/14/2018
Bradshaw-3	1.4	n/a	Wetzel	WV	Bats – detailed habitat assessment	5/11/2018	5 potential roost trees documented	3/29/2018	3/30/2018

Appendix F. Monitoring Plan.

The Service is adopting the "Proposed Aquatic Species Monitoring Plan" provided by Mountain Valley on 9/1/2020 (T. Sibley, Hunton Andrews Kurth LLP, email to C. Schulz, Service September 1, 2020), developed in coordination with the Service and reviewed by USGS.

Proposed Aquatic Species Monitoring Plan

The Draft Biological Opinion[1] (BO) for the Mountain Valley Pipeline Project (the "Project") relies, in relevant part, on total suspended sediment (TSS) concentration, herein referred to as suspended sediment concentration (SSC), thresholds to determine take of Roanoke logperch (RLP) and candy darters (CD) from Project-related sediment. To ensure compliance with the amount or extent of sediment-related take identified by the U.S. Fish and Wildlife Service (USFWS) for those species, the Incidental Take Statement (ITS) requires Mountain Valley to monitor areas of RLP and CD streams to ensure that Project-related sediment concentrations do not cause more take of RLP or CD than USFWS anticipates. Specifically, the BO identifies stream areas where, under conditions modeled to delineate the aquatic portion of the Project's action area, the Project is expected to cause an increase of >20 mg/L SSC within the RLP and CD streams ("Streams of Interest") or an increase of >20 mg/L in a tributary that feeds into a Stream of Interest and could create a mixing zone at the tributary's confluence with the Stream of Interest. Tables 1 and 2 of Appendix D to the BO identify these areas as determined by USFWS.

On August 4, 2020, Mountain Valley submitted a proposed framework for monitoring sediment contributions from the Project to Streams of Interest impact areas and their tributaries.[2] Because there are numerous point sources (e.g., third party construction), nonpoint sources (e.g., disturbed land associated with forestry operations, agriculture, mining, and residential and commercial development), and natural sources (e.g., upland stormwater runoff, streambank erosion), which are unrelated to the Project but actively contribute sediment to the Streams of Interest impact areas and their tributaries, that framework describes an approach for monitoring Project-related sediment more accurately while significantly reducing the risk of measuring sediment from non-Project sources, which would skew the monitoring results.[3] As a result, monitoring in the tributary to the mixing zone, together with monitoring upstream and downstream of the mixing zone impact areas directly in the Stream of Interest, will provide a robust and more precise monitoring system for assessing any potential sediment contributions, and therefore species impacts, attributed to the Project.

To implement this monitoring approach, Mountain Valley has developed proposed "Sediment Concentration Action Thresholds" for each tributary and for the Streams of Interest using the modeling analysis and impact assessment methodology that USFWS

[1] United States Fish and Wildlife Service. 2020. Draft Biological Opinion - Docket Number CP16-10-000. Transmitted July 22, 2020.

[2] "MVP Summary of Alternative Monitoring Approach for Aquatic Species," dated August 4, 2020.

[3] In addition to reducing the likelihood of capturing contributions from non-Project sources, measuring within tributaries is expected to enable Mountain Valley to more accurately discern greater-than-anticipated SSC concentrations. Monitoring exclusively within Streams of Interest for sediment from the Project's upland construction activities would require discerning very small increases in SSC concentrations, at least some of which are likely within the error range for SSC measurement under the elevated background SSC conditions experienced in those streams during heavy rain events. By contrast, Project-related SSC concentrations from tributaries necessary to cause a >20 mg/L increase within a Stream of Interest will be much higher relative to background levels and thus much easier to discern accurately.

relied on to identify the ≥20 mg/L impact areas and the mixing zone impact areas in the Streams of Interest (see Table 2 for tributaries and below for Streams of Interest). Mountain Valley first will calculate the concentration of Project-related sediment that must occur in the tributary corresponding to those impact areas in order for the amount or extent of RLP or CD take to potentially be exceeded (the "Take Risk Concentration")—i.e., if the elevated sediment concentration from the Project expanded the downstream limit of the impact area in the Stream of Interest. The Sediment Concentration Action Threshold for each tributary will be set at 75% of the Take Risk Concentration, and Mountain Valley will monitor the tributary and complete the steps described under the Early Action Protocol below any time the concentration of Project-related sediment in the tributary exceeds the Sediment Concentration Action Threshold.[4]

Mountain Valley will set the Sediment Concentration Action Thresholds for the Streams of Interest at 75% of the durations or concentration that USFWS identifies in the BO as affecting RLP and CD. At the same time it is monitoring the tributaries, Mountain Valley also will monitor each Stream of Interest 200 meters upstream of the tributary confluence and 800 meters downstream of the tributary confluence and complete the steps described under the Early Action Protocol below any time a Project-related concentration measured at the downstream monitoring station exceeds one of the Stream of Interest Sediment Concentration Action Thresholds. Specifically, if the increase in Project-related sediment concentration in the Stream of Interest meets or exceeds 20 mg/L for more than 315 minutes continuously, 40 mg/L for more than 135 minutes continuously, 99 mg/L for more than 45 minutes continuously, or 111 mg/L for any duration, Mountain Valley will initiate the Early Action Protocol.

This paper provides the methodology for determining and implementing the Take Risk Concentration and the Sediment Concentration Action Threshold for each tributary and the protocols for implementing the above-described Sediment Concentration Action Thresholds and the USFWS-defined Take Risk Concentrations for the Streams of Interest, describes the proposed monitoring that Mountain Valley will perform to measure Project-related sediment in the tributaries and the Streams of Interest, and describes the steps that Mountain Valley will take to ensure that Project-related sediment does not increase above the Take Risk Concentration in the Streams of Interest.

This monitoring plan is designed to be consistent with USFWS's impacts analysis in the BO for the listed aquatic species. USFWS based that impacts analysis in relevant part on the modeling approach used to delineate the aquatic portion of the action area, which is described in full in the Supplement to the Biological Assessment[5] (SBA). That approach models incremental increases in delivered sediment concentration to a stream segment for a "during construction" scenario compared to a "baseline" scenario, under conditions associated with a 10-year design storm. The specific methodology was based on the

[4] The tributary's Sediment Concentration Action Threshold accounts only for the concentration of sediment in the tributary. It does not account for the duration that the elevated concentration occurs. This creates additional conservativism in Mountain Valley's protocol because USFWS's take assessment recognizes that the elevated concentrations must persist continuously to result in take of RLP and CD. Furthermore, the tributary's Sediment Concentration Action Threshold is based solely on the lowest Take Risk Concentration of 20 mg/L.

[5] Mountain Valley. 2020. Supplement to the Biological Assessment.

Hydrologic Analysis of Sedimentation, which was subjected to extensive peer review from multiple federal agencies, including USFWS, U.S. Geological Survey (USGS), and U.S. Forest Service.

The BO identifies (a) portions of Streams of Interest where the aquatic action area analysis shows the Project causing an increase of $\geq$20 mg/L, and (b) "mixing zones" where the analysis predicts that a tributary would carry 20 mg/L or more of Project-related sediment at the point of confluence with a Stream of Interest.[6] The purpose of the monitoring framework is to identify when the Project's sediment contribution would cause an increase in sediment concentration within the Stream of Interest beyond the identified impact zones that would exceed the magnitudes and durations identified in the BO.

In its August 4, 2020 framework for monitoring sediment contributions, Mountain Valley explained the importance of monitoring within the tributaries to the Streams of Interest to more accurately isolate and measure sediment originating from the Project. As a result of subsequent conversations with USFWS and USGS, Mountain Valley not only will conduct sediment monitoring within the tributaries, but also upstream and downstream of the tributary's confluence with the Stream of Interest. Mountain Valley will identify proposed monitoring locations for each tributary and Stream of Interest and submit the proposals to USFWS and FERC for review and approval. Each tributary monitoring location will be selected based on several tributary-specific factors, such as prevalence and scope of non-Project-related sources of sediment, topography, and availability of landowner access, but will not be installed farther upstream than the most downstream point of anticipated Project-related sediment-generating activity within the tributary catchment. Stream of Interest monitoring locations will typically focus on the limits of the mixing zone impact areas, 200 meters upstream and 800 meters downstream of the confluence with the monitored tributary. In instances where mixing zones overlap and/or the estimated sediment concentration in the Stream of Interest was calculated as >20 mg/L, the monitoring stations in the Stream of Interest may be spaced farther than 1,000 meters apart.

The results of the modeling analysis used to identify the aquatic action area provide a straightforward approach for identifying the Project-related sediment concentration within each tributary at the proposed monitoring location that would be necessary for that tributary to subsequently cause a concentration increase within the Stream of Interest of any specified magnitude. For the purpose of identifying the Sediment Concentration Action Threshold in the tributary at which Mountain Valley would need to take steps in the field to minimize, assess, or prevent the Project from contributing sediment at levels that could surpass the Take Risk Concentration, Mountain Valley calculated the amount of Project-related sediment required to cause a $\geq$20 mg/L increase at the downstream boundary of the impact area within the Stream of Interest. The methods used to calculate

[6] This analysis showed that the flow in the aquatic species stream would dilute the sediment concentration delivered by the tributary to a level below 20 mg/L and, in most cases, below a level that could be practically discerned.

the Take Risk Concentration and Sediment Concentration Action Threshold for each tributary are described below:

1. Estimate the "during construction" sediment concentration[7] in the Stream of Interest segment upstream of the tributary (C_u) for the 10-year, 24-hour duration design storm using the established aquatic action area methodology presented in the SBA. This concentration includes any Project-related sediment from upstream sources.

