June 14, 2017

U.S. Forest Service
ATTN: Joby P. Timm
5162 Valleypointe Parkway
Roanoke, VA 24019

Re: Forest Service letter dated April 24, 2017
Comments on the Updated Biological Evaluation
OEP/DG2E/Gas3
Mountain Valley Pipeline,
LLC
Docket No. CP16-10-000

Dear Mr. Timm:

Please see the following response by Mountain Valley Pipeline, LLC (Mountain Valley) in regards to the United States Forest Service's (USFS) April 24, 2017 Comments on the Updated Biological Evaluation.

Comment	Section	Page	Comment
1	5.1	25	The BE is being used to address only Regional Forester's Sensitive species. Federally listed species will be addressed in the BA. To eliminate/reduce confusion remove references to federally listed species except for a statement that these species will be addressed in the BA.

Mountain Valley Response:

References to federally listed species have been removed from the Field Survey Results and Effects Determinations section (Section 5.0) of the document. Section 5.0 includes the following statement:

"*Survey results and effects determinations for federally listed species are not included in this document (5 species). Those determinations, as well as analyses of direct, indirect, and cumulative effects, are detailed in the BA.*"

Federally listed species are briefly mentioned in Section 4.0, which describes the process of evaluating the species. These references are included to provide a full description of the process for assigning the appropriate Occurrence Analysis Results (OAR) Codes to the species listed on the table provided by the U.S. Forest Service (Appendix B of the Biological Evaluation).

Comment	Section	Page	Comment
2	5.2.7	29	BE statement: Sweet pinesap is a vascular plant found in mesic to dry upland forests, typically under oaks, pines, or shrubs (Kartesz 1994). In Virginia, it is known from Montgomery County (Kartesz 1994). Comment: This species is found in a number of VA counties. The BE implies it is only found in Montgomery County.

Mountain Valley Response:

This has been clarified in the Biological Evaluation. Section 5.7 (formerly 5.2.7) now states:

"*In Virginia, it is known from multiple counties, including Montgomery (Kartesz 1994).*"

Comment	Section	Page	Comment
3	5.2.8	30	BE statement: 5.2.8 Yellow Lance (Elliptio lanceolata) Comment: The USFWS is proposing the federal listing of yellow lance as threatened under the Endangered Species Act as of 4/5/2017. Include this information in the BE and include the yellow lance as a Proposed Threatened species in the BA.

Mountain Valley Response:

This has been added to the Biological Evaluation. Section 5.8 (formerly 5.2.8) now states:

"*The yellow lance was proposed for federal listing under the ESA on April 5, 2017.*"

As part of the Supplemental Information provided in an appendix to the Biological Assessment (Appendix D), Mountain Valley acknowledged that the yellow lance is proposed for federal listing under ESA. However, the species will be addressed through 7(a)(4) conferencing rather than Section 7 consultation since the species is not listed yet.

Comment	Section	Page	Comment
4	6.3	37	BE statement: "during critical autecological time periods" Comment: autecology is incorrectly used. It would be better to write "during critical phases of the life cycle".

Mountain Valley Response:

This has been corrected in the Biological Evaluation. Section 6.3 now states:

"*Adhering to TOYR guidelines will help avoid elevated turbidity and sedimentation in the streams during critical phases of the life cycle (e.g., spawning, egg development, larval development) and help facilitate survival and proliferation of populations.*"

Comment	Section	Page	Comment
5	Appendix B	-	BE statement: Hypotrachyna virginica Hydrothyria lichen Augusta, Amherst, Alleghany, Bedford, Botetourt, Giles, Highland, Madison, Nelson, Rockbridge, Shenandoah, Smyth, Wyth Cos VA; Pendleton Co WV Aquatic – in streams/springs/cascade. Grows at or below water level in cool, clear, partially-shaded streams. S G4 S1 Comment: Delete the second reference to Hypotrachyna virginica. The species should be Hydrothyria venosa, the common name should be waterfan.

Mountain Valley Response:

This has been corrected in Appendix B of the Biological Evaluation.

1	X	X	*Hydrothyria venosa*	waterfan	Augusta, Amherst, Alleghany, Bedford, Botetourt, Giles, Highland, Madison, Nelson, Rockbridge, Shenandoah, Smyth, Wyth Cos VA; Pendleton Co WV	Aquatic – in streams/springs/cascade. Grows at or below water level in cool, clear, partially-shaded streams.	S	G4	S1	-

Comment	Page	Section	Comment of Additional Analysis
6	5.2.8	30	BE statement: "According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (ESI 2017), increased sedimentation rates in excess of 10 percent are not expected to occur outside the negative survey extent for the Project." Comment: The commonly used threshold of 10% may be a valid assumption for reaches meeting water quality standards or do not contain sensitive aquatic biota. However, in downstream areas where TES aquatic species are present, it is important to further evaluate cumulative impacts less than 10 percent increase in sediment load, particularly if construction may coincide with low flow conditions. For example, Stony Creek with the presence of Candy Darter and Craig Creek with several TES species. Sensitive species must receive special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. If there are impacts to sensitive species the FS must analyze the significance of adverse effects on the populations, its habitat, and on the viability of the species as a whole. (FSM 2672.1) The agency is required to document in the BE activities in sufficient detail to determine how an action may affect sensitive species. Thus, project actions taken on private property that may affect these species must be analyzed to determine any and all direct, indirect, and cumulative impacts of the propose action. See additional FS comments on the Hydrological Analysis of Sedimentation.

Mountain Valley Response:

As stated in the report for the Hydrologic Analysis of Sedimentation, no nationally accepted sedimentation standard or exceedance threshold for sediment is available. The level of 10 percent was chosen because it was a commonly used impact threshold for sediment metrics in a review conducted by the U.S. Environmental Protection Agency (USEPA 2003). From a sensitive-species perspective, a 10 percent increase over background would likely be within the normal variance experienced in a stream system. For example, as part of the Final Environmental Impact Statement (FEIS) for the Revised Land and Resource Management Plan (RLRMP) for the Jefferson National Forest, the USFS evaluated if sediment from the implementation of the RLRMP would produce a detectable change in sediment loads. Using data from the Clinch River at Speers Ferry over 62 years, it was determined that a change of annual sediment yield of 52 percent represents the natural variation that would occur within one standard deviation of the long-term mean (i.e., the coefficient of variation). This coefficient of variation is on the lower end of what is expected in streams and rivers. According to NCASI (1999), large variation is expected in sediment yields with coefficients of variation ranging between 50 and 100 percent. In the FEIS for the RLRMP, the USFS determined that increases from the RLRMP in the range of 5 to 14 percent may not be detectable due to the amount of data required to detect such a change. For example, detection of a 14-percent increase in annual sediment yield would require 53 years of sampling data; a detection of a 5 percent increase would be even more difficult, requiring 415 years of sampling data. Based on the approach provided in NCASI

(1999) and the lower range of the coefficient of variation expected in streams (i.e., 50 %), it may take nearly 96 years to detect a change of 10 percent:

$$96 \approx \left(\frac{1.96}{10} \times 50\right)^2$$

where 10 is the number of years and 50 is the coefficient of variation. Therefore, there is strong support for the conclusion that increases of less than 10 percent are likely undetectable or not measureable.
In its guidance for implementing Section 7 of the Endangered Species Act (USFWS and NMFS 1998), the U.S. Fish and Wildlife Service indicated that insignificant effects relate to the size or severity of the impact and are effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. This was recognized as part of the Biological Opinion for the Jewell Ridge Gas Pipeline. As part of the Terms and Conditions in the Biological Opinion, turbidity was monitored in Indian Creek prior to, during, and after construction of the pipeline. In the monitoring report published by the U.S. Geological Survey (Moyer and Hyer 2009), a 15-percent increase in turbidity above natural conditions was deemed an appropriate threshold for detecting changes that may require remediation or a reconsideration of the erosion and sediment controls to limit the impact on federally listed mussels. Over the 24-month monitoring period in Indian Creek, significant increases in turbidity were only observed during the construction phase; however, the magnitude of the increase was relatively small and much less than the 15-percent threshold determined to be acceptable (Moyer and Hyer 2009).

References:

NCASI. 1999. Scale considerations and the detectability of sedimentary cumulative watershed effects. National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI). Technical Bulletin No. 776, Research Triangle Park, North Carolina. 326 pp.

Moyer, D. L. and K. E. Hyer. 2009. Continuous turbidity monitoring in the Indian Creek Watershed, Tazewell County, Virginia, 2006–08. Prepared in cooperation with East Tennessee Natural Gas and the U.S. Department of Interior, Fish and Wildlife Service. U.S. Geological Survey, Scientific Investigations Report 2009–5085, Reston, Virginia.

USFS. 2004. Final Environmental Impact Statement for the Revised Land and Resource Management Plan: Jefferson National Forest. U.S. Department of Agriculture, Forest Service Southern Region, Management Bulletin R8-MB 115B, Atlanta, Georgia. 588 pp.

USFWS and NMFS. 1998. Endangered species consultation handbook, procedures for conducting section 7 consultations and conferences. U.S. Department of Interior, Fish and Wildlife Service and National Marine Fisheries Service. 371 pp.

Comment	Page	Section	Comment of Additional Analysis
7	5.2.9	31	BE statements: "In Virginia, they are commonly found in Big Stony Creek (also referred to as Stony Creek), perhaps solely above the gypsum plant at Kimbalton (Leftwich et al. 1996)." "Extensive surveys in 1995 in Stony Creek demonstrated that the species was distributed throughout the upper portion (i.e., upstream of the gypsum plant of Stony Creek)(Leftwich et al. 1996). The proposed Project crossing occurs downstream of the gypsum plant at Kimbalton and presumably downstream of the candy darter population. Comment: More current VDGIF data shows that the candy darter is found in Big Stony Creek at and downstream from the proposed pipeline crossing.

Mountain Valley Response:

This has been clarified in the Biological Evaluation. Section 5.10 (formerly 5.2.9) now states:

"*Extensive surveys in 1995 in Stony Creek demonstrated that the species was distributed throughout the upper portion (i.e., upstream of the gypsum plant of Stony Creek) (Leftwich et al. 1996), and more recent information available from the VDGIF demonstrates that the species also occurs in the lower portion.*"

Comment	Page	Section	Comment of Additional Analysis
8	5.2.9	31	BE statement: "According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (ESI 2017), sediment loads originating from the Project are expected to be less than 10 percent above baseline within this portion of Stony Creek. The Project crossing of Stony Creek is downstream of Kimbalton and therefore downstream of suitable habitats that occur on JNF. Due to avoidance of suitable habitats, implementation of erosion and sediment control measures during construction, and adherence to time-of-year restrictions (TOYR), the Project is not likely to cause a trend toward federal listing or a loss of viability for this species. " Comment: The commonly used threshold of 10% may be a valid assumption for reaches meeting water quality standards or do not contain sensitive aquatic biota. However, in downstream areas where TES aquatic species are present, it is important to further evaluate cumulative impacts less than 10 percent increase in sediment load, particularly if construction may coincide with low flow conditions. For example, Stony Creek with the presence of Candy Darter and Craig Creek with several TES species. Sensitive species must receive special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. If there are impacts to sensitive species the FS must analyze the significance of adverse effects on the populations, its habitat, and on the viability of the species as a whole. (FSM 2672.1) The agency is required to document in the BE activities in sufficient detail to determine how an action may affect sensitive species. Thus, project actions taken on private property that may affect these species must be analyzed to determine any and all direct, indirect, and cumulative impacts of the propose action. See additional FS comments on the Hydrological Analysis of Sedimentation. We agree that there will be no loss of viability in the JNF at those locations since it is private land, but it cannot be verified that the impact to downstream individuals will not be large enough to "not cause a trend toward federal listing," since Table 4 in the Hydrological analysis shows a 63% load of sediment above baseline for Kimbalton Creek at the confluence with Stony creek that increases to 69% at year five. Candy darters are known from Stony Creek at that confluence. Table 4 also shows a sediment increase in Stony Creek of almost 7% at the confluence of the New River; it can be assumed that the impact of sediment will be greater closer to the pipeline construction.

Mountain Valley Response:

The justification for the use of the 10 percent threshold is provided in the response to comment 6.

According to the Hydrologic Analysis of Sedimentation performed for the Project, increases above 10 percent are expected for Kimballton Creek. Estimates have been revised using the pre-existing Pocahontas Road within the baseline estimates, and sediment increases at year 5 are now estimated at 44 percent over baseline (see Table 5 of the revised report for the Hydrologic Analysis of Sedimentation). These increases are partially due to the low baseline load that is expected to currently occur within the stream system. The

Kimballton catchment is 96 percent forested, and thus, baseline sediment loads are relatively low. Mountain Valley proposes to utilize 46.74 acres within the catchment (4%) for construction (i.e., access road and ROW). It is expected that sediment loads will be higher than baseline during construction and during operations. Operational impacts are largely attributed to the use of the pre-existing Pocahontas Road, which will be improved for use during construction and operations. The current width of the road is approximately 10 feet; however, during construction the limits of disturbance may span up to 50 feet in some locations. The permanent easement for operations is 25 feet. Candy darters (*Etheostoma osburni*) are not known from Kimballton Creek, and therefore the species is unlikely to be affected within the waterbody; however, candy darters have been captured immediately downstream in Stony Creek.

Percent increases in sediment load within Stony Creek are less than those expected for Kimballton Creek. Above the confluence of Stony Creek and the next downstream tributary from Kimballton Creek (Unnamed Tributary to Stony Creek [ReachCode=05050002003299]), the increase in sediment load is 4 percent above baseline; however, Project activities are also proposed downstream of this confluence. Above the confluence of Stony Creek and the New River, maximum increases in sediment load represent a 7-percent increase over baseline. However, this is not sustained beyond the construction phase of the Project. Sediment loads after construction only represent a 1-percent increase in sediment load over baseline. These increases in sediment load are within the normal variation expected within streams (NCASI 1999) and therefore unlikely to represent a significant impact to candy darter. For example, NCASI (1999) demonstrated that large variation is expected in sediment yields in streams with coefficients of variation ranging between 50 and 100 percent. Given the lower end of this range (i.e., 50 %), increases in sediment loads constituting a 4 and 7 percent increase in sediment yield/load would likely be undetectable or unmeasurable because of the high variation expected (see response to comment 6).

References:

NCASI. 1999. Scale considerations and the detectability of sedimentary cumulative watershed effects. National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI). Technical Bulletin No. 776, Research Triangle Park, North Carolina. 326 pp.

Comment	Page	Section	Comment of Additional Analysis
9	5.2.11	32	BE statement: "The implementation of erosion and sediment control measures is expected to reduce the sedimentation yields in the Trout Creek-Craig Creek subwatershed; however, elevated sedimentation rates are predicted to occur for approximately 0.47 kilometer (0.29 mi) within Craig Creek and 3.09 kilometers (1.92 mi) within unnamed tributaries (Table 4)." Comment: Section 2.3.5 in the hydrological analysis clearly demonstrates the wide variety of effectiveness, even citing as low as 10% (EPA 1993). Yet the assumption chosen for the practice factor is very high. p=0.21 such that containment is 79%. Since many of the literature citations are laboratory based and proper installation is widely understood in the industry to be a limiting factor for effectiveness in the field, I believe this is a vast overestimate of containment. It is more appropriate to err on the side of the worst case scenario, rather than the best case (equal to or less than 48% containment). As such, for this section (and similar sections) in the BE and Table 4, erosion containment is likely over-estimated and sedimentation underestimated.

Mountain Valley Response:

While it is true that many of the studies cited within Section 2.3.5 in the Hydrological Analysis of Sedimentation come from laboratory investigations (e.g., Farias et al. [2006], Faucette et al. [2008], Faucette et al. [2009]), these studies were used in tandem with information from field-scale tests to provide a range of efficiencies that are reasonably attainable. The chosen practice factor supporting 79%

containment is not the best-case scenario, but rather the mean reported value for both silt fences and compost filter socks, two predominant controls proposed to be used on the Project ROW. The 79% containment is directly related to a study conducted by Dubinsky (2014) that predicts containment performance using a field-scale test. Field-scale tests represent a compromise between laboratory and field tests, allowing for the ability to incorporate conditions relevant to typical installations while operating in a controlled environment that allows for standardized testing procedures. Field-scale testing has become common practice for the assessment of best management practices (BMPs) or sediment retention devices because they incorporate full-scale, "as installed" conditions (TRI/Environmental 2012). The 79% from Dubinsky (2014) is a mean value, which represents a reasonable expectation of overall performance efficiency.

In addition, these field-scale tests look exclusively at the performance of the perimeter control in isolation without consideration of other erosion controls and sediment detention devices. Mountain Valley intends to use a variety of erosion and sedimentation control devices in addition to sediment barriers, including, but not limited to, trench breakers, permanent slope breakers, temporary seeding, mulching, soil stabilization mats and blankets, rock check dams, temporary ROW diversions, and/or sediment basins and traps as depicted on the erosion and sedimentation control drawings included in the Plan of Development. Denuded areas remaining idle for more than 14 days will be stabilized with temporary seeding. In addition, stabilization through temporary seeding will occur within seven days for areas within a Clean Water Act 303(d)-impaired watershed and in Craig Creek Watershed areas. In addition, temporary spoil piles will be mulched/seeded at the end of each day that they are generated within the Craig Creek Watershed. Although mulching and seeding have been incorporated into the estimate of the cover management factor within the Revised Universal Soil Loss Equation applied for the proposed pipeline, these other erosion and sedimentation control measures (other than sediment perimeter controls [e.g., silt fencing]) have not been incorporated directly into the model. The use of these devices will further limit soil erosion and slow and/or pond runoff to encourage sedimentation within the limits of disturbance rather than at the sediment perimeter control. In combination, these measures will reasonably attain a sediment containment of 79% or higher.

Mountain Valley recognizes and understands the variability in sediment control performance as a function of proper installation and maintenance. For that reason, Mountain Valley is committed to proper installation, maintenance, and frequent inspections to reduce erosion and sedimentation control failures or inadequacies. Mountain Valley, at the request of the Virginia Department of Environmental Quality (VADEQ), has developed Project-Specific Annual Standards and Specifications that are currently being reviewed by the VADEQ. The Annual Standards and Specifications outline the erosion and sedimentation control measures, stormwater management methods, and site restoration measures that are proposed for use on the Project and explain in specific detail the installation and maintenance requirements of all proposed BMPs. The Annual Standards and Specifications also outline the inspection staffing requirements for Project activities in Virginia including, at a minimum, one Lead Environmental Inspector (LEI) and at least one Environmental Inspector (EI) per construction spread. In addition to the Mountain Valley inspectors, the FERC will employ a third-party inspector and the VADEQ will also have inspectors. VADEQ oversight of the Project will include pre-scheduled and random site inspections for the Project. Random site inspections in response to complaints may be conducted without prior notification to Mountain Valley, its contractors, and/or inspection staff. Inspections are intended to ensure compliance with the federal Clean Water Act, Virginia Stormwater Management Act, the Virginia Erosion and Sedimentation Control Law, and regulations adopted under these statutes. The VADEQ may take enforcement actions if areas of non-compliance are identified during the routine inspection or in response to a complaint report.

The LEI and EI will be experienced in erosion and sedimentation control and stormwater management BMP installation, operation and maintenance requirements, and the FERC's Upland Erosion Control, Revegetation and Maintenance Plan (Plan) and Wetland and Waterbody Construction and Mitigation Procedures (Procedures). Mountain Valley will also conduct Project-specific training, focusing on sensitive resources, state and federal regulations, and Project permit conditions. Mountain Valley will also require at least one EI per construction spread to obtain/maintain a valid Responsible Land Disturber Certification and Erosion and Sediment Control Inspector certification from VADEQ throughout the

Project construction and restoration activities, which will ensure proper installation and maintenance of BMPs.

BMP inspections will occur:

- immediately following initial installation of erosion and sediment controls;
- on a daily basis in areas of active construction or equipment operation;
- on a weekly basis in areas with no construction or equipment operation;
- to ensure revegetation/restoration requirements are being met;
- within 24 hours of a rainfall event producing 0.25 inch of rain or greater over 24 hours; and
- until Project completion.

For 303(d)-impaired watersheds, Erosion and Sediment Control inspections will be conducted at a frequency of (i) at least once every four business days or (ii) at least once every five business days and no later than 48 hours following a measurable storm event. In the event that a measurable storm event occurs when there are more than 48 hours between business days, the inspection shall be conducted on the next business day.

Mountain Valley explicitly requires that all Company and Contractor personnel comply with environmental permits authorizing the construction, operation, and restoration of the Project and requires all Company and Contractor personnel to immediately notify the Mountain Valley Environmental Coordinator and the EI when there is the potential for noncompliance, including any visible sedimentation outside of the limits of disturbance, so that the issue can be resolved in a timely and appropriate manner. It is also important to note that in sensitive areas of the Jefferson National Forest, such as the Craig Creek drainage, Mountain Valley has committed to construction during times of the year with minimal rainfall (i.e., low-flow time periods). Within the Craig Creek drainage, Mountain Valley has committed to an expedited time frame that reduces the chance (through reduced exposure) of a large rainfall event occurring during active construction. These additional conservation measures will help ensure that erosion is minimized, thus limiting sedimentation in adjacent waterbodies.

Based on these commitments and requirements, it is appropriate to use the 79% containment standard. Moreover, as noted above, the suggestion to use 48% containment as a worst-case scenario is inconsistent with case law and regulations for implementing the impact analysis under NEPA, which should focus on reasonably foreseeable impacts. Because the 79% containment is supportable and represents reasonably foreseeable impacts, it is appropriate for evaluating potential impacts.

References:

Dubinsky, G. S. 2014. Performance evaluation of two silt fence geosynthetic fabrics during and after rainfall event. Master's thesis, University of Central Florida, Orlando, Florida. 157 pp.

Farias, R. J. C., E. M. Palmeira, and J. C. Carvalho. 2006. Performance of geotextile silt fences in large flume tests. Geosynthetics International 13:133-144.

Faucette, L. B., J. Governo, R. Tyler, G. Gigley, C. F. Jordan, and B. G. Lockaby. 2009. Performance of compost filter socks and conventional sediment control barriers used for perimeter control on construction sites. Journal of Soil and Water Conservation 64:81-88.

Faucette, L. B., K. A. Sefton, A. M. Sadeghi, and R. A. Rowland. 2008. Sediment and phosphorus removal from simulated storm runoff with compost filter socks and silt fence. Journal of Soil and Water Conservation 63:257-264.

TRI/Environmental, Inc. 2012. BMP testing for erosion and sediment control. Final report to the Georgia Soil and Water Conservation Commission. TRI/ Environmental, Inc, Austin, Texas.

Comment	Section	Page	Comment
10	5.2.13	34	The green floater and Atlantic pigtoe are currently under review by the FWS for listing under the Endangered Species Act. Include this information in the BE.

Mountain Valley Response:

This has been added to the Biological Evaluation. Section 5.9 now states:

"*The Atlantic pigtoe is currently under review for federal listing under the ESA.*"

Section 5.14 now states:

"*The green floater is currently under review for federal listing under the ESA.*"

Comment	Section	Page	Comment
11	6.3	37	Include TOYR for the candy darter.

Mountain Valley Response:

This has been added to the Biological Evaluation. Section 6.3 now states:

"*The TOYR for roughhead shiner is March 15 to June 30, August 15 to July 31 for candy darter, and March 15 to May 31 for orangefin madtom within its native range (Roanoke River drainage).*"

Comment	Section	Page	Comment
12	5.2.2	27	The potential impacts of blasting are not discussed for this species. If blasting is used in exposed rock and talus slope areas in the proposed pipeline route, eastern small footed bats have the highest likelihood of roosting there during daytime hours. Small-footed bats were captured in the vicinity. The direct and concussive impacts of blasting are known to effect species within a certain range of the blast area. These impacts need to be analyzed and disclosed in this section.

Mountain Valley Response:

This has been updated in the Biological Evaluation. Section 5.2 (formerly 5.2.2) now states:

"*Blasting, if required, may temporarily disturb eastern small-footed bats in the Project area; however, no direct impacts are expected. Indirect impacts, such as sound, are not expected either as bats are not particularly sensitive to sound during hibernation. Bats echolocate and communicate using ultrasonic frequencies that are well above the human hearing range and that are much higher than the low-frequency dominated sounds generated by blasting. In addition, all blasting will occur in daytime hours when the bats are least active. Blasting may potentially disturb bats breeding, feeding, or sheltering in the area; however, they could return once the blasting ceases.*"

Jefferson National Forest likely provides ample potential summer roosting habitat for the eastern small-footed bat; however, any potential habitat within the Project area is highly marginal to non-existent.

Known potential habitat within the vicinity of the Project area (such as a limestone quarry to the south) is much more likely to provide suitable summer roosting habitat for the species. This is addressed in the Biological Evaluation:

"*Potential summer habitat for the eastern small-footed bat appeared limited along the proposed alignment and Pocahontas Road on JNF during field surveys (mist netting and portal searches). Four eastern small-footed bats (three adult males and one pregnant female) were captured during survey efforts along the existing Pocahontas Road. The closest captured individual was approximately 0.9 kilometer (0.60 mi) from the western boundary of the construction ROW. No suitable cave openings or portals were observed along the proposed alignment or Pocahontas Road on JNF*."

The Biological Evaluation also addresses potential effects to the species from construction:

"*This species may be temporarily affected by construction of the proposed alignment and modifications to Pocahontas Road if it is using the Project impact area for summer roosting; however, this habitat is considered marginal. It is likely the bats are roosting outside of this area (a limestone quarry was observed south of the Project area) and only using Pocahontas Road as a travel and/or foraging corridor. This species may benefit from additional clearings associated with Project development and operation as this will increase the amount of foraging habitat and may also expose currently marginal rocky outcrops thus increasing their suitability for summer roosting. This is especially important for maternity colonies as roosts with greater solar exposure decrease required energy expenditures and provide more thermal stability for young thus increasing their probability of survival.*"

With respect to potential blasting, blasting for grade or trench excavation will be considered only after all other reasonable means of excavation have been evaluated and determined to be unlikely to achieve the required results. The amount of blasting will be minimized to the extent possible, but may be required in areas of shallow bedrock where unrippable subsurface rock is encountered. The proposed pipeline will be installed to allow a minimum cover of 36 inches in areas of shallow bedrock. Therefore, the proposed Project area was evaluated for areas where bedrock might be encountered above a depth of 80 inches (attached shallow bedrock table). However, specific locations requiring blasting will be determined in the field, based on the limitations of the mechanical excavation equipment. Potential short-term impacts would be minimized by utilizing blasting mats or padding, restricted charge sizes and/or charge delays, as necessary

Surface excavation blasting uses the release of energy from a confined explosive to break up rocks to facilitate removal. Most of the energy released goes towards rock breakage and movement, but a small portion passes outside the intended work zone in the form of ground or air vibrations. Air vibrations are pressure waves generated by the blast, referred to as "airblast" or "air overpressure." Higher frequency pressure waves may be heard by people or wildlife as sound, while lower frequency pressure waves may be felt rather than heard, similar to a gust of wind. Different species have differing sensitivities to sound, so that frequencies that may be audible to some species are not detected as well by other species. In general, surface detonations involving unconfined or poorly confined blasts will cause louder, higher frequency noise, while well confined blasts such as those used to excavate rock generate lower frequency effects with airblast energy predominantly at very low frequencies (often less than 10 Hz, below the range of most human hearing). For this reason, and because noise from blasting is inherently short-term, there are no audible noise limits applicable to blasting for this Project. The Mountain Valley Pipeline Project General Blasting Plan describes the procedures and safety measures the contractor will be required to adhere to while implementing blasting activities. The Blasting Plan specifies compliance with ground vibration limits recommended in the U.S. Bureau of Mines Report of Investigations 8507 (Siskind et al. 1980).

Bats echolocate and communicate using ultrasonic frequencies that are well above the human hearing range and that are much higher than the low-frequency dominated sounds generated by blasting. In addition, all blasting will occur in daytime hours when the bats are least active. Blasting may potentially disturb bats breeding, feeding, or sheltering in the area. Bats could return to the area once the blasting ceases.

Bats are not particularly sensitive to sound during hibernation. Big brown bats did not respond during hibernation when presented sound at 30-15,000 Hz and 95 dB (Twente and Twente, 1987). Hibernating bats may be "deaf" if the auditory nervous system shuts down at lower temperatures used for hibernation. Harrison (1965) found no neural activity in auditory nerves of little brown bats hibernating below 54°F (12°C).

Several field studies have assessed the effect of noise on hibernating bats. In Missouri, Myers (1975) studied the effect of blasting on Indiana bats and three other bats species. The acoustic frequency of blasts ranged between 1 and 40 Hz; seismic vibrations of blasting are between 3 to 1000 Hz. With blasts as close as 394 feet (120 m) to hibernating Indiana bats and 98 feet (30 m) to eastern pipistrelle bats, he found no evidence of disturbance.

In New York, Besha (1984) identified increasing populations of hibernating Indiana bats near Jamesville with a quarrying operation 1,000 feet (304.8 m) from the cave, with blasts involving up to 200 pounds (90.7 kg) of explosive. He noted a similar situation at Howes Cave and at Glen Park. Blasting at Glen Park occurred within 400 feet (121.9 m) of the bats.

At Fort Leonard Wood, Missouri, training mission activities near hibernacula of endangered Indiana and gray bats included small arms fire, construction engineers' training (clamshells, bulldozers, graders, earthmovers, CEVS, and scrappers), demolition of explosive ordnances, heavy ordnance demolition, and F16 and A10 strafing and inert bomb training. Indiana bats and surrogate bat species were brought into the laboratory and presented sound and seismic stimuli during hibernation. Stimuli duration and intensity mimicked those under field conditions, up to 25 percent of actual distances to hibernacula. Sound stimuli was presented for 3 to 10 minutes at 93 to 126 decibels, at frequencies like those at each of the training ranges (Range 1: 20 - 20,000 Hz with a dominant frequency of 1,000 Hz; Range 4: 20-20,000 Hz with dominant frequency bands at 50, 63, 80, and 100 Hz; Range 36: 25 - 20,000 Hz with dominant frequency bands at 25, 31.5, 50, 63, 80, 200, and 250 Hz; Range TA 244: 24 - 20,000 Hz with dominant frequency bands at 200, 400, 500, 630, 800, and 1000 Hz). Bats were also presented seismic stimuli of magnitudes representing 250-pound charges at 531 feet and 985 feet. This study concluded that sound and seismic stimuli from training activities would not affect hibernating bats (3D/Environmental, 1996).

References:

Besha, J.A. 1984. Glen Park Hydroelectric Project. Supplemental report, article 34: Indiana bat monitoring requirements. James Besha Associates, Consulting Engineers, Albany, New York. 52 pp.

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Comment	Section	Page	Comment
13	6.1	36	If rock outcrops and talus slopes are identified and are required to be blasted in the proposed route, describe mitigation measures that would be needed to minimize potential direct and concussive impacts to small-footed bats. These need to be analyzed in section 5.2.2 and disclosed here. Clarify if small-footed bats, which can move around and change roosting sites during summer months, would be searched for and cleared from the area.

Mountain Valley Response:

This has been updated in the Biological Evaluation. Section 6.1 now states:

"*If blasting is required, Mountain Valley will utilize mitigation measures to reduce noise and vibration, such as blasting mats or padding, restricted charge sizes, and/or charge delays.*"

This is in addition to language already included in the Biological Evaluation addressing actions should undocumented potential habitat be observed within the Project area. This language states:

"*Notifications will be made to JNF biologists and appropriate federal and state agencies if undocumented caves, mine openings, or rock outcrops are observed during construction activities. These openings will be assessed for use by bats and conservation measures will be implemented based on coordination with JNF and the respective agencies.*"

Please feel free to contact me if you have questions or need any additional information. Thank you for your time and consideration.

Sincerely,

Megan Neylon
Supervisor – Environmental Permitting
(724) 873-3645
MNeylon@eqt.com

Mountain Valley Pipeline Project

Docket No. CP16-10-000

BIOLOGICAL EVALUATION FOR FOREST SERVICE SENSITIVE SPECIES

MOUNTAIN VALLEY PIPELINE

JEFFERSON NATIONAL FOREST
EASTERN DIVIDE RANGER DISTRICT

June 2017

Executive Summary

The purpose of this Biological Evaluation (BE) is to evaluate the effects of the proposed Mountain Valley Pipeline Project (Project) on sensitive species identified by the U.S. Forest Service (USFS) specific to Jefferson National Forest (JNF) under the National Forest Management Act (NFMA). The Project is a 303-mile, 42-inch-diameter natural gas pipeline in 17 counties in Virginia and West Virginia. The Project will extend from the existing Equitrans, L.P. transmission system and other natural gas facilities in Wetzel County, West Virginia to the existing Transcontinental Gas Pipe Line Company, LLC's (Transco) Zone 5 compressor station 165 in Pittsylvania County, Virginia. The Project is being proposed to provide timely, cost-effective access to the growing demand for natural gas for use by local distribution companies, industrial users, and power generation in the Mid-Atlantic and southeastern markets, as well as potential markets in the Appalachian region. Approximately 3.5 miles of the proposed alignment cross JNF lands in Monroe County, West Virginia and Giles and Montgomery counties, Virginia. The Project requires a Certificate of Public Convenience and Necessity from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act, a right-of-way from the Bureau of Land Management under the Mineral Leasing Act, and a right-of-way from the National Park Service.