2. Estimate the 10-year, 24-hour duration design storm runoff volumes for the tributary watershed (V_t) and the Stream of Interest watershed upstream of the tributary (V_u) using the Curve Number method as described in the aquatic action area methodology presented in the Supplement to the Biological Assessment.

3. Calculate the maximum Stream of Interest sediment concentration downstream of the tributary such that the concentration does not reach or exceed 20 mg/L over background. The maximum downstream sediment concentration (C_d) is calculated using Equation (1).

   $$C_d = C_u + (20 - C_{inc}) \qquad (1)$$

   Where:

   C_d = modeled sediment concentration corresponding to 20 mg/L over background in the Stream of Interest segment downstream of the tributary (mg/L),

   C_u = modeled background sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L), and

   C_{inc} = modeled incremental increase in Project-related sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L).

   With respect to C_{inc}, in zones where areas disturbed by the Project do not drain into the Stream of Interest upstream of the zone, C_{inc} = 0 mg/L and the maximum downstream concentration is 20 mg/L above the upstream concentration. In zones where the Project has contributed sediment to the Stream of Interest upstream, C_{inc} > 0 mg/L and the maximum downstream concentration is <20 mg/L above the upstream concentration to account for the Project-related sediment already within the Stream of Interest.

[7] Rather than analyzing the difference (i.e., incremental increase) in delivered sediment between baseline and during construction scenarios, only the delivered sediment load for the during construction scenario is used to estimate the during construction sediment concentration. This ensures that the maximum sediment concentration established in the tributary accounts for the existing Project-related sediment contribution in the Stream of Interest.

4. Using Equation (2) from established mass balance principles, calculate the tributary sediment concentration (C_t) that will result in the maximum downstream Stream of Interest sediment concentration from Equation (1) above.

$$C_t = \frac{\left[C_u + \left(20\frac{\text{mg}}{\text{L}} - C_{inc}\right)\right] \times [\text{V}_d] - C_u \times V_u}{V_t} \tag{2}$$

Where:

C_t = sediment concentration in the tributary (mg/L) necessary to produce an increase of 20 mg/L or greater in a Stream of Interest under modeled conditions,

C_u = modeled background sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L),

V_t = 10-year, 24-hour design storm runoff volume in the tributary (L),

V_u = 10-year, 24-hour design storm runoff volume in the Stream of Interest segment upstream of the tributary (L), and

V_d = 10-year, 24-hour design storm runoff volume in the Stream of Interest segment downstream of the tributary (L); assuming $V_d = V_u + V_t$.

The Project-related impacts in the Stream of Interest upstream of the tributary's confluence are accounted for by including the anticipated incremental increase in during construction sediment concentration in the Stream of Interest segment upstream of the tributary (i.e., C_{inc}).

The calculated sediment concentration in the tributary (C_t) reflects the concentration from the tributary from all sources—i.e., from the Project and other sources—necessary to cause C_d to equal or exceed 20 mg/L above background. Therefore, an exceedance of C_t in samples taken from a given tributary may not indicate that the Project alone would have caused the increase. But, as described below, in most locations, a measured reading approaching C_t would indicate a need to evaluate the Project's erosion control devices, as well as potential contributions from other sources. Mountain Valley proposes to set this Sediment Concentration Action Threshold at 75% of C_t, measured through turbidity as described below.

Sediment concentrations at these locations will be measured using traditional methods for measuring SSC. In addition, to allow for more rapid feedback, turbidity also will be measured at these locations, and turbidity measurements in nephelometric turbidity units (NTUs) will be converted to sediment concentrations based on guidelines developed by Hyer et al. (2015).[8] Due to the conservative nature of this approach, it is anticipated that use of these conversions initially could result in measurements that trigger Mountain

[8] Hyer, et al. (2015). Evaluation and Application of Regional Turbidity-Sediment Regression Models in Virginia.

Valley's obligation to implement the Early Action Protocol, but that the SSC samples collected at the same time could show that Project-related sediment did not actually reach the Sediment Concentration Action Threshold. While that will provide important conservatism initially, as monitoring continues and additional site-specific SCC sampling data are collected, Mountain Valley will fine-tune the conversions as appropriate to make them even more precise and reduce the risk of false positives.

Using guidelines from Hyer, et al. (2015), the Sediment Concentration Action Threshold based on turbidity can be calculated using the relationship described in Equation (3).

$$\ln(0.75 \times C_t) = 0.5204 + 0.9592 \times \ln(turbidity) \quad (3)$$

Solving for the monitoring turbidity threshold as described in Equation (4).

$$Turbidity\ threshold = e^{[\ln(0.75*Ct) - 0.5204] \div 0.9592} \quad (4)$$

Where:

ln(turbidity) = natural logarithm transformation of turbidity (in units of NTU), and

$\ln(0.75 \times C_t)$ = natural logarithm transformation of Sediment Concentration Action Threshold (in units of mg/L).

This approach may be modified to account for characteristics specific to each impact area. In some areas, for example, the size of the Project's expected contribution relative to the expected concentrations from other sources would make it impracticable to sample within the tributary feeding a mixing zone. In other areas, landowners may preclude access to areas within the tributary where sampling would be effective.

The use of this methodology to identify Sediment Concentration Action Thresholds for tributaries would not preclude the use of other sampling locations relevant to the Project's contribution to a specific impact zone. For example, Mountain Valley may elect to sample at additional points within the tributary or within the Stream of Interest to develop data that would allow the Project's contribution to be more precisely defined.

The tributary concentrations and Sediment Concentration Action Thresholds for turbidity are summarized in Table 2.

Monitoring Bradshaw Creek During Open-Cut Crossing

The Project crosses three Streams of Interest using dry open-cut crossing methods: North Fork Roanoke River[9], Bradshaw Creek, and Harpen Creek. Mountain Valley intends to submit a variance request to FERC to modify the Harpen Creek crossing to microtunneling/boring methods but has submitted[10] to USFWS an addendum to the Proposed Monitoring Plan for monitoring the Harpen Creek crossing to ensure that a plan

[9] The open-cut crossing of the North Fork Roanoke River has already been completed.
[10] Addendum to Proposed Aquatic Species Monitoring Plan (Aug. 19, 2020).

is available for use if needed. Therefore, Bradshaw Creek at MP 230.9 is the only open-cut crossing addressed here.

The crossing of Bradshaw Creek falls within the impact area identified in Appendix D, Table 1 of the BO. Take is anticipated to occur within all areas of Bradshaw Creek downstream of the crossing, so monitoring SSC downstream of that crossing to determine whether the thresholds and associated durations identified in the BO have been exceeded would not indicate an exceedance of the take limit identified in the ITS. An exceedance of the take limit based on Project-related SSC concentrations in Bradshaw Creek would only occur if the Project causes a SSC increase of sufficient duration at the downstream boundary of the mixing area created at the confluence of Bradshaw Creek with North Fork Roanoke River. Monitoring otherwise specified by this approach would identify whether Project-related sedimentation—whether from upland construction or the crossing itself—exceeds the Sediment Concentration Action Threshold or Take Risk Concentration.

Nonetheless, to more fully evaluate the effect of the crossing itself and identify potential issues with stream diversion structures, during the instream work associated with the crossing, Mountain Valley will monitor turbidity and SSC at locations 200m above the crossing and 800m below the crossing.

Overview of Monitoring Protocols

Instream monitoring of sediment concentrations will incorporate in-situ (i.e., continuously logging sensors) and traditional laboratory analysis. Data collected will include turbidity, water level (i.e., stage), rainfall, and SSC. The parameter collection frequency and units are presented in Table 1.

Table 1 – Monitoring Parameters

Parameter	Sample Type	Frequency[11]	Units
Turbidity	In-Situ	15 minutes	NTU
Stage	In-Situ	15 minutes	feet
Rainfall	In-Situ	15 minutes	inches
Suspended Sediment Concentration	Automated Grab	15 minutes[12]	milligram per liter

In-situ monitoring equipment will include a turbidity sensor, a water-level sensor, a rain gauge, and a security camera. All in-situ data will be collected at a minimum of 15-minute intervals for the duration of the deployment. Site-specific conditions in the tributaries (e.g., tributaries with short-duration flow events) may require more frequent monitoring intervals

[11] Initial monitoring frequency will be conducted at 15-minute increments; site-specific conditions (e.g., tributaries with short-duration flow events) may require more frequent monitoring intervals. The 15-minute frequency is expected to be sufficient for the Streams of Interest.

[12] SSC will be triggered by a change in stage during Phase 1 sampling activities (as described below) or once the turbidity level exceeds 65% of the Take Risk Concentration during both Phase 1 and Phase 2 sampling activities.

(i.e., 5-minute). Turbidity sensors will be Formazin Nephelometric Unit (FNU) instruments, which use near infrared (780-900 nm) light source with a 90-degree detection angle and one detector. The sensor will be capable of measuring the range of anticipated turbidity levels, and data will be reported in NTU. Water-level sensors will be used to measure stage at each monitoring location. Stage data will be converted to flow using Manning's equation,[13] until sufficient discharge measurements are taken to develop site-specific correlations of stage and flow. Initially, surveyed channel geometry and water level will be used for area estimates; surveyed channel slope and Manning's roughness[14] will be used to derive estimated flow velocities. A tipping bucket rain gauge will record rainfall at each monitoring location.

Traditional laboratory analysis will consist of SSC analysis of water samples collected by an automatic sampler deployed at the monitoring location. The automatic sampler will have the ability to collect 24 individual samples. Samples will be time-paced at site-specific (e.g., 15-minutes) intervals following the threshold trigger from the turbidity sensor. Following the trigger of sampling, the sample bottles will be collected and sent to the laboratory for SSC analysis. To capture the hydrograph, sampling will continue until turbidity has returned to levels below the Sediment Concentration Action Threshold. The sampler will be programmed to rinse and purge between each sample interval.

Monitoring stations will be established following guidance in USGS's *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting*.[15] Stations will consist of the previously mentioned sensors and automated sampler connected to data logger; additional details are listed in the following section. Stations will be maintained according to manufacturer recommendations, guidance in *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting* and Project-specific protocols. Routine maintenance is vital to maintaining data quality. Monitoring stations will incorporate a telemetry system to allow real-time access to data and provide a means for transmittal of notifications (e.g., thresholds, malfunction) to the Project team. Further details related to routine monitoring and maintenance are provided in Monitoring and Maintenance Protocols – Phase 1 and Monitoring and Maintenance Protocols – Phase 2 sections below.

Monitoring and Maintenance Protocols – Phase 1

Phase 1 of monitoring will commence within one week of commissioning of a monitoring station. During Phase 1, accelerated data collection activities will include routine weekly discrete sampling for turbidity, SSC, stage, and flow. Turbidity data collection will include

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[13] Chow, T.V. 1959. Open-Channel Hydraulics.

[14] Arcement, George J., Guide for Selecting Manning's roughness coefficients for natural channels and flood plains.

[15] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at http://pubs.water.usgs.gov/tm1d3

equal width cross-sectional measurements at the monitoring location(s) to compare to fixed turbidity sensor measurements. An equal width interval sample will be collected across the cross-section for SSC analysis; this provides comparison to the automated sampling location and data for refining site-specific relationships. A flow measurement will be collected at the monitoring location during weekly site visits for establishing stage-flow relationships to improve confidence in the estimated flow velocities described above.

During Phase 1, to generate additional information with which to fine-tune the conversions, storm events will be targeted (beyond that described above) for collection of storm event data. Storm event protocols will be consistent with routine weekly sampling protocols. Storm event automated sampling will be triggered by change in stage. For tributaries, sampling will be triggered by a four-inch increase in stage. Automated sampling at Streams of Interest will be triggered by a six-inch rise in stage. Stage triggers may be adjusted to accommodate site-specific conditions at each of the monitoring locations.

The routine weekly and storm event sampling will continue until sufficient samples have been collected to allow for any appropriate fine-tuning of the NTU-SSC conversions, at which point Mountain Valley will transition to the Phase 2 monitoring approach described below following written notification to and approval of FERC and USFWS.

In addition, weekly site visits will include maintenance of the deployed equipment. Maintenance activities will follow guidance in *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting* and Project-specific protocols.

Once commissioned, the monitoring station will initiate “take risk sampling” protocols consisting of measuring the turbidity of the water in the stream. When turbidity reaches the pre-established “notification threshold” (i.e., 65% of the Take Risk Concentration), the datalogger will confirm that the water-level sensor has an upward trend. If these conditions are met, the data logger will trigger the automatic sampler to begin its sampling routine. Simultaneously, a notification will be sent to the Project team alerting them sampling has commenced. If turbidity levels reach the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration), the datalogger will transmit a notification to the Project team alerting them of the condition. The automatic sampler will continue to collect samples until the turbidity drops below the “notification threshold” or all the bottles have been filled. A notification will also be sent to the Project team when eight (8) of the 24 bottles remain to be filled (e.g., two hours at 15-minute intervals) to allow the Project team to mobilize to the sampling location with additional bottles. When the sampler has stopped sampling, a message will be transmitted to the Project team so samples can be collected.

Monitoring and Maintenance Protocols – Phase 2

Following the initial accelerated data collection period, routine sampling and maintenance will be conducted on a monthly basis. Phase 2 routine discrete sampling and maintenance will follow the same protocols as those in Phase 1 except with a reduced frequency.

For Phase 2, the monitoring station will continue only the “take risk sampling” protocols consisting of measuring the turbidity of the water in the stream. When turbidity reaches the pre-established “notification threshold” (i.e., 65% of the Take Risk Concentration in a tributary or Stream of Interest), the datalogger will confirm that the water-level sensor has an upward trend. If these conditions are met, the data logger will trigger the automatic sampler to begin its sampling routine. Simultaneously, a notification will be sent to the Project team alerting them sampling has commenced. If turbidity levels reach the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration), the datalogger will transmit a notification to the Project team alerting them of the condition. The automatic sampler will continue to collect samples until the turbidity drops below the “notification threshold” or all the bottles have been filled. A notification will also be sent to the Project team when eight (8) of the 24 bottles remain to be filled (e.g., two hours at 15-minute intervals) to allow the Project team to mobilize to the sampling location with additional bottles. When the sampler has stopped sampling, a message will be transmitted to the Project team so samples can be collected.

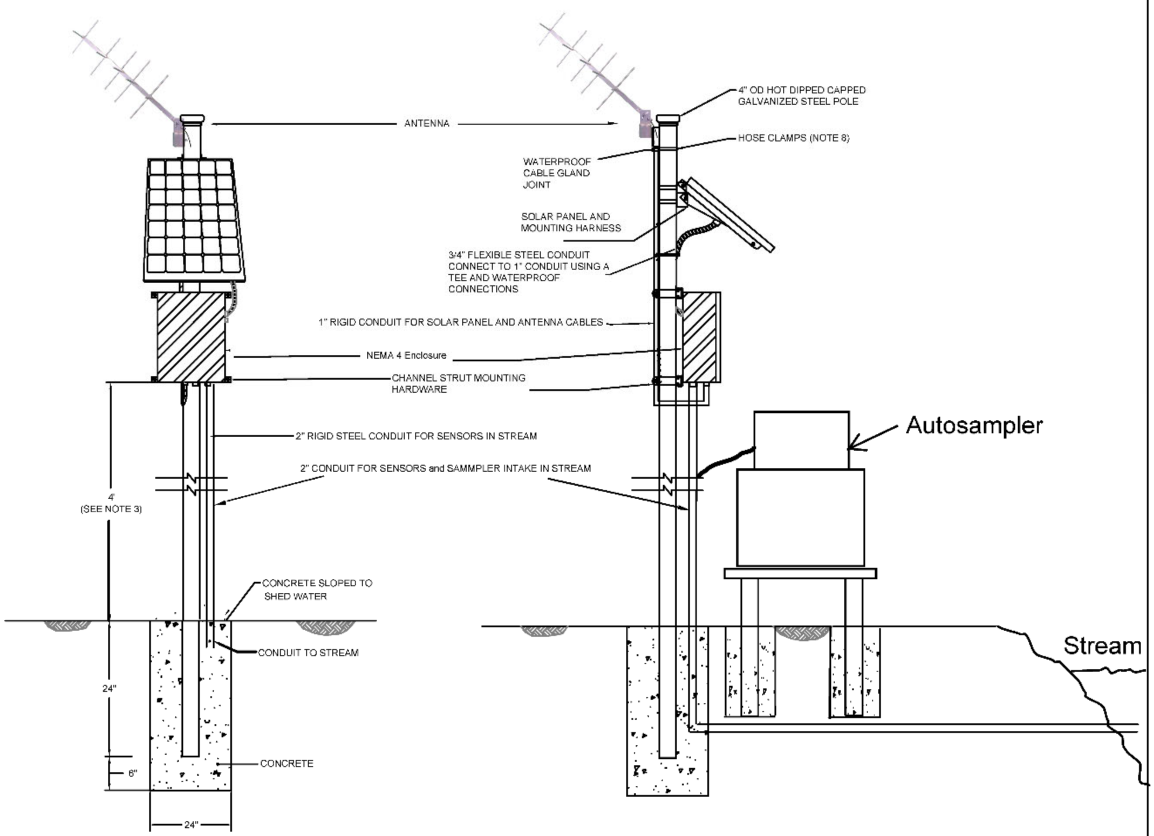
Overview of Monitoring Station Arrays

Monitoring stations will generally consist of the following major components:[16]

1) Datalogger appropriate for receiving, storing, and transmitting monitoring station data. In addition, the datalogger will be programmable in order to transmit threshold notifications and control the collection of water samples.
2) Turbidity sensor capable of measuring to the anticipated maximum turbidity levels and following the International Organization for Standardization (ISO) method 7027.
3) Automatic sampler with multi-bottle configuration (i.e., 24 bottles).
4) Water-level sensor (i.e., stage), such as a pressure transducer or bubbler, for flow estimation.
5) Tipping bucket rain gauge.
6) Camera for visual monitoring of stream conditions
7) Cellular modem or other site-appropriate telemetry.
8) Power source appropriately sized stand-alone 12-volt power source with solar charger.
9) All-weather enclosures.