This BE has been prepared by Environmental Solutions & Innovations (ESI) on behalf of the Project proponent, Mountain Valley Pipeline, LLC (Mountain Valley). The objectives of the BE are to ensure that USFS actions do not contribute to loss of viability of any native or desired non-native plants or animals or contribute to trends toward federal listing of any species as well as provide a process and standard by which to ensure that all USFS sensitive species receive full consideration in the decision-making process. It evaluates the effects of the Project on 144 Forest Service Sensitive Species. Survey results and effects determinations for species listed as federally endangered or threatened under the 1973 Endangered Species Act, as amended, are not included in the BE as they are specifically detailed in a Biological Assessment drafted for the Project.

One hundred and seventeen Forest Service Sensitive Species were determined to have ranges outside of the Project area (Occurrence Analysis Result [OAR] Code 1) or not have suitable habitat within the Project area (OAR Code 2). Field surveys were conducted for the remaining 27 species. Eleven of the 27 species were eliminated from further consideration because they were not found during field assessments and surveys (OAR Code 3). The remainder of the species and the effects determination for each is summarized in the table below.

Species	OAR Code*	Determination
Maureen's shale stream beetle (*Hydraena maureenae*)	4	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Eastern small-footed bat (*Myotis leibii*)	4	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
American barberry (*Berberis canadensis*)	4	No Impacts
Rock skullcap (*Scutellaria saxatilis*)	5	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Diana fritillary (*Speyeria diana*)	6	Beneficial Impacts
Regal fritillary (*Speyeria idalia*)	6	Beneficial Impacts
Sweet pinesap (*Monotropsis odorata*)	6	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Yellow lance (*Elliptio lanceolata*)	7	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Atlantic pigtoe (*Fusconaia masoni*)	7	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Candy darter (*Etheostoma osburni*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Roughhead shiner (*Notropis semperasper*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Orangefin madtom (*Noturus gilberti*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Kanawha minnow (*Phenacobius teretulus*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Green floater (*Lasmigona subviridis*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Green-faced clubtail (*Gomphus viridifrons*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability
Allegheny snaketail (*Ophiogomphus incurvatus alleganiensis*)	8	May Impact Individuals – Is not Likely to Cause a Trend Toward Federal Listing or Loss of Viability

* Occupancy Analysis Results Ranks:

4. Species occurs in Project area, but outside of activity area.
5. Field survey located species in Project area.
6. Species not seen during field survey, but possibly occurs in Project area based on habitat observed, or field survey not conducted when species is recognizable (time of year or time of day). Therefore assume presence and no additional surveys needed.
7. Aquatic species or habitat known or suspected downstream of Project area, but outside identified geographic bounds of water resource cumulative effects analysis area.
8. Aquatic species or habitat known or suspected downstream of Project area, but inside identified geographic bounds of water resource cumulative effects analysis area.

In addition to effects determinations, this BE also provides recommendations for avoiding, minimizing, and mitigating for any adverse effects. Recommendations are

made for the eastern small-footed bat, rock skullcap, and Forest Service Sensitive Fishes, Mussels, and Dragonflies.

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Appendices

1.0 Introduction

1.1 Project Introduction

Mountain Valley Pipeline, LLC (Mountain Valley), a joint venture between EQT Midstream Partners, LP, NextEra Energy, Inc., WGL Holdings, Inc., Con Edison Gas Midstream, LLC, and RGC Midstream, LLC, is seeking a Certificate of Public Convenience and Necessity (Certificate) from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act authorizing it to construct and operate the proposed Mountain Valley Pipeline Project (Project) located in 17 counties in West Virginia and Virginia. Mountain Valley plans to construct an approximately 488.3-kilometer (303.4-mi), 106.7-centimeter (42-in) diameter natural gas pipeline to provide timely, cost-effective access to the growing demand for natural gas for use by local distribution companies, industrial users and power generation in the Mid-Atlantic and southeastern markets, as well as potential markets in the Appalachian region.

The proposed pipeline will extend from the existing Equitrans, L.P. transmission system and other natural gas facilities in Wetzel County, West Virginia to the existing Transcontinental Gas Pipe Line Company, LLC's (Transco) Zone 5 compressor station 165 in Pittsylvania County, Virginia (Appendix A, Figure 1). In addition to the pipeline, the Project will require approximately 171,600 horsepower of compression at three compressor stations currently planned along the route as well as measurement, regulation, and other ancillary facilities required for the safe operation of the pipeline. The pipeline is designed to transport up to 2.0 million dekatherms per day of natural gas.

1.2 Mountain Valley Pipeline and Jefferson National Forest

Approximately 3.5 miles of the proposed alignment cross Jefferson National Forest (JNF) lands in Monroe County, West Virginia and Giles and Montgomery counties, Virginia. Six miles of Pocahontas Road (Forest Road 972) and one mile of Mystery Ridge Road (Forest Road 11080) in Giles County, Virginia are currently proposed to provide access to portions of the alignment near Peters Mountain. Also two additional temporary workspaces (ATWS) are currently proposed in Montgomery County. No ancillary facilities or new access roads are proposed to be constructed on JNF land.

Alternative pipeline alignments were considered and reviewed in the field on JNF. Alternatives 110, 110J, and 110R—discussed further in the draft Environmental Impact Statement—cross portions of Monroe County, West Virginia as well as Craig, Montgomery, and Roanoke counties, Virginia. These alternatives were not incorporated into the proposed alignment.

Tracts were delineated in order to reference individual crossings of the proposed alignment on JNF lands (Appendix A, Figure 2, Maps 1-12). The Project crosses the JNF Eastern Divide Ranger District.

1.3 Biological Evaluation

The National Forest Management Act (NFMA) is a federal law passed in 1976 that establishes procedures for management of the national forests. Under NFMA, land and resource management plans identify sensitive species within each forest. A Biological Evaluation (BE) is required (Forest Service Manual, Section 2672.4) for all United States Forest Service (USFS) planned, funded, executed, or permitted programs and activities to assess possible effects to these sensitive species. This differs from a Biological Assessment (BA), which is prepared for major federal construction projects requiring an Environmental Impact Statement, in accordance with legal requirements under Section 7 of the Endangered Species Act (ESA).

The objectives of this BE are to:

- Ensure that USFS actions do not contribute to loss of viability of any native or desired non-native plants or animals or contribute to trends toward federal listing of any species;
- Provide a process and standard by which to ensure that all USFS sensitive species receive full consideration in the decision-making process.

JNF has occurrences of and provides known suitable habitat for several threatened, endangered, and sensitive (TES) species. A list of species addressed is provided in Appendix B. This BE documents the analysis of potential effects of the Project to sensitive species and associated habitat. The potential effects of the Project on species that are listed as threatened or endangered under the ESA are separately addressed in the BA drafted for the Project. This BE also serves as biological input into the environmental analysis for project-level decision-making to ensure compliance with the National Environmental Policy Act (NEPA) and NFMA.

2.0 Project Area

2.1 Proposed Alignment on JNF Land

Tracts were identified based on individual JNF crossings. In total, eight tracts were identified along the proposed alignment (Table 1; Appendix A, Figure 2, Maps 1-12). Additional tracts for abandoned and alternate routes are referenced in this document but not included in Table 1. For the terrestrial effects analysis, the Project area is

considered to be the survey corridor (300 ft centered on the proposed pipeline centerline) on JNF land. The Project analysis area for aquatic species varies from the terrestrial area and is defined in Section 2.3.

Table 1. Tracts of Jefferson National Forest crossed by the proposed Mountain Valley Pipeline.

Tract	Alignment	Approximate Miles
001	Proposed	1.18
002	Proposed	0.11
003	Proposed	0.04
004	Proposed	0.02
005	Proposed	0.84
006	Proposed	0.96
008	Proposed	0.12
035	Proposed	0.19
Total		3.46

The Project crosses into Tract 001 of the JNF in Monroe County, West Virginia, southwest of the town of Lindside, and continues to the edge of JNF land at the border of Virginia. The proposed alignment continues through Virginia and into Tracts 002, 003, 004, 005, 006, 008, and 035 (Appendix A, Figure 2, Maps 1-12).

The West Virginia portion of the Project lies in the Allegheny Plateau, Allegheny Mountains, and Valley and Ridge Physiographic regions. In Virginia, the Project lies in the Valley and Ridge, Blue Ridge, and Piedmont Physiographic regions. All JNF areas crossed by the Project are within the Valley and Ridge Province (Fenneman 1938).

The geologic strata of the Valley and Ridge mountains consist of several bedrock formations. Silurian sandstones underlie ridge tops and upper to middle slopes are underlain by shale and minor sandstone. The lower portion of the mountains is underlain by a layer of calcareous shale, shale, and minor limestone. Mountain bases are characterized by limestone and valleys are underlain by dolomite. The Valley and Ridge province is underlain by essentially the same strata as the Allegheny Plateau, which is located in western and central New York, northern and western Pennsylvania, northern and western West Virginia, and eastern Ohio. The Valley and Ridge province, however, contains older parts of the stratigraphic column. Structurally, the Valley and Ridge is much more severely deformed than the Allegheny Plateau. The ridges were formed where stronger rocks resisted erosion, and the valleys were formed by constant erosion and down-cutting over time. The Valley and Ridge contrasts the Allegheny Plateau with its longitudinal ridges and much deeper dips in the strata (Fenneman 1938). Elevations of the Project within the JNF range between approximately 518 and 1,097 meters (1,700 and 3,600 ft).

The West Virginia/Virginia border approximately forms the western edge of the Valley and Ridge province, which extends from southeast Tennessee northeast to eastern Pennsylvania in a fairly narrow band. The Valley and Ridge is part of the Oak-Chestnut forest described by Braun (1950). The region was traditionally dominated by oak and chestnut, but chestnut has been replaced in the canopy by oaks and hickories (Braun 1950). The portion of the JNF crossed by the Project is composed primarily of deciduous forest (Appendix C).

2.2 Streams and Wetlands

The Project, as proposed, crosses 19 waterbodies on JNF (Appendix A, Figure 3, Maps 1-12). Of these, 15 are unnamed tributaries (UNT). Table 2 provides the names of each crossed waterbody and the stream to which it contributes.

The Project also includes two crossings of Craig Creek that are upstream of where Craig Creek crosses the JNF. One crossing will be completed via open-cut dry-ditch methods to install the pipeline. The second crossing will be used for access to the pipeline via timber mat bridge. No in-stream work or disturbance is proposed at this second location.

Table 2. Waterbodies Crossed by the proposed Mountain Valley Pipeline on Jefferson National Forest.

Waterbody Crossed	Subwatershed[c]
Clendennin Creek S-UU8	Clendennin Creek – Bluestone Lake
Clendennin Creek S-UU9	Clendennin Creek – Bluestone Lake
Curve Branch S-PP18	Clendennin Creek – Bluestone Lake
Kimballton Branch S-PP14	Stony Creek
UNT to Clendennin Creek S-HH11	Clendennin Creek – Bluestone Lake
UNT to Clendennin Creek S-HH12	Clendennin Creek – Bluestone Lake
UNT to Clendennin Creek S-HH14	Clendennin Creek – Bluestone Lake
UNT to Clendennin Creek S-HH15	Clendennin Creek – Bluestone Lake
UNT to Clendennin Creek S-HH16	Clendennin Creek – Bluestone Lake
UNT to Craig Creek S-PP20	Trout Creek – Craig Creek
UNT to Craig Creek S-PP21	Trout Creek – Craig Creek
UNT to Craig Creek S-PP22	Trout Creek – Craig Creek
UNT to Craig Creek S-HH18	Trout Creek – Craig Creek
UNT to Craig Creek S-RR14	Trout Creek – Craig Creek
UNT to Curve Branch S-PP19	Clendennin Creek – Bluestone Lake
UNT to Kimballton Branch S-PP15	Stony Creek
UNT to Kimballton Branch S-MN18	Stony Creek
UNT to Kimballton Branch S-MN19	Stony Creek
UNT to New River S-PP17	Clendennin Creek – Bluestone Lake
Craig Creek 1[a]	Trout Creek – Craig Creek

Waterbody Crossed	Subwatershed[c]
Craig Creek – Access Road [b]	Trout Creek – Craig Creek

[a]Not on JNF property (approximately 0.25 mile upstream)
[b]Not on JNF property (approximately 0.01 mile upstream)
[c]Subwatersheds were identified using the 12-digit U.S. Geological Survey's Hydrologic Unit Code (HUC12) as represented in the Watershed Boundary Dataset.

Three palustrine emergent wetlands (Wetland IDs W-UU11, W-UU12, and W-HH15) were identified within the Limits of Disturbance (LOD) of Pocahontas Road on JNF. Wetland W-UU11 is approximately 0.008 hectare (0.02 ac; with an open boundary; therefore, size may be larger than reported). Dominant species observed included mountain-laurel (*Kalmia latifolia*), great laurel (*Rhododendron maximum*), polytrichum moss (*Polytrichum commune*), northern spicebush (*Lindera benzoin*), and woolgrass (*Scirpus cyperinus*). Wetland W-UU12 is approximately 0.001 hectare (0.003 ac) (closed boundary). Dominant species observed included mountain-laurel, woolgrass, and wild mint (*Mentha arvensis*). Wetland W-HH15 is approximately 0.01 hectare (0.03 ac; with an open boundary; therefore, size may be larger than reported). Dominant species observed included melic mannagrass (*Glyceria melicaria*) and jewelweed (*Impatiens capensis*).

2.3 Sedimentation Bounds for Effects Analysis

In order to quantify the amount of sediment expected within waterways and associated impacts to TES species within the JNF and in downstream areas, Environmental Solutions & Innovations, Inc. (ESI) contracted a hydrologist (Hydrogeology Inc.) to investigate the potential for downstream sedimentation impacts. The analysis was developed through consultation with Mr. Ken Landgraf, Natural Resources Group Staff Officer, and Ms. Dawn Kirk, Forest Service Fisheries Biologist. On June 7, 2016, ESI, on the behalf of Mountain Valley, submitted a Hydrologic Analysis of Sedimentation documenting potential sedimentation introduced during Project construction. Upon review, the USFS, ESI, and Mountain Valley discussed the analysis and how to best document the level of impacts of potential sedimentation introduced by the Project. Taking into account the USFS comments and recommendations, ESI re-conducted the analysis to include all aspects of the Project.

The Revised Universal Soil Loss Equation (RUSLE; Renard et al. 1997) was used to estimate erosion due to disruption of land from construction, restoration, and operational activities for the Project within the vicinity of the JNF. Specific details regarding the RUSLE and its application to construction activities are available in Renard et al. (1997) and Galetovic (1998) as well as the report submitted in support of this BE (MVP 2017). In brief, the RUSLE is used to estimate the sediment loads and sediment yields by multiplying a series of values representing erosivity (associated with rainfall and runoff), erodibility, slope length and steepness, land cover and management, and conservation practices and erosion and sediment control measures. The benefit of RUSLE is that it can be easily incorporated into a Geographic

Information Systems (GIS) environment, and sediment load can be estimated for a series of cells belonging to a watershed or catchment.

For the proposed Project, the RUSLE was used to estimate sediment loads and yields for all stream catchments within the 1:24,000 National Hydrography Dataset (NHD) within the vicinity of the Project. More specifically, a study area was established that included: (1) all subwatersheds from the U.S. Geological Survey's (USGS) Watershed Boundary Dataset that intersect the boundaries of the JNF and the Project area (Table 3), (2) all subwatersheds upstream of the intersecting subwatersheds (i.e., all upstream drainage areas), and (3) subwatersheds downstream of the intersecting subwatersheds that demonstrate substantial increases in cumulative sediment loads. Sediment loads within these catchments are estimated using current land use (based on the 2011 National Land Cover Database) and expected land use classes during construction, restoration, and operation of the Project within the LOD. Current sediment loads and yields are considered baseline conditions (i.e., baseline treatment) and provide a measure of the present sediment loads within streams in the vicinity of the Project. This baseline treatment is then used to assess potential increases of soil loss expected under Project construction, restoration, and operation (i.e., proposed action treatment).

Table 3. Subwatersheds in Virginia and West Virginia with Limits of Disturbance for the Mountain Valley Pipeline within the Jefferson National Forest.

Subwatershed Name	HUC12	State	Subwatershed Area (ac)	Project Area (ac)	Area within JNF (ac)	Project Area within JNF (ac)
Stony Creek	050500020305	VA,WV	31,105	112	25,312	38
Clendennin Creek-Bluestone Lake	050500020602	VA,WV	24,899	22	4,883	19
Rich Creek	050500020601	VA,WV	34,089	82	808	1
Trout Creek-Craig Creek	020802011001	VA	33,173	35	24,544	27
Dry Run-North Fork Roanoke River	030101010201	VA	32,787	138	2,126	<1

In order to estimate potential sediment introduced into nearby streams from the Project, construction, restoration, and operational impacts were projected on a two-week interval using a sequential, assembly-line construction schedule for each construction segment or spread in a north-to-south direction through the JNF (see MVP [2017] for a more detailed description of construction activities and their associated treatments within the RUSLE). Soil losses were then summed to estimate yearly sediment loads and yields for a five-year period that includes Project construction, restoration, and operations. At year five, the landscape was assumed to enter into a new sediment equilibrium, and sediment produced during year five was used to forecast sediment produced for the life of the Project. Results were compared to baseline conditions to assess potential impacts, and the maximum load over any consecutive 52-week period

was used to define the sedimentation bounds for effects. Unfortunately, no nationally accepted sedimentation standard regarding the permissible amount of sediment allowed to enter into waterways is available (Kemp et al. 2011); however, a commonly used impact threshold is one in which the metric of impact is increased by 10 percent or more (USEPA 2003). This approach recognizes the biological reality that even a relatively small (in absolute terms) amount of sediment may degrade a pristine stream, while a larger amount might be needed to further degrade a historically impacted stream. Thus, streams with a 10 percent increase in sediment load over baseline were used to identify the extent of sedimentation effects from the proposed action on JNF and surrounding lands.

From a sensitive-species perspective, a 10 percent increase over background would likely be within the normal variance experienced in a stream system. NCASI (1999) demonstrated that the natural variation in streams is relatively high such that a 50 to 100 percent increase in sediment yield represents one standard deviation of the long-term mean (i.e., the coefficient of variation). With this high variability, detecting sediment increases in streams is fairly difficult. In its guidance for implementing Section 7 of the ESA (USFWS and NMFS 1998), the USFWS indicated that insignificant effects relate to the size or severity of the impact and are effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated.

Analysis using the RUSLE identified the boundaries associated with a 10 percent increase in sediment load. In total, 45.11 stream kilometers (28.03 mi) downstream of the Project area but within the study area in the JNF are expected to have a 10 percent increase or more (Table 4). Nearly 21 kilometers (13 mi) of stream impacts can be attributed to a pre-existing approximate 9.7-kilometer (6-mi) Forest Road (Pocahontas Road; Figure 1) that will be used for the Project. This road was treated as a construction component of the Project; however, the road will only need to be upgraded in sections and extended to the Project right-of-way (ROW) in order to be used for the Project. Similarly, approximately 1.6 kilometers (1 mi) of Mystery Ridge Road (Forest Development Road 11080) were also treated as a construction component of the Project. The road already exists but will need improvements.

Table 4. Waterbodies with an expected increase in sediment load of 10 percent or greater from the proposed Mountain Valley Pipeline within the vicinity of the Jefferson National Forest.

Waterbody	Subwatershed	Stream Kilometers Impacted*
Unnamed Tributaries to Craig Creek	Trout Creek-Craig Creek	3.09
Craig Creek	Trout Creek-Craig Creek	0.47
Unnamed Tributary to Mill Creek	Dry Run-North Fork Roanoke River	2.53
Mill Creek	Dry Run-North Fork Roanoke River	5.18

Waterbody	Subwatershed	Stream Kilometers Impacted*
Unnamed Tributaries to Stony Creek	Stony Creek	1.42
Unnamed Tributaries to Kimballton Branch	Stony Creek	1.87
Kimballton Branch	Stony Creek	4.12
Unnamed Tributaries to Clendennin Creek	Clendennin Creek-Bluestone Lake	2.88
Clendennin Creek	Clendennin Creek-Bluestone Lake	6.15
Unnamed Tributaries to Curve Branch	Clendennin Creek-Bluestone Lake	1.69
Curve Branch	Clendennin Creek-Bluestone Lake	3.81
Unnamed Tributaries to New River	Clendennin Creek-Bluestone Lake	5.05
Rich Creek	Rich Creek	6.86
Totals	-	45.11

* Assumes a 79 percent containment of sediment by sediment controls during the construction phase of the Project (MVP 2017).

Sediment yields in excess of 10 percent above baseline are expected within most unique catchments (i.e., the catchment area uniquely draining to an individual stream segment) crossed by the Project during the construction phase of the Project (i.e., year 1). Although many of these catchments are expected to have sediment yields that decrease after the construction phase of the Project, the majority of catchments (n=20) are expected to have a new sediment equilibrium in excess of 10 percent above baseline once restoration activities are complete. For 8 catchments, a new sediment equilibrium in excess of 50 percent over baseline is expected. These higher equilibriums are in relation to the pre-existing Pocahontas Road that will be improved for the Project.

To better examine the impacts of these increased sediment yields, expected sediment introduced by the proposed Project was also put into the context of actual stream segments with total sediment loads. In this context, loads above baseline originate from catchments crossed by the proposed action and are expected to be transported to streams downstream of the Project area outside the catchment of origin. Based on this approach, substantial increases (i.e., ≥ 10% over baseline) in sediment loads from the proposed Project are largely (>90%) confined to headwater streams (i.e., 1-3 Strahler order; Table 5); however, increased loads are expected in the larger-ordered Rich Creek (Table 5).

Table 5. Maximum yearly sediment loads above baseline in downstream waterbodies and associated percent increases from the proposed Mountain Valley Pipeline in the Jefferson National Forest.

Subwatershed	Waterbody	Location	Drainage Area (km^2)	Strahler Order	Load Above Baseline (ton per yr)	Percent Inc.
Trout Creek-Craig Creek	Craig Creek	Above Confluence with Muddy Branch	59.52	4	31	2.66

Subwatershed	Waterbody	Location	Drainage Area (km^2)	Strahler Order	Load Above Baseline (ton per yr)	Percent Inc.
		Above Confluence with Cabin Branch	78.79	4	29	1.93
		Above Confluence with Trout Creek	115.10	4	26	1.30
		Above Confluence with McAfee Run	150.74	5	24	0.94
		Above Confluence with Broad Run	199.46	5	22	0.72
		Above Confluence with Meadow Creek	252.24	5	21	0.53
		Above Confluence with Johns Creek	284.33	5	20	0.40
		Above Confluence with Barbours Creek	596.32	6	15	0.23
Dry Run-North Fork Roanoke River	Mill Creek	Above Confluence with North Fork Roanoke River	10.93	3	148	29.42
	North Fork Roanoke River	Above Confluence with Indian Run	91.22	4	241	7.17
		Above Confluence with Slate Lick Run	117.66	4	226	6.24
		Above Confluence with Wilson Creek	126.31	4	221	5.94
Stony Creek	Stony Creek	Above Confluence with Laurel Branch	95.29	4	1	0.06
		Above Confluence with Kimballton Creek	112.74	4	24	1.81
		Above Confluence with New River	125.25	4	120	6.91
	Kimballton Creek	Above Confluence with Stony Creek	4.45	2	74	49.22
Clendennin Creek-Bluestone Lake	Curve Branch	Above Confluence with New River	3.11	2	46	34.84
	Clendennin Creek	Above Confluence with New River	9.43	2	48	20.14
	New River	Above Confluence with Curve Branch	8862.27	6	172	1.00
		Above Confluence with Clendennin Creek	8876.36	6	172	1.00
		Above Confluence with Wolf Creek	8911.84	6	170	1.00
		Above Confluence with Rich Creek	9537.74	6	153	0.87
		Above Confluence with East River	9882.29	6	160	0.89
Rich Creek	Rich Creek	Above Confluence with Mud Run	30.38	4	91	17.92
		Above Confluence with Crooked Creek	41.08	4	84	11.04
		Above Confluence with Scott Branch	66.69	5	75	5.99

Subwatershed	Waterbody	Location	Drainage Area (km^2)	Strahler Order	Load Above Baseline (ton per yr)	Percent Inc.
		Above Confluence with Brush Creek	85.57	5	70	4.98
		Above Confluence with New River	135.15	5	63	2.97

Note: A maximum sediment load is defined as the maximum yearly sediment load of any contiguous 52-week period.
* Assumes a 79 percent containment of sediment by sediment controls during the construction phase of the Project (MVP 2017).

It is important to recognize that these results are based on the assumption of adherence to the FERC 2013 Upland Erosion Control, Revegetation, and Maintenance Plan (FERC Plan) and the Project Erosion and Sedimentation Control Plan (E&SCP). Sedimentation is greatly influenced by the amount of bare soil exposed to erosive forces and the distance and method of transport of the eroded soil to the stream system. Adherence to these plans, as well as site-specific erosion and sedimentation control plans, will reduce the amount of sedimentation introduced into waterbodies. In general, Mountain Valley will place erosion and sedimentation control measures along the LOD prior to disturbance to the soil. These measures will be monitored and repaired or replaced as needed until revegetation is deemed complete by the appropriate agencies. Mountain Valley will revegetate the Project ROW as soon as possible following construction in an effort to reduce sediment run off resulting from exposed soils.

3.0 Proposed Actions

All activities associated with construction, operation, and maintenance of the pipeline and ancillary facilities will be conducted in a manner that complies with the conditions outlined in the FERC Certificate, Bureau of Land Management Right-of-Way Grant, State Erosion and Sedimentation Control permits, and other permits, as applicable. Prior to initiating construction-related activities, ROW easements and other authorizations will be obtained. The proposed width of the permanent ROW is 15 meters (50 ft) and the proposed width of the construction ROW is generally 38 meters (125 ft) (it will be narrowed in some sensitive areas). The following subsections detail construction procedures as they will occur on the JNF and not a complete Project-wide construction sequence.

3.1 Typical Upland Construction Procedures

Construction in upland terrain uses conventional overland construction techniques for large-diameter pipelines. The following subsections outline typical steps for this type of construction.

3.1.1 Clearing and Grading

After the ROW has been surveyed and easements have been secured (for the permanent and temporary construction ROW), the permitted ROW will be cleared of obstructions (i.e., trees and stumps, brush, logs, and large rocks) according to the FERC Plan, as agreed upon with the USFS, and as outlined in an updated Annual Standards and Specifications, which will be included as Appendix D upon completion. The ROW will be cleared to the width required for construction, but not more than specified on the pipeline alignment sheets. At no time will Mountain Valley or its contractor clear or alter any areas outside of the boundaries of the permitted pipeline ROW area.

The pipeline's 38-meter (125-ft) wide construction ROW and temporary workspaces will be cleared of vegetation (including timber) prior to the initiation of construction. All areas to be cleared during construction will be clearly marked by the USFS with paint and staked by the civil survey crew prior to the start of clearing operations. Also, in accordance with the invasive species plan, Mountain Valley will arrange a location in which a JNF-designated employee will examine and certify that equipment is clean and permitted to be used on USFS property. Once removal has begun, timber will be cut into usable lengths and stacked as indicated in the Timber Removal Plan included in the Plan of Development. Merchantable timber will be hauled away. All non-merchantable brush and slash will be windrowed to the edge of the ROW, utilized in downslope areas of the ROW and access roads, or removed from the area in accordance with USFS requirements. The windrows will generally range from 3 to 6.1 meters (10 to 20 ft) in width and 1.8 to 2.4 (6 to 8 ft) in height. Breaks will be left in the windrows at approximately 30-meter (100-ft) intervals in order to provide fire breaks and wildlife crossings.

Where needed and as dictated by the E&SCPs, best management practices (BMPs) will be placed, maintained, and monitored throughout construction and will remain in place until permanent erosion controls are installed and restoration is deemed complete by the USFS and FERC.

3.1.2 Trenching

To bury the pipeline underground, it will be necessary to excavate a trench. The trench will be excavated with a track-mounted backhoe or similar equipment. Explosives will only be used when necessary in areas where rock substrates are found at depths that interfere with conventional excavation or rock-trenching methods. On JNF property, topsoil will be stockpiled separately from other soils (or the upper 30.5 centimeters [12 in] of topsoil, if the topsoil is deeper).

Generally, the trench will be excavated at least 30.5 centimeters (12 in) wider than the diameter of the pipe. The sides of the trench will be sloped with the top of the trench up to 3.6 meters (12 ft) across, or more, depending upon the stability of the native soils.

The trench will be excavated to a sufficient depth to allow a minimum of 0.9 meter (3 ft) of soil cover between the top of the pipe and the final land surface after backfilling (minimum of 45.7 centimeters [18 in] of cover will be provided in consolidated rock in Class 1 or greater locations or in ditches, where 61 centimeters [24 in] of cover is required). Locations such as waterbodies, roads, and railroads will include 91.4 centimeters (36 in) of cover per applicable permits.

Excavated soils will typically be stockpiled along the ROW on the side of the trench (the "spoil" side) away from the construction traffic and pipe assembly area (the "working" side). Where the route is co-located adjacent an existing infrastructure, the spoil generally will be placed on the same side of the trench as the existing infrastructure.

3.1.3 Padding and Backfilling

After the pipe is lowered into the trench, the trench will be backfilled. Previously excavated materials will be pushed back into the trench using equipment or backhoes. Where the previously excavated material contains large rocks or other materials that could damage the pipe or coating, clean fill will be used to protect the pipe. However, limestone dust or sand, which is typically basic and will often aid in the cathodic protection of the pipeline, may be used as backfill material. The first 30.5 centimeters (12 in) above the top of the pipe will be clean fill free of rocks from the excavation. The remaining fill of the trench will be the aggregate of the excavation material removed at the time of the excavation. If additional fill is brought in, it will be either flowable fill or topsoil. The segregated topsoil will be placed after backfilling the trench above the subsoil. In wetlands, hydrology will be restored to pre-existing conditions. In upland areas, excess soil will be distributed evenly on the ROW, while maintaining existing contours, and will be done in accordance with requirements.

3.1.4 Construction in Rugged Terrain

In mountainous areas, where the pipeline will encounter steep slopes (typically in exceedance of 30 to 35 degrees), Mountain Valley will employ special construction techniques. The elevation data were collected using 3-meter digital elevation model (DEM) files generated from flown LiDAR. Average slopes were calculated for each 0.1-mile interval along the pipeline centerline, and every 0.25-mile interval along the access road. In each 0.1-mile interval, the steepest data point was taken as the maximum slope. These special construction techniques will require expanded workspace areas. ATWS are located outside the 125-foot construction ROW for the pipeline. One acre of ATWS will be utilized within the JNF. These are located along the pipeline alignment on the south side of Sinking Creek Mountain, between MP 218.5 and 219.0. No additional ATWS are proposed on National Forest System lands. In rugged terrain, temporary sediment barriers in accordance with the approved E&SCP will be installed during clearing to prevent movement of sediment off the ROW. In

addition, temporary slope breakers will be installed during grading in accordance with the approved E&SCP to reduce water runoff or divert water to vegetated areas.

Construction activities on rugged terrain will be similar to the typical construction; however, equipment will be tethered via winch lines to other equipment at the top of the slopes to ensure the safety of the construction personnel and surrounding areas. Equipment used for the construction activity will be suspended from a series of winch tractors to maintain control of the equipment and provide an additional level of safety. All construction equipment and their winch lines will be inspected prior to operation to ensure the equipment is operable and sound. Spoil piles adjacent to the trench will be protected by temporary sediment barriers to keep excavated soils on the ROW. Pipe joints will be stockpiled at the top or bottom of each slope. A side-boom tractor will be suspended from a winch that will carry one joint at a time up or down the slope and place the joint along the trenchline. The joint will then be lowered into the ditch by a tractor. Welders will connect the joint to the previous joint within the trench to assemble the pipeline. Once welding is complete, the welds will be visually and radiographically inspected. The weld joints will be hand-coated with fusion-bonded epoxy coatings in accordance with required specifications. The coating on the pipe and at the weld will be inspected for defects and repaired, if necessary. Sand trench breakers will be installed in the trench along the pipeline to prevent or slow the movement of water along the trench. The pipeline will be padded and the trench will be backfilled by equipment tethered to the winch tractors. The surface of the ROW will be restored to original contours to the extent practical, and permanent slope breakers will be installed in accordance with the E&SCP. Erosion control blankets or hydroseed, in lieu of mulch, will be installed on steep slopes to provide stabilization for vegetation to help control sediment and water runoff.

In areas where the Project route crosses laterally across the face of a slope (side-hill construction), cut-and-fill grading may be required to establish a safe, flat work terrace, which will be reclaimed as close as practical to original contours. Mountain Valley will incorporate erosion and sediment control measures such as super silt fence, silt fence, sock filtration, erosion control socks, temporary and permanent water bars, ditch breakers, temporary mulch, and erosion control blankets as per Project design specifications based on slope.