[16] Monitoring station components may require minor adjustments to address site-specific conditions. Adjustments will improve, not diminish, the functionality of the station.

The following images and illustrations are included to provide a conceptual view of the monitoring station described above.



NOTES:

1. BOLT ENCLOSURE TO SUPPORT POLE USING CHANNEL STRUT AND STAINLESS STEEL MOUNTING HARNESS PROVIDED BY OPTIRTC.
2. ALL CONDUIT PENETRATIONS INTO ENCLOSURE OR TERMINATIONS ARE TO BE IP68 RATED.
3. CONTROL PANEL SHOULD BE MOUNTED AS HIGH AS POSSIBLE, HIGHER THAN THE EXPECTED HIGH WATER LEVEL IS MINIMUM RECOMMENDATION.
4. SOLAR PANEL AND MOUNTING HARNESS (EXAMPLE: AMERESCO SOLAR PART VLS-20W).
5. LEAVE MINIMUM OF 1 FOOT SPARE CABLING NEATLY COILED IN JUNCTION BOXES FOR FUTURE MAINTENANCE OR SYSTEM MODIFICATIONS.
6. MOUNT TIPPING BUCKET RAIN GAGE PER MANUFACTURERS INSTRUCTIONS. TIPPING BUCKET CAN BE MOUNTED WITH WORM-DRIVE HOSE CLAMPS TO FIT ANY SIZE POLE. ALTERNATIVELY, CHANNEL STRUT OR 90 DEGREE METAL BRACKET CAN SUPPORT THE BUCKET FROM UNDERNEATH. THE BUCKET MUST BE MOUNTED LEVEL.
7. ANTENNA SHOULD BE SITED SUCH THAT SURROUNDING OBJECTS ARE NO CLOSER THAN TWO TIMES THEIR HEIGHT ABOVE THE GAGE.
8. USE ALL STAINLESS STEEL HOSE CLAMPS OR EQUIVALENT FOR SECURING CONDUIT TO POLE.

Response to Detection of Sediment Concentration Action Threshold

In the event a monitoring station detects a concentration of Project-related sediment in a tributary above the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration) or an increase within the Stream of Interest above the concentrations/durations described above, Mountain Valley will initiate the Early Action Protocol described below. Establishing the Sediment Concentration Action Threshold at 75% of the corresponding Take Risk Concentration for each site provides a minimum[17] 25% protective buffer against sediment from the Project increasing the concentration within a Stream of Interest sufficiently to expand the limits of the impact area and risk exceeding the amount or extent of RLP and CD take anticipated in the ITS. The Early Action Protocol therefore requires Mountain Valley to respond to elevated, but non-impactful, concentrations to ensure that sediment from the Project will not exceed the Take Risk Concentration.

<u>Early Action Protocol</u>: Mountain Valley will take the following steps if, at any time during the monitoring period, a designated Project monitoring station measures a turbidity level greater than or equal to the Sediment Concentration Action Threshold identified in Table 2 for that station and less than the corresponding Take Risk Concentration, or if an increase measured at the downstream monitoring station for an impact area in the Stream of Interest exceeds the thresholds and corresponding durations identified above.

1) Unless a different deadline is specifically identified below, complete each of the following steps within 48 hours or as soon as conditions safely allow:

    a. Inspect the monitoring equipment that measured the Sediment Concentration Action Threshold for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, return the station to correct working order within 72 hours following inspection or as soon as conditions safely allow. If the station cannot be returned to service within that time, contact FERC and USFWS to identify an alternative monitoring approach to implement until the monitoring station can be brought back online.

    b. Comprehensively inspect all Project erosion and sediment (E&S) controls within the catchment area(s) draining to the monitoring station to identify any damage to or failures of existing controls.

[17] As explained above, the Take Risk Concentration accounts for all sediment within a tributary, including sediment contributed by non-Project sources. As shown in Table 2, the Project's contribution is a small fraction of the total expected under modeled conditions.

i. Any evidence of such damage or failure will be documented and photographed, and the control will be repaired or replaced (if warranted).

ii. The inspector will prepare a written determination stating whether the damaged or failed control(s) contributed to the elevated concentration measured at the monitoring station and explain the basis for that determination.

iii. If a damaged or failed E&S control resulted in Project-related sediment leaving the limits of disturbance but not entering the monitored stream, the inspector will document that and determine in writing whether an enhancement to the E&S control is needed to prevent recurrence and recommend any enhancement deemed needed. Within 72 hours of receiving a recommendation or as soon as conditions safely allow, Mountain Valley will implement the enhancement(s) to the E&S control. All such enhancements will be photographed upon completion of installation.

iv. If a damaged or failed E&S control resulted in Project-related sediment entering the monitored stream, the inspector will document that and identify one or more enhancements to the E&S control to prevent recurrence. Within 72 hours of receiving notification from the inspector or as soon as conditions safely allow, Mountain Valley will implement the enhancement(s) to the E&S control. All such enhancements will be photographed upon completion of installation.

v. Within 72 hours of completing installation of an enhancement under the above requirements or as soon as conditions safely allow, identify other locations within the catchment area where similar Project E&S controls did not experience damage or failure but that would benefit from installation of enhanced control to minimize the risk of future damage or failure. Mountain Valley will implement the enhanced control in all identified areas.

c. Within 72 hours or as soon as conditions safely allow, inspect accessible areas of the monitored stream and the catchment to identify any non-Project sources of sediment that the inspector believes could have appreciably contributed to the elevated concentration measured by the monitoring station. The inspector will record the location of and photograph the source and prepare a written description of the source, the inspector's opinion of the significance of its sediment contribution, and the basis for that opinion.

2) After completing the above-described inspections, documentation, and response actions, Mountain Valley will notify FERC and USFWS of its activities under the Early Action Protocol and provide any additional information that FERC or USFWS may request.

Response to Detection of Take Risk Concentration

In the event a monitoring station detects a concentration of Project-related sediment above the Take Risk Concentration for a tributary or an increase within a Stream of Interest that meets or exceeds the thresholds as presented in the BO, Mountain Valley will initiate the Rapid Response Protocol described below. Specifically, if the increase in sediment concentration measured at the downstream monitoring station for an impact area in the Stream of Interest meets or exceeds 20 mg/L for more than 7 hours continuously, 40 mg/L for more than 3 hours continuously, 99 mg/L for more than 1 hour continuously, or 148 mg/L for any duration, the Rapid Response Protocol will be initiated. The Rapid Response Protocol contemplates that sediment from the Project *might* cause an increase in the concentration within a Stream of Interest sufficiently to expand the limits of the impact area and risk exceeding the amount or extent of RLP and CD take anticipated in the ITS. The Rapid Response Protocol therefore requires Mountain Valley to respond to potentially impactful concentrations of sediment from the Project by providing immediate notice, identifying the Project- and non-Project cause(s) of the elevated concentration, quickly implementing any measures to reduce Project-related contributions, analyzing all available information to make a preliminary determination of whether Project-related sediment in fact caused a Take Risk Concentration exceedance.

<u>Rapid Response Protocol</u>: Mountain Valley will take the following steps if, at any time during the monitoring period, a designated Project monitoring station measures a turbidity level greater than Take Risk Concentration identified in Table 2 for that station or if the downstream monitoring station for an impact area in a Stream of Interest exceeds the thresholds and corresponding durations identified above:

1) Notify FERC and USFWS in writing (e.g., email) within 24 hours, identify the location, concentration measured, provide any additional information of relevance (e.g., rainfall amount/duration) if known, and confirm that Mountain Valley is initiating the Rapid Response Protocol.

2) Unless a different deadline is specifically identified below, complete each of the following Rapid Response Protocol steps within 48 hours or as soon as conditions safely allow:

    a. Inspect the monitoring equipment that measured the Take Risk Concentration for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, return the station to correct working order within 72 hours or as soon as conditions safely allow. If the station cannot be returned to service within that time, contact FERC and USFWS to identify an alternative monitoring approach to implement until the monitoring station can be brought back online.

b. Comprehensively inspect all Project E&S controls within the catchment area(s) draining to the monitoring station to identify any damage to or failures of existing controls.

   i. The inspector will document and photograph any evidence of such damage or failure and will repair or replace (if warranted) the control.

   ii. The inspector will prepare a written determination stating whether the damaged or failed control(s) contributed to the elevated concentration measured at the monitoring station and explain the basis for that determination.

   iii. If the inspector determines that the damage to or failure of the E&S control resulted from a design deficiency or that the damage or failure resulted in Project sediment leaving the limits of disturbance, regardless of whether it entered the monitored stream, the inspector will document that and identify one or more enhancements to the E&S control to further reduce sediment loss from the Project area and prevent recurrence. Mountain Valley will implement the enhancement(s) to the E&S control within 72 hours of receiving the inspector's notice or as soon as conditions safely allow. All such enhancements will be photographed upon completion of installation.

   iv. Within 72 hours of completing installation of an enhancement under the above requirements or as soon as conditions safely allow, Mountain Valley will identify other locations within the catchment area where similar Project E&S controls did not experience damage or failure but that would benefit from installation of enhanced control to minimize the risk of future damage or failure. Mountain Valley will implement the enhanced control in all identified areas. All such enhancements will be photographed upon completion of installation.

   v. If the inspector determined that the problem resulted from a design deficiency, within 72 hours of that determination or as soon as conditions safely allow, Mountain Valley will identify all similar Project E&S controls installed within each RLP and CD watershed that remains under construction and implement similar enhancements in those locations. All such enhancements will be photographed upon completion of installation.

c. Within 72 hours or as soon as conditions safely allow, inspect accessible areas of the monitored stream and the catchment to identify any non-Project sources of sediment that the inspector believes could have appreciably contributed to the elevated concentration measured by the monitoring station. The inspector will record the location of and photograph the source and prepare a written description of the source, the inspector's opinion of the significance of its sediment contribution, and the basis for that opinion.

3) After completing the above-described inspections, documentation, and response actions, within five days, Mountain Valley will submit a report to FERC and USFWS detailing each action taken, summarizing its analysis of the issue, and providing any additional information that FERC or USFWS may request.

Table 2. Summary of Action and Take Risk Concentration Thresholds for Monitoring Impact Areas Identified in BO

ID	County	River Basin	Stream of Interest	Location of Tributary Entering Stream of Interest	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m) in Stream of Interest	Percent Contribution of Project-related Sediment in Tributary Under Modeled Conditions (%)	Tributary Take Risk Concentration Resulting in 20 mg/L increase in Stream of Interest (mg/L)	Tributary Sediment Concentration Action Threshold for Turbidity (NTU)
1	Montgomery	Roanoke	North Fork Roanoke River	Approximately 0.7 km upstream of MP 227.4 crossing of North Fork Roanoke	03010101000799	Dry Run	perennial	700	5.3	669	380
2	Montgomery	Roanoke	North Fork Roanoke River	Approximately 3.5 km downstream of MP 227.4 crossing of North Fork Roanoke	03010101000892	Mill Creek	perennial	1,810	7.8	927	534
3	Montgomery	Roanoke	North Fork Roanoke River	Approximately 3 km downstream of MP 229.7 crossing of Flatwoods Branch tributary	03010101000783	Flatwoods Branch	perennial	1,000	5.7	721	411
4	Montgomery	Roanoke	Bradshaw Creek	Above MP 230.9 crossing of Bradshaw; two tributaries entering Bradshaw Creek	03010101002185, 03010101002195	no name, Womack Branch	both intermittent	4,807	[Note 1]	[Note 1]	[Note 1]
5	Montgomery	Roanoke	North Fork Roanoke River	Approximately 2.5 km downstream of MP 230.9 crossing of Bradshaw Creek	03010101000317	Bradshaw Creek	perennial	1,000	3.8	622	352
6	Montgomery	Roanoke	North Fork Roanoke River	Approximately 4.5 km upstream of MP 235.6 crossing of Roanoke River	03010101002184	no name	intermittent	1,000	28.5	2,074	1,236
7	Montgomery	Roanoke	South Fork Roanoke River	Approximately 1.5 km upstream of confluence with the Roanoke River	03010101008530	Indian Run	intermittent	1,000	47.6	5,212	3,230
8	Montgomery	Roanoke	North Fork Roanoke River & Roanoke River	Approximately 2 km upstream of MP 235.6 crossing of Roanoke River	03010101002183	no name	intermittent	925 (465 in North Fork Roanoke River; 460 in Roanoke River)	62.4	3,019	1,828
9	Montgomery	Roanoke	Roanoke River	Approximately 1 km upstream of MP 235.6 crossing of Roanoke River	03010101002183	no name	intermittent	800	26.0	2,995	1,813
10	Montgomery/ Roanoke	Roanoke	Roanoke River	Approximately 0.3 km downstream of MP 235.6 crossing of Roanoke River	03010101002181	no name	intermittent	670	12.7	8,714	5,520
11	Roanoke	Roanoke	Roanoke River	Approximately 0.8 km downstream of MP 235.6 crossing of Roanoke River	03010101002349	no name	perennial	800	14.8	1,843	1,093
12	Roanoke	Roanoke	Roanoke River	Approximately 5.5 km downstream of MP 235.6 crossing of Roanoke River	03010101002351	no name	perennial	1,000	6.1	1,326	775
13	Franklin	Pigg	Pigg River	Approximately 2 km downstream of MP 280.0 crossing of Little Jacks Creek	03010101001376	Jacks Creek	perennial	1,000	3.5	1,174	683

ID	County	River Basin	Stream of Interest	Location of Tributary Entering Stream of Interest	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m) in Stream of Interest	Percent Contribution of Project-related Sediment in Tributary Under Modeled Conditions (%)	Tributary Take Risk Concentration Resulting in 20 mg/L increase in Stream of Interest (mg/L)	Tributary Sediment Concentration Action Threshold for Turbidity (NTU)
14	Franklin	Pigg	Pigg River	Approximately 3 km downstream of MP 280.7 crossing of Turkey Creek	03010101001373	Turkey Creek	perennial	1,000	2.8	3,092	1,874
15	Franklin	Pigg	Pigg River	Approximately 3 km downstream MP 283.0 crossing of Parrot Branch	03010101001359	Parrot Branch	perennial	1,000	3.4	1,256	732
16	Pittsylvania	Pigg	Pigg River	Approximately 2 km downstream of MP 287.2 crossing of unnamed tributary	03010101001349	Rocky Creek	perennial	900	4.0	3,365	2,047
17	Pittsylvania	Pigg	Pigg River	Approximately 0.7 km downstream of confluence of Rocky Creek and Pigg River	03010101001348	no name	intermittent	800	1.4	13,757	8,886
18	Pittsylvania	Pigg	Pigg River	Approximately 0.6 km downstream of MP 289.2 crossing of Pigg River	03010101001347	no name	perennial	1000	1.1	6,966	4,371
19	Webster	Gauley	Gauley River	Approximately 1.8 km upstream of Strouds Creek confluence with Gauley River	05050005000952	Coon Creek	Perennial	1,000	12.0	2,803	1,692
20	Nicholas	Gauley	Gauley River	Approximately 0.9 km upstream of MP 118.9 crossing of Gauley River	05050005000554	Little Laurel Creek	Perennial	1,000	6.7	2,415	1,449
21	Giles	New River	Stony Creek	Approximately 1.1 km upstream from MP 200.3	05050002000869	Kimballton Branch	Perennial	1,000	25.1	886	509

Note 1: Tributary concentrations for Bradshaw Creek are not listed because the action area methodology indicates that the Project will cause an increase >20 mg/L in the entire impact area within Bradshaw Creek. Bradshaw Creek would be monitored as a tributary of North Fork Roanoke River.

Addendum to Proposed Aquatic Species Monitoring Plan

The following supplements the Proposed Aquatic Species Monitoring Plan (Aug. 9, 2020) (the "Proposed Plan") for the Mountain Valley Pipeline project (the "Project"). On page 5 of the Proposed Plan, Mountain Valley mistakenly stated that the Bradshaw Creek crossing is the only dry open-cut crossing of a Stream of Interest that has not been completed. The open-cut crossing of Harpen Creek also has not been completed. Mountain Valley therefore provides this proposed monitoring plan for the Harpen Creek crossing at Project milepost (MP) 289.9.

Monitoring Harpen Creek at MP 289.9 Open-Cut Crossing

Unlike the crossing of Bradshaw Creek, the crossing of Harpen Creek does not overlap with an impact area identified in Appendix D, Table 1 of the BO. In fact, no TSS concentration impact area or mixing zone impact area, both of which correspond to sedimentation from upland construction activity, occurs within Harpen Creek. The Harpen Creek impact area results entirely from the instream activity associated with performing the open-cut crossing of the stream. Accordingly, the BO identifies the Harpen Creek impact area as 1,023m: 200m upstream of the crossing, 800m downstream of the crossing, and 23m for the construction right-of-way (ROW) width. FWS anticipates that take will occur within all areas of the Harpen Creek crossing impact area.

Mountain Valley will execute the dry open-cut crossing of Harpen Creek using a dam-and-pump system during low-flow conditions consistent with applicable conditions of the FERC Certificate, Nationwide Permit 12, and conditions imposed by the Virginia DEQ, including installation and maintenance of erosion and sediment (E&S) controls for the crossing. Mountain Valley will install TSS and turbidity monitoring stations sufficiently upstream of the crossing to measure baseline concentration in Harpen Creek without capturing Project crossing-related sediment and 800m downstream of the crossing location. Due to the presence of significant, active farming operations immediately adjacent to the Harpen Creek crossing impact area, Mountain Valley will install additional TSS and turbidity monitoring stations, as well as streamflow monitoring equipment, within that range to measure, isolate, and account for sediment contributions from non-Project sources.