On steep slopes, various measures will be taken in order to properly control erosion and sedimentation on the ROW. Spoil piles from trenching operations will be staged along the side of the ROW and will be compacted via rolling with dozers on site as additional material is added. Once a soil pile is completed, it will be temporarily mulched to control washouts. Additionally, spoil piles will be separated at intervals of 15 meters (50 ft) by temporary water bars, which will serve to slow the flow of runoff down the ROW and divert it into No. 3 aggregate. Silt fence and super silt fence will

be used to stop rocks from rolling off the ROW. Other measures such as erosion control blankets, temporary mulching, hydroseed, and sock filtration may be used.

Within the trench, sand-filled sacks will be stacked across the width of the trench as necessary based on field conditions. This will permit water to slowly filter through without carrying large amounts of soil with it. Similarly, permeable trench breakers constructed of sand- or aggregate-filled sacks will be installed along the open ditch. Rock-fall protection measures such as rock fences, placement of concrete barriers, or creation of catchment areas may be added where excavation is planned subjacent to steep slopes, as determined by the contractor. Following construction, Mountain Valley will remove any temporary stabilization methods once the area becomes stablized. Contours will be returned to pre-existing conditions to the extent practicable.

In addition to the measures taken on slopes to control erosion and sedimentation, trench drains will be installed on side slopes and steep slopes before the pipe is placed in order to channel water away from the ditch. These drains will not be removed after construction is complete. These permanent drains will consist of perforated tile or pipe surrounded with rock (2.5-centimeter [1-in] stone or similar, which may be taken from excavated spoils) that will terminate at a riprap pad near the edge of the ROW. Geotechnical inspectors will evaluate the need for additional engineering controls based on the subsurface conditions exposed in the pipeline excavation. Such engineering controls could include regrading adjacent areas, embedding the pipeline in a bedrock trench, installing drains, buttressing unstable slopes, reinforcing fill slopes with geosynthetics, or other stabilization measures as appropriate.

On side-hill construction, tree stumps and other organic material will be removed from backfill material along the ROW, as decomposing organic materials and organic soils tend to exhibit low shear strengths and may accumulate water, increasing the likelihood of a landslide. Special attention will be paid to ensure that natural drains alongside slopes are properly restored after construction activities are complete. In order to accomplish this, additional French drains or rock-lined channels may be constructed to efficiently convey water across or around the ROW. Where seeps and springs are observed in the cut slope, cutoff drains and/or transverse trench drains will be installed to prevent saturation of the backfilled material. Where possible, compaction on side-cut sections should be completed in 30-centimeter [12-in] lifts using a sheep's foot roller.

Specific slope stability considerations and construction measures are included in the May 2017, *Site-Specific Design of Stabilization Measures in Selected High-Hazard Portions of the Route of the Proposed Mountain Valley Pipeline Project in the Jefferson National Forest* as well as the February 2017, *Landslide Mitigation Plan* both included in the Plan of Development (POD). Additional landslide mitigation measures will be

prescribed by geotechnical inspectors as subsurface conditions are revealed during construction.

3.1.5 Stovepipe Construction

On slopes steeper than 30 degrees, the pipeline will be installed via a "stovepiping" method. The stovepipe method entails excavating a trench long enough to install two joints of pipe (approximately 40 feet long), lowering the pipe into the trench, and then welding the pipe in the trench. Following welding, inspection, and coating, the welded joint of pipe is backfilled before moving on to the next two joints of pipe. This process is performed for each successive joint of pipe up the slope. This construction technique will reduce the length of pipe that will be handled at any one time and minimize the amount of open trench on steep slopes. The general construction and restoration methods that will be applied during stovepipe construction will be similar to those described above for rugged terrain.

3.1.6 Winter Construction

Mountain Valley has developed a Winter Construction Plan (included in the POD), which identifies BMPs for construction activities during snow accumulation. Mountain Valley will stop working in winter if weather conditions occur that are deemed unsafe to perform pipeline construction. Inspections will occur within 24 hours of each 1.3 centimeter (0.5 in) of rainfall or snowmelt. Mountain Valley will ensure the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this time frame would result in the greater environmental impacts.

As necessary during snow accumulation, snow will be removed from construction work areas to expose soils for grading and excavation. Snow removal will be limited to active construction areas and areas needed to maintain access to the construction ROW. Snow will be bladed or pushed to the edges of the ROW with a motor-grader, snowplow, or bulldozer fitted with a "shoe" to minimize impacts on underlying soils and vegetation and stockpiled within the ROW or an approved ATWS areas. Snow will not be bladed off the ROW. Snow removal equipment will access the Project areas from approved access roads and will operate from within the construction ROW or approved ATWS areas. When snow accumulation is more than 0.3 meter (1 ft), it will be removed from both the working and spoil sides of the construction ROW prior to topsoil segregation and grading to prevent mixing of snow with excavated spoil. Erosion and sediment control devices and diversion berms will be installed where needed to control snow and melting runoff.

3.1.7 Hydrostatic Test and Final Tie-In

Following backfilling of the trench, the pipeline will be hydrostatically tested to ensure that it is capable of safely operating at the design pressure. No water withdrawals or discharges will occur on JNF land.

3.1.8 Dust Control

Water withdrawal for dust abatement will not occur on JNF land. Water will be obtained through municipal sources. The locations and amount of disbursement of water will be decided by the lead environmental inspector for each specific construction spread.

3.1.9 Cleanup and Restoration

Post-construction restoration activities are undertaken in accordance with measures specified in FERC, USFS, and State restoration guidelines as applicable as well as the Restoration Plan appended to the POD. The ROW and other disturbed areas are finish-graded and construction debris is disposed of properly after a segment of pipe is installed, backfilled, and successfully tested. The surface of the ROW disturbed by construction activities is graded to match original contours and retain compatibility with surrounding drainage patterns. An exception is made at locations where permanent changes in drainage are required to prevent erosion, scour, and possible exposure of the pipeline. Unless otherwise requested by the agency, segregated topsoil is returned to its original horizon. At that time, temporary and permanent stabilization measures, including seed and mulch, are installed.

3.1.10 Typical Waterbody Crossings

Construction across waterbodies is performed to minimize the time that the trenches for the pipeline crossings of flowing streams and rivers are left open. The construction method used at a waterbody crossing depends on characteristics of the waterbody. Each method is performed in a manner consistent with regulatory permit conditions. All streams on JNF will be crossed by open-cut dry ditch dam-and-pump or flume crossing methods. Descriptions of these methods are provided below.

3.1.10.1 Dam-and-Pump Crossing Method

The dam-and-pump method involves installation of temporary dams upstream and downstream of the proposed waterbody crossing. The temporary dams will typically be constructed using sandbags and plastic sheeting. Following dam installation, appropriately sized pumps will be used to dewater and transport the stream flow around the construction work area and trench. Intake screens will be installed at the pump inlets to prevent entrainment of aquatic life, and energy-dissipating devices will be installed at the pump discharge point to minimize erosion and stream bed scour. Trench excavation and pipeline installation will then commence through the dewatered portion of the waterbody channel. Following completion of pipeline installation, backfill of the trench, and restoration of stream banks, the temporary dams will be removed, and water flow through the construction work area will be restored. This method is generally only appropriate for those waterbody crossings where pumps can adequately transfer the stream flow volume around the work area. This crossing method generally minimizes the duration of downstream turbidity by allowing excavation of the pipeline trench under relatively dry conditions.

3.1.10.2 Flume Crossing Method

The flume crossing method will consist of temporarily directing the flow of water through one or more flume pipes placed over the area to be excavated. This method will allow excavation of the pipe trench across the waterbody completely underneath the flume pipes without disruption of water flow in the stream. Stream flow will be diverted through the flumes by constructing two bulkheads and using sand bags or plastic dams to direct the stream flow through the flume pipes. Following completion of pipeline installation, backfill of the trench, and restoration of stream banks, the bulkheads and flume pipes will be removed. This crossing method generally minimizes the duration of downstream turbidity by allowing excavation of the pipeline trench under relatively dry conditions.

3.2 Access Roads and Ancillary Facilities

The 9.7-kilometer (6-mi) Pocahontas Road (Forest Road 972) in Giles County, Virginia is currently proposed to provide access to portions of the proposed alignment near Peters Mountain. This road will need to be upgraded in sections in order to be useable for the Project. A portion of Mystery Ridge Road (Forest Road 11080 [approximately 1.6 kilometers [1 mi]]) in Giles County, Virginia will also be used to access portions of the alignment on JNF. Previously existing access roads that were modified and used during construction will be returned to original or better condition upon completion of the pipeline facilities as coordinated with the JNF. No ancillary facilities will be constructed on JNF land.

3.3 Appalachian National Scenic Trail Crossing

For the crossing of the Appalachian National Scenic Trail, pipe will be installed using the conventional bore method. The bore will be approximately 182.9 meters (600 ft). This method requires excavation of two pits, one on each side of the feature bored. A boring machine is lowered into the pit on one side and a horizontal hole is bored to the other pit at a diameter equal to the diameter of the pipe at the depth of the pipeline installation. The pipeline section is then pushed through the bore to the opposite pit. If additional pipeline sections are required to span the length of the bore, they are welded to the first section of the pipeline in the bore pit before being pushed through the bore.

3.4 Surface Disturbance, Erosion, and Downstream Sedimentation

Mountain Valley intends to implement the FERC Plan and FERC's Wetland and Waterbody Construction and Mitigation Procedures (Procedures) as well as the Virginia Department of Environmental Quality approved Annual Standards and Specifications as a minimum standard during construction (unless noted otherwise). These plans identify mitigation measures for minimizing erosion and enhancing revegetation, as well as minimizing the extent and duration of disturbance on wetlands and waterbodies. Environmental inspectors are present during on-site activities to ensure compliance with requirements for the Project and that proposed measures are

implemented. Proposed measures are incorporated throughout the Project, including during preconstruction filing and planning, installation of the pipeline and associated facilities (e.g., access roads), restoration of the Project area, and post-construction. A brief overview of possible erosion and sediment control measures are provided in the following sections.

3.4.1 Environmental Inspection and Supervision

At least one environmental inspector with knowledge of wetland and waterbody conditions is assigned to each construction spread during construction and restoration based on the length of the construction spread and the number and significance of the resources affected. Some noted responsibilities of inspectors include ensuring sensitive resources (e.g., cultural; wetlands) are visibly marked, identifying erosion and sediment control and soil stabilization measures (as well as inspection of these controls), ensuring sensitive resources are not impacted by erosion or the deposition of sediment, and ensuring the preservation and maintenance of topsoil. The inspectors monitor all aspects of construction and restoration activities and have authority to stop activities that may violate conditions of the ROW Grant and Annual Standards and Specifications as well as all other applicable permits and approvals. The inspectors identify corrective actions and ensure an activity is brought back into compliance. The inspectors keep accurate and detailed records of compliance with environmental conditions and proposed mitigation measures that will be submitted regularly to the USFS and FERC.

3.4.2 Preconstruction Filing and Planning

Mountain Valley has coordinated with all appropriate local, state, and federal agencies regarding erosion control and revegetation. Construction is planned to limit the amount of open trench sections to the length necessary to safely construct the pipeline in an effort to avoid erosion and sediment deposition in and near sensitive resources. Beneficial reuse of materials will not result in adverse environmental impacts and will comply with all applicable surveys, landowner and agency approval, and permit requirements.

3.4.3 Installation of Pipeline and Associated Facilities

Measures are taken during construction to stabilize soils and to reduce erosion and sedimentation. Temporary erosion controls are installed immediately prior to disturbance of soil. The environmental inspector assigned to each construction spread maintains temporary controls throughout construction until permanent erosion controls are installed or restoration is deemed complete.

Temporary upland spoil will be placed, if possible, in the construction ROW at least 15.2 meters (50 ft) from the edge of a waterbody, and necessary sediment barriers are installed to prevent the flow of spoil or silt-laden water into waterbodies and wetlands.

3.4.4 Restoration

Following the backfilling of a trench, final grading, topsoil replacement, and installation of permanent erosion control structures will be completed within 20 days. If weather conditions prevent compliance, temporary erosion controls will be maintained until weather improves and allows activities to be completed. Temporary erosion controls will be removed following the installation of permanent erosion controls or when revegetation is deemed successful.

Disturbed areas are planted with appropriate vegetation during the recommended seeding dates within six working days of final grading, weather and soil conditions permitting. If seeding cannot occur within these dates, temporary erosion controls will be maintained until the next recommended seeding dates. Areas are monitored until revegetation is deemed successful.

3.4.5 Post-construction

Inspections of all disturbed areas will be completed to determine the success of revegetation. A minimum of two inspections are completed: one after the first and one after the second growing season. Revegetation in non-agricultural areas is considered successful if upon visual inspection the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed areas. Follow-up inspections and revegetation efforts are continued until revegetation is considered successful. Reporting regarding revegetation efforts is completed following standards in the POD.

3.5 Special Construction Procedures

3.5.1 Blasting

Blasting for grade or trench excavation will be considered only after all other reasonable means of excavation have been evaluated and determined to be unlikely to achieve the required results. The amount of blasting will be minimized to the extent practical, but may be required in areas of shallow bedrock where unrippable subsurface rock is encountered. The proposed pipeline will be installed to allow a minimum cover of 36 inches in areas of shallow bedrock. Therefore, the proposed Project area was evaluated for areas where bedrock might be encountered above a depth of 80 inches (attached shallow bedrock table). However, specific locations requiring blasting will be determined in the field, based on the limitations of the mechanical excavation equipment. Potential short-term impacts would be minimized by utilizing blasting mats or padding, restricted charge sizes and/or charge delays, as necessary.

Surface excavation blasting uses the release of energy from a confined explosive to break up rocks to facilitate removal. Most of the energy released goes towards rock breakage and movement, but a small portion passes outside the intended work zone in the form of ground or air vibrations. Air vibrations are pressure waves generated by

the blast, referred to as "airblast" or "air overpressure." Higher frequency pressure waves may be heard by people or wildlife as sound, while lower frequency pressure waves may be felt rather than heard, similar to a gust of wind. Different species have differing sensitivities to sound, so that frequencies that may be audible to some species are not detected as well by other species. In general, surface detonations involving unconfined or poorly confined blasts will cause louder, higher frequency noise, while well confined blasts such as those used to excavate rock generate lower frequency effects with airblast energy predominantly at very low frequencies (often less than 10 Hz, below the range of most human hearing). For this reason, and because noise from blasting is inherently short-term, there are no audible noise limits applicable to blasting for this Project. The Mountain Valley Project General Blasting Plan describes the procedures and safety measures the contractor will be required to adhere to while implementing blasting activities. The Blasting Plan specifies compliance with ground vibration limits recommended in the U.S. Bureau of Mines Report of Investigations 8507 (Siskind et al. 1980).

The pre-construction condition of human-occupied buildings will be documented. Occupied buildings and their condition within 150 feet of the blasting area will be documented as to their pre-blast condition. All blasting will be conducted during daylight hours and will not begin until occupants of nearby buildings, stores, residences, places of business, and farms have been notified. Mountain Valley will utilize blasting sirens, post warning signs near blasting zones, post public announcements on USFS bulletin boards, and provide information on the USFS website for the JNF (Alerts & Warnings), as authorized to do so by USFS. Where competent sandstone bedrock occurs in the stream bed, blasting may be used to reduce bedrock so that the trench can be excavated. Pre- and post-blasting structural surveys will be conducted of occupied structures, water supply wells, and water supply springs that will be specified in the site-specific Blasting Plan developed by the contractor conducting the blasting activities.

3.5.2 Karst Area

Based on consultation with Mountain Valley's karst experts, Draper Aden, following their local geologic expertise and a preliminary review of mapping from the USGS, West Virginia Department of Environmental Protection, and Virginia Department of Mines, Minerals, and Energy, among other sources, it was determined that the pipeline will cross areas with the potential to contain karst features. However, no such features were identified on JNF. Mountain Valley will have a geotechnical contractor and karst specialists on site daily for construction in karst areas, which is further documented in the Karst Mitigation Plan. The contractor will be able to immediately identify potential problematic features and direct crews to employ mitigation measures as needed. A typical mitigation method for a sinkhole would be to excavate the feature to expose its throat, and then plug the throat using graded rock or sand fill to allow drainage and minimize alteration of flow patterns.

3.5.3 Trench Dewatering

In most cases, trench dewatering will be limited to the removal of storm water or perched groundwater seeping from the trench in the pipe trench excavated in upland locations. Storm water will typically be removed from the trench prior to lowering the pipe into place. The storm water will be pumped from the trench to a location down-gradient of the trench. The trench will be dewatered in a manner that does not cause erosion and does not result in heavily silt-laden water flowing into any waterbody or wetland. The storm water will be discharged to an energy dissipation/filtration dewatering device, such as a staw-bale structure. Heavily silt-laden water may first be passed through a filter bag. The dewatering structure will be removed as soon as possible after completion of the dewatering activates. Trench breakers (ditch plugs) will be used where necessary to separate the upland trench from adjacent wetlands or waterbodies to prevent the inadvertent draining of the wetland or diversion of water from the waterbody in to the pipe trench.

3.6 Restoration

Post-construction restoration activities are undertaken in accordance with measures specified in FERC, USFS, and State restoration guidelines as applicable as well as the Restoration Plan appended to the POD. Areas disturbed by construction will be restored to their original grades, condition, and use, to the greatest extent practicable. Restoration will be considered successful if the disturbed surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless requested otherwise by the land-management agency), revegetation is successful, proper drainage has been restored, and the appropriate federal and state agencies approve.

Herbaceous vegetative cover is re-established by spreading a grass seed and hydro/straw-mulch mixture over the disturbed surface. The type of seed is selected to match adjacent cover or as approved by JNF in order to avoid introduction of aggressive non-native vegetation. Depending upon the time of year, a temporary seed mix recommended by the USFS may be broadcast or drilled until a more permanent cover can be established. Steep slopes may require erosion control fabric, revetments, or sod. Vegetation success in these areas will be closely monitored and reseeding, fertilizing, and other measures will be employed until the density and cover of non-nuisance vegetation is similar in density and cover to adjacent lands undisturbed by the Project. An exception to this approach is the permanent ROW, which must be maintained in herbaceous vegetative cover. No woody vegetation will be allowed to grow in the permanent ROW.

3.6.1 Topsoil Segregation

In a response to a request from the USFS received on November 15, 2016, Mountain Valley agreed to conduct topsoil segregation within the disturbed areas of the JNF. Topsoil segregation involves removing and storing topsoil separate from subsoil in disturbed areas. Following construction activities, topsoil is reapplied to disturbed

areas. The removal, storage, and reapplication of topsoil will better facilitate growth of vegetation promoting the establishment of early successional habitat in disturbed areas. The act of segregating topsoil is unlikely to have negative impacts to species because topsoil segregation (1) will be temporary, (2) will occur in areas that are already disturbed, and (3) will occur in an active construction area. Topsoil segregation is likely to have a beneficial impact due to the more timely establishment of vegetation that will promote nesting and foraging habitat for early successional avifauna.

3.6.2 Herbicide Use

Nonnative plant species can spread rapidly in areas without natural controls (e.g., predation or disease), which can result in a reduction of plant diversity, alteration of ecological functions (e.g., sunlight and nutrients). Herbicide use is common in treating and eradicating noxious, nonnative vegetation. Following construction, Mountain Valley will replant disturbed areas of the Project with native vegetation as directed by the USFS in documents received on November 21, 2016, titled Suggested Seed Mixes for Pipeline Rights-of-Way and Associated Disturbance on the Monongahela and George Washington-Jefferson National Forests and Suggested Seeding Techniques for Pipeline Rights-of-Way and Associated Disturbance on the Monongahela and George Washington-Jefferson National Forests. Mountain Valley will only use herbicides as directed by the USFS to address nonnative plants via treatment of individual problem plants/areas. To reduce the risk to non-target flora and fauna, Mountain Valley will comply with all local, state, and federal requirements related to the type and use of herbicides, including any requirements specified by the USFS on the JNF. As stated in Mountain Valley's Restoration and Rehabilitation Plan, Mountain Valley will take measures to avoid the introduction of noxious, nonnative vegetation. Such measures will help to reduce and eliminate the use of herbicides in portions of the Project.

As previously mentioned, herbicides will be used to reduce noxious, nonnative plant species in order to promote native vegetation. The establishment of native vegetation in disturbed areas is expected to improve the overall quality of habitat for fauna, including birds that use early successional habitat. Improving long-term habitat quality by reducing the colonization and spread of nonnative plants will outweigh the short-term impacts associated with herbicide use.

Short-term impacts could include the potential to directly kill some individuals during application, but this is unlikely as most locally rare species will be able to flee the area. Other impacts could include a decrease in cover for smaller species and an increase in organic matter. Mountain Valley will follow the Herbicide Use Plan as approved by the USFS to minimize the short-term effects to species in the area of herbicide use.

4.0 Species Evaluated

4.1 Desktop Assessment

Federally listed threatened and endangered species under the ESA, species proposed for federal listing under the ESA, and Region 8 Forest Sensitive Species that may potentially be affected by the proposed Project were examined using the following existing available information:

- Assembled Occurrence Analysis Result (OAR) list of TES plant and animal species known or likely to occur within the Project area based on preferential habitat known to be present on JNF (list attached as Appendix B);
- Official Species List received from submission of the Project through the USFWS online Information, Planning, and Conservation (IPaC) tool;
- Results of a Virginia Department of Game and Inland Fisheries (VDGIF) Wildlife Environmental Review Map Service (WERMS) review of state-listed species occurring within the vicinity of the Project in Virginia;
- Habitat classifications within the identified tracts on the JNF (Appendix C); and
- Sources listed in the Literature Cited section of this BE.

Many JNF TES species that occur on the JNF have unique habitat requirements, such as shale barrens, rock outcrops, bogs, caves, and natural ponds. Appendix B lists all 193 JNF TES species currently known or expected to occur on or near the JNF; all were considered during analyses for this Project.

A “step down” process is followed to eliminate species from further analysis and increase focus on species that may be affected by Project activities. Species not eliminated in the “step down” process are analyzed in greater detail. Results of this “step down” analysis process are displayed in Appendix E. First, the range of a species is considered. Species’ ranges on the JNF are based on county records contained in such documents as the Digital Atlas of Virginia Flora, Biota of North American Plants, NatureServe, the U.S. Department of Agriculture (USDA) PLANTS database, and the VDGIF WERMS review, but were refined further when additional information was made available, such as more recent occurrences documented in scientific literature or in Natural Heritage databases. Often, range information clearly indicates a species will not occur in the Project area due to a restricted geographic distribution. When the Project area is outside of the known range of a species, that species is eliminated from further consideration and is coded as OAR Code 1 in the Appendix B table. One hundred twenty-eight species were eliminated using this step of the method.

The remaining 65 species were analyzed based on habitat preferences using identified habitat classifications for the proposed Project (Appendix C). Habitat classifications were field verified. If the Project area lacked suitable habitat for a particular species, it was coded as OAR Code 2. For this Project, 29 species were eliminated from further consideration because suitable habitat was lacking.

Thirty-six species could not be eliminated from further consideration based on range or habitat suitability; therefore, a field survey or additional USFS consultation was necessary to determine the presence or probable absence of these species.

4.2 Field Surveys

Field surveys were completed along the length of the proposed alignment. A 91-meter (300-ft) study corridor was used for field surveys unless a larger corridor was specified by applicable guidelines. Surveys were based on guidance provided by federal and state agencies, including the USFS for activities on JNF lands.

The survey method consisted of walking the study corridor searching for different habitat types and TES species occurrences. Plant surveys employed a meander search method (Goff et al. 1982) where new habitat variations or unique areas were constantly searched for in order to maximize floristic variation. Wildlife surveys consisted of searching for individuals and/or signs of their presence. Searching for individuals largely consisted of visually scanning vegetation and looking under logs and rocks. Searching for signs of species consisted of studying scat, tracks, calls, nests, and/or egg masses detected during the survey. Survey intensity was concentrated on potential sites where ground disturbance will be greatest.

Mist-net surveys for listed bat species along the proposed alignment (Tracts 001-004, 008, and 035) and Pocahontas Road began in May 2015 and concluded in August 2015 (Appendix A, Figure 2, Map 1). Tracts 005 and 006 were not completed in 2015 because Permit BBW433301T was not amended until after the USFWS survey window had closed. These tracts were surveyed in May 2016 (Appendix A, Figure 2, Map 2). Mist-net surveys were not completed for abandoned routes except in instances where survey buffers along the proposed alignment overlapped these routes.

Portal searches were completed along the proposed alignment and Pocahontas Road on JNF (Tracts 001 – 006, 008, and 035) as well as Tracts 007 – 014 and 032 - 037 (Appendix A, Figure 2, Maps 1 – 3). This involved conducting pedestrian searches along the Project ROW and associated features for signs indicative of caves and/or mines that may provide suitable winter habitat for listed bat species. These searches began in July 2015 and concluded in November 2016. Portal searches were not conducted for the remaining alternative routes.

Detailed habitat assessments were completed for Tracts 012 – 014 because these previously proposed crossings were within the USFWS-defined buffer around a known bat occurrence (Appendix A, Figure 2, Map 3). These assessments were completed in July and August 2015. No other JNF alternatives cross buffers around known occurrences.

Plant surveys were completed on various tracts on JNF within the varying survey windows of the TES plant species (species listed in Appendix B). The specific survey dates are provided in Table 6.

Table 6. Plant Surveys on Tracts of Jefferson National Forest crossed by the proposed Mountain Valley Pipeline.

Survey	Date(s)	Survey Tracts
1	May 23 – June 3, 2015	009, 011 – 031
2	June 20 – July 1, 2015	009, 011 – 027
3	August 3 – 4, 2015	001 – 004, 007 – 014, 035
4	May 4 – 7, 2016	001 - 006, 008, 033 – 035
5	May 11, 2016	032
6	June 23 – 25, 2016	001 – 006, 008, 035
7	August 2 – 4, 2016	001 – 006, 008, 035

Avian habitat assessments and observations were completed on all tracts on JNF concurrently with other survey activities. These activities began in May 2015 and concluded in March 2017.

An abbreviated mussel survey was completed on October 20, 2015, for the current and abandoned Craig Creek crossings. Abbreviated surveys are qualitative mussel survey efforts (as described in USFWS and VDGIF Draft Freshwater Mussel Survey Guidelines for Virginia [dated September 4, 2013]) that extend a minimum of 100 meters (328 ft) upstream and 400 meters (1,312 ft) downstream of the Project area at each crossing (where possible). Abbreviated surveys are completed in streams with little to no potential of supporting federally listed mussel species. Fourteen hours and 20 minutes of search time was expended along 1,553 meters (5,095 ft) of stream reach at the Project crossing. No signs of mussels (live or deadshell) were observed.

4.2.1 JNF TES OAR Categorization

Based on results of field surveys, additional species were eliminated from further consideration because (1) there was a lack of suitable habitat in the Project area (OAR Code 2 [4 additional species eliminated]) or (2) habitat was present and searches for the species were conducted but the species was not found (OAR Code 3 [14 additional species eliminated]).

4.2.2 Species Identified as In the Action Area or Potentially Affected by the Action

Species analyzed and discussed further in this document are those that:

1. were in the Project area but outside the area where ground disturbance will occur (OAR Code 4);
2. were found in the Project area (OAR Code 5); or
3. were not seen during the survey but possibly occur in the Project area based on habitat observed during the survey or field survey was not conducted when the species is recognizable (OAR Code 6).

In addition to species within the Project area, aquatic species potentially occurring outside the Project area are analyzed and classified as: (1) aquatic species that occur outside the hydrological analysis area downstream from the Project area (OAR Code 7) or (2) aquatic species that are known or suspected downstream of Project area and are within identified geographic bounds of the water resource cumulative effects analysis area (OAR Code 8). If aquatic species are determined to occur in a HUC 6th-level watershed based on the Federally Listed Mussel and Fish Conservation Plan developed by USFWS and USFS in 2004 for the George Washington and Jefferson National Forests, an OAR Code 9 is assigned and appropriate conservation measures apply.

5.0 Field Survey Results and Effects Determinations

Field surveys were completed to determine the presence or probable absence of the remaining 32 TES species that may occur within the proposed alignment. [redacted]

Survey results and effects determinations for federally listed species are not included in this document (5 species). Those determinations, as well as analyses of direct, indirect, and cumulative effects, are detailed in the BA. Based on coordination with the USFS, effects determinations for Forest Service Sensitive Species differ from federal determinations. These determinations are provided and defined as follows: A **No Impacts** determination is appropriate when the action will have no impacts on the species. A **Beneficial Impacts** determination is appropriate when positive effects occur without any adverse effects. Two types of **May Impact Individuals** determinations can be made: one is appropriate when the impact is not likely to cause

a trend toward federal listing or loss of viability, and the other is appropriate when the impact is likely to cause a trend toward federal listing or loss of viability.

Twenty-seven Forest Service Sensitive Species had potential to occur in the proposed Project area based on habitat suitability. Field habitat assessments and surveys began in May 2015 and concluded in March 2017. Eleven of the 27 species were eliminated from further consideration because they were not found during field surveys (OAR Code 3). OAR Codes were assigned to the remaining 16 Forest Service Sensitive Species based on the results of these assessments and surveys. OAR Codes for the Forest Service Sensitive Species are provided in Table 7.

Table 7. OAR Codes for Forest Service Sensitive Species associated with Jefferson National Forest along the Mountain Valley Pipeline in Virginia and West Virginia.

Species	OAR Code(s)
Maureen's shale stream beetle (*Hydraena maureenae*)	4
Eastern small-footed bat (*Myotis leibii*)	4
American barberry (*Berberis canadensis*)	4
Rock skullcap (*Scutellaria saxatilis*)	5
Diana fritillary (*Speyeria diana*)	6
Regal fritillary (*Speyeria idalia*)	6
Sweet pinesap (*Monotropsis odorata*)	6
Yellow lance (*Elliptio lanceolata*)	7
Atlantic pigtoe (*Fusconaia masoni*)	7
Candy darter (*Etheostoma osburni*)	8
Roughhead shiner (*Notropis semperasper*)	8
Orangefin madtom (*Noturus gilberti*)	8
Kanawha minnow (*Phenacobius teretulus*)	8
Green floater (*Lasmigona subviridis*)	8
Green-faced clubtail (*Gomphus viridifrons*)	8
Allegheny snaketail (*Ophiogomphus incurvatus alleganiensis*)	8

5.1 Maureen's Shale Stream Beetle (*Hydraena maureenae*)

Maureen's shale stream beetle is a very small 1.2 – 1.5-millimeter (0.05-0.06-in) aquatic beetle (White 1983). It prefers the margins of very clear mountain streams, occurring mostly among fine shale gravels but sometimes on aquatic vegetation. Appalachian shale-bottom streams are considered habitat for this species. Sedimentation and subsequent loss of interstitial spaces in the shale gravels are a threat. This species has been collected from Alleghany, Bath, Bland, Botetourt, Craig, Highland, and Rockingham counties in Virginia (USFS, Dawn Kirk and Fred Huber, *personal communication*).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the Maureen's shale stream beetle.

Information from JNF consultation indicates surveys for this species were previously completed in the Project area (but not for this specific project) by JNF biologists. The species was located in Broad Run near the confluence with Craig Creek; however, it was not found in the immediate vicinity of the Project (OAR Code 4). The species is likely absent from the Project area; therefore, it is unlikely to be directly impacted by Project development and operation.

5.2 Eastern Small-footed Bat (*Myotis leibii*)

The eastern small-footed bat roosts in vertical cracks of cliff faces and horizontal cracks on talus slopes near deciduous or coniferous forest. It may also use man-made structures such as rip-rap and bridges. This bat hibernates in caves during the winter. The eastern small-footed bat forages widely in forested and open habitat types of mountainous habitat. Along the Project ROW, it is specifically known from Giles County, Virginia and Monroe County, West Virginia (Best and Jennings 1997, Amelon and Burhans 2006).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the eastern small-footed bat. Potential summer habitat for the eastern small-footed bat appeared limited along the proposed alignment and Pocahontas Road on JNF during field surveys (mist netting and portal searches). Four eastern small-footed bats (three adult males and one pregnant female) were captured during survey efforts [redacted] No suitable cave openings or portals were observed along the proposed alignment or Pocahontas Road on JNF. There are no known winter hibernacula along the proposed alignment; however, it is likely that suitable winter habitat for the species is present on or within the vicinity of JNF as summer and winter habitats are often close together. Based on the habitat observations, an OAR Code 4 is assigned to this species.

This species may be temporarily affected by construction of the proposed alignment and modifications to Pocahontas Road if it is using the Project impact area for summer roosting; however, this habitat is considered marginal. It is likely the bats are roosting outside of this area (a limestone quarry was observed south of the Project area) and only using Pocahontas Road as a travel and/or foraging corridor. This species may benefit from additional clearings associated with Project development and operation as this will increase the amount of foraging habitat and may also expose currently marginal rocky outcrops thus increasing their suitability for summer roosting. This is especially important for maternity colonies as roosts with greater solar exposure decrease required energy expenditures and provide more thermal stability for young, thus increasing their probability of survival.