Because monitoring the Harpen Creek crossing necessarily focuses on impacts associated with the instream construction activities, Mountain Valley's proposes a slightly different approach for defining the Sediment Concentration Action Threshold and the Take Risk Threshold than for the other aquatic action areas. Likewise, Mountain Valley proposes a Harpen Creek-specific Early Action Protocol and Rapid Response Protocol that are tailored to the instream construction activities required to complete the open-cut crossing. In addition, due to the short timeframe for completing the Harpen Creek crossing, when instream construction activities are occurring, a Mountain Valley environmental inspector will be present to ensure that all crossing-related E&S controls are installed and functioning correctly, and one or more Mountain Valley monitoring inspectors will be present to ensure that the monitoring equipment is functioning properly and to initiate timely implementation of the Protocols if triggered.

The Harpen Creek Crossing Sediment Concentration Action Threshold—the trigger for Mountain Valley to implement its Early Action Protocol—will be when the concentration difference of Project-related sediment between the upstream (baseline) monitoring station and the station 800m downstream is:

- ≥111 mg/L (75% of 148 mg/L) for any duration
- ≥99 mg/L continuously over 45 minutes (75% of 1 hour)
- ≥40 mg/L continuously over 135 minutes (75% of 3 hours)
- ≥20 mg/L continuously over 315 minutes (75% of 7 hours)

For all but the highest concentration threshold (i.e., 148 mg/L), the proposed approach for monitoring the Sediment Concentration Action Threshold is to measure *the duration* of Project-related sediment concentrations that continuously equal or exceed the respective impact concentrations that FWS adopted from Muck (2010). This approach is appropriate for three reasons: (1) the Harpen Creek impact area results entirely from the instream construction activities for the open-cut crossing; (2) modeled sedimentation in the impact area from the Project's upland construction activities is not discernible, meaning that this segment of Harpen Creek would not be either action area or impact area but for the instream work; and (3) there are no identified tributaries that could create Project-related sediment mixing zones within the impact area.

Harpen Creek Crossing Early Action Protocol: Mountain Valley will take the following steps if, at any time during the Harpen Creek crossing monitoring period, the Project monitoring stations show that the turbidity concentration during instream construction reaches or exceeds one of the Sediment Concentration Action Thresholds for the duration prescribed above without triggering one of the Take Risk Thresholds described below:

1) Within one hour or as soon as conditions safely allow, inspect the monitoring equipment that measured the baseline and the Sediment Concentration Action Threshold for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, implement backup monitoring equipment (e.g., portable monitor) until the primary equipment returns to service and notify FERC in writing (e.g., email) that backup equipment has been implemented.

2) Within two hours or as soon as conditions safely allow, comprehensively inspect all Project E&S controls associated with construction of the crossing to identify any damage to or failures of existing controls. If any damage or a failure is identified, Mountain Valley will suspend instream construction activities for the crossing until the control is repaired or (if warranted) replaced and approved as

compliant by the environmental inspector, and the inspector will document and photograph such damage or failure and how it was corrected.

3) Within four hours or as soon as conditions safely allow, inspect accessible areas of the impact area to identify any non-Project sources of sediment that the inspectors believe could have appreciably contributed to the elevated concentration measured. This evaluation also will consider the concentrations measured by the Project monitoring stations located between the upstream (baseline) station and the station 800m downstream to determine whether non-Project sources likely are contributing sediment to the impact area. The inspectors will record the location of and photograph the source and prepare a written description of the source, the inspectors' opinion of the significance of its sediment contribution, the bases for that opinion, and the concentrations measured by the other Project monitoring stations within the impact area.

4) After completing the above-described inspections, evaluations, documentation, and response actions, Mountain Valley will notify FERC of its activities under the Early Action Protocol and provide any additional information that FERC may request.

<u>The Harpen Creek Crossing Take Risk Threshold</u>—the trigger for Mountain Valley to implement its Rapid Response Protocol—will be when the concentration difference of Project-related sediment between the upstream (baseline) monitoring station and the station 800m downstream is 95% of one of the following:

- ≥141 mg/L (95% of 148 mg/L) for any duration
- ≥94 mg/L (95% of 99 mg/L) continuously over 1 hour
- ≥38 mg/L (95% of 40 mg/L) continuously over 3 hours
- ≥19 mg/L (95% of 20 mg/L) continuously over 7 hours

The proposed approach for monitoring the Take Risk Threshold for the Harpen Creek crossing impact area is to measure *the duration* of Project-related concentrations that continuously equal or exceed the 95% of respective impact concentrations that FWS adopted from Muck (2010). Due to the instream nature of construction activities, this approach will enable Mountain Valley to take steps to ensure that Project-related sediment does not reach an impact concentration.

Harpen Creek Crossing Rapid Response Protocol: Mountain Valley will take the following steps if, at any time during the Harpen Creek crossing monitoring period, the Project monitoring stations show that the turbidity concentration during instream construction reaches or exceeds one of the Take Risk Thresholds for the duration prescribed above:

1) Immediately suspend instream construction activities.

2) Within one hour, notify FERC in writing (e.g., email), identify the concentration measured, provide any additional information of relevance if known, and confirm that Mountain Valley has suspended instream construction activities and is initiating the Rapid Response Protocol. Mountain Valley also will notify FERC in writing (e.g., email) before resuming instream construction activities under Step 1 above.

3) Before instream construction activities may resume, the following steps must be completed:

   a. Inspect the monitoring equipment that measured the baseline and the Take Risk Threshold for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, implement backup monitoring equipment (e.g., portable monitor) until the primary equipment returns to service and notify FERC in writing (e.g., email) that backup equipment has been implemented.

   b. Comprehensively inspect all Project E&S controls associated with construction of the crossing to identify any damage to or failures of existing controls. If any damage or a failure is identified, Mountain Valley will repair or replace (if warranted) the control, the environmental inspector will confirm that the control was made to be compliant, and the inspector will document and photograph such damage or failure and how it was corrected.

   c. Install additional instream E&S controls (e.g., turbidity curtain) within the impact area to further safeguard against Project-related sediment from instream construction activities reaching or exceeding the respective impact concentrations/durations that FWS adopted from Muck (2010).

   d. Inspect accessible areas of the impact area to identify any non-Project sources of sediment that the inspectors believe could have appreciably contributed to the elevated concentration measured. This evaluation also will consider the concentrations measured by the Project monitoring stations located between the upstream (baseline) station and the station 800m downstream to determine whether non-Project sources likely are contributing sediment to the impact area. The inspectors will record the location of and photograph the source and prepare a written description of the source, the inspectors' opinion of the significance of its sediment contribution, the bases for that opinion, and the concentrations measured by the other Project monitoring stations within the impact area.

   e. Monitor the Project-related sediment concentration in the impact area until it decreases below the Sediment Concentration Action Threshold for at least one hour.

5) After completing the above-described inspections, evaluations, documentation, and response actions, Mountain Valley will notify FERC of its activities under the Rapid Response Protocol and provide any additional information that FERC may request.

Appendix G. Nonjurisdictional Facilities.