Blasting, if required, may temporarily disturb eastern small-footed bats in the Project area; however, no direct impacts are expected. Indirect impacts, such as sound, are not expected either as bats are not particularly sensitive to sound during hibernation. Bats echolocate and communicate using ultrasonic frequencies that are well above the human hearing range and that are much higher than the low-frequency dominated sounds generated by blasting. In addition, all blasting will occur in daytime hours when the bats are least active. Blasting may potentially disturb bats breeding, feeding, or sheltering in the area; however, they could return once the blasting ceases.

Big brown bats did not respond during hibernation when presented sound at 30-15,000 Hz and 95 dB (Twente and Twente 1987). Hibernating bats may be "deaf" if the auditory nervous system shuts down at lower temperatures used for hibernation. Harrison (1965) found no neural activity in auditory nerves of little brown bats hibernating below 54°F (12°C).

Several field studies have assessed the effect of noise on hibernating bats. In Missouri, Myers (1975) studied the effect of blasting on Indiana bats and three other bats species. The acoustic frequency of blasts ranged between 1 and 40 Hz; seismic vibrations of blasting are between 3 to 1000 Hz. With blasts as close as 394 feet (120 m) to hibernating Indiana bats and 98 feet (30 m) to eastern pipistrelle bats, he found no evidence of disturbance.

In New York, Besha (1984) identified increasing populations of hibernating Indiana bats near Jamesville with a quarrying operation 1,000 feet (304.8 m) from the cave, with blasts involving up to 200 pounds (90.7 kg) of explosive. He noted a similar situation at Howes Cave and at Glen Park. Blasting at Glen Park occurred within 400 feet (121.9 m) of the bats.

At Fort Leonard Wood, Missouri, training mission activities near hibernacula of endangered Indiana and gray bats included small arms fire, construction engineers' training (clamshells, bulldozers, graders, earthmovers, CEVS, and scrappers), demolition of explosive ordnances, heavy ordnance demolition, and F16 and A10 strafing and inert bomb training. Indiana bats and surrogate bat species were brought into the laboratory and presented sound and seismic stimuli during hibernation. Stimuli duration and intensity mimicked those under field conditions, up to 25 percent of actual distances to hibernacula. Sound stimuli was presented for 3 to 10 minutes at 93 to 126 decibels, at frequencies like those at each of the training ranges (Range 1: 20 - 20,000 Hz with a dominant frequency of 1,000 Hz; Range 4: 20-20,000 Hz with dominant frequency bands at 50, 63, 80, and 100 Hz; Range 36: 25 - 20,000 Hz with dominant frequency bands at 25, 31.5, 50, 63, 80, 200, and 250 Hz; Range TA 244: 24 - 20,000 Hz with dominant frequency bands at 200, 400, 500, 630, 800, and 1000 Hz). Bats were also presented seismic stimuli of magnitudes representing 250-pound

charges at 531 feet and 985 feet. This study concluded that sound and seismic stimuli from training activities would not affect hibernating bats (3D/Environmental 1996).

5.3 American Barberry (*Berberis canadensis*)

American barberry is a deciduous shrub with a range from southern Pennsylvania to northern Georgia and as far west as Missouri. Its habitat includes dry open woodlands, rocky slopes, cliffs, bluffs, exposed hillsides, mountains, and occasionally calcareous siltstone, shale, and sandstone (Hill 2003). Neutral well-drained soils are preferred (Harvill et al. 1981).

A **No Impacts** determination is made for American barberry. This species was found at four locations during plant surveys on pipeline routes on JNF land [redacted]. Although potentially suitable habitat is present within the Project area, the species is likely absent based on the negative survey results. It is unlikely to be directly impacted by Project development and operation; however, this species may benefit from an increase of potentially suitable habitat (woodland clearings and exposed hillsides) associated with the construction of the ROW.

5.4 Rock Skullcap (*Scutellaria saxatilis*)

Rock skullcap is a perennial herb that prefers mesic to dry, rocky forests and boulder fields. It frequently occurs in mountains and occasionally can be found on stream banks. This species is known from all counties crossed by the proposed alignment on JNF land (Strausbaugh and Core 1978, Gleason and Cronquist 1991).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for rock skullcap. A single population of approximately 10,000 individuals was identified [redacted]. This population spans approximately 1.45 hectares (3.58 ac); however, only an approximate 0.78 hectare (1.94 ac) is within the proposed construction ROW (Appendix A, Figure 4, Maps 1-4) as the proposed alignment was shifted in this area to avoid the majority of this population. Additionally, the construction footprint of the pipeline ROW in this area was reduced to 23 meters (75 ft) to minimize impacts to this species. This species was also observed on alternative routes not part of the pipeline alignment. Habitat does not appear to be a limiting factor for this species on JNF; therefore, a trend toward federal listing or loss of viability is not expected.

5.5 Diana Fritillary (*Speyeria diana*)

The Diana fritillary, a butterfly, feeds on a variety of flowering plant species while occupying deciduous or mixed forests with moist rich soil (Wells and Smith 2013). The species may also occupy adjacent fields, pastures, shrublands, and grasslands during various stages of its life. The Diana fritillary is known from Monroe County, West Virginia and Giles and Montgomery counties, Virginia.

A **Beneficial Impacts** determination is made for the Diana fritillary. Potentially suitable habitat was identified during field habitat assessments; however, the species itself was not observed during surveys. The biggest threat to the Diana fritillary from Project development and operation would be removal of potentially suitable habitat from the Project area; however, this species is known to benefit from the presence of woodland clearings, including ROWs, as they increases the amount of nectar forage available. Construction of the ROW will increase the amount of potentially suitable habitat for this species. Revegetation of the ROW will follow a two-step process as recommended by the USFS. This includes stabilization of soils immediately following tree removal and construction activities with appropriate seed mixes and techniques, as well as revegetation of the ROW corridor as needed with native seed mixes recommended in consultation with the USFS.

5.6 Regal Fritillary (*Speyeria idalia*)

A petition to list the regal fritillary was submitted to the USFWS in April 2013 (WildEarth Guardians 2013); listing status is currently under review. The regal fritillary is a relatively large butterfly that uses a variety of habitats such as herbaceous wetlands, riparian areas, grasslands, old fields, and savannas; however, it prefers high-quality remnant tallgrass prairies. Nectar sources for the entire flight season are very important, and the regal fritillary prefers areas with wet patches or streams (Wagner et al. 1997, Wells and Smith 2013). The species primarily deposits eggs in close proximity to violets (especially birdfoot violet [*Viola pedata*] and prairie violet [*V. pedatifida*]), which are the sole sources of food for larvae (Allen 1997). Suitable habitat exists along the proposed alignment.

A **Beneficial Impacts** determination is made for the regal fritillary. This species was not observed during field habitat assessments and surveys; however, it possibly occurs along the proposed alignment based on the presence of potentially suitable habitat. The biggest threat to the regal fritillary from Project development and operation would be removal of potentially suitable habitat from the Project area; however, this species is only known from clearings in forested ecosystems and would potentially benefit from the presence of woodland clearings, including ROWs. Construction of the ROW will increase the amount of potentially suitable habitat for this species. Revegetation of the ROW will follow a two-step process as recommended by the USFS. This includes stabilization of soils immediately following tree removal and construction activities with appropriate seed mixes and techniques, as well as revegetation of the ROW corridor as needed with native seed mixes recommended in consultation with the USFS.

5.7 Sweet Pinesap (*Monotropsis odorata*)

Sweet pinesap is a vascular plant found in mesic to dry upland forests, typically under oaks, pines, or shrubs (Kartesz 1994). In Virginia, it is known from multiple counties,

including Montgomery (Kartesz 1994). This species is difficult to observe in the field due to its small size and propensity for blending in with and being covered by leaf litter.

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for sweet pinesap. Potentially suitable habitat for this species was identified in the field; however, this plant was not found during the plant survey. Its absence from the Project area cannot be confirmed due to the presence of potentially suitable habitat and its obscure nature. Project development and operation could remove potentially suitable habitat from the Project area. However, given the abundance of such habitat on JNF, coupled with this species' often concealed nature, it is likely sweet pinesap is more common than documented. While some potentially suitable habitat will be removed (and potentially concealed individuals), the generality of the habitat preferences for this species will prevent a trend toward federal listing or loss of viability.

5.8 Yellow Lance (*Elliptio lanceolata*)

The yellow lance was proposed for federal listing under the ESA on April 5, 2017. This species is an elongate freshwater mussel approximately 7.6 centimeters (3 in) long and is usually found in the main channels of streams, some as small as 0.9 meter (3 ft) in width (Johnson 1970). It is native to Atlantic slope drainages such as the James River basin. The species is typically found in clean, unimpounded areas of streams of varying sizes with substrates of smaller material (e.g., sand and fines).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for yellow lance. Populations of this species were not identified at any of the Project stream crossings, and the closest known population (according to the VDGIF WERMS database) occurs in Craig Creek downstream of the confluence with Barbours Creek approximately 58 stream kilometers (36.0 mi) downstream of the Project area. However, given the known presence of the species within the Upper Johns Creek Subwatershed (020802011101), a similarly sized watershed adjacent to the Trout Creek-Craig Creek Subwatershed, the species may occur closer to the Project area than what is documented in the WERMS database. The species is known to occupy the Upper James River (HUC Code 02080201) subbasin; however, it typically inhabits relatively large creeks and small rivers. The Project may result in temporary sedimentation increases within streams downstream of the Project area. Acute siltation events and chronic turbidity have been documented to reduce growth rates and survivability in other mussel species. According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (MVP 2017), increased sedimentation rates in excess of 10 percent are not expected to occur outside the negative survey extent for the Project (i.e., beyond the areas where no mussels were observed). More than 20 mussel survey records exist in the Trout Creek-Craig Creek Subwatershed (including

past records upstream and downstream of the Project crossing and mussel surveys associated with the Project); however, no yellow lance have been collected.

5.9 Atlantic Pigtoe (*Fusconaia masoni*)

The Atlantic pigtoe is currently under review for federal listing under the ESA. This species, a freshwater unionid mussel, is typically found in swift, clean, and well-oxygenated streams, larger in size (e.g., large creek to medium-sized river) with gravel and sand substrates (Terwilliger 1991). This species was designated as state threatened in Virginia in January 1987. Atlantic pigtoe is one of the Atlantic slope unionids that prefers to inhabit the upper parts of rivers, usually above the geological boundary, typically denoted by rapids or a waterfall, between an upland region and a plain (i.e., fall line).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for Atlantic pigtoe. Populations of this species were not identified at any of the Project stream crossings, and the closest known population (according to the VDGIF WERMS database) occurs in Craig Creek downstream of the confluence with Johns Creek approximately 48.6 stream kilometers (30.2 mi) downstream of the Project area. However, given the known presence of the species within the Upper Johns Creek Subwatershed (020802011101), a similarly sized watershed adjacent to the Trout Creek-Craig Creek Subwatershed, the species may exist closer to the Project area. The species is known to occupy the Upper James River (02080201) subbasin; however, it typically inhabits relatively large creeks and small rivers. The Project may result in temporary sedimentation increases within stream habitat downstream of the Project area. Acute siltation events and chronic turbidity have been documented to reduce growth rates and survivability in other mussel species. According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (MVP 2017), increased sedimentation rates are not expected to occur outside of the Trout Creek-Craig Creek Subwatershed, and the cumulative impact area (i.e., areas with a 10 percent increase or more in sediment load) does not extend beyond the negative survey area. According to the VDGIF WERMS database, more than 20 mussel survey events occurred in the Trout Creek-Craig Creek Subwatershed (including past records upstream and downstream of the Project crossing and mussel surveys associated with the Project); however, no Atlantic pigtoe have been collected.

5.10 Candy Darter (*Etheostoma osburni*)

The candy darter, a benthic fish species that is currently under review for federal listing under the ESA. The candy darter is considered rare in Virginia. Adults inhabit unsilted runs, riffles, and swift pockets of current in and around large rubble and boulders. Candy darters are threatened by degraded water quality resulting primarily from siltation, stocked trout, and habitat disturbance by recreationists (i.e., anglers walking through possible spawning site) (Leftwich et al. 1996). Their range includes the New

River drainage, in the Ridge and Valley Province of Virginia, and the Appalachian Plateaus of West Virginia. In Virginia, they are commonly found in Big Stony Creek (also referred to as Stony Creek) (Leftwich et al. 1996). They are extremely localized in Laurel Fork and Clear Creek of the Wolf Creek system and Dismal Creek. They are also known from Reed, Big Walker, Little Stony, and Sinking creeks, and Spruce and Pine runs (Jenkins and Burkhead 1994).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the candy darter. Potentially suitable habitat and populations are likely at the Project crossings of Stony Creek near JNF as well as downstream of the Project area in the New River. Extensive surveys in 1995 in Stony Creek demonstrated that the species was distributed throughout the upper portion (i.e., upstream of the gypsum plant of Stony Creek) (Leftwich et al. 1996), and more recent information available from the VDGIF demonstrates that the species also occurs in the lower portion. The Project crosses Stony Creek approximately 1.9 kilometers (1.2 mi) upstream of the confluence with the New River, thereby limiting the potential for sedimentation impacts only to fish populations in the lower portions of Stony Creek; however, downstream impacts from Project activities occurring in the catchment (e.g., Kimballton Creek watershed) also has the potential to impact the species. Baseline sediment loads within Stony Creek and the New River are relatively high, and therefore it is unlikely that the Project will cumulatively impact Stony Creek in a detectable way. Furthermore, the increased river discharge of the New River will help facilitate the dilution of potential sedimentation effects if they are to occur. The Project may result in temporary destabilization or removal of localized substrates. Fish-removal surveys are proposed to occur in Virginia at each perennial stream crossing immediately prior to construction. Therefore, all fishes will be removed from the instream construction footprint, limiting the potential for a direct take of individuals, if present. Downstream populations of candy darter may potentially experience minimal and temporary indirect effects in the form of sedimentation as a result of upland and instream construction activities; however, the implementation of erosion and sediment control measures is expected to limit such impacts. According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (MVP 2017), sediment loads originating from the Project are expected to be less than 10 percent above baseline within this portion of Stony Creek. Due to avoidance measures (e.g., fish removals), implementation of erosion and sediment control measures during construction, and adherence to time-of-year restrictions (TOYR [August 15 – July 31]), the Project is not likely to cause a trend toward federal listing or a loss of viability for this species.

5.11 Roughhead Shiner (*Notropis semperasper*)

The roughhead shiner is a medium-sized minnow with an elongated body and pointed dorsal and anal fins with falcate margins. This species is endemic to the Ridge and Valley Province of the upper James River watershed (Stauffer et al. 1995). Habitat for

the roughhead shiner includes clear rocky pools and backwaters of small to large rivers (Page et al. 2011) as well as cool to warm clear pristine streams with moderate gradient, hard bottom, and little siltation. This species prefers moderate currents of runs but can occasionally be found in swifter water (Jenkins and Burkhead 1994).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the roughhead shiner. The Project traverses Craig Creek in the Trout Creek-Craig Creek Subwatershed. Craig Creek is known to support populations of roughhead shiner; however, all known occurrence records (according to the VDGIF WERMS database) are approximately 27.1 kilometers (16.9 mi) downstream of the Project crossing and outside of the Trout Creek-Craig Creek Subwatershed. Therefore, direct effects to the species are unlikely. Fish removal surveys are proposed to occur at each perennial stream crossing in Virginia immediately prior to construction. Therefore, all fishes will be removed from the instream construction footprint, limiting the potential for a direct take of individuals, in the unlikely event that roughhead shiner is present. The Project may result in temporary sedimentation increases within potentially suitable roughhead shiner habitat downstream of the Project area. The implementation of erosion and sediment control measures is expected to reduce the sedimentation yields in the Trout Creek-Craig Creek Subwatershed; however, elevated sedimentation rates are predicted to occur for approximately 0.47 kilometer (0.29 mi) within Craig Creek and 3.09 kilometers (1.92 mi) within unnamed tributaries (Table 4). Given that the closest known occurrence of the roughhead shiner is approximately 27.1 kilometers (16.9 mi) downstream of the Project area, any potential impacts are expected to be minimal and temporary and not likely to cause a trend toward federal listing or a loss of viability for this species.

5.12 Orangefin Madtom (*Noturus gilberti*)

The orangefin madtom has a long, slender body and a flattened head ranging in length from 5 to 7.6 centimeters (2 to 3 in). It is olive to brown in color on the dorsal side, and yellow to white on the ventral side, with yellow to white edges on its fins. The species occurs in rocky riffles in small swift-moving rivers and streams. The species typically spawns in 10 to 20 degree Celsius water from April through May. Orangefin madtom is currently under review for federal listing under the ESA and is considered a state-threatened species in Virginia.

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the orangefin madtom. Two distinct populations of this species occur in Virginia: a native population in the Roanoke River drainage and an introduced population in the James River drainage. The Project traverses both drainages and is therefore within the range of both populations. The species is known to occupy the Upper James River (HUC Code 02080201) and Upper Roanoke River (HUC Code 03010101) subbasins; however, there are no collections of the species within the Trout Creek-Craig Creek or Dry Run-North Fork Roanoke

River subwatersheds. The native population in the Roanoke River subbasin is not likely to occur on JNF lands; however, the introduced population in Craig Creek is known to occur immediately downstream of the Trout Creek-Craig Creek Subwatershed. Fish-removal surveys are proposed to occur at each perennial stream crossing in Virginia immediately prior to construction. Therefore, all fishes will be removed from the instream construction footprint, limiting the potential for a direct take of individuals, if present. The Project may result in temporary sedimentation increases within potentially suitable orangefin madtom habitat downstream of the Project area. The implementation of erosion and sediment control measures is expected to reduce the sedimentation yields in the Trout Creek-Craig Creek Subwatershed; however, elevated sedimentation rates are predicted to occur for approximately 0.47 kilometer (0.29 mi) within Craig Creek and 3.09 kilometers (1.92 mi) within unnamed tributaries (Table 4). Project-related impacts may potentially affect individuals and potentially suitable habitats of the introduced population in the Trout Creek-Craig Creek Subwatershed. Any impacts are expected to be minimal and temporary and not likely to cause a trend toward federal listing or a loss of viability for this species.

5.13 Kanawha Minnow (*Phenacobius teretulus*)

The Kanawha minnow is an elongate, slender minnow with a dark dorsal, greenish sides; a pale, silvery underside; and orange-tinged fins and tail. This species is endemic to the New River system of North Carolina, Virginia, and West Virginia. This species prefers the riffles and runs over bedrock or boulder substrates in medium-sized rivers (Stauffer et al. 1995). The species is known to occupy the Middle New River (HUC 05050002) subbasin; however, according the VDGIF WERMS database, the species has only been captured in a few localities within the subbasin.

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for the Kanawha minnow. According to the VDGIF WERMS database, the closest known population occurs within the Little River drainage, a tributary of the New River located upstream and outside of the Project area; therefore, direct effects to the species are not expected. Fish-removal surveys are proposed to occur at each perennial stream crossing in Virginia immediately prior to construction. Therefore, all fishes will be removed from the instream construction footprint, limiting the potential for a direct take of individuals, in the unlikely event the species is present. The Project may result in temporary sedimentation increases within potentially suitable Kanawha minnow habitat downstream of the Project area; however, with the exception of Rich Creek, impacts to waterbodies within the New River drainage are largely confined to smaller waterbodies where the Kanawha minnow is unlikely to occur (Stauffer et al. 1995). Due to avoidance of suitable habitats and implementation of erosion and sediment control measures during construction, the Project is not likely to cause a trend toward federal listing or a loss of viability for this species.

5.14 Green Floater (*Lasmigona subviridis*)

The green floater is currently under review for federal listing under the ESA. This species, state-threatened in Virginia, is a small freshwater mussel, typically less than 5.1 centimeters (2 in) long. It has a trapezoidal to subovate shape and is yellow-green in color. This species mainly occurs in stagnant pools and other calm-water pockets 0.3 to 1.2 meters (1 to 4 ft) in depth. It is native to many drainage basins in the United States, including the New and James River basins. The species is typically found in clear pool habitats of streams of varying sizes with substrates of gravel and sand. The species is known to occupy the Middle New River (HUC Code 05050002) and Upper James River (HUC Code 02080201) subbasins.

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for green floater. Mussel surveys were performed at stream crossings, known or with potential to, support freshwater mussels in Virginia and West Virginia. Green floater mussels were not encountered during surveys; therefore, a direct take of individuals is unlikely. Green floater populations may occur both upstream and downstream of JNF land, particularly within Stony Creek. According to the VDGIF WERMS database, the closest known occurrence of green floater within the Upper James occurs outside of the Craig Creek drainage. However, within the Middle New, relic shells have been collected in relative proximity to the Project, but only within the New River between Little Stony Creek and Stony Creek (Pinder et al. 2002). Although no individuals have been collected within Stony Creek, the drainage area may be large enough to contain the species, and suitable habitat was available at the crossing when assessed for the Project. The proposed Project crosses Stony Creek approximately 1.9 kilometers (1.2 mi) upstream of the confluence with the New River thereby, limiting potential sedimentation impacts only to populations (if present) in the lower portions of Stony Creek. According to the Hydrologic Analysis of Sedimentation conducted in support of this BE (MVP 2017), sediment loads originating from the Project are expected to be less than 10 percent above baseline within this portion of Stony Creek. Acute siltation events and chronic turbidity have been documented to reduce growth rates and a lack of survivability in other mussel species. Any impacts are expected to be minimal and temporary and not contribute to reduced growth rates and a lack of survivability.

5.15 Green-faced Clubtail (*Gomphus viridifrons*)

The green-faced clubtail is a small, primarily black dragonfly with a clear gray-green face. It prefers clean, small to large, highly oxygenated streams with a moderate current. The larval (i.e., nymph) stages of the species prefers substrates that consist of gravel-sand and lightly silted rocks. This species has an extremely local distribution, slightly under 50 counties across approximately 15 states (Dunkle 2000).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for green-faced clubtail. The proposed

alignment traverses streams within the known range of the green-faced clubtail and some streams may support populations of the species. Populations of the species (nymph stages) may occur at Project stream crossing locations where a direct take of individuals could occur, and downstream of construction activities, nymphs (if present) may be subject to sedimentation issues. Adults are highly mobile and are likely able to avoid direct mortality by construction activities within the Project area. Green-faced clubtail exhibits a broad geographic distribution across numerous regions and states and any potential indirect effects due to temporary sedimentation are not likely to cause a trend toward federal listing or a loss of viability for this species.

5.16 Allegheny Snaketail (*Ophiogomphus incurvatus alleganiensis*)

The Allegheny snaketail is a dragonfly that requires riffle areas of spring-fed piedmont streams for nymph growth and seems to prefer shallow waters where gravel lies over soft mud. It has been found in Monroe County, West Virginia but is considered to be possibly extirpated from Giles County, Virginia along the proposed alignment (Schweitzer 1989, Needham et al. 2000).

A **May Impact Individuals – Is Not Likely to Cause a Trend Toward Federal Listing or Loss of Viability** determination is made for Allegheny snaketail. The proposed alignment traverses streams within the known range of the Allegheny snaketail and some streams may support populations of the species. Populations of the species (nymph stages) may occur at Project stream crossing locations where a direct take of individuals could occur; if present downstream of construction activities, nymphs may be subject to sedimentation issues. Adults are highly mobile and are likely able to avoid direct mortality by construction activities. This species is considered extirpated from the Project counties; therefore, it is not expected in the Project area. Sedimentation impacts may occur downstream of the Project area if nymphs are present; however, any potential effects are not expected to cause a trend toward federal listing or a loss of viability of this species.

6.0 Recommendations for Avoiding, Minimizing, and Mitigating for Adverse Effects and Impacts

Project-wide mitigation measures are included in Appendix G. Conservation measures to avoid and minimize the potential for adverse effects from construction, operation, and maintenance activities on federally listed species and their suitable habitat will be detailed in the BA whereas such measures for Forest Service Sensitive Species are provided below.

6.1 Eastern Small-footed Bat

Notifications will be made to JNF biologists and the appropriate federal and state agencies if undocumented caves, mine openings, or rock outcrops are observed during construction activities, including blasting (if required). These openings will be assessed for use by bats and conservation measures will be implemented based on coordination with JNF and the respective agencies.

Indirect effects from blasting are not expected to detrimentally impact eastern small-footed bats in the vicinity of the Project area. If blasting is required, Mountain Valley will utilize mitigation measures to reduce noise and vibration, such as blasting mats or padding, restricted charge sizes, and/or charge delays.

6.2 Rock Skullcap

The construction footprint through the rock skullcap area will be reduced to 23 meters (75 ft) to minimize impact to the species. Additionally, seeds from existing rock skullcap plants will be collected prior to construction. These seeds will be planted during the appropriate time of year upon the completion of construction activities in locations determined in consultation with the USFS.

6.3 Forest Service Sensitive Fishes

The proposed alignment traverses streams within the known range of the candy darter, roughhead shiner, orangefin madtom, and Kanawha minnow. Avoidance and minimization measures will be implemented to prevent adverse effects to the species. In Virginia, fish-removal surveys will occur prior to instream construction to prevent a direct take of individuals. Instream construction activities will be scheduled in accordance with the Virginia TOYR at streams potentially supporting sensitive fish populations. The TOYR for roughhead shiner is March 15 to June 30, August 15 to July 31 for candy darter, and March 15 to May 31 for orangefin madtom within its native range (Roanoke River drainage). There is no TOYR for the Kanawha minnow. Adhering to TOYR guidelines will help avoid elevated turbidity and sedimentation in the streams during critical phases of the life cycle (e.g., spawning, egg development, larval development) and help facilitate survival and proliferation of populations. To further minimize potential adverse indirect effects of sedimentation to the species, strict erosion and sediment control measures will be implemented. The implementation of these control measures will be instrumental in reducing sediment yields to all streams, particularly those watersheds expected to exceed baseline conditions (i.e., Stony Creek, Clendennin Creek – Bluestone Lake, and Trout Creek – Craig Creek).

6.4 Forest Service Sensitive Mussels

The proposed alignment traverses streams within the known range of the yellow lance, Atlantic pigtoe, and green floater. Avoidance and minimization measures will be implemented to prevent adverse effects to the species. Mussels were not located at stream crossings in the vicinity of JNF; therefore, occupied habitats are avoided, and

there will not be a direct take of individuals. Instream construction activities will be scheduled in accordance with the Virginia TOYR in streams potentially supporting mussel populations of these species. Adhering to TOYR guidelines for short-term brooding mussels (e.g., yellow lance and Atlantic pigtoe) between May 15 and July 31 and long-term brooding mussels (e.g., green floater) between April 15 to July 15 and August 15 to September 30 will help avoid elevated turbidity and sedimentation in the streams during critical autecological time periods (e.g., spawning, glochidia liberation, juvenile development) and help facilitate survival and proliferation of populations. To further minimize potential adverse indirect effects of sedimentation to downstream mussel populations, strict erosion and sediment control measures will be implemented. The implementation of these control measures will be instrumental in reducing sediment yields to all streams, particularly those watersheds expected to exceed baseline conditions (i.e., Stony Creek, Clendennin Creek – Bluestone Lake, and Trout Creek – Craig Creek).

6.5 Forest Service Sensitive Dragonflies

The proposed alignment traverses habitats for the nymph and adult life stages within the known range of the green-faced clubtail and Allegheny snaketail. To minimize direct mortality to adults by vehicles, slow speed limits along constructed access roads will be established. To further minimize potential adverse indirect effects of sedimentation to nymphs, strict erosion and sediment control measures will be implemented. The implementation of these control measures will be instrumental in reducing sediment yields to all streams, particularly those watersheds expected to exceed baseline conditions (i.e., Stony Creek, Clendennin Creek – Bluestone Lake, and Trout Creek – Craig Creek).

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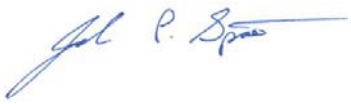

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APPENDIX A
FIGURES

Figure 1. Potential routes for the Proposed Mountain Valley Pipeline within the Jefferson National Forest in Virginia and West Virginia.

- Proposed Route
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- MVP Abandoned/Alternate Route
- National Forest (Forest Service) Lands

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.

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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

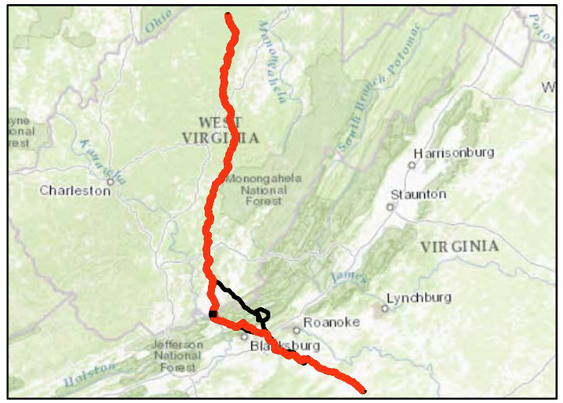
Map 1 of 12

- Proposed Route
- MVP Abandoned/Alternate Route
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 001
- Tract 002
- Tract 003
- Tract 004
- Tract 007
- Tract 008
- Tract 009
- Tract 010
- Tract 011
- Tract 032
- Tract 033
- Tract 035

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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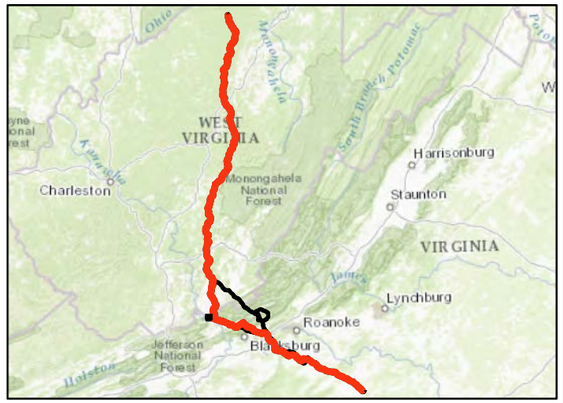
Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 2 of 12

- Appalachian National Scenic Trail (ANST)
- Pocahontas Road
- National Forest (Forest Service) Lands

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

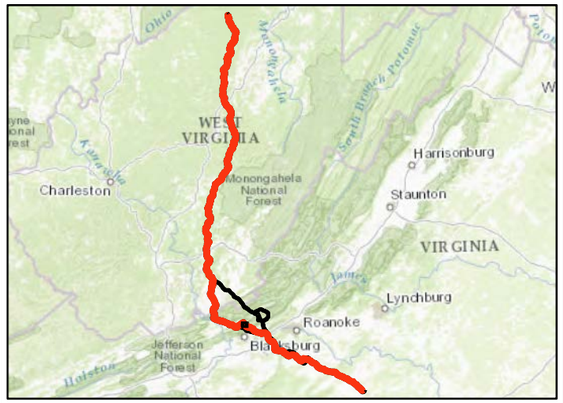
Map 3 of 12

- Proposed Route
- MVP Abandoned/Alternate Route
- National Forest (Forest Service) Lands
- Proposed All Temporary Workspace

Tract Identified on Jefferson National Forest Land

- Tract 005
- Tract 006
- Tract 034
- Tract 036
- Tract 037

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 4 of 12

MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 012

Tract 013

Tract 014

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.