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	IPAC Results	Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2020 Desktop Survey)	Nearest Known or Presumed Occupied Portal (miles)	Tree Felling Complete
MLV25	VA	Giles	209.3	37.316149	-80.545026	0.35	1965.10	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Known use spring staging/fall swarming	No	N/A	0.37	No
Transco South Tap	VA	Pittsylvania	On H-602	36.830736	-79.34408	1.10	1176.66	40.00	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	52.92	No
MLV6	WV	Lewis	52.9	38.995521	-80.591854	0.00	959.78	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unoccupied summer habitat	No	N/A	17.13	Yes
MLV7	WV	Lewis	64.6	38.872441	-80.531408	0.00	1905.76	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unoccupied summer habitat	No	N/A	8.33	Yes
MLV10	WV	Webster	93.1	38.548186	-80.540223	0.05	282.94	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsili abrupta*) Rayed bean (*Villosa fabilis*) Running buffalo clover (*Trifolium soloniferum*) No critical habitat identified	Unoccupied summer habitat	No	No potential habitat. Species is dependent on frequent disturbance. Area appears to be mown lawn and scrubby stream crossing.	3.92	No
MLV12	WV	Webster	102.3	38.4439	-80.551487	0.00	1267.47	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsili abrupta*) Rayed bean (*Villosa fabilis*) Running buffalo clover (*Trifolium soloniferum*) No critical habitat identified	Unoccupied summer habitat	No	No potential habitat. Species is dependent on frequent disturbance. Area appears to be mature woods and driveway/farmroad.	11.14	Yes
MLV35	VA	Pittsylvania	299.5	36.856323	-79.392372	0.06	741.24	20.00	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	49.59	No
MLV28	VA	Montgomery	236.2	37.223793	-80.202141	0.79	2338.65	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke log perch (*Percina rex*) Smooth coneflower (*Echinacea laevigata*) No critical habitat identified	Unknown use spring staging/fall swarming	No	Potential habitat exists. Smooth coneflower is found along roadsides and edges and has the potential to exist along a two-track crossed by the utility line. The utility provider will likely be able to span this potential habitat.	2.21	No
Sherwood Measuring Station	WV	Harrison	23.6	39.314	-80.535	0.41	1178.16	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	38.53	No
WB Interconnect	WV	Braxton	77.3	38.724428	-80.500881	0.00	1587.31	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	2.02	Yes
MLV15	WV	Greenbrier	138.7	38.04592	-80.739917	0.58	5524.47	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium soloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat. Running buffalo clover is dependent on disturbance; this is established forest. Small whorled pogonia is found in forest interiors; this line runs alongside the roadway. Virginia spiraea is only found at stream crossings.	15.60	No
MLV16	WV	Greenbrier	140.9	38.02064	-80.752505	0.20	704.07	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium soloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat for running buffalo clover. Running buffalo clover is dependent on disturbance; area is roadside and forest interior. Small whorled pogonia potential habitat was identified in the portion of this area within the MVP limits of disturbance in 2015, but no individuals were identified. Unsurveyed area is roadside so no potential habitat exists in that remaining area. No potential habitat for Virginia spiraea. Virginia spiraea is only found at stream crossings.	17.71	No
MLV17	WV	Greenbrier	143.9	37.983657	-80.75626	0.05	201.19	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium soloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists for any of these species. 2015 survey covered this area; no potential habitat found.	20.21	No
Mobley Interconnect	WV	Wetzel	0	39.56253	-80.542329	0.00	104.35	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Known use summer habitat	No	N/A	55.87	Yes
Transco Interconnect	VA	Pittsylvania	303.4	36.832102	-79.342853	0.00	962.85	20.00	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	52.72	Yes
Webster Tap	WV	Wetzel	0.8	39.552143	-80.545608	0.00	88.89	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Known use summer habitat	No	N/A	55.16	Yes

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	IPAC Results	Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2020 Desktop Survey)	Nearest Known or Presumed Occupied Portal (miles)	Tree Felling Complete
Transco North Tap	VA	Pittsylvania	303.87	36.833637	-79.337088	0.00	78.12	20.00	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	53.00	Yes
Bradshaw Compressor Station	WV	Wetzel	2.7	39.533082	-80.532927	0.00	182.40	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Known use summer habitat	No	N/A	53.90	Yes
Harris Compressor Station	WV	Braxton	77.3	38.722444	-80.502616	0.00	439.87	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	2.11	Yes
Stallworth Compressor Station	WV	Fayette	154.5	37.867732	-80.757415	0.00	2746.11	20.00	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) Running buffalo clover (*Trifolium soloniferum*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unoccupied summer habitat	No	No potential habitat exists for these species based on the results of a 2016 survey.	17.99	Yes
MLV3	WV	Harrison	15.3	39.398799	-80.476495	0.00	92.43	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	44.61	Yes
MLV4	WV	Harrison	15.4	39.39793	-80.477629	0.00	802.78	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	44.56	Yes
MLV5	WV	Doddridge	34.3	39.208633	-80.55198	0.00	86.41	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unoccupied summer habitat	No	N/A	31.50	Yes
MLV8	WV	Lewis	65.4	38.863141	-80.525503	0.00	85.88	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	7.63	Yes
MLV11	WV	Webster	98.6	38.48244	-80.555732	0.00	54.66	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsili abrupta*) Rayed bean (*Villosa fabilis*) Running buffalo clover (*Trifolium soloniferum*) No critical habitat identified	Unknown use summer habitat	No	Location is entirely in MVP limits of disturbance.	8.55	Yes
MLV13	WV	Webster	111.1	38.357176	-80.631407	0.00	867.94	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	Location is entirely in MVP limits of disturbance.	6.38	Yes
MLV14	WV	Nicholas	120.2	38.25648	-80.687327	0.00	79.62	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*) Candy darter (*Etheostoma osburni*) Fanshell (*Cyprogenia stegaria*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsili abrupta*) Sheepnose mussle (*Plethobasus cyphus*) Snuffbox mussle (*Epiolblasma tiquerta*) Spectacle case mussel (*Cumberlandis monodonta*) Tubercled blossom (*Epioblasma torulosa torulosa*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use spring staging/fall swarming	No	Location is entirely in MVP limits of disturbance.	3.00	Yes
MLV18	WV	Greenbrier	144.2	37.980868	-80.75478	0.00	85.21	20.00	Northern long-eared bat (*Myotis septentrionalis*) Indiana bat (*Myotis sodalis*) Running buffalo clover (*Trifolium soloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists for any of these species. Area is graveled parking/pulloff.	20.41	Yes
MLV20	WV	Summers	170	37.693067	-80.733134	0.00	193.61	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray Bat (*Myotis grisescens*) Virginia Big-Eared Bat (*Plecotus townsendii virginianus*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat. Virginia spiraea is only found at stream crossings.	6.74	Yes

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	IPAC Results	Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2020 Desktop Survey)	Nearest Known or Presumed Occupied Portal (miles)	Tree Felling Complete
MLV21	WV	Summers	171.9	37.674585	-80.731009	0.00	68.69	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray Bat (*Myotis grisescens*) Virginia Big-Eared Bat (*Plecotus townsendii virginianus*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat. Virginia spiraea is only found at stream crossings.	5.78	Yes
MLV22	WV	Summers	186.1	37.516786	-80.701991	0.00	128.64	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray Bat (*Myotis grisescens*) Virginia Big-Eared Bat (*Plecotus townsendii virginianus*) No critical habitat identified	Known use spring staging/fall swarming	No	N/A	2.39	Yes
MLV23	VA	Giles	199.5	37.3696	-80.687277	0.01	129.65	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Candy darter (*Esteonstoma osburni*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	0.72	No
MLV24	VA	Giles	201.6	37.353566	-80.664144	0.00	257.23	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Candy darter (*Esteonstoma osburni*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	3.12	Yes
MLV26	VA	Montgomery	222.7	37.2961	-80.367812	0.00	1636.77	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	3.25	Yes
MLV27	VA	Montgomery	234.8	37.239799	-80.199178	0.00	793.06	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	6.76	Yes
MLV29	VA	Franklin	249.7	37.123132	-80.074839	0.00	43.65	20.00	Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unknown use summer habitat	No	N/A	18.80	Yes
MLV30	VA	Franklin	258.2	37.089129	-79.961117	0.00	830.15	20.00	Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	22.98	Yes
MLV31	VA	Franklin	265.4	37.057683	-79.880452	0.00	121.77	20.00	Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unknown use summer habitat	No	N/A	28.07	Yes
MLV32	VA	Franklin	269.4	37.055145	-79.829261	0.00	358.65	20.00	Northern long-eared bat (*Myotis septrentionalis*) Roanoke logperch (*Percina rex*) No critical habitat identified	Unoccupied summer habitat	No	N/A	30.56	Yes
MLV33	VA	Franklin	283.5	36.965835	-79.620858	0.00	180.25	20.00	Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	43.68	Yes
MLV34	VA	Pittsylvania	296.2	36.888355	-79.43275	0.00	835.38	20.00	Northern long-eared bat (*Myotis septrentionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	55.38	Yes
CPGB-01A	WV	Wetzel	2.3	39.533939	-80.541225	0.00	23.43	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Known use summer habitat	No	N/A	53.91	Yes
CPGB-01B	WV	Wetzel	6.5	39.490037	-80.521823	0.03	413.00	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unoccupied summer habitat	No	N/A	50.84	No
CPGB-02	WV	Harrison	15.4	39.398873	-80.478224	0.00	431.31	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	44.56	Yes
CPGB-03	WV	Harrison	23	39.316743	-80.524681	0.03	174.54	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	38.88	No
CPGB-04	WV	Doddridge	34.8	39.201012	-80.552144	0.00	189.87	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unoccupied summer habitat	No	N/A	31.00	Yes
CPGB-05	WV	Lewis	45.8	39.07996	-80.582709	0.00	108.77	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	22.88	Yes
CPGB-06	WV	Lewis	55.1	38.970309	-80.592533	0.00	225.70	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	15.60	Yes
CPGB-07	WV	Lewis	62.2	38.892263	-80.556864	0.06	126.40	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septrentionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	9.90	No