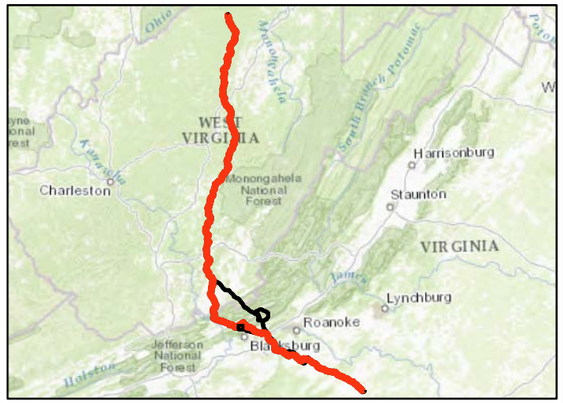

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 5 of 12

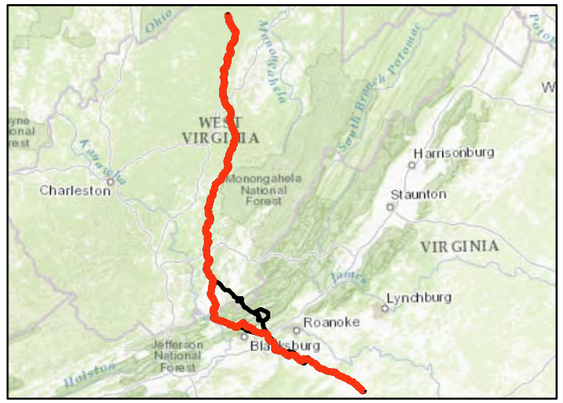
MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 015

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 6 of 12

MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

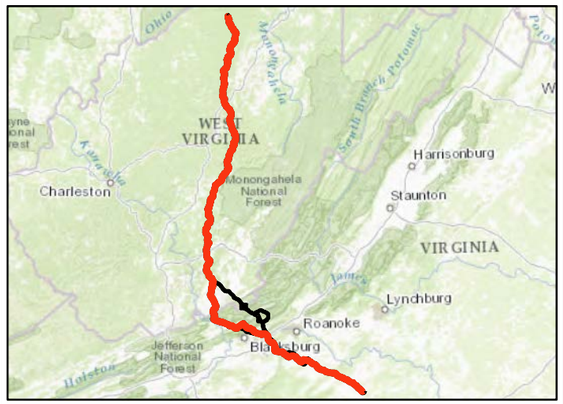
Tract Identified on Jefferson National Forest Land

Tract 016

Tract 017

Tract 018

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 7 of 12

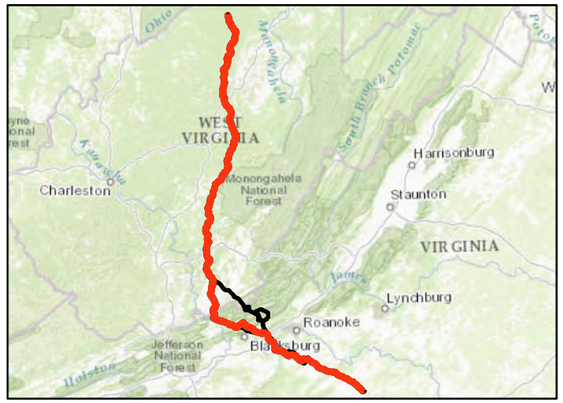
MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 019

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig2 20170516.mxd (mbrueninng) - 5/16/2017

Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 8 of 12

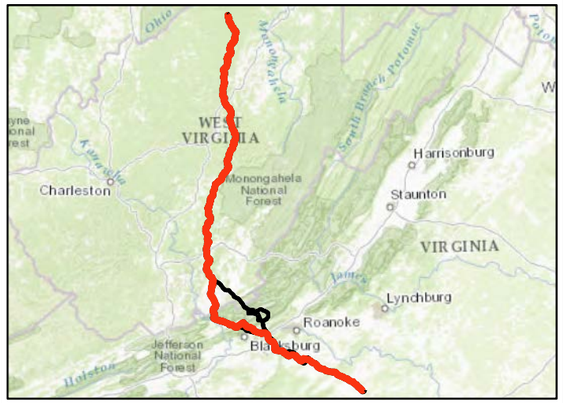
MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 020

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

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Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 9 of 12

MVP Abandoned/Alternate Route

Appalachian National Scenic Trail (ANST)

National Forest (Forest Service) Lands

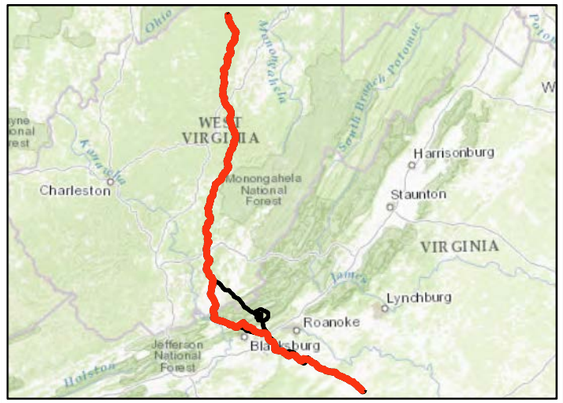
Tract Identified on Jefferson National Forest Land

Tract 021

Tract 022

Tract 026

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig2 20170516.mxd (mbruening) - 5/16/2017

Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 10 of 12

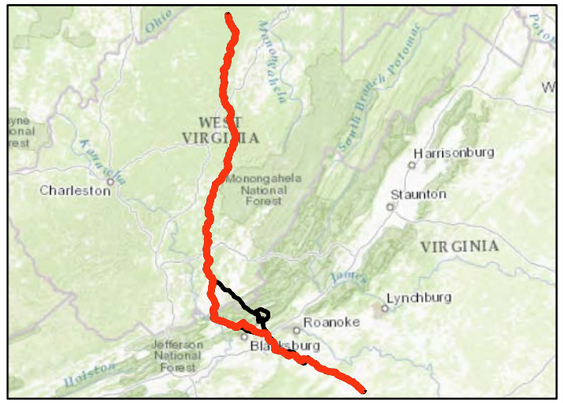
MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 023
- Tract 024
- Tract 025
- Tract 027

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI

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Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_fig\s593_BE_Appendix_A_Fig2_20170516.mxd (mbruening) - 5/16/2017

Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 11 of 12

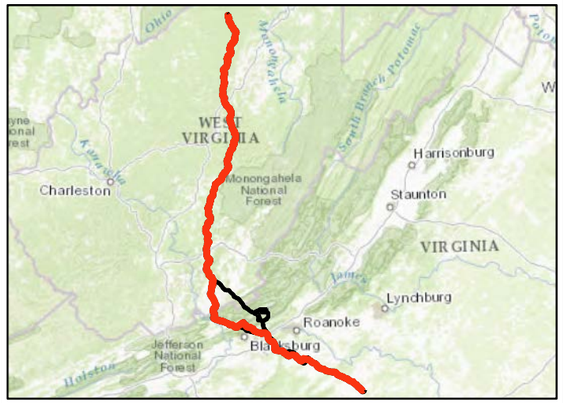
MVP Abandoned/Alternate Route

National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 028

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig2 20170516.mxd (mbruening) - 5/16/2017

Figure 2. Tracts identified along MVP's proposed alignment and previous alternatives for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

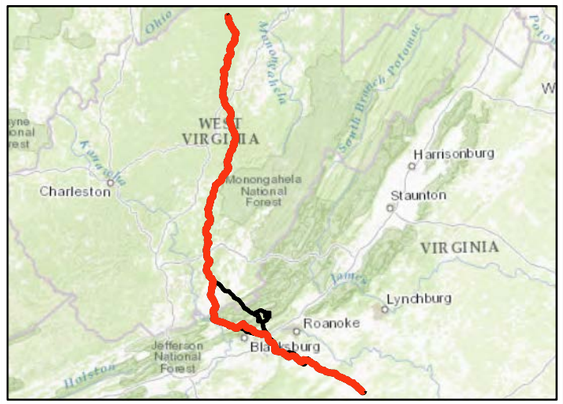
Map 12 of 12

- MVP Abandoned/Alternate Route
- Appalachian National Scenic Trail (ANST)
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 029
- Tract 030
- Tract 031

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig2_20170516.mxd (mbruening) - 5/16/2017

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

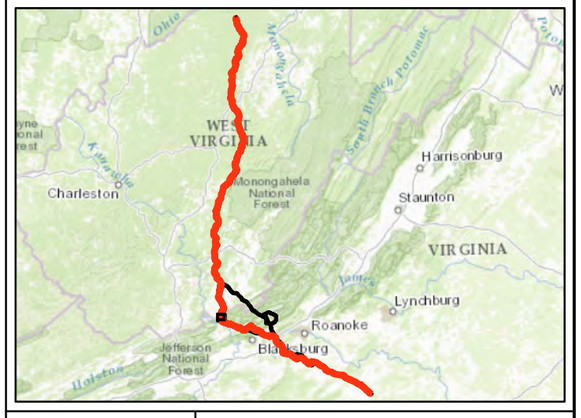
Map 1 of 12

- Proposed Route
- MVP Abandoned/Alternate Route
- Identified Stream Crossing on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

Tract 001	Tract 007	Tract 011
Tract 002	Tract 008	Tract 032
Tract 003	Tract 009	Tract 033
Tract 004	Tract 010	Tract 035

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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225 0 225 450 Meters

Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/31/2017

ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/31/2017

Rich Creek Watershed

Clendennin Creek

Clendennin Creek-Bluestone Lake Watershed

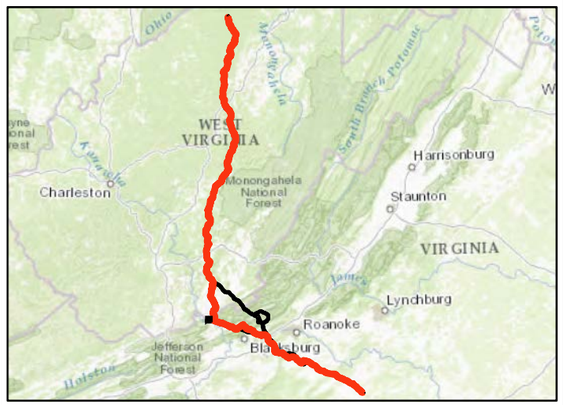
New River

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

Map 2 of 12

- Identified Stream Crossing on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Pocahontas Road
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



N W E S

150 0 150 300 Meters

Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

ESI ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig3 20170516.mxd (mbruening) - 5/16/2017

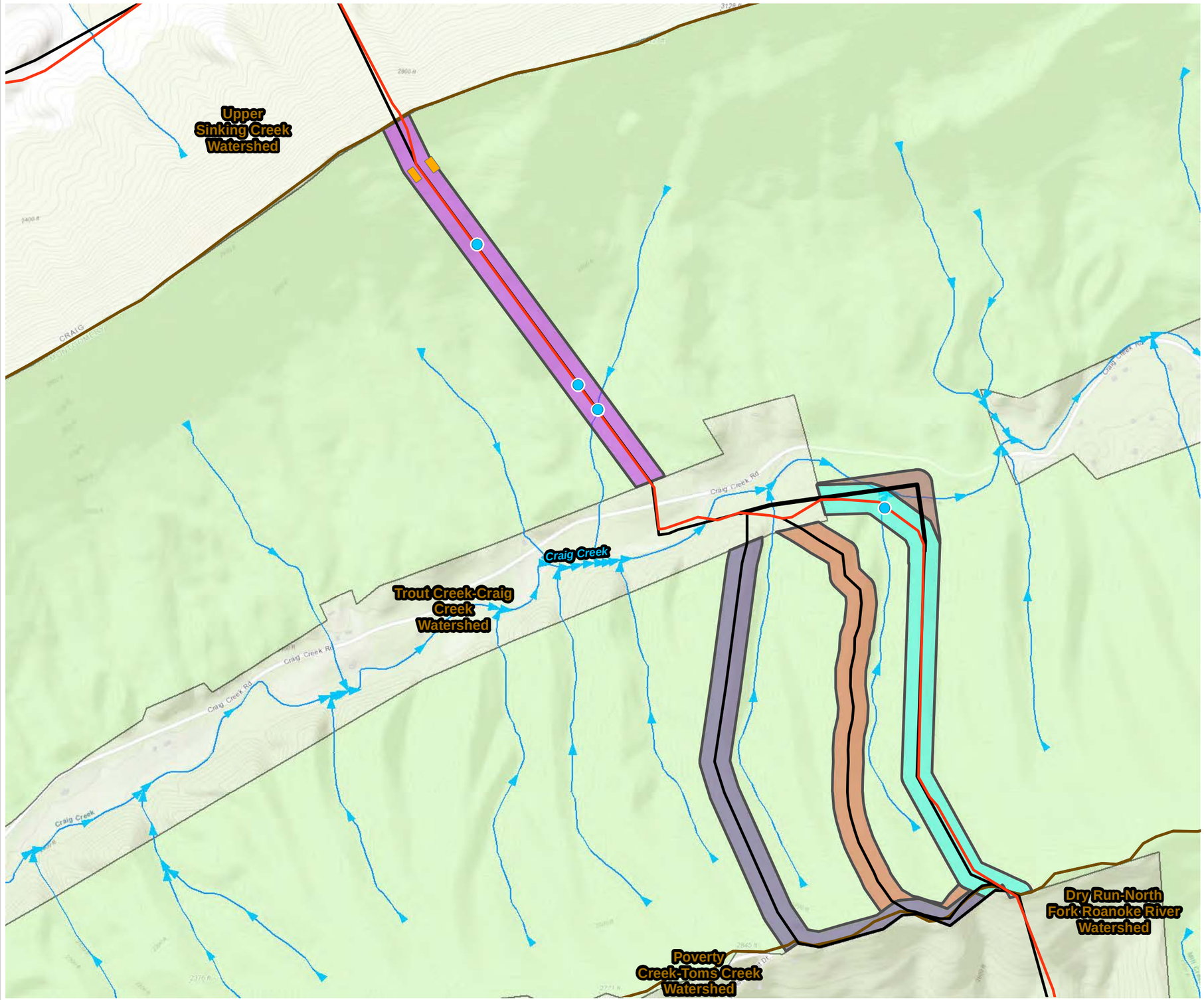


Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

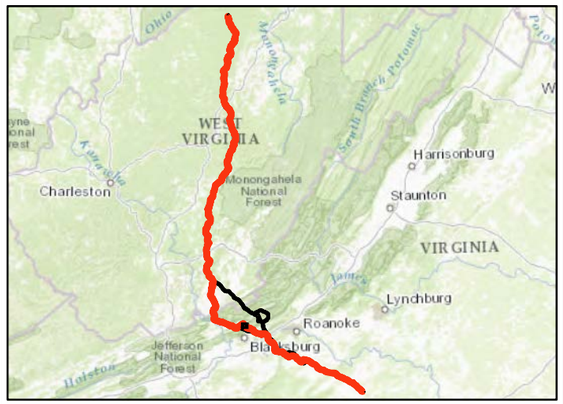
Map 3 of 12

- Proposed Route
- MVP Abandoned/Alternate Route
- Identified Stream Crossing on Jefferson National Forest Land
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 005
- Tract 006
- Tract 034
- Tract 036
- Tract 037
- Proposed ATWS

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig3 20170516.mxd (mbruening) - 5/16/2017

Upper Sinking Creek Watershed

Trout Creek-Craig Creek Watershed

Craig Creek

Poverty Creek-Toms Creek Watershed

Poverty Creek

Poverty Creek-Toms Creek Watershed

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

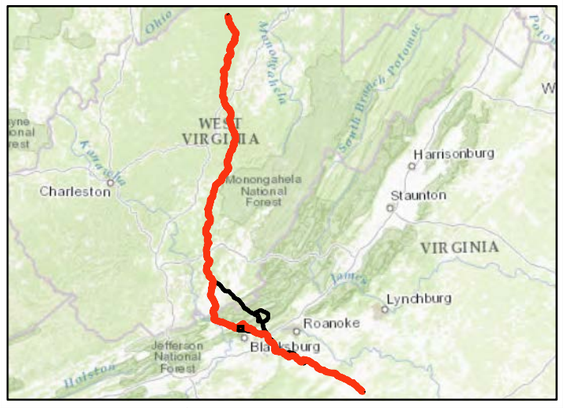
Map 4 of 12

- Proposed Route
- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 012
- Tract 013
- Tract 014

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/16/2017

Upper Indian Creek Watershed

South Fork Potts Creek-North Fork Potts Creek Watershed

Bob Branch

North Fork Potts Creek

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

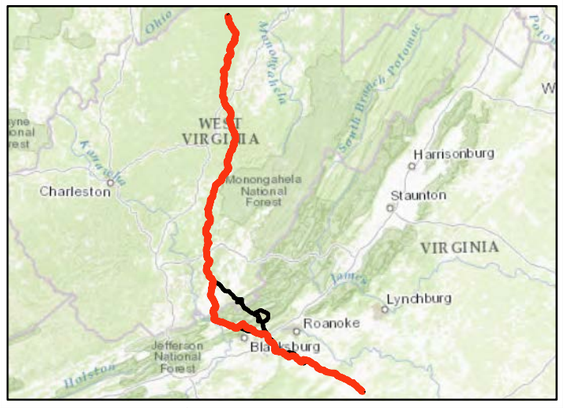
Map 5 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 015

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

ESI **ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.**

Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_fig\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/16/2017

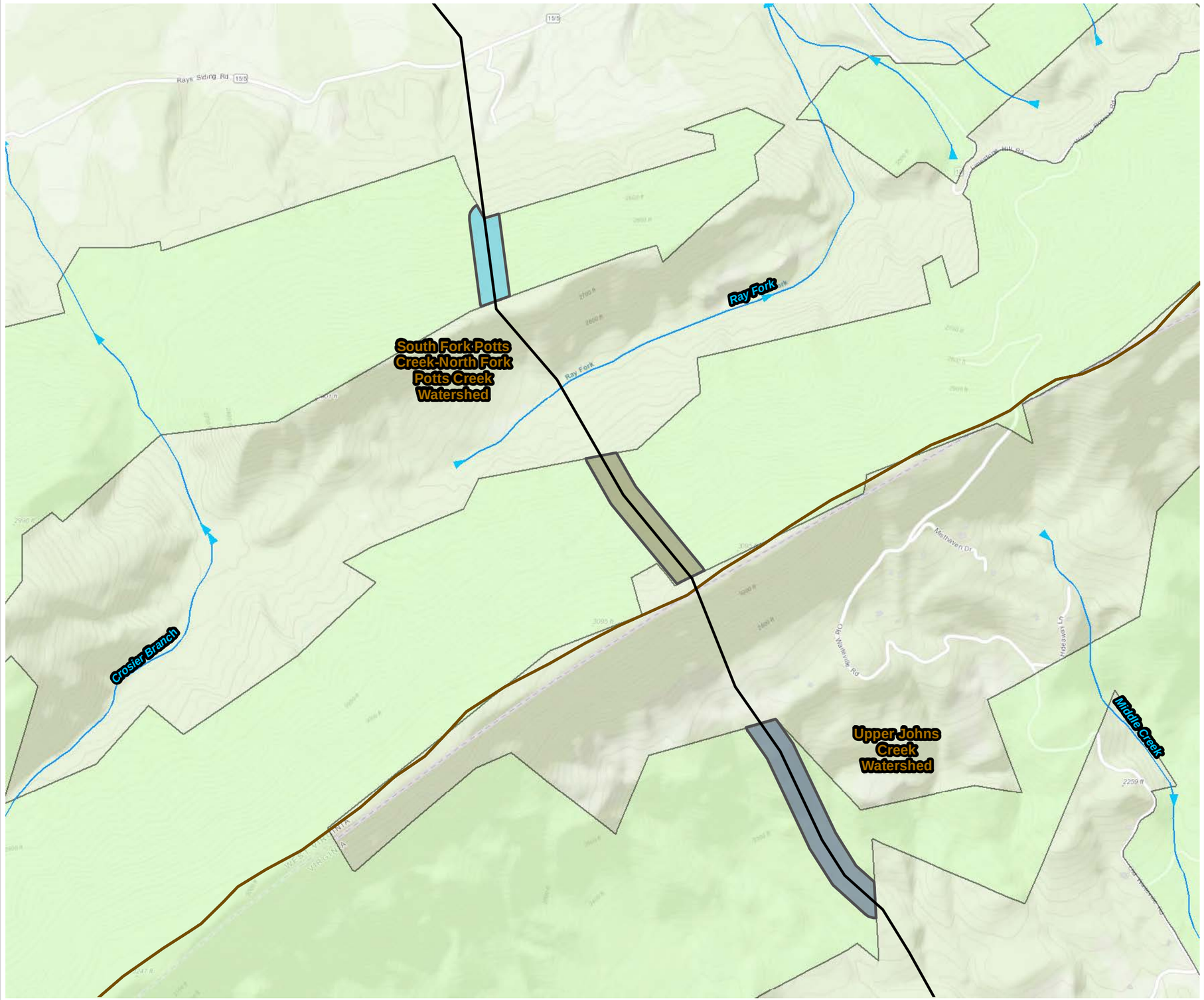


Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

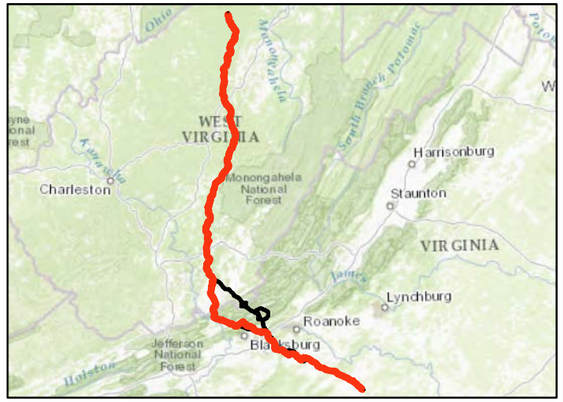
Map 6 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 016
- Tract 017
- Tract 018

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593 EQT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig3 20170516.mxd (mbruening) - 5/16/2017

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

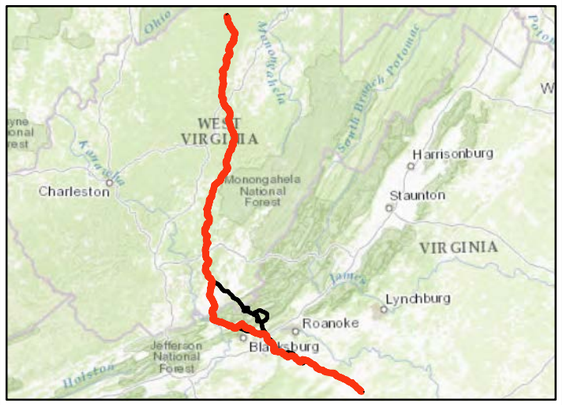
Map 7 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 018
- Tract 019

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

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Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

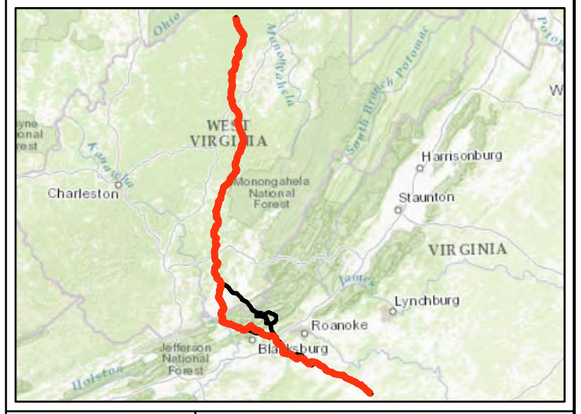
Map 8 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 020

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

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Upper Sinking Creek Watershed

Trout Creek-Craig Creek Watershed

Adaline Branch

Cabin Branch

Sandy Branch

Muddy Branch

Craig Creek

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

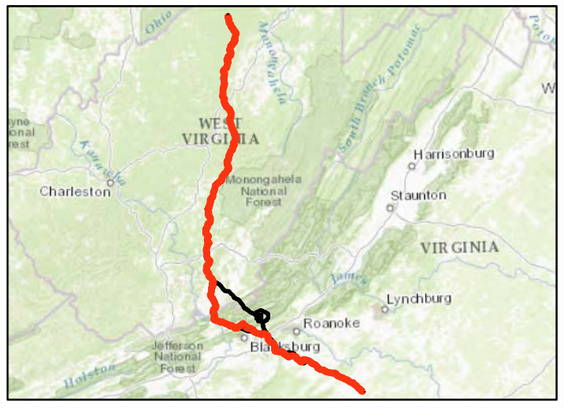
Map 9 of 12

- MVP Abandoned/Alternate Route
- Appalachian National Scenic Trail (ANST)
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 021
- Tract 022
- Tract 026

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



N W E S

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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/16/2017

Craig Creek

Trout Creek-Craig Creek Watershed

Dry Run-North Fork Roanoke River Watershed

Dickey Farm Branch

Callion Branch

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

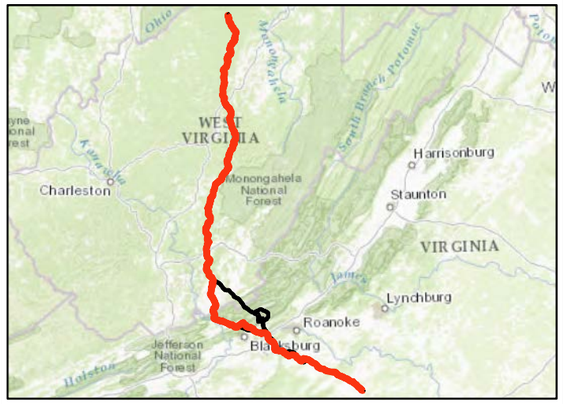
Map 10 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 023
- Tract 024
- Tract 025
- Tract 027

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix A Fig3 20170516.mxd (mbruening) - 5/16/2017

Upper Sinking Creek Watershed

Broad Run-Craig Creek Watershed

Trout Creek-Craig Creek Watershed

Turnpike Creek

Mill Creek

Hall Rd

Bar Ck Ranch Rd

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

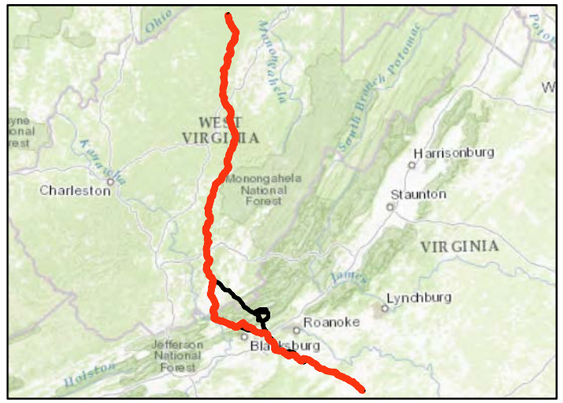
Map 11 of 12

- MVP Abandoned/Alternate Route
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 028

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/16/2017

Figure 3. Stream and watershed boundaries for tracts identified along MVP's proposed alignment for the Mountain Valley Pipeline Project within the Jefferson National Forest in Virginia and West Virginia.

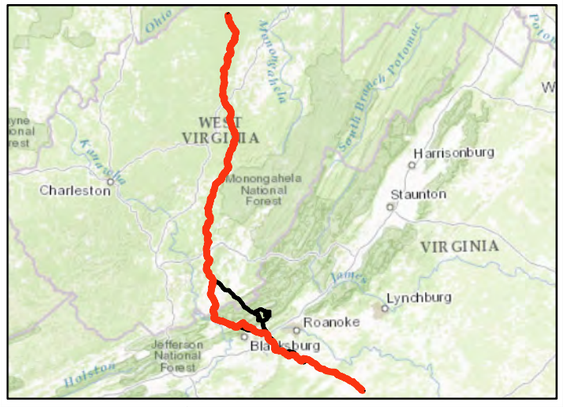
Map 12 of 12

- MVP Abandoned/Alternate Route
- Appalachian National Scenic Trail (ANST)
- National Hydrography Dataset Flowline
- National Hydrography Dataset HUC12 Watershed Boundary
- National Forest (Forest Service) Lands

Tract Identified on Jefferson National Forest Land

- Tract 029
- Tract 030
- Tract 031

NOTE: Appalachian Trail Conservancy provided an updated GIS layer on March 21, 2017.



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Base Map: ESRI ArcGIS Web service - "US TOPO MAPS" accessed - 5/16/2017

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Project No. 593.02

Path: G:\Current\593_EOT_MVP\MXD\Biologic_Eval\20170516_BE_figs\593_BE_Appendix_A_Fig3_20170516.mxd (mbruening) - 5/16/2017

FIGURE 4
REMOVED: CONTAINS CONFIDENTIAL INFORMATION

APPENDIX B
DOCUMENTATION OF THREATENED, ENDANGERED, OR SENSITIVE SPECIES OCCURRENCES FOR THE JEFFERSON NATIONAL FOREST (OCCURRENCE ANALYSIS RESULTS TABLE)

APPENDIX B
Documentation of Threatened, Endangered or Sensitive Species Occurrences for Jefferson National Forest
Coding for Occurrence Analysis Results (OAR) for 193 species

Forest updated July 28, 2016 (based on Region 8 sensitive species list effective January 1, 2002)

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
VERTEBRATE										
Fish										
1	-	X	*Ammocrypta clara*	Western sand darter	Clinch R, Powell R	Aquatic-rivers	S	G3	S1	-
1	-	X	*Cottus baileyi*	Black sculpin	Little R, Upper Clinch R, S Fk Holston R	Aquatic-streams	S	G4Q	S2	-
1	-	X	*Chrosomus cumberlandensis*	Blackside dace	Upper Cumberland R, Upper Powell R, Poor Fk Cumberland R	Aquatic-streams	T	G2	S1	S3 (KY)
1	-	X	*Chrosomus tennesseensis*	Tennessee dace	Lick Ck, N Fk Holston R, Beaverdam Ck, M Fk Holston R	Aquatic-streams	S	G3	S1	-
1	-	X	*Erimonax monachus*	Spotfin chub	Lower N Fk Holston R	Aquatic-streams	T	G2	S1	-
1	-	X	*Erimystax cahni*	Slender chub	Two sites - Powell R, Lee Co	Aquatic-rivers	T	G1	S1	-
1	-	X	*Etheostoma acuticeps*	Sharphead darter	S and Middle Fk Holston R	Aquatic-rivers	S	G3	S1	-
8	-	X	*Etheostoma osburni*	Candy darter	Big Stony Ck, Laurel Fork in New R watershed	Aquatic-streams	S	G3	S1	S2
1	-	X	*Etheostoma percnurum*	Duskytail darter	Copper Ck, Clinch R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Etheostoma tippecanoe*	Tippecanoe darter	Four sites Clinch R, lower Copper Ck	Aquatic-rivers	S	G2	S1	S2
1	-	X	*Icthyomyzon greeleyi*	Mountain brook lamprey	M, N Fk Holston R, Copper Ck, Indian Ck, Clinch R, Powell R	Aquatic-rivers	S	G3G4	S2	S1
1	-	X	*Notropis ariommus*	Popeye shiner	N Fk Holston R, Clinch R, Powell R	Aquatic-rivers	S	G3	S2S3	S2
8	X	X	*Notropis semperasper*	Roughhead shiner	Upper James R watershed above Buchanan	Aquatic-rivers	S	G2G3	S2S3	-
1	-	X	*Noturus flavipinnis*	Yellowfin madtom	Lower & Mid reaches of Copper Ck, Powell R	Aquatic-streams	T	G1	S1	-
8	X	X	*Noturus gilberti*	Orangefin madtom	S Fk Roanoke R watershed, Roanoke R above Salem, Craig Ck, Johns Ck, Cowpasture R	Aquatic-streams	S	G2	S2	-
1	-	X	*Percina burtoni*	Blotchside logperch	N Fk Holston R, Clinch R, Copper Ck, Little R	Aquatic-rivers	S	G2G3	S1	-
7/9	-	X	*Percina rex*	Roanoke logperch	Upper Roanoke R watershed	Aquatic-rivers	E	G1G2	S1S2	-
1	-	X	*Percina williamsi*	Sickle darter	N Fk Holston R above Saltville, lower Copper Ck	Aquatic-rivers	S	G2	S1S2	S2
1	-	X	*Phenacobius crassilabrum*	Fatlips minnow	Unimpounded lower S Fk Holston R, Whitetop Laurel Ck	Aquatic-rivers	S	G3G4	S2	-
8	-	X	*Phenacobius teretulus*	Kanawha minnow	Upper New R watershed	Aquatic-streams	S	G3G4	S2S3	S1
Amphibian										
1	-	X	*Plethodon hubrichti*	Peaks of Otter salamander	Peaks of Otter, Apple Orchard Mtn	Mixed oak, late successional with loose rocks and logs, >1800'.	S	G2	S2	-
1	X	-	*Plethodon punctatus*	Cow Knob salamander	Shenandoah Mtn, VA & WV	Mixed oak, late successional with loose rocks and logs, >2500'.	S	G3	S2	S1
1	-	-	*Plethodon shenandoah*	Shenandoah salamander	Three isolated populations in SNP: Hawksbill Mtn, The Pinnacles, Stony Man Mtn. GW occurrence questionable.	Talus slopes. Erroneous records from Three Ridges, The Priest, Pompeii on the Pedlar.	E	G1	S1	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	-	X	*Plethodon welleri*	Weller's salamander	Mt Rogers & Whitetop Mtn	Spruce-fir forests and adjacent northern hardwoods.	S	G3	S2	-
Bird										
2	X	X	*Falco peregrinus*	Peregrine Falcon	Hack sites late 80s and early 90s – Mt Rogers, Grayson; Cole Mtn, Amherst; Big Schloss, Shenandoah; Elliot Knob, Augusta; High Knob, Rockingham Cos. No nests, current migrant.	Nests on ledges or cliffs, buildings, bridges, quarry walls. Non-breeding sites, farmland, open country, lakeshores, broad river valleys, airports, cities. Prefers pigeons, ducks.	S	G4	S1B/S2N	S1B/S2N
2	X	-	*Haliaeetus leucocephalus*	Bald Eagle	Potomac R, James R, New R, Upper Tennessee watersheds	Feeds and nests on or near large lakes and rivers.	S	G5	S3S4B/S3S4N	S2B/S3N
2	X	-	*Lanius ludovicianus migrans*	Migrant Loggerhead Shrike	Ridge & Valley (Shenandoah Valley)	Open grasslands with trees and shrubs, fencerows.	S	G4	S2B/S3N	S1B/S2N
2	X	X	*Thryomanes bewickii altus*	Appalachian Bewick's Wren	Historical records in Botetourt, Giles, Highland Washington Cos.	Thickets, old fields, fencerows, old home sites.	S	G5T2Q	SHB/S1N	S1B/S1N
Mammal										
2	X	X	*Corynorhinus townsendii virginianus*	Virginia big-eared bat	Summer: VA - Tazewell Co (3 caves), Highland Co (1 cave); WV - Pendleton Co (4 caves); Winter: Highland, Rockingham, Bland, and Tazewell Cos (6 caves); Pendleton Co (6 caves). Largest VA population in Tazewell Co and largest WV population in Pendleton Co. Small numbers of bats (usually <10) in a few other widely scattered caves during summer months. Bath & Pulaski Co records are historic. No occupied caves currently known on Forest.	Resides in caves winter and summer. Short distance migrant (<40 miles) between winter and summer caves. Forages primarily on moths and foraging habitat is common (fields, forests, meadows, etc.). Forages within 6 miles of summer caves. USFWS Critical Habitat is 5 caves in WV (4 Pendleton Co and 1 Tucker Co). Closest Critical Habitat cave to GWJNF is ~3 miles in Pendleton Co, WV. OAR code of "2" used when project further than 6 miles from summer or winter occupied cave.	E	G3G4T2	S1	S2
1	-	X	*Glaucomys sabrinus coloratus*	Carolina northern flying squirrel	Mt Rogers & Whitetop area	Spruce-fir forests and adjacent northern hardwoods.	E	G5T2	S1	-
1	X	-	*Glaucomys sabrinus fuscus*	Virginia northern flying squirrel	Laurel Fork area, Highland Co	Spruce forests and adjacent northern hardwoods.	S	G5T2	S1	S2
1	X	-	*Microtus chrotorrhinus carolinensis*	Southern rock vole	Alleghany Mtn, Bath Co	Cool, moist, mossy talus under oaks/northern hardwoods.	S	G4T3	S1	S2
1	-	X	*Myotis grisescens*	Gray bat	Ridge & Valley, Clinch R watershed	Caves winter and summer, forages widely.	E	G3	S1	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
4	X	X	*Myotis leibii*	Eastern small-footed bat	Ridge & Valley	Hibernates in caves during winter, roosts in crevices of large rock outcrops, cliffs, and under large rocks in talus & boulder-fields during summer, plus similar man-made structures like rip-rap and bridges, forages widely in all forested and open habitat types over both ridges and valleys.	S	G1G3	S2	S1
3	X	X	*Myotis septentrionalis*	Northern long-eared bat	Blue Ridge, Ridge & Valley, Cumberland Mtns	Hibernates in crevices and cracks of cave walls during winter (sometimes mines & tunnels), difficult to find and rarely seen. During summer, forages widely and roosts singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Also may roost in structures like barns, sheds, & houses.	T	G1G2	S3	S3
3	X	X	*Myotis sodalis*	Indiana bat	Blue Ridge, Ridge & Valley, Cumberland Mtns	Caves winter, upland hardwoods summer, forages widely along riparian areas and open woodlands.	E	G2	S1	S1
1	X	-	*Sorex palustris punctulatus*	Southern water shrew	Alleghany Mtn, Bath Co; Laurel Fork, Highland Co	Riparian areas w/in spruce-fir forests and northern hardwoods.	S	G5T3	S1S2	S1
INVERTEBRATE										
Snail (Mollusk, Class Gastropoda)										
2	X	X	*Glyphyalinia raderi*	Maryland glyph	Alleghany, Montgomery Cos	Calciphile, edge of seeps within leaf litter. May burrow.	S	G2	S1S2	S2
1	X	-	*Helicodiscus diadema*	Shaggy coil	Alleghany Co	Calciphile; semi-open, calcium-rich environments, especially limestone rubble/ talus and thinly wooded limestone hills.	S	G1	S1	-
1	X	-	*Helicodiscus lirellus*	Rubble coil	Rockbridge Co	Calciphile, limestone rubble and rich fossiliferous shale talus. Found among leaf litter and limestone stones or talus, or rich shale scree, upon steep, forested slopes which are associated with certain rivers in the upper James River watershed, including Maury R & Kerr's Ck.	S	G1	S1	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	X	X	*Helicodiscus triodus*	Talus coil	Alleghany, Botetourt, Rockbridge Cos	Calciphile, limestone rubble on wooded hillsides and near cave entrances.	S	G2	S1S2	SH
1	-	X	*Io fluvialis*	Spiny riversnail	Clinch R, N Fk Holston R	Aquatic-rivers	S	G2	S2	-
2	-	X	*Paravitrea reesei*	Round supercoil	Monroe Co, WV; Grayson, Montgomery, Pulaski, Smyth Cos., VA	Calcareous woodlands and glades. Prefers moist environments.	S	G3	S2	S1
Mussel (Mollusk, Class Bivalvia)										
1	X	-	*Alasmidonta varicosa*	Brook floater	Potomac drainage	Aquatic-rivers	S	G3	S1	S1
1	-	X	*Cumberlandia monodonta*	Spectaclecase	2 sites Clinch R	Aquatic-rivers	E	G3	S1	-
1	-	X	*Cyprogenia stegaria*	Fanshell	Lower Clinch R, Scott Co	Aquatic-rivers	E	G1Q	S1	S1
1	-	X	*Dromus dromas*	Dromedary pearlymussel	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
7	X	X	*Elliptio lanceolata*	Yellow lance	Roanoke R, James R	Aquatic-rivers	S	G2G3	S2S3	-
1	-	X	*Epioblasma brevidens*	Cumberlandian combshell	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Epioblasma capsaeformis*	Oyster mussel	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
1	-	-	*Epioblasma florentina aureola*	Golden riffleshell	Restricted to lower 1.0 mile of Indian Ck to Clinch R. All other historical populations in M & Upper Tennessee R system now extirpated.	Aquatic-rivers	E	G1T1	S1	-
1	-	X	*Epioblasma torulosa gubernaculum*	Green-blossom pearlymussel	Clinch R, N Fk Holston R	Aquatic-rivers	E	G2TX	SX	-
1	-	X	*Epioblasma triquetra*	Snuffbox	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G3	S1	S2
1	-	X	*Fusconaia cor*	Shiny pigtoe	Clinch R, Powell R, N Fk Holston R, Copper Ck	Aquatic-rivers	E	G1	S1	-
1	-	X	*Fusconaia cuneolus*	Fine-rayed pigtoe	Clinch R, Powell R, Copper Ck, Little R	Aquatic-rivers	E	G1	S1	-
7	-	X	*Fusconaia masoni*	Atlantic pigtoe	Roanoke R, Craig Ck drainage	Aquatic-rivers	S	G2	S2	-
1	-	X	*Hemistena lata*	Cracking pearlymussel	Clinch R, Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Lampsilis abrupta*	Pink mucket	Clinch R	Aquatic-rivers	E	G2	SX	S1
1	-	X	*Lasmigona holstonia*	Tennessee heelsplitter	Upper Clinch, N and M Fk Holston R drainages; Wolf Ck, Bland Co below Burkes Garden	Aquatic-streams	S	G3	S1	-
8	X	-	*Lasmigona subviridis*	Green floater	Widely distributed in N & S Fk Shenandoah R, Pedlar R, James R	Aquatic-rivers	S	G3	S2	S2
1	-	X	*Lemiox rimosus*	Birdwing pearlymussel	Clinch R, Powell R, Copper Ck, Little R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Pegias fabula*	Little-winged pearlymussel	Clinch R, N Fk Holston R, S Fk Holston R, Little R	Aquatic-streams	E	G1	S1	-
1	-	X	*Plethobasus cyphyus*	Sheepnose	Clinch R, Powell R	Aquatic-rivers	E	G3	S1	S1
7/9	X	X	*Pleurobema collina*	James spinymussel	Potts Ck, Craig Ck, Johns Ck, Patterson Run, Pedlar R, Cowpasture R, Mill Ck (Deerfield)	Aquatic-rivers	E	G1	S1	S1
1	-	X	*Pleurobema cordatum*	Ohio pigtoe	Clinch R	Aquatic-rivers	S	G4	S1	S2
1	-	X	*Pleurobema oviforme*	Tennessee clubshell	Clinch R, Powell R, N, Middle, S Fk Holston R	Aquatic-streams	S	G2G3	S2S3	-
1	-	X	*Pleurobema plenum*	Rough pigtoe	Clinch R	Aquatic-rivers	E	G1	SH	SH

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1	-	X	*Pleurobema rubrum*	Pyramid pigtoe	Upper Clinch R	Aquatic-rivers	S	G2G3	SH	-
1	-	X	*Pleuronaia barnesiana*	Tennessee pigtoe	Clinch R, Powell R, N Middle, S Fk Holston R	Aquatic-rivers	S	G2G3	S2	-
1	-	X	*Pleuronaia dolabelloides*	Slabside pearlymussel	Clinch R, M Fk Holston, N Fk Holston R	Aquatic-rivers	E	G2	S2	-
1	-	X	*Ptychobranchus subtentum*	Fluted kidneyshell	Holston R., Powell R., Indian R., Clinch R., Little R., Copper Ck., Big Moccasin Ck. Critical Habitat: Indian Ck, VA: Middle Fk Holston R. VA: Big Moccasin Ck., VA: Copper Ck., VA; Clinch R, TN, VA: Powell R., TN, VA	Aquatic-rivers	E	G2	S2	-
1	-	X	*Quadrula cylindrica strigillata*	Rough rabbits foot	Clinch R, Powell R, N Fk Holston R, Copper Ck	Aquatic-streams	E	G3G4T2	S2	-
1	-	X	*Quadrula intermedia*	Cumberland monkeyface	Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Quadrula sparsa*	Appalachian monkeyface	Clinch R, Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Toxolasma lividum*	Purple lilliput	N Fk Holston R, Clinch R	Aquatic-rivers	S	G3Q	SH	-
1	-	X	*Villosa perpurpurea*	Purple bean	Clinch R, Copper Ck	Aquatic-rivers	E	G1	S1	-
1	-	X	*Villosa trabalis*	Cumberland bean	Clinch R	Aquatic-rivers	E	G1	SX	-
Spider (Arachnid)										
1	-	X	*Microhexura montivaga*	Spruce-fir moss spider	Whitetop Mtn	Damp, well-drained moss and liverwort mats on boulders in mature spruce-fir forests.	E	G1	S1	-
Pseudoscorpion (Arachnid, Order Pseudoscoriones)										
1	-	X	*Kleptochthonius orpheus*	Orpheus cave pseudoscorpion	Patton cave, Monroe Co, WV	Caves	S	G1	-	S1
Amphipod (Crustacean, Order Amphipoda)										
1	-	X	*Stygobromus abditus*	James Cave amphipod	James, Sam Bells caves, Pulaski Co; Watsons cave, Wythe Co; and other New River caves	Aquatic-caves, water well	S	G3	S3	-
1	-	X	*Stygobromus cumberlandus*	Cumberland cave amphipod	Lee, Scott, Wise Cos	Aquatic-caves	S	G3G4	S1S2	-
2	-	X	*Stygobromus estesi*	Craig County cave amphipod	Caves in Upper Sinking Ck Valley and Potts Ck, Poverty Hollow seeps, Captain seeps	Aquatic-caves, seeps	S	G4	S3	-
2	-	X	*Stygobromus fergusoni*	Montgomery County cave amphipod	Botetourt, Montgomery Cos	Aquatic-caves	S	G2G3	S1	-
1	X	-	*Stygobromus gracilipes*	Shenandoah Valley cave amphipod	Frederick, Rockingham, Shenandoah, Warren Cos	Aquatic-caves	S	G3G4	S3	S1
1	X	-	*Stygobromus hoffmani*	Alleghany County cave amphipod	Low Moor cave, Alleghany Co	Aquatic-caves, groundwater habitats including springs and seeps	S	G2	S2	-
1	X	-	*Stygobromus mundus*	Bath County cave amphipod	Alleghany, Bath Cos	Aquatic-caves	S	G2G3	S1S2	-
Isopod (Crustacean, Order Isopoda)										
1	-	-	*Antrolana lira*	Madison Cave isopod	Documented population centers in Waynesboro-Grottoes area, Augusta Co., Harrisonburg area Rockingham Co., and valley of main stem of Shenandoah R., Warren, Clarke Cos., VA; Jefferson Co. WV. Not known from the GWJNF	Aquatic-subterranean obligate in caves and karst groundwater	T	G2G4	S2	S1

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1	-	X	*Caecidotea incurva*	Incurved cave isopod	McCullin Cave, Smyth Co; Groseclose Cave No. 1, Wythe Co	Aquatic-caves	S	G2G4	S2	-
1	X	X	*Miktoniscus racovitzai*	Racovitza's terrestrial cave isopod	Allegheny, Botetourt, Page, Rockbridge, Shenandoah Cos	Aquatic-caves	S	G3G4	S2	-
Crayfish (Crustacean, Order Decapoda)										
1	-	X	*Cambarus callamus*	Big Sandy crayfish	In VA, Upper Russel Fk drainage Big Sand R	Aquatic-streams. Fast flowing streams of moderate width.	T	G2	S1S2	S1
Millipede (Class Diplopoda)										
1	-	X	*Brachoria dentata*	A millipede	Known only from Pennington Gap and Cave Spring Recreation Area, Lee Co.	Leaf litter, deciduous forests.	S	G1	S1	-
1	-	X	*Brachoria eutypa ethotela*	Hungry Mother millipede	Pine Mtn above Troutdale	Leaf litter, deciduous forests.	S	GNRT NR	S3	-
1	-	X	*Buotus carolinus*	A millipede	Brush Mtn, Whitetop Mtn, Apple Orchard Mtn, Tazewell Beartown	Beech leaf litter, deciduous forests.	S	G3	S3	-
1	-	X	*Cleidogona hoffmani*	Hoffman's cleidogonid millipede	Mt Rogers, Whitetop Mtn, Elk Garden; Hamilton cave (private) Bland Co	Mountaintop species, leaf litter, deciduous forests.	S	G3	S2S3	-
1	-	X	*Cleidogona lachesis*	A millipede	Mt Rogers & Whitetop Mtn	Beech leaf litter, deciduous forests.	S	G2	S1	-
1	-	X	*Dixioria fowleri*	Fowler's millipede	Walker Mtn; Comers Rock on Iron Mtn; Laurel Ck, Damascas; 1/2 mile west of NRA office; Tazewell Beartown	Leaf litter, deciduous forests.	S	G2	S2	-
1	-	X	*Dixioria pela coronata*	A millipede	Endemic to Mt Rogers	Leaf litter, northern hardwood and spruce-fir forests. Altitudinally restricted, >5000'.	S	G2T2	S2	-
1	X	-	*Nannaria shenandoah*	Shenandoah Mountain xystodesmid millipede	One site: along Long Run Road, Rockingham Co.	Leaf litter, mixed oak forest.	S	G1	S1	-
1	X	-	*Pseudotremia alecto*	A millipede	Griffith Knob, Alleghany Co; near Mountain Grove Saltpetre Cave, Bath Co	Leaf litter, deciduous forests.	S	GNR	SNR	-
1	X	X	*Semionellus placidus*	A millipede	Hawksbill Mtn, Apple Orchard Mtn, Tomahawk Mtn	Leaf litter, deciduous forests.	S	G3	S3 (old rank S2)	-
Centipede (Class Chilopoda)										
1	X	X	*Escaryus cryptorobius*	Montane centipede	The Priest, Nelson Co; Whitetop Mtn, near junction of Grayson, Washington, Smyth Cos	Upper soil horizon, spruce - birch forests.	S	G2	S2	-
1	-	X	*Escaryus orestes*	Whitetop Mountain centipede	Whitetop Mtn, near junction of Grayson, Washington, Smyth Cos	Dark moist soil and litter, spruce - birch forests.	S	G1G2	S1S2	-
1	X	-	*Nampabius turbator*	A cave centipede	One known site: Low Moor cave, Alleghany Co	Caves	S	G1G2	S1	-
Springtail (Insect, Order Collembola)										
1	X	X	*Pygmarrhopalites carolynae*	A cave springtail	Augusta, Bath, Highland, Lee, Wise Cos	Caves	S	G4	S3	-
2	-	X	*Pygmarrhopalites commorus*	A cave springtail	Giles, Lee, Wise Cos	Caves	S	G2G3	S2S3	-
1	X	-	*Pygmarrhopalites sacer*	A cave springtail	Bath Co	Caves	S	G2	S2	-
Mayfly (Insect, Order Ephemeroptera)										
1	-	X	*Leptophlebia johnsoni*	Johnson's pronggill mayfly	One location: Lewis Fk north slope Mt Rogers	Aquatic-streams	S	G4	S1	-
Dragonfly (Insect, Order Odonata)										
8	X	X	*Gomphus viridifrons*	Green-faced clubtail	New R, Craig Ck, Pound R, Locust Spring	Aquatic-rivers	S	G3G4	S2	S2

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
8	-	X	*Ophiogomphus incurvatus alleghaniensis*	Allegheny snaketail	Rich Ck, Giles Co	Aquatic-streams	S	G3T2T3	S1	S1
Stonefly (Insect, Order Plecoptera)										
1	-	X	*Acroneuria kosztarabi*	Virginia stonefly	Station Spring Ck, Tazewell Co	Aquatic-streams	S	G1G2	S1S2	-
1	-	X	*Isoperla major*	Big stripetail stonefly	Burkes Garden, Tazewell Co	Aquatic-streams	S	G1	S1	-
1	-	X	*Megaleuctra williamsae*	Smokies needlefly	Mt Rogers & Whitetop Mtn	Aquatic-streams	S	G2	S1S2	-
1	-	X	*Taeniopteryx nelsoni*	Cryptic willowfly	Lewis Fk & Grindstone Branch N of Mt Rogers	Aquatic-streams	S	G1	S1	-
Beetle (Insect, Order Coleoptera)										
1	X	X	*Cicindela ancocisconensis*	Appalachian tiger beetle	Alleghany, Bath, Highland, Lee, Rockbridge, Washington, Wise Cos	Riparian - sandy/silty edges of streams and rivers.	S	G3	S2	S3
2	X	X	*Cicindela patruela*	Northern barrens tiger beetle	Blue Ridge, Ridge & Valley	Eroded slopes of exposed sandstone and conglomerate.	S	G3	S2	S2S3
1	-	X	*Cyclotrachelus incisus*	A ground beetle	Breaks Interstate Park, Dickenson Co	Dry, well drained site, red maple, magnolia, mountain laurel.	S	G4	S1	-
4	X	X	*Hydraena maureenae*	Maureen's Shale Stream Beetle	Alleghany, Bath, Botetourt, Bland, Craig, Cos	Interstitial water in riparian-shale substrate along stream edge.	S	G2?	S2?	-
Scorpionfly (Insect, Order Mecoptera)										
2	-	X	*Brachypanorpa jeffersoni*	Jefferson's short-nosed scorpionfly	Sugar Run Mountain, Giles Co; Whitetop Mtn, Smyth Co	Moist soil around seeps. Only known from high elevation. Larvae use short burrows in loose soil and moss.	S	G2	S1S2	-
Butterfly, Skipper, Moth (Insect, Order Lepidoptera)										
2	X	X	*Callophrys irus*	Frosted elfin	Frederick, Montgomery, Page, Roanoke Cos	Dry, open woods, clearings, and road/powerline ROWs with abundant wild indigo, *Baptisia tinctoria*.	S	G3	S2?	S1
6	X	X	*Speyeria diana*	Diana fritillary	Blue Ridge, Ridge & Valley	Grasslands-shrublands, near streams with thistles and milkweeds. Larval host plant, violets, *Viola* spp.	S	G3G4	S3	S2S3
6	X	X	*Speyeria idalia*	Regal fritillary	Blue Ridge, Ridge & Valley	Riparian, grasslands-shrublands. Larval host plant, violets, *Viola* spp.	S	G3	S1	S1
2	X	X	*Erynnis persius persius*	Persius duskywing	Blue Ridge, Ridge & Valley	Bogs, wet meadows, open seepages in boreal forests. Larval host plant, lupine, *Lupinus perennis*, wild indigo, *Baptisia tinctoria*.	S	G5T1T3	S1	-
2	X	-	*Pyrgus centaureae wyandot*	Appalachian grizzled skipper	Ridge & Valley	Shale barrens, open shaley oak woodlands. Larval host plant, cinquefoil, *Potentilla* spp, strawberry, *Fragaria virginina.*	S	G5T1T2	S1	S1
2	X	X	*Catocala herodias gerhardi*	Herodias underwing	Bald Knob, Bath Co; Poverty Hollow, Montgomery Co; Sand Mtn, Wythe Co (non FS property)	Pitch pine/bear oak scrub woodlands, >3000'. Larval host plant oak, *Quercus* spp.	S	G3T3	S2S3	SU

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	X	-	*Euchlaena milnei*	Milne's euchlaena moth	Warm Springs Mtn, Catawba Creek Slopes, Sweet Spring Hollow, Salt Pond Mtn. (Doe Creek)	Moist, forested slopes of mixed pine hardwoods. Acidic oak woods.	S	G2G4	S2	S2
1	X	-	*Psectrotarsia hebardi*	Hebard's noctuid moth	Bath Co	Rich, mesic hardwood forest. Larvae host plant, Canada horse-balm, *Collinsonia canadensis*.	S	GU	SH	-
NON-VASCULAR PLANT										
Lichen										
1	-	X	*Gymnoderma lineare*	Rock gnome lichen	Whitetop Mtn	Spruce-fir forests	E	G2	S1	-
2	-	X	*Hypotrachyna virginica*	Virginia hypotrachyna lichen	Mt Rogers & Whitetop Mtn	Spruce-fir forest. Found on *Abies, Picea, Rhododendron* in spruce-fir and fire-cherry, *Prunus pensylvanica* communities in southern Appalachian Mountains. Typically at higher elevations, has been found at lower elevations.	S	G1G2	S1	SNR
1	X	X	*Hydrothyria venosa*	waterfan	Augusta, Amherst, Alleghany, Bedford, Botetourt, Giles, Highland, Madison, Nelson, Rockbridge, Shenandoah, Smyth, Wyth Cos VA; Pendleton Co WV	Aquatic – in streams/springs/cascade. Grows at or below water level in cool, clear, partially-shaded streams.	S	G4	S1	-
Liverwort										
1	-	X	*Bazzania nudicaulis*	A liverwort	Mt Rogers & Whitetop Mtn	Bark and rock outcrops in spruce-fir forests.	S	G2G3	S?	-
1	-	X	*Frullania oakesiana*	A liverwort	Mt Rogers & Whitetop Mtn	Bark in spruce-fir forests.	S	G3?	S?	-
1	-	X	*Mertzgeria fruticulosa*	A liverwort	Whitetop Mtn	Bark in spruce-fir forests, >5000'.	S	G2Q	S?	-
2	-	X	*Nardia lescurii*	A liverwort	Blue Ridge, Ridge & Valley	Riparian - on peaty soil over rocks, usually in shade and associated w/ water, <3000'.	S	G3?	S1	-
1	-	X	*Plagiochila austinii*	A liverwort	Little Stony Ck – Cascades; Red Ck on Beartown Mtn	Rich, moist, densely forested ravines; shaded outcrops.	S	G3	S?	-
3	-	X	*Plagiochila sullivantii var. sullivantii*	A liverwort	Whitetop Mtn, Salt Pond Mtn	Moist shaded rock outcrops, under cliff ledges, in crevices.	S	G2T2	SNR	-
1	-	X	*Sphenolobopsis pearsonii*	A liverwort	Mt Rogers & Whitetop Mtn	Bark of Fraser fir, mountain ash, occasionally red spruce, >5000'.	S	G2	S?	-
Moss										
1	-	X	*Sphagnum flavicomans*	Northeastern peatmoss	Whitetop Mtn	Bogs, seeps	S	G3	SU	-
VASCULAR PLANT										
3	X	X	*Aconitum reclinatum*	Trailing white monkshood	Blue Ridge, Ridge & Valley	Rich cove sites, streambanks, seepages all with high pH.	S	G3	S3	S3
1	-	X	*Actaea rubifolia*	Appalachian black cohosh	Lower Clinch R watershed, Scott, Wise Cos	Moist, rich wooded bluffs over limestone.	S	G3	S1	-
2	X	X	*Allium oxyphilum*	Nodding onion	Monroe, Summers, Mercer, Greenbrier Cos, WV	Shale barrens, sandstone glades.	S	G2	S1	S2

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	X	-	*Arabis patens*	Spreading rockcress	Frederick, Lee, Page, Shenandoah, Warren Cos, VA; Hampshire, Hardy, Pendleton, Cos, WV	Shaded, calcareous cliffs, bluffs, and talus slopes.	S	G3	S1	S2
4	X	X	*Berberis canadensis*	American barberry	Blue Ridge, Ridge & Valley	Calcareous open woods, bluffs, cliffs, and along fencerows.	S	G3	S3S4	S1
1	-	X	*Betula uber*	Virginia round-leaf birch	One location: Cressy Ck, Smyth Co	Riparian, mixed open forest, usually disturbed sites.	T	G1Q	S1	-
2	X	-	*Boechera serotina*	Shale barren rockcress	Ridge & Valley N of James R watershed	Shale barrens and adjacent open oak woods.	E	G2	S2	S2
3	X	X	*Buckleya distichophylla*	Piratebush	Blue Ridge S of Roanoke R, Ridge & Valley S of James R	Open oak and hemlock woods.	S	G3	S2	-
1	-	X	*Cardamine clematitis*	Mountain bittercress	Blue Ridge, Ridge & Valley, S of New R watershed	Riparian, spring seeps, rocky streamsides.	S	G3	S1	-
1	-	X	*Cardamine flagellifera*	Blue Ridge bittercress	Blue Ridge, Ridge & Valley, S of New R watershed	Riparian, spring seeps, rocky streamsides.	S	G3	SH	S2
1	X	X	*Carex polymorpha*	Variable sedge	Blue Ridge, Ridge & Valley, N of James R	Open acid soil, oak-heath woodlands, responds positively to fire.	S	G3	S2	S1
2	X	X	*Carex schweinitzii*	Schweinitz's sedge	Augusta, Bath, Highland, Montgomery, Pulaski, Washington Cos	Bogs, limestone fens, marl marshes.	S	G3G4	S1	-
1	-	X	*Chelone cuthbertii*	Cuthbert turtlehead	Blue Ridge Plateau, Grayson, Carroll Cos	Bogs, wet meadows, boggy woods and thickets.	S	G3	S2	-
3	-	X	*Cleistesiopsis bifaria*	Small spreading pogonia	Craig, Dickenson, Scott, Wise Cos	Well drained, rather open, scrubby hillsides, oak-pine-heath woodlands, acidic soils.	S	G4?	S2	S1
2	-	X	*Clematis addisonii*	Addison's leatherflower	Montgomery, Roanoke, Botetourt, Rockbridge Cos	Open glades & rich woods over limestone and dolostone.	S	G1?	S2	-
2	X	X	*Clematis coactilis*	Virginia white-haired leatherflower	Ridge & Valley, Rockbridge Co, S to Wythe Co	Shale barrens, rocky calcareous woodlands.	S	G3	S3	-
3	X	X	*Corallorhiza bentleyi*	Bentley's coralroot	Alleghany, Bath, Giles Cos VA; Monroe, Pocahontas Cos WV	Dry, acid woods, along roadsides, well-shaded trails.	S	G2	S2	S1
3	X	X	*Delphinium exaltatum*	Tall larkspur	Blue Ridge, Ridge & Valley	Dry calcareous soil in open grassy glades or thin woodlands.	S	G3	S3	S2
1	X	-	*Echinodorus tenellus*	Dwarf burhead	Pines Chapel Pond, Augusta Co	Pond margins, wet depressions in sandy soil.	S	G5?	S1	-
2	X	X	*Echinacea laevigata*	Smooth coneflower	Alleghany, Montgomery Cos	Open woodlands and glades over limestone or dolomite.	E	G2G3	S2	-
2	X	X	*Euphorbia purpurea*	Glade spurge	Blue Ridge, Ridge & Valley	Rich, swampy woods, seeps and thickets.	S	G3	S2	S2
1	-	X	*Gentiana austromontana*	Appalachian gentian	Mt Rogers, Whitetop Mtn, High Knob	High elevation forests and grassy balds. Southern Appalachian endemic.	S	G3	S3	S1
2	-	X	*Hasteola suaveolens*	Sweet-scented Indian-plantain	Giles, Montgomery, Pulaski Cos	Riverbanks, wet meadows.	S	G4	S2	S3
1	X	-	*Helenium virginicum*	Virginia sneezeweed	Endemic to Augusta, Rockingham Cos	Seasonally dry meadows and sinkhole depressions.	T	G3	S2	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	X	-	*Helonias bullata*	Swamp-pink	Augusta, Nelson Cos	Sphagnum bogs, seeps, and streamsides.	T	G3	S2S3	-
1	X	-	*Heuchera alba*	White alumroot	Shenandoah Mtn	High elevation rocky woods and bluffs.	S	G2Q	S1	S2
2	X	X	*Hypericum mitchellianum*	Blue Ridge St. John's-wort	Blue Ridge, Ridge & Valley	Grassy balds, forest seepages, moderate to high elevations.	S	G3	S3	S1
2	X	X	*Ilex collina*	Long-stalked holly	Blue Ridge, Ridge & Valley	Bogs, seep, shrubby streamheads, >3100'.	S	G3	S1	S2
1	-	X	*Iliamna corei*	Peter's Mountain-mallow	One location: Narrows, Peters Mountain, Giles Co.	Rich, open woods along sandstone outcrops, soil pockets, fire maintained.	E	G1	S1	-
1	X	X	*Iliamna remota*	Kankakee globe-mallow	Alleghany, Botetourt, Rockbridge, Bedford Cos	Open, disturbed riverbanks and roadsides.	S	G1Q	S1	-
1	X	-	*Isoetes virginica*	Virginia quillwort	Augusta Co	Summer-dry sinkhole ponds, seasonally wet upland depressions, and small, wet-weather drains, especially in moss hummocks.	S	G1	S1	-
3	X	X	*Isotria medeoloides*	Small whorled pogonia	In mountains of VA known only from Bedford, Craig, and Lee Cos; other VA occurrences in Piedmont & Coastal Plain	Open, mixed hardwood forests on level to gently sloping terrain with north to east aspect.	T	G2?	S2	S1
3	X	X	*Juglans cinerea*	Butternut	Blue Ridge, Ridge & Valley	Well-drained bottomland and floodplain, rich mesophytic forests mostly along toeslopes.	S	G4	S3?	S3
2	X	X	*Liatris helleri*	Turgid gayfeather	Blue Ridge, Ridge & Valley	Shale barrens, mountain hillside openings.	S	GNR	S3	S2
1	-	X	*Lilium grayi*	Gray's lily	Blue Ridge, Mt Rogers & Whitetop Mtn (occurrences north of Floyd Co questionable)	Bogs, open seeps, wet meadows, grassy balds.	S	G3	S2	-
1	X	-	*Lycopodiella margueritae*	Marguerite's clubmoss	Bath Co	Seasonally moist soils, wet acidic ditches, borrow pits.	S	G2	NA	-
1	-	X	*Micranthes caroliniana*	Carolina saxifrage	Blue Ridge, Ridge & Valley, S of New R	Moist, shaded rocks and cliffs.	S	G3	S3	S1
6	X	X	*Monotropsis odorata*	Sweet pinesap	Blue Ridge, Ridge & Valley	Dry oak-pine-heath woodlands, soil usually sandy.	S	G3	S3	S1
1	-	X	*Packera millefolium*	Piedmont ragwort	Lee, Scott Cos	Open limestone outcrops and cedar barrens.	S	G2	S2	-
2	X	-	*Paxistima canbyi*	Canby's mountain lover	Ridge & Valley, Sarver Barrens SBA, Craig Co	Calcareous cliffs and bluffs, usually undercut by stream.	S	G2	S2	S2
3	X	X	*Phlox buckleyi*	Sword-leaf phlox	Blue Ridge, Ridge & Valley	Open, often dry oak woodlands and rocky slopes, usually over shale in humus rich soils, often along roadsides.	S	G2	S2	S2
3	X	X	*Poa paludigena*	Bog bluegrass	Blue Ridge, Ridge & Valley	Shrub swamps and seeps, usually under shade.	S	G3	S2	S1
1	X	-	*Potamogeton hillii*	Hill's pondweed	Bath Co	Clear, cold calcareous ponds.	S	G3	S1	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
2	X	-	*Potamogeton tennesseensis*	Tennessee pondweed	Ridge & Valley	Ponds, back water of streams and rivers.	S	G2G3	S1	S2
1	-	X	*Prenanthes roanensis*	Roan Mountain rattlesnake-root	Mt Rogers & Whitetop Mtn	Grassy balds, open high elevation forests and outcrops.	S	G3	S3	-
3	X	X	*Pycnanthemum torrei*	Torrey's mountain-mint	Bland, Bath, Giles, Rockbridge, Wythe Cos	Open, dry rocky woods, roadsides, and thickets near streams, heavy clay soil over calcareous rock.	S	G2	S2	S1
2	-	X	*Rudbeckia triloba var. pinnatiloba*	Pinnate-lobed coneflower	Giles, Montgomery, Smyth, Wise Cos	Dry calcareous soil of open woods and roadsides.	S	G5T3	S1	-
1	-	X	*Sceptridium jenmanii*	Alabama grapefern	Scott, Russell, Wise Cos	Open woods, old fields, pastures.	S	G3G4	SH	-
1	X	X	*Scirpus ancistrochaetus*	Northeastern bulrush	Ridge & Valley	Mountain ponds, sinkhole ponds in Shenandoah Valley.	E	G3	S2	S1
5	X	X	*Scutellaria saxatilis*	Rock skullcap	Blue Ridge, Ridge & Valley	Rich, dry to mesic ridgetop woods, 32 counties in VA, likely G4/S4.	S	G3	S3	S2
1	X	X	*Sida hermaphrodita*	Virginia mallow	Ridge & Valley, James R watersheds	Riverbank glades with loose rock or sandy soil.	S	G3	S1	S3
1	-	X	*Silene ovata*	Mountain catchfly	Dickenson, Lee, Wise Cos	Rich woodlands and forests over limestone.	S	G3	S1	-
1	-	X	*Spiraea virginiana*	Virginia spiraea	Blue Ridge, Ridge & Valley, S of New R	Scoured banks of streams, riverside or island shrub thickets.	T	G2	S1	S1
1	X	-	*Trillium pusillum var. moniticulum*	Virginia least trillium	Great North Mtn & Shenandoah Mtn, VA and WV	Open oak woodlands in well drained soil and margins of thickets.	S	G3T2	S2	S1
3	-	X	*Tsuga caroliniana*	Carolina hemlock	Blue Ridge north to James R.	Rocky ridges and slopes, usually dry and well drained.	S	G3	S3	-
2	X	X	*Vitis rupestris*	Sand grape	Ridge & Valley	Scoured banks of rivers and streams over calcareous bedrock.	S	G3	S1	S2

LEGEND FOR TES SPECIES LIST IN OCCURRENCE ANALYSIS RESULTS:

OAR CODES:

1 = Project located out of known species range.
2 = Lack of suitable habitat for species in project area.
3 = Habitat present, species was searched for during field survey, but not found.
4 = Species occurs in project area, but outside of activity area.
5 = Field survey located species in activity area.
6 = Species not seen during field survey, but possibly occurs in activity area based on habitat observed. or Field survey not conducted when species is recognizable (time of year or time of day). Therefore assume presence and no additional surveys needed.
7 = Aquatic species or habitat known or suspected downstream of project/activity area, but outside identified geographic bounds of water resource cumulative effects analysis area (defined as point below which sediment amounts are immeasurable and insignificant).
8 = Aquatic species or habitat known or suspected downstream of project/activity area, but inside identified geographic bounds of water resource cumulative effects analysis area.
9 = Project occurs in a 6th level watershed included in the USFWS/FS T&E Mussel and Fish Conservation Plan (August 8, 2007 U.S. Fish & Wildlife Service concurrence on updated watersheds). Conservation measures from the USFWS/FS T&E Mussel and Fish Conservation Plan applied.