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	IPAC Results	Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2020 Desktop Survey)	Nearest Known or Presumed Occupied Portal (miles)	Tree Felling Complete
CPGB-08	WV	Braxton	73.7	38.763489	-80.518536	0.00	132.75	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquerta*) No critical habitat identified	Unknown use summer habitat	No	N/A	0.77	Yes
CPGB-09	WV	Webster	84	38.647722	-80.489266	0.00	52.31	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium stoloniferum*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists. Species is dependent on frequent light disturbance. Area is a roadway and roadside.	3.59	Yes
CPGB-10	WV	Webster	93.1	38.548409	-80.54014	0.00	47.76	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Rayed bean (*Villosa fabalis*) Running buffalo clover (*Trifolium stoloniferum*) No critical habitat identified	Unoccupied summer habitat	No	Location is entirely in MVP limits of disturbance.	3.92	Yes
CPGB-11	WV	Webster	98.6	38.483085	-80.554984	0.00	24.75	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Rayed bean (*Villosa fabalis*) Running buffalo clover (*Trifolium stoloniferum*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists based on results of 2015 survey.	8.50	Yes
CPGB-12	WV	Webster	107	38.400719	-80.5977	0.00	49.23	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Diamond darter (*Crystallaria cincotta*) Clubshell (*Pleurobema clava*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Rayed bean (*Villosa fabalis*) Snuffbox mussel (*Epioblasma triquetra*) Running buffalo clover (*Trifolium stoloniferum*) No critical habitat identified	Unoccupied summer habitat	No	No potential habitat exists for any of the listed plant species. The area does not provide these species' habitat requirements.	10.08	Yes
CPGB-13	WV	Nicholas	122.4	38.232396	-80.709359	0.00	21.84	20	Indiana bat (*Myotis sodalis*) Northern Long-eared Bat (*Myotis septentrionalis*) Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use spring staging/fall swarming	No	No potential habitat. Virginia spiraea is only found at stream crossings.	3.02	Yes
CPGB-14	WV	Nicholas	128.2	38.163726	-80.733441	0.00	170.99	20	Indiana bat (*Myotis sodalis*) Northern Long-eared Bat (*Myotis septentrionalis*) Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat. Virginia spiraea is only found at stream crossings.	7.90	Yes
CPGB-15	WV	Greenbrier	138.3	38.051236	-80.740693	0.00	2053.91	20	Indiana bat (*Myotis sodalis*) Northern Long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium stoloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists based on results of 2015 survey.	15.50	Yes
CPGB-16	WV	Greenbrier	149.5	37.924026	-80.739282	0.00	14.82	20	Indiana bat (*Myotis sodalis*) Northern Long-eared bat (*Myotis septentrionalis*) Running buffalo clover (*Trifolium stoloniferum*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat exists based on results of 2015 survey.	21.48	Yes
CPGB-17	WV	Summers	159.5	37.80586	-80.745764	0.00	222.34	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unoccupied summer habitat	No	No potential habitat. Virginia spiraea is only found at stream crossings.	13.81	Yes
CPGB-18	WV	Summers	171.9	37.674621	-80.730922	0.00	33.36	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use summer habitat	No	No potential habitat. Virginia spiraea is only found at stream crossings.	5.78	Yes
CPGB-19	WV	Monroe	182.3	37.560588	-80.710384	0.00	155.01	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) No critical habitat identified	Known use spring staging/fall swarming	No	N/A	1.48	Yes
CPGB-20	WV	Monroe	192	37.451081	-80.667397	0.00	103.92	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) No critical habitat identified	Unoccupied summer habitat	No	N/A	5.07	Yes

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	IPAC Results	Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2020 Desktop Survey)	Nearest Known or Presumed Occupied Portal (miles)	Tree Felling Complete
CPGB-21	VA	Giles	200.6	37.358634	-80.681933	0.03	94.26	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Candy darter (*Etheostoma osburni*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	0.38	No
CPGB-22	VA	Giles	211.2	37.311547	-80.515259	0.00	152.20	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	NLEB known use spring staging/fall swarming habitat	No	N/A	0.08	Yes
CPGB-23	VA	Montgomery	227.2	37.268971	-80.313626	0.00	939.95	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke logperch (*Percina rex*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	0.28	Yes
CPGB-24	VA	Montgomery	235.5	37.233355	-80.199093	0.00	579.08	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke logperch (*Percina rex*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	1.79	Yes
CPGB-25	VA	Roanoke	245.9	37.128955	-80.129824	0.00	123.86	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unknown use summer habitat	No	N/A	6.88	Yes
CPGB-26	VA	Franklin	255.5	37.088401	-80.003658	0.00	42.52	20	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	12.88	Yes
CPGB-27	VA	Franklin	264.2	37.047279	-79.894335	0.00	22.35	20	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	19.23	Yes
CPGB-28	VA	Franklin	274.9	37.0105	-79.755393	0.00	83.83	20	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	26.89	Yes
CPGB-29	VA	Pittsylvania	286.1	36.954857	-79.582809	0.00	50.84	20	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	37.05	Yes
CPGB-30	VA	Pittsylvania	296.2	36.888418	-79.432585	0.00	18.57	20	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unoccupied summer habitat	No	N/A	46.56	Yes
Bleier IC	VA	Montgomery	236.8	37.22	-80.20	1.60	2961.24	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	2.00	No
DEWV IC	WV	Nicholas	113.8	38.34	-80.66	0.68	131.93	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Virginia big-eared bat (*Corynorhinus townsendii virginianus*) Candy darter (*Etheostoma osburni*) Fanshell (*Cyprogenia stegaria*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsili abrupta*) sheepnose mussel (*Plethobasus cyphyus*) Snuffbox mussel (*Epioblasma triquerta*) Spectaclecase (*Cumberlandia monodonta*) Tubercled blossom (*Epioblasma torulosa*) Virginia spiraea (*Spiraea virginiana*) No critical habitat identified	Unknown use spring staging/fall swarming	No	No potential habitat. Virginia spiraea is only found at stream crossings.	4.58	No
RGC Franklin	VA	Franklin	234.9	37.24	-80.20	1.30	564.05	20.00	Northern long-eared bat (*Myotis septentrionalis*) No critical habitat identified	Unknown use spring staging/fall swarming	No	N/A	16.96	No
RGC Lafayette	VA	Montgomery	261.4	37.07	-79.92	0.17	75.01	20.00	Northern long-eared bat (*Myotis septentrionalis*) Roanoke logperch (*Percina rex*) No critical habitat identified	Unoccupied summer habitat	No	N/A	1.45	No

Appendix H. List of Acronyms used in Opinion.

Acronym	Description
AL	Alabama
AMM	avoidance and minimization measure
AMRU	Appalachian Mountain Recovery Unit
ANSI	American National Standards Institute
AR	access road
ATWS	additional temporary workspace
BA	biological assessment
BiOp	biological opinion
BLM	Bureau of Land Management
BMPs	best management practices
CD	candy darter
CFR	Code of Federal Regulations
CFS	compost filter sock
CI	Confidence interval
CnOp	conference opinion
Corps	U.S. Army Corps of Engineers
CPUE	catch-per-unit-effort
dB	Decibel
dBA	A-weighted decibel
DC	District of Columbia
DOI	Department of the Interior
DO	dissolved oxygen
E&S	erosion and sediment
eDNA	Environmental DNA
EI	environmental inspector
EO	element occurrence
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FR	Federal Register
ft	foot
GA	Georgia
GIS	geographic information system
HDD	horizontal directional drill
Ibat	Indiana bat
IN	Indiana
IPaC	Information for Planning and Consultation tool

Acronym	Description
IR	inadvertent return
ITS	incidental take statement
km	kilometer
KY	Kentucky
LAA	likely to adversely affect
Leq	ambient equivalent sound level
LOD	limits-of-disturbance
m	meter
M&R	meter and regulation
mg/L	milligrams/liter
MLV	mainline valve
MP	milepost
MS	Mississippi
MTBM	microtunneling boring machine
MVP	Mountain Valley Project
NC	North Carolina
NE	no effect
NHD	National Hydrography Dataset
NJF	Nonjurisdictional facilities
NLAA	not likely to adversely affect
NLCD	National Land Cover Database
NLEB	northern long-eared bat
NPS	National Park Service
NTU	nephelometric turbidity unit
NY	New York
O&M	operation and maintenance
OHWM	ordinary high water mark
OH	Ohio
Opinion	biological opinion and conference opinion
PA	Pennsylvania
PBF	physical or biological features
PCB	polychlorinated biphenyl
psi	pounds per-square-inch
RH	relative humidity
RLP	Roanoke logperch
RND	reproduction, numbers, and distribution
ROW	right-of-way
RU	recovery unit
RUSLE	Revised Universal Soil Loss Equation

Acronym	Description
RUSLE2	Revised Universal Soil Loss Equation, Version 2
SBA	Supplement to the Biological Assessment
SE	standard error
Service	U.S. Fish and Wildlife Service
SEV	severity-of-effect
skm	stream kilometers
smi	stream miles
SSA	species status assessment
SSC	suspended sediment concentration
SWP	small whorled pogonia
TMDL	total maximum daily load
TOYR	time-of-year restriction
TN	Tennessee
TSS	total suspended sediments
UNT	unnamed tributary
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VA	Virginia
VAFO	Virginia Field Office
VASP	Virginia spiraea
VDACS	Virginia Department of Agricultural and Consumer Services
VDCR-DNH	Virginia Department of Conservation and Recreation - Division of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
WA	Washington
WAFWO	Washington Fish and Wildlife Office
WNS	white-nose syndrome
WV	West Virginia
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVFO	West Virginia Field Office
YOY	young-of-the-year

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