SPECIES: The term "species" includes any subspecies of fish, wildlife or plants, and any distinct population segment of any species or vertebrate fish or wildlife, which interbreeds when mature (Endangered Species Act of 1973, as amended through the 100th Congress).

RANGE: The geographical distribution of a species. For use here "range" is expressed as where a species is known or expected to occur on or near the George Washington and Jefferson National Forests in terms of landform (feature name, physiographic province), political boundary (county name), or watershed (river, or stream name).

HABITAT: A place where the physical and biological elements of ecosystems provide a suitable environment and the food, cover and space resources needed for plant and animal livelihood (FSM 2605-91-8, pg. 10 of 13).

TES CODES:

T = Federally listed as Threatened
E = Federally listed as Endangered
P = Federally Proposed as T or E
S = Southern Region (R8) Sensitive species

GLOBAL RANK: Global ranks are assigned by a consensus of the network of natural heritage programs, scientific experts, NatureServe and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species or variety. This system was developed by The Nature Conservancy and is widely used by other agencies and organizations as the best available scientific and objective assessment of taxon rarity and level of threat to its existence. The ranks are assigned after considering a suite of factors including number of occurrences, numbers of individuals, and severity of threats.

G1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.
G2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.
G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range; or vulnerable to extinction because of other factors. Usually fewer than 100 occurrences are documented.
G4 = Common and apparently secure globally, although it may be rare in parts of its range, especially at the periphery.
G5 = Very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery.
GH = Formally part of the world's biota with the exception that may be rediscovered.
GX = Believed extinct throughout its range with virtually no likelihood of rediscovery.
GU = Possibly rare, but status uncertain and more data needed.
G? = Unranked, or, if following a ranking, ranking uncertain (ex. G3?).
G_Q = Taxon has a questionable taxonomic assignment, such as G3Q.
G_T = Signifies the rank of a subspecies or variety. For example, a G5T1 would apply to a subspecies of a species that is demonstrably secure globally (G5) but the subspecies warrants a rank of T1, critically imperiled.

STATE RANK: The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources (NHRs) are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The criterion for ranking NHRs is the number of populations or occurrences, i.e. the number of known distinct localities; the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals; the quality of the occurrences, the number of protected occurrences; and threats.

- **S1** - Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- **S2** - Very rare; usually between 6 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- **S3** - Rare to uncommon; usually between 21 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- **S4** - Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- **S5** - Very common; demonstrably secure under present conditions.
- **SA** - Accidental in the state.

- **S#B -** Breeding status of an organism within the state.
- **SH** - Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- **S#N** - Non-breeding status within the state. Usually applied to winter resident species.
- **SR** – Reported for Virginia, but without persuasive documentation that would provide a basis for either accepting or rejecting the report.
- **SU** - Status uncertain, often because of low search effort or cryptic nature of the element.
- **SX** - Apparently extirpated from the state.
- **SZ** - Long distance migrant, whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.
- **NA** – Not Applicable- A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

These ranks should not be interpreted as legal designations.

APPENDIX C
HABITAT CLASSIFICATIONS WITHIN THE IDENTIFIED AREAS ALONG MOUNTAIN VALLEY'S POTENTIAL ROUTES FOR THE PROPOSED MOUNTAIN VALLEY PIPELINE PROJECT WITHIN THE JEFFERSON NATIONAL FOREST IN VIRGINIA AND WEST VIRGINIA

Tract 001

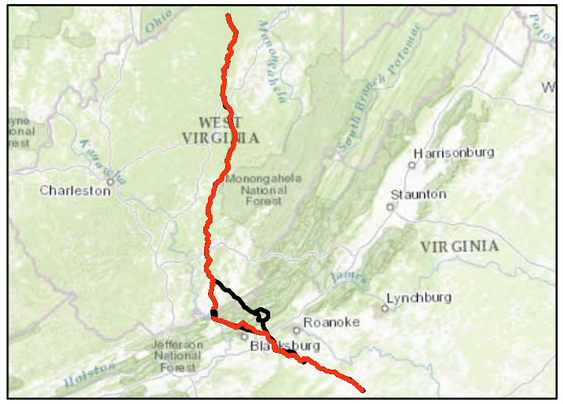
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 1 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



N
W E
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110 0 110 220 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI **ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.**

Project No. 593.02

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

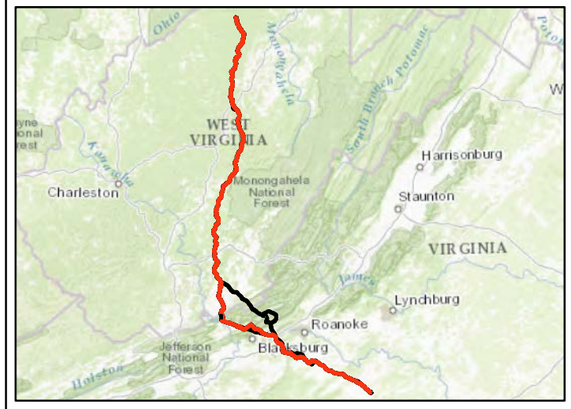
Map 2 of 37

Tract 002

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI **ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.**

Project No. 593.02

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 3 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Shrub/Scrub

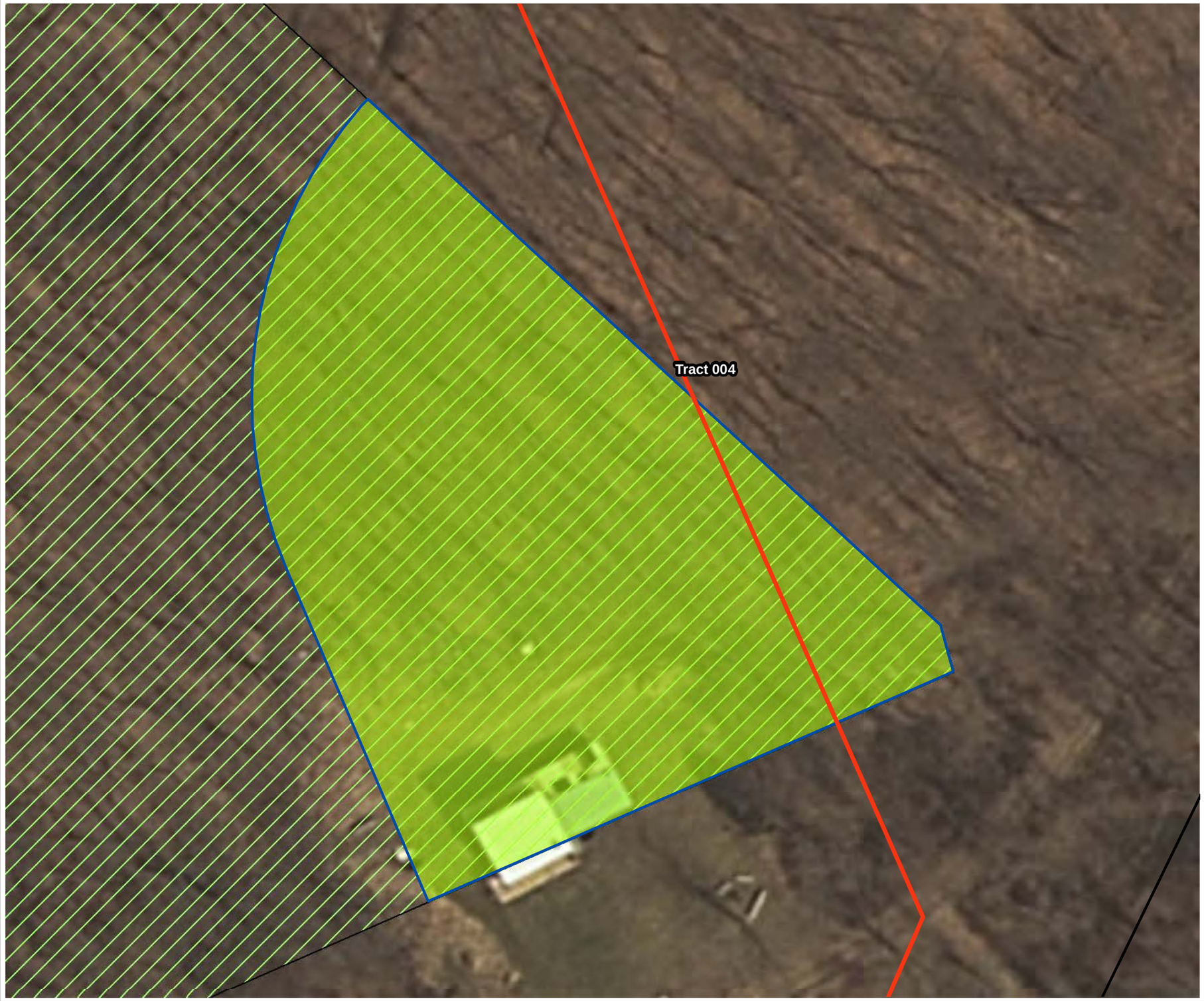
N W E S

10 0 10 20 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02



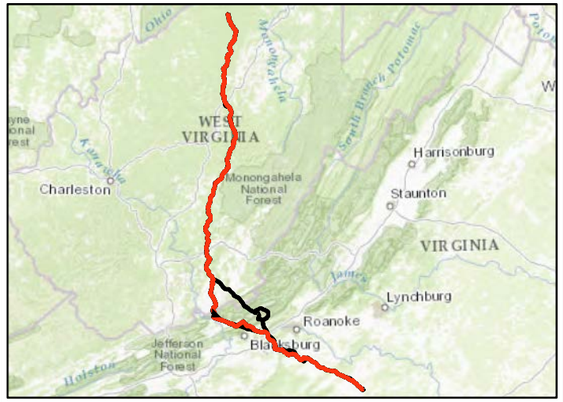
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 4 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



N W E S

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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI **ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.**

Project No. 593.02

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

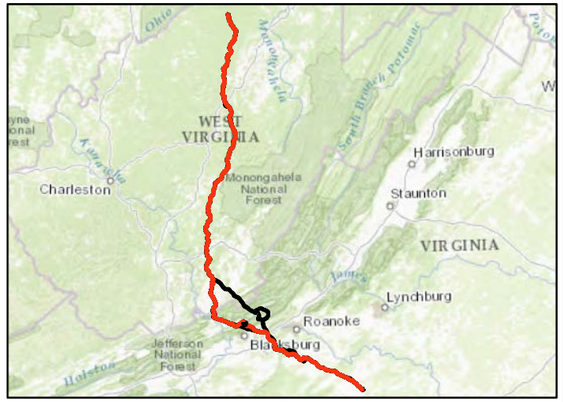
Map 5 of 37

Tract 005

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest
- Proposed ATWS



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02

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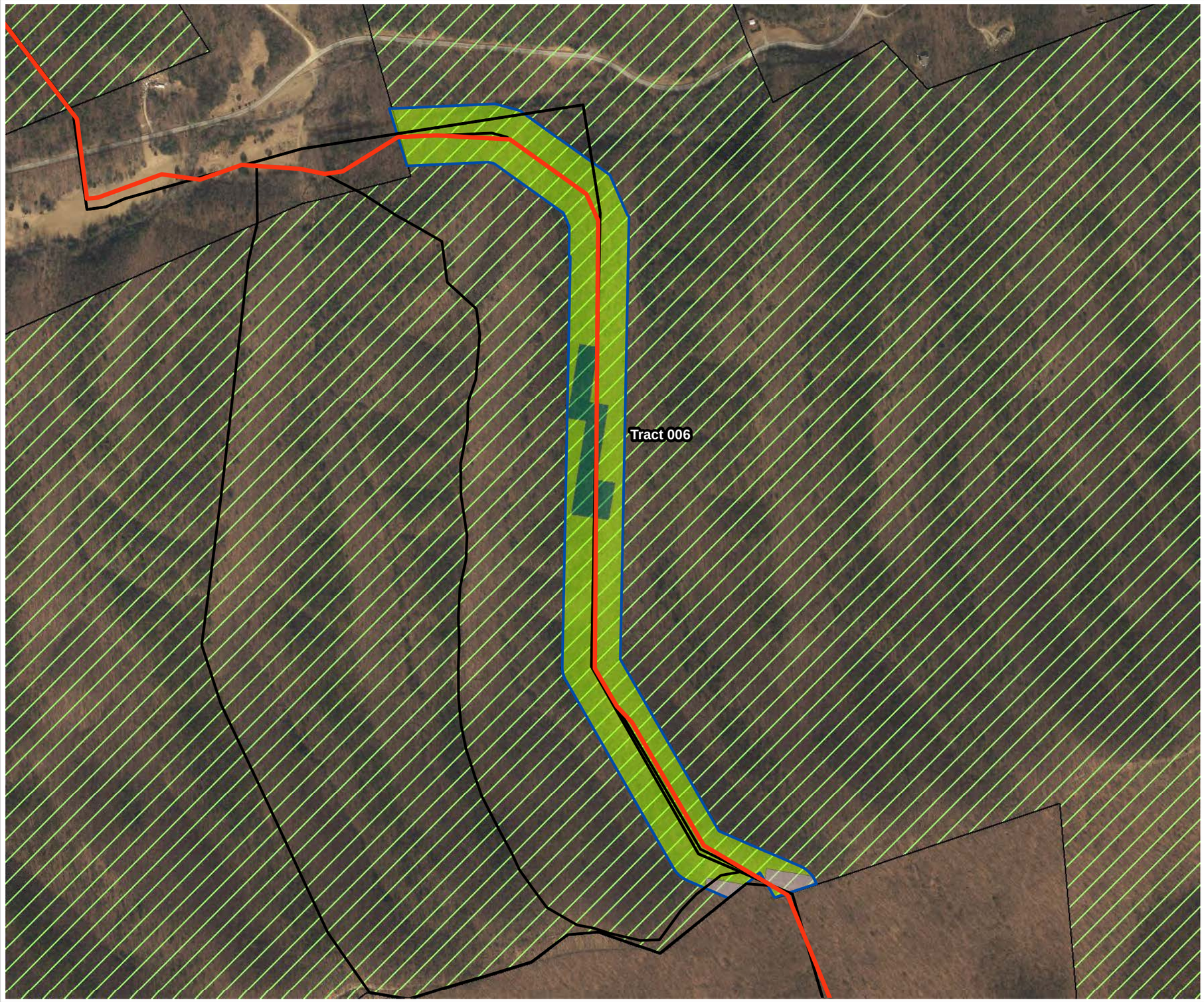


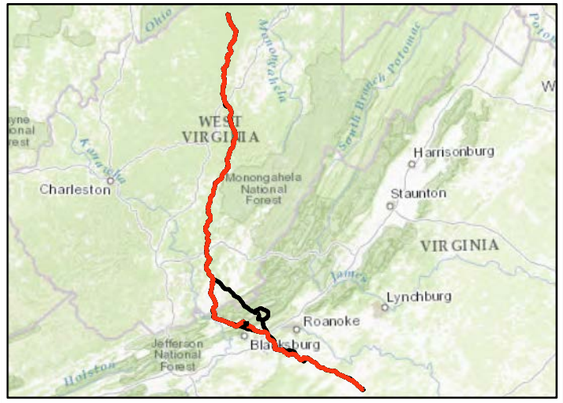
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 6 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest
- Developed, Open Space



N W E S

80 0 80 160 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 007

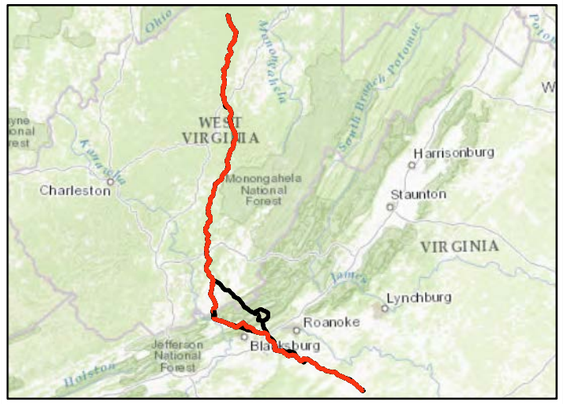
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 7 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest



N
W E
S

75 0 75 150 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 008

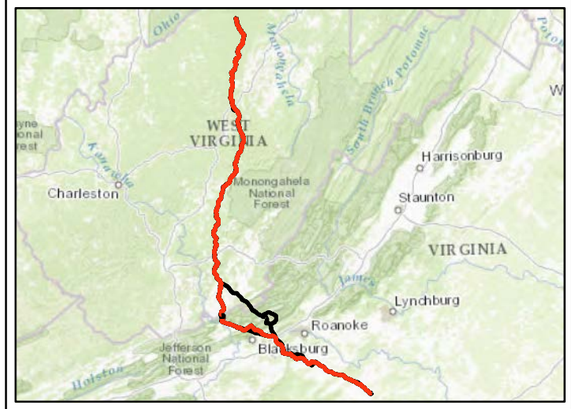
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 8 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



N
W E
S

25 0 25 50
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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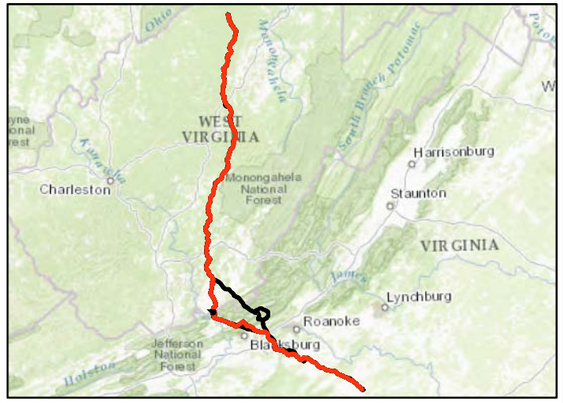
Tract 009

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 9 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
Appalachian National Scenic Trail (ANST)
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest



N
W E
S

10 0 10 20
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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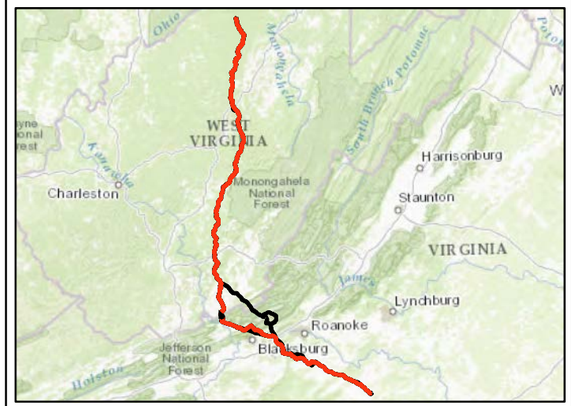
Tract 010

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 10 of 37

Proposed Route
MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
Appalachian National Scenic Trail (ANST)
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest



N
W
E
S

30 0 30 60
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 011

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix C 20170516.mxd (mbruening) - 5/16/2017

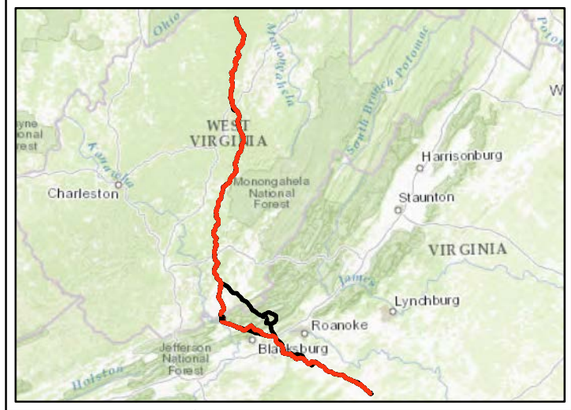
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 11 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest



N
W E
S

60 0 60 120
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 12 of 37

Tract 012

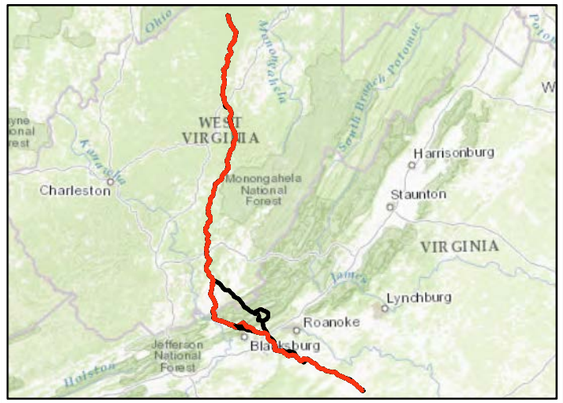
MVP Abandoned/Alternate Route

Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest



N

W E

S

30 0 30 60

Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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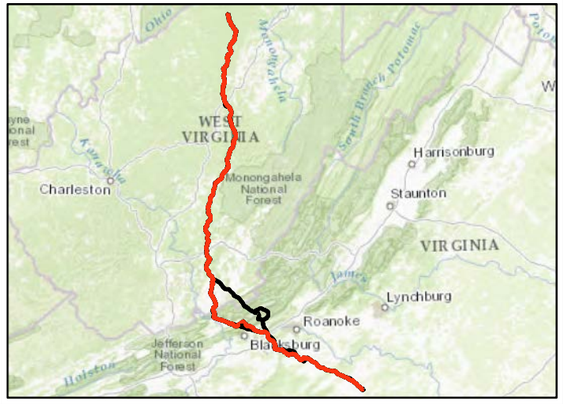
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 13 of 37

- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Developed, Low Intensity
- Developed, Open Space
- Hay/Pasture



N W E S

10 0 10 20 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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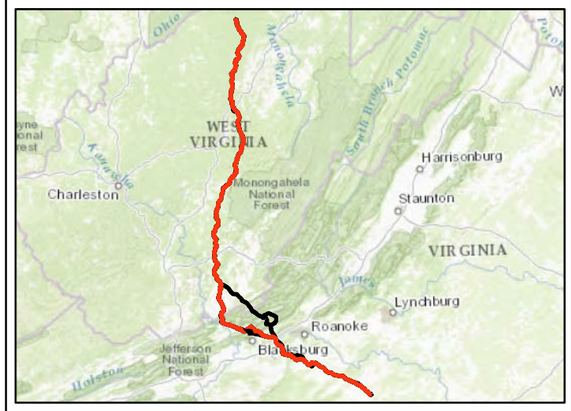
Tract 014

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 14 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest
Evergreen Forest



N
W E
S

50 0 50 100
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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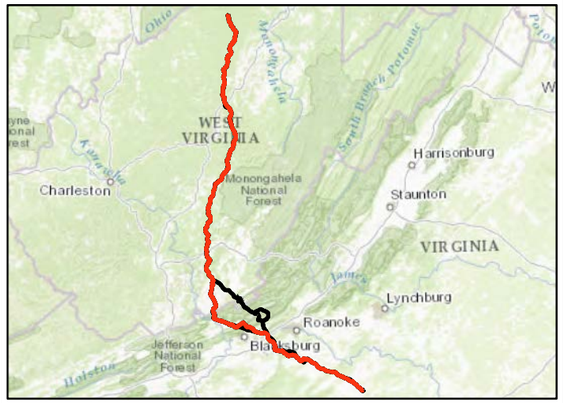
Tract 015

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 15 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands
Land Cover
Deciduous Forest
Developed, Open Space



N
W E
S

60 0 60 120 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 016

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 16 of 37

MVP Abandoned/Alternate Route

Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest

N

W E

S

20 0 20 40

Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

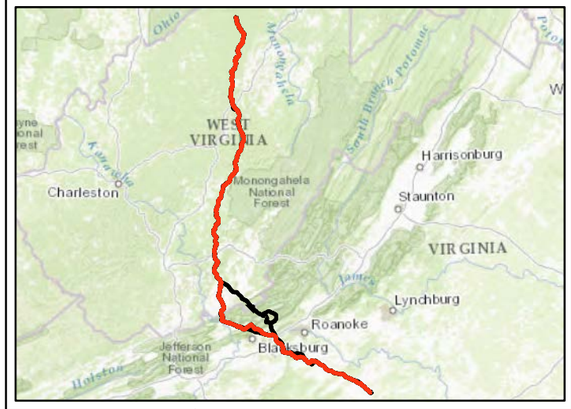
Map 17 of 37

Tract 017

- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



N
W E
S

25 0 25 50 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 018

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 18 of 37

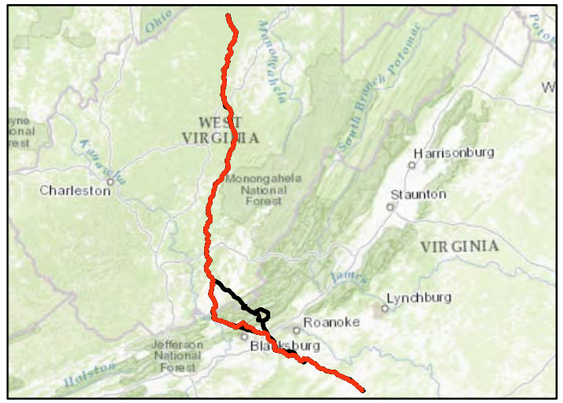
MVP Abandoned/Alternate Route

Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest



N

W E

S

30 0 30 60 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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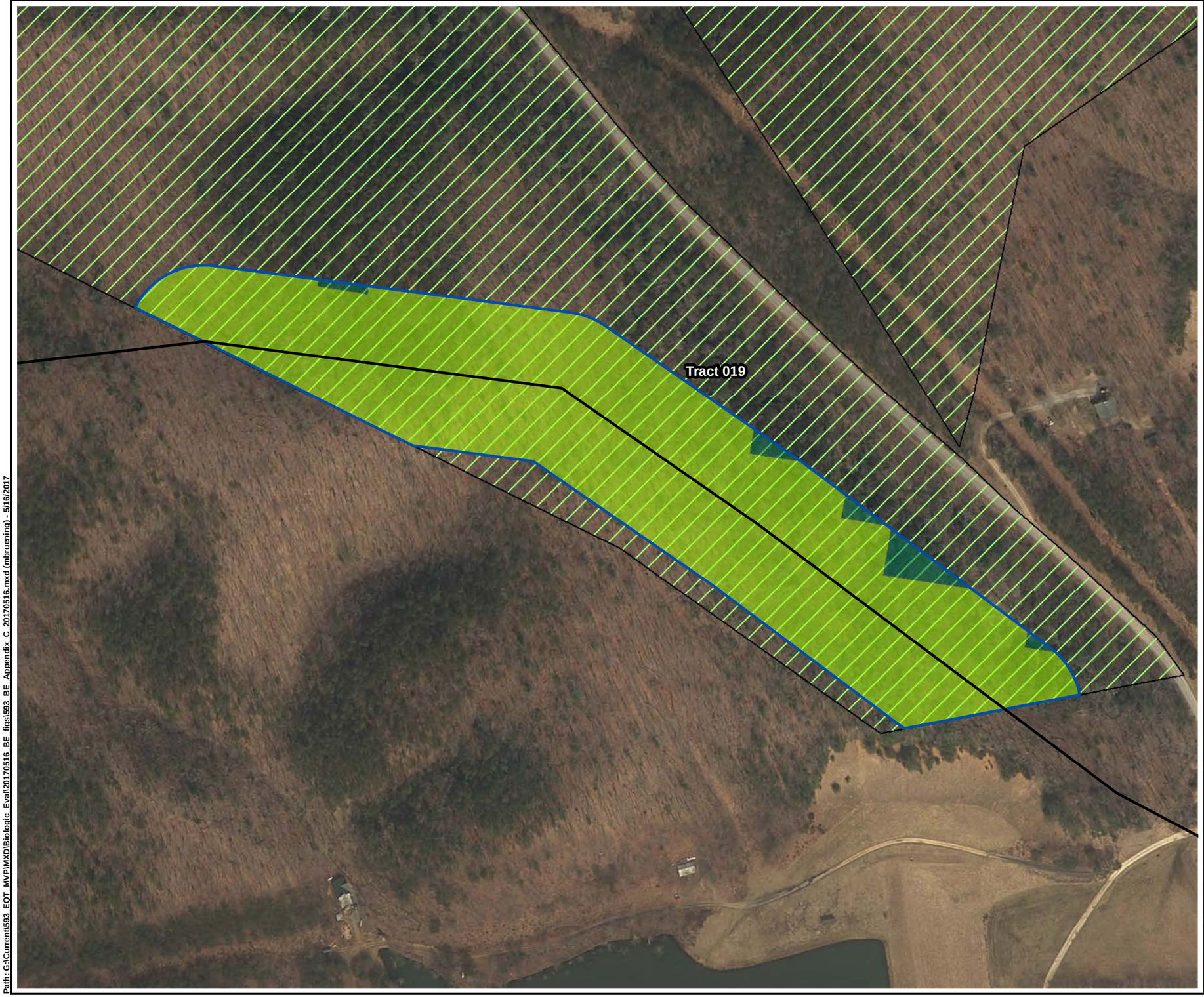
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 19 of 37



MVP Abandoned/Alternate Route

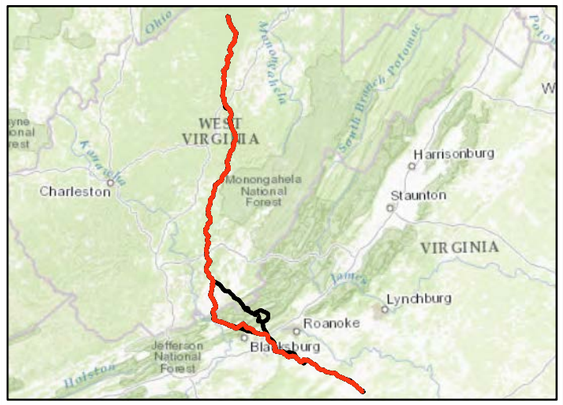
Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest

Evergreen Forest



N

W E

S

30 0 30 60

Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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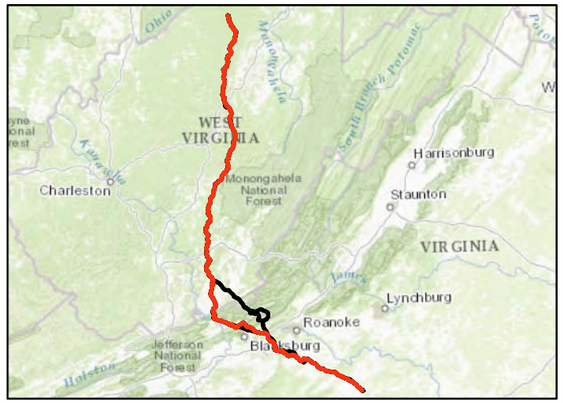
Tract 020

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 20 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands
Land Cover
Deciduous Forest
Developed, Open Space



N
W E
S

90 0 90 180
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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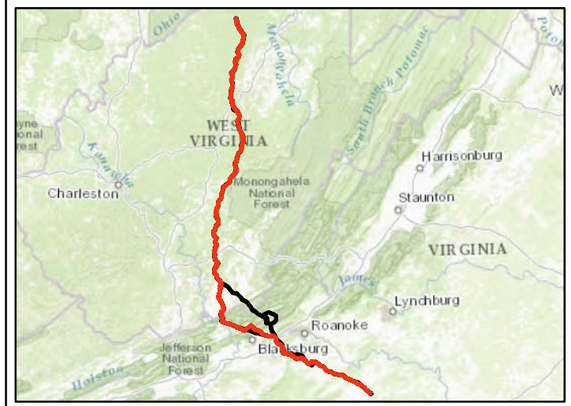
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 21 of 37

Tract 021

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
Appalachian National Scenic Trail (ANST)
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest



N
W E
S

40 0 40 80
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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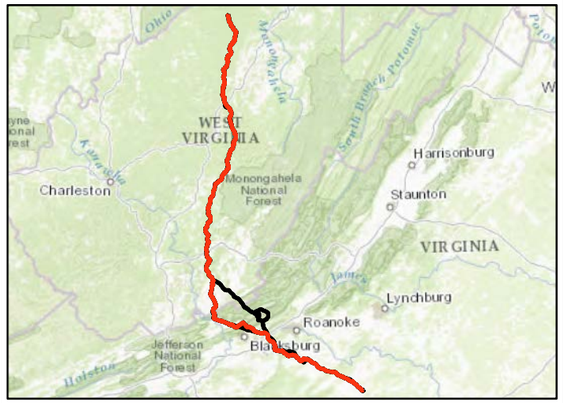
Tract 022

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 22 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
Appalachian National Scenic Trail (ANST)
National Forest (Forest Service) Lands
Land Cover
Deciduous Forest
Evergreen Forest
Mixed Forest



N
W E
S

80 0 80 160
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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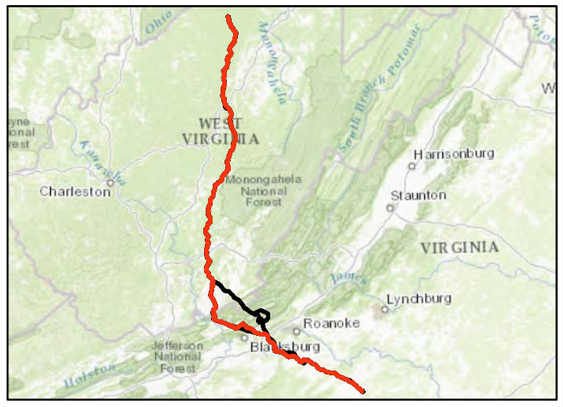
Tract 023

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 23 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest
Evergreen Forest
Developed, Open Space



N
W E
S

110 0 110 220
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 24 of 37

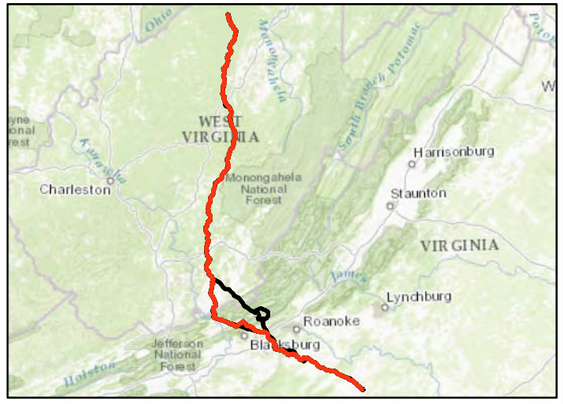
MVP Abandoned/Alternate Route

Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest



N W E S

10 0 10 20 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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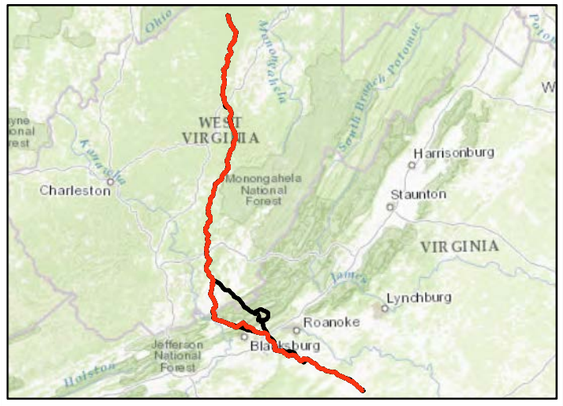
Tract 025

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 25 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands
Land Cover
Deciduous Forest
Developed, Open Space



N
W E
S

10 0 10 20
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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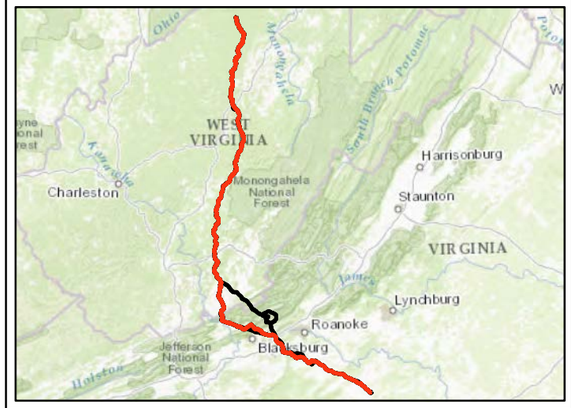
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 26 of 37

MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
Appalachian National Scenic Trail (ANST)
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest
Evergreen Forest
Mixed Forest



N
W E
S

90 0 90 180
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 027

Path: G:\Current\593 EOT MVP\MXD\Biologic Eval\20170516 BE figs\593 BE Appendix C 20170516.mxd (mbruening) - 5/16/2017

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 27 of 37

MVP Abandoned/Alternate Route

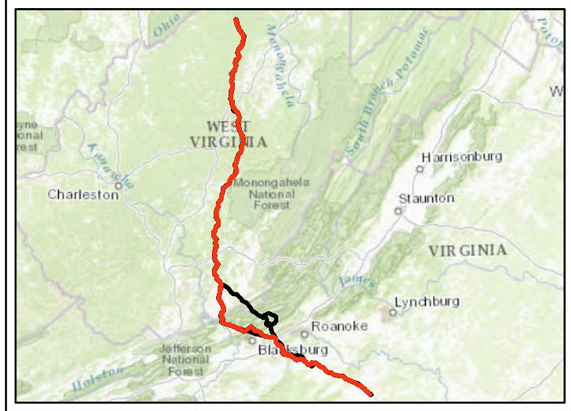
Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest

Evergreen Forest



N

W E

S

100 0 100 200 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

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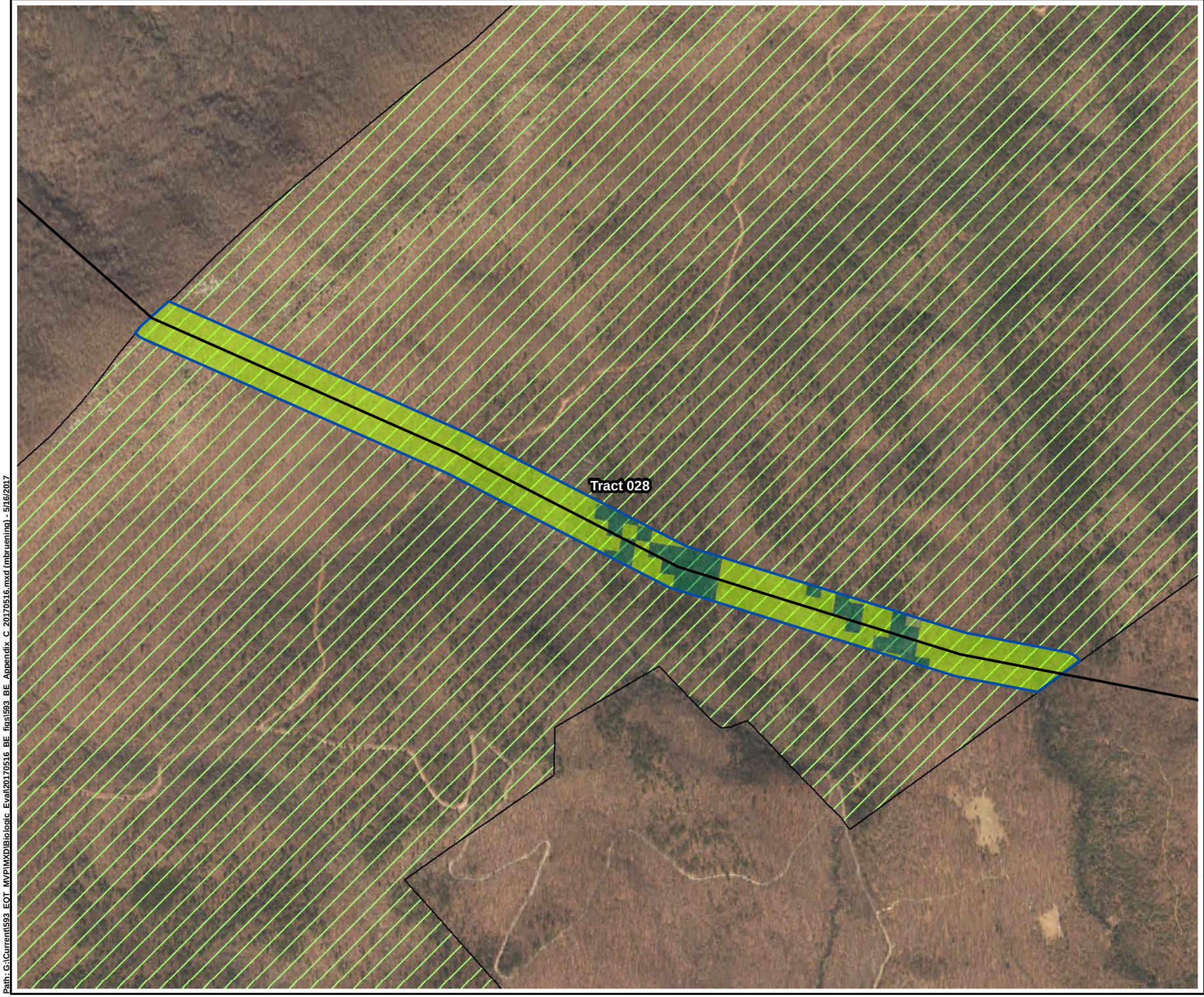
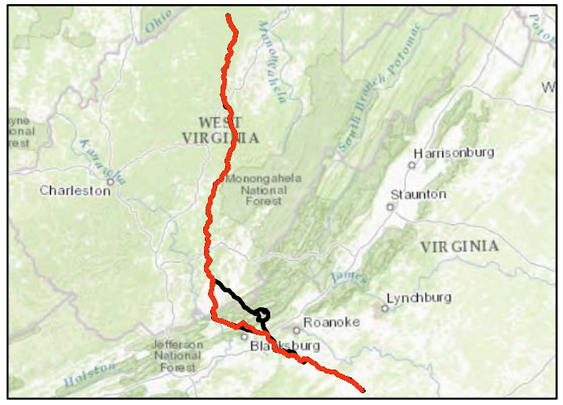


MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest
Evergreen Forest
Mixed Forest



N
W E
S

100 0 100 200 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 29 of 37

MVP Abandoned/Alternate Route

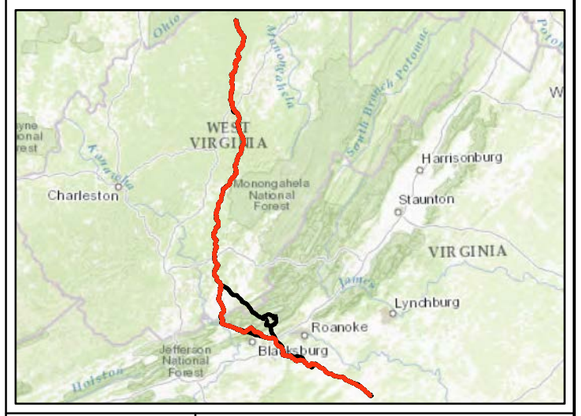
Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest

Herbaceuous



N W E S

10 0 10 20 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Tract 030

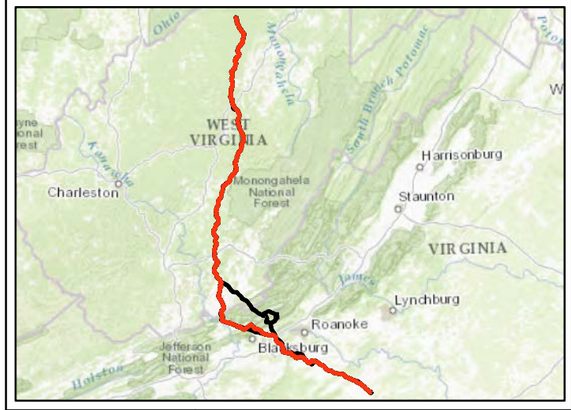
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 30 of 37

- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest



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80 0 80 160 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 31 of 37

MVP Abandoned/Alternate Route

Tract Identified on Jefferson National Forest Land

National Forest (Forest Service) Lands

Land Cover

Deciduous Forest

N W E S

7 0 7 14 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

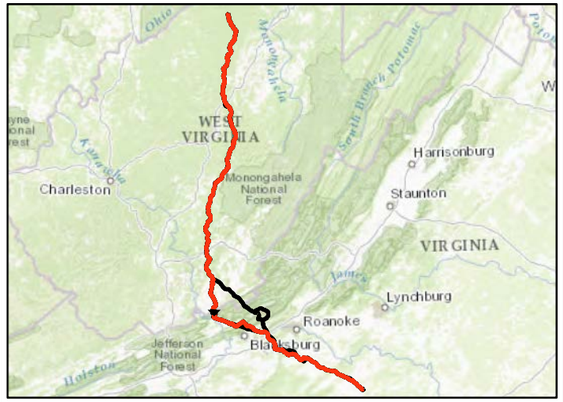
Map 32 of 37

Tract 032

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



N W E S

50 0 50 100 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

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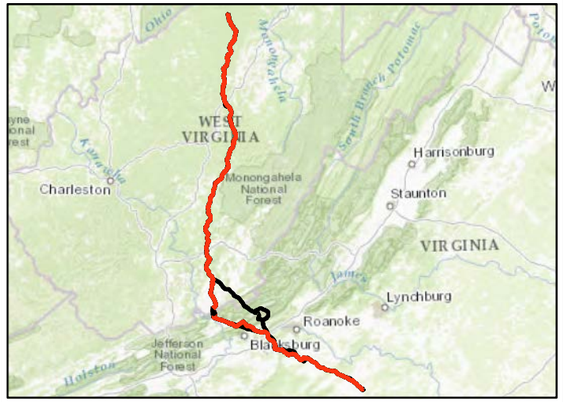
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 33 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest



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40 0 40 80 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI

ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Project No. 593.02

Tract 034

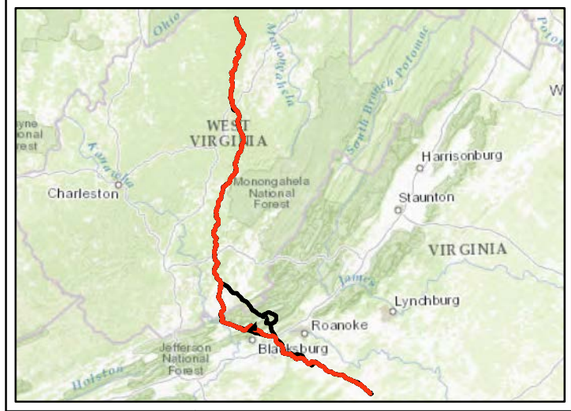
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 34 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Developed, Open Space



N W E S

20 0 20 40 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

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Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

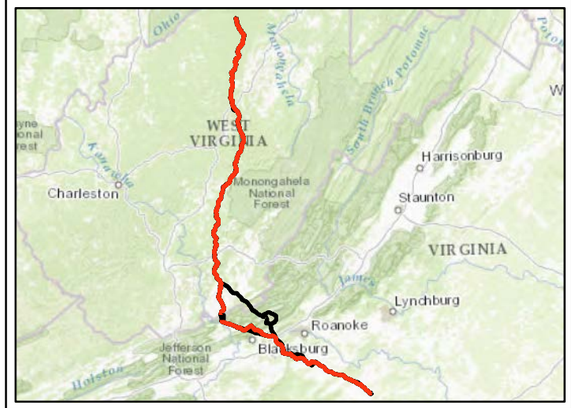
Map 35 of 37

Tract 035

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- Appalachian National Scenic Trail (ANST)
- Mystery Ridge Road
- Pocahontas Road
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest



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Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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Project No. 593.02

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Tract 036

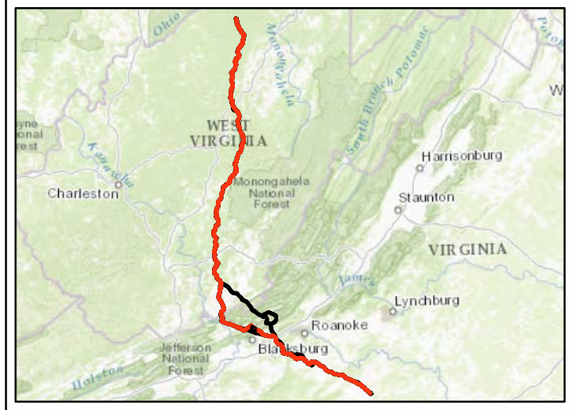
Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 36 of 37

- Proposed Route
- MVP Abandoned/Alternate Route
- Tract Identified on Jefferson National Forest Land
- National Forest (Forest Service) Lands

Land Cover

- Deciduous Forest
- Evergreen Forest



N W E S

80 0 80 160 Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

ESI **ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.**

Project No. 593.02

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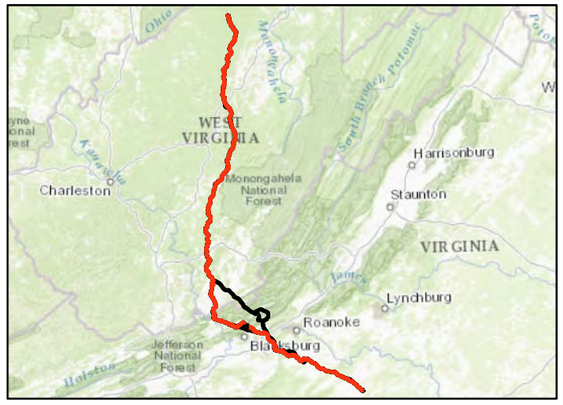
Tract 037

Appendix C. Habitat classifications along the proposed Mountain Valley Pipeline Project within the Jefferson National Forest.

Map 37 of 37

Proposed Route
MVP Abandoned/Alternate Route
Tract Identified on Jefferson National Forest Land
National Forest (Forest Service) Lands

Land Cover
Deciduous Forest



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75 0 75 150
Meters

Base Map: ESRI ArcGIS Web service - "World_Imagery" accessed - 5/16/2017

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ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.
Project No. 593.02

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APPENDIX D
ANNUAL STANDARDS AND SPECIFICATIONS
(WILL BE INCLUDED UPON VADEQ APPROVAL)

APPENDIX E
SPECIES ANALYSIS RESULTS

APPENDIX E
SPECIES ANALYSIS RESULTS

TES species eliminated due to known species range (OAR Code 1)

Species	Common Name
VERTEBRATE	
Fish	
Ammocrypta clara	Western sand darter
Cottus baileyi	Black sculpin
Chrosomus cumberlandensis	Blackside dace
Chrosomus tennesseensis	Tennessee dace
Erimonax monachus	Spotfin chub
Erimystax cahni	Slender chub
Etheostoma acuticeps	Sharphead darter
Etheostoma percnurum	Duskytail darter
Etheostoma tippecanoe	Tippecanoe darter
Icthyomyzon greeleyi	Mountain brook lamprey
Notropis ariommus	Popeye shiner
Noturus flavipinnis	Yellowfin madtom
Percina burtoni	Blotchside logperch
Percina williamsi	Sickle darter
Phenacobius crassilabrum	Fatlips minnow
Amphibian	
Plethodon hubrichti	Peaks of Otter salamander
Plethodon punctatus	Cow Knob salamander
Plethodon Shenandoah	Shenandoah salamander
Plethodon welleri	Weller's salamander
Mammal	
Glaucomys sabrinus coloratus	Carolina northern flying squirrel
Glaucomys sabrinus fuscus	Virginia northern flying squirrel
Microtus chrotorrhinus carolinensis	Southern rock vole
Myotis grisescens	Gray bat
Sorex palustris punctulatus	Southern water shrew
INVERTEBRATE	
Snail (Mollusk, Class Gastropoda)	
Helicodiscus diadema	Shaggy coil
Helicodiscus lirellus	Rubble coil
Helicodiscus triodus	Talus coil
Io fluvialis	Spiny riversnail
Mussel (Mollusk, Class Bivalvia)	
Alasmidonta varicosa	Brook floater
Cumberlandia monodonta	Spectaclecase
Cyprogenia stegaria	Fanshell
Dromus dromas	Dromedary pearlymussel
Epioblasma brevidens	Cumberlandian combshell

Species	Common Name
Epioblasma capsaeformis	Oyster mussel
Epioblasma florentina aureola	Golden riffleshell
Epioblasma torulosa gubernaculum	Green-blossom pearlymussel
Epioblasma triquetra	Snuffbox
Fusconaia cor	Shiny pigtoe
Fusconaia cuneolus	Fine-rayed pigtoe
Hemistena lata	Cracking pearlymussel
Lampsilis abrupta	Pink mucket
Lasmigona holstonia	Tennesse heelsplitter
Lemiox rimosus	Birdwing pearlymussel
Pegias fabula	Little-winged pearlymussel
Plethobasus cyphyus	Sheepnose
Pleurobema cordatum	Ohio pigtoe
Pleurobema oviforme	Tennessee clubshell
Pleurobema plenum	Rough pigtoe
Pleurobema rubrum	Pyramid pigtoe
Pleuronaia barnesiana	Tennessee pigtoe
Pleuronaia dolabelloides	Slabside pearlymussel
Ptychobranchus subtentum	Fluted kidneyshell
Quadrula cylindrical strigillata	Rough rabbits foot
Quadrula intermedia	Cumberland monkeyface
Quadrula sparsa	Appalachian monkeyface
Toxolasma lividum	Purple lilliput
Villosa perpurpurea	Purple bean
Villosa trobalis	Cumberland bean
Spider (Arachnid)	
Microhexura montiyaga	Spruce-fir moss spider
Pseudoscorpion (Arachnid, Order Pseudoscoriones)	
Kleptochthonius orpheus	Orpheus cave pseudoscorpion
Amphipod (Crustacean, Order Amphipoda)	
Stygobromus abditus	James Cave amphipod
Stygobromus cumberlandus	Cumberland cave amphipod
Stygobromus gracilipes	Shenandoah Valley cave amphipod
Stygobromus hoffmani	Alleghany County cave amphipod
Stygobromus mundus	Bath county cave amphipod
Isopod (Crustacean, Order Isopoda)	
Antrolana lira	Madison cave isopod
Caecidotea incurva	Incurved cave isopod
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod
Crayfish (Crustacean, Order Decapoda)	
Cambarus callamus	Big Sandy crayfish
Millipede (Class Diplopoda)	
Brachoria dentata	A millipede
Brachoria eutypa ethotela	Hungry Mother millipede
Buotus carolinus	A millipede

Species	Common Name
Cleidogona hoffmani	Hoffman's cleidogonid millipede
Cleidogona lachesis	A millipede
Dixioria fowleri	Fowler's millipede
Dixioria pela coronata	A millipede
Nannaria shenandoah	Shenandoah Mountain xystodesmid millipede
Pseudotremia alecto	A millipede
Semionellus placidus	A millipede
Centipede (Class Chilopoda)	
Escaryus cryptorobius	Montane centipede
Escaryus orestes	Whitetop Mountain centipede
Nampabius turbator	A cave centipede
Springtail (Insect, Order Collembola)	
Pygmarrhopalites carolynae	A cave springtail
Pymarrhopalites sacer	A cave springtail
Mayfly (Insect, Order Ephemeroptera)	
Leptophlebia johnsoni	Johnson's pronggill mayfly
Stonefly (Insect, Order Plecoptera)	
Acroneuria kosztarabi	Virginia stonefly
Isoperla major	Big stripetail stonefly
Megaleuctra williamsae	Smokies needlefly
Taeniopteryx nelsoni	Cryptic willowfly
Beetle (Insect, Order Coleoptera)	
Cicindela ancocisconensis	Appalachian tiger beetle
Cyclotrachelus incisus	A ground beetle
Butterfly, Skipper, Moth (Insect, Order Lepidoptera)	
Euchlaena milnei	Milne's euchlaena moth
Psectrotarsia hebardi	Hebard's noctuid moth
NON-VASCULAR PLANT	
Lichen	
Gymnoderma lineare	Rock gnome lichen
Hypotrachyna virginica	Hydrothyria lichen
Liverwort	
Bazzania nudicaulis	A liverwort
Frullania oakesiana	A liverwort
Mertzgeria fruticulosa	A liverwort
Plagiochila austinii	A liverwort
Sphenolobopsis pearsonii	A liverwort
Moss	
Sphagnum flavicomans	Northeastern peatmoss
VASCULAR PLANT	
Actaea rubifolia	Appalachian black cohosh
Arabis patens	Spreading rockcress
Betula uber	Virginia round-leaf birch
Cardamine clematitis	Mountain bittercress
Cardamine flagellifera	Blue ridge bittercress

Species	Common Name
Carex polymorpha	Variable sedge
Chelone cuthbertii	Cuthbert turtlehead
Echinodorus tenellus	Dwarf burhead
Gentiana austromontana	Appalachian gentian
Helenium virginicum	Virginia sneezeweed
Helonias bullata	Swamp-pink
Heuchera alba	White alumroot
Iliamna corei	Peter's Mountain mallow
Iliamna remota	Kankakee globe-mallow
Isoetes virginica	Virginia quillwort
Lilium grayi	Gray's lily
Lycopodiella margueritae	Marguerite's clubmoss
Micranthes caroliniana	Carolina saxifrage
Packera millefolium	Piedmont ragwort
Potamogeton hilii	Hill's pondweed
Prenanthes roanensis	Roan Mountain rattlesnake-root
Sceptridium jenmanii	Alabama grapefern
Scirpus ancistrochaetus	Northeastern bulrush
Sida hermaphrodita	Virginia mallow
Silene ovata	Mountain catchfly
Spiraea virginiana	Virginia spiraea
Trillium pusillum var. moniticulum	Virginia least trillium

TES species eliminated due to lack of suitable habitat in project area (OAR Code 2)

Species	Common Name
VERTEBRATE	
Bird	
Falco peregrinus	Peregrine Falcon
Haliaeetus leucocephalus	Bald Eagle
Lanius ludovicianus migrans	Migrant Loggerhead Shrike
Thryomanes bewickii altus	Appalachian Bewick's Wren
Mammal	
Corynorhinus townsendii virginianus	Virginia big-eared bat
INVERTEBRATE	
Snail (Mollusk, Class Gastropoda)	
Glyphyalinia raderi	Maryland glyph
Paravitrea reesei	Round supercoil
Amphipod (Crustacean, Order Amphipoda)	
Stygobromus estesi	Craig County cave amphipod
Stygobromus fergusoni	Montgomery County Cave amphipod
Springtail (Insect, Order Collembola)	
Pygmarrhopalites commorus	A cave springtail
Beetle (Insect, Order Coleoptera)	
Cicindela patruela	Northern barrens tiger beetle
Scorpionfly (Insect, Order Mecoptera)	
Brachypanorpa jeffersoni	Jefferon's short-nosed scorpionfly
Butterfly, Skipper, Moth (Insect, Order Lepidoptera)	
Callophrys irus	Frosted elfin
Erynnis persius persius	Persius duskywing
Pyrgus centaureae wyandot	Appalachian grizzled skipper
Cotocala herodias gerhardi	Herodias underwing
NON-VASCULAR PLANT	
Lichen	
Hypotrachyna virginica	Virginia hypotrachyna lichen
Liverwort	
Nardia lescurii	A liverwort
VASCULAR PLANT	
Allium oxyphilum	Nodding onion
Boechera serotina	Shale barren rockcress
Carex schweinitzii	Schweinitz's sedge
Clematis addisonii	Addison's leatherflower
Clematis coactilis	Virginia white-haired leatherflower
Echinacea laevigata	Smooth coneflower
Euphorbia purpurea	Glade spurge
Hasteola suaveolens	Sweet-scented Indian-plantain
Hypericum mitchellianum	Blue Ridge St. John's-wort
Ilex collina	Long-stalked holly
Liatris helleri	Turgid gayfeather

Species	Common Name
Paxistima canbyi	Canby's mountain lover
Potamogeton hillii	Hill's pondweed
Rudbeckia triloba var. pinnatiloba	Pinnate-lobed coneflower
Vitis rupestris	Sand grape

TES species eliminated due to negative survey results (OAR Code 3)

Species	Common Name
VERTEBRATE	
Mammal	
Myotis septentrionalis	Northern long-eared bat
Myotis sodalis	Indiana bat
NON-VASCULAR PLANT	
Liverwort	
Plagliochila sullivantii var. sullivantii	A liverwort
VASCULAR PLANT	
Acontinum reclinatum	Trailing white mokshood
Buckleya distichophylla	Piratebusch
Cleistesiopsis bifaria	Small spreading pogonia
Corallorhiza bentleyi	Bentley's coralroot
Delphinium exaltatum	Tall larkspur
Isotria medeoloides	Small whorled pogonia
Juglans cinerea	Butternut
Phlox buckleyi	Sword-leaf phlox
Poa paludigena	Bog bluegrass
Pycnanthemum torrei	Torrey's mountain-mint
Tsuga caroliniana	Carolina hemlock

TES species occurring within project area, but outside activity area (OAR Code 4)

Species	Common Name
VERTEBRATE	
Mammal	
Myotis leibii	Eastern small-footed bat
INVERTEBRATE	
Beetle (Insect, Coleoptera)	
Hydraena maureenae	Maureen's shale stream beetle
VASCULAR PLANT	
Berberis canadensis	American barberry

TES species located during surveys within activity area (OAR Code 5)

Species	Common Name
VASCULAR PLANTS	
Scutellaria saxatilis	Rock skullcap

TES species not identified during surveys but may occur due to habitat (OAR Code 6)

Species	Common Name
INVERTEBRATE	
Butterfly, Skipper, Moth (Insect, Order Lepidoptera)	
Speyeria diana	Diana fritillary
Speyeria idalia	Regal fritillary
Bumblebee (Insect, Order Hymenoptera)	
Bombus affinis	Rusty patched bumblebee
VASCULAR PLANT	
Monotropsis odorata	Sweet pinesap

Aquatic TES species or habitat known or suspected downstream of Project, but outside of geographic bounds of water resource cumulative effects analysis area (OAR Code 7)

Species	Common Name
VERTEBRATE	
Fish	
*Percina rex**	Roanoke logperch
INVERTEBRATE	
Mussel (Mollusk, Class Bivalvia)	
Elliptio lanceolata	Yellow lance
Fusconaia masoni	Atlantic pigtoe
*Pleurobema collina**	James spinymussel

*Also OAR Code 9

Aquatic TES species or habitat known or suspected downstream of Project, but inside identified geographic bounds of water resource cumulative effects analysis area (OAR Code 8)

Species	Common Name
VERTEBRATE	
Fish	
Etheostoma osburni	Candy darter
Notropis semperasper	Roughhead shiner
Notrus gilberti	Orangefin madtom
Phenacobius teretulus	Kanawha minnow
INVERTEBRATE	
Mussel (Mollusk, Class Bivalvia)	
Lasmigona subviridis	Green floater
Dragonfly (Insect, order Odonata)	
Gomphus viridifrons	Green-faced clubtail
Ophiogomphus incurvatus alleghaniensis	Allegheny snaketail

Project occurs in a 6th level watershed included in the USFWS/FS T&E Mussel and Fish Conservation Plan (OAR Code 9)

Species	Common Name
VERTEBRATE	
Fish	
*Percina rex**	Roanoke logperch
INVERTEBRATE	
Mussel (Mollusk, Class Bivalvia)	
*Pleurobema collina**	James spinymussel

*Also OAR Code 7

APPENDIX F
FIELD SURVEY OBSERVATIONS AND NOTES
PRIVILEDGED AND CONFIDENTIAL

APPENDIX G
PROJECT-WIDE MITIGATION MEASURES

APPENDIX G
PROJECT-WIDE MITIGATION MEASURES

Project-wide mitigation measures will be implemented on Jefferson National Forest (JNF). These measures include:

- Routing Project facilities to avoid sensitive resources where possible
- Reduction of the right-of-way (ROW) in sensitive stream and wetland habitats
- Co-locating Project facilities with existing pipeline or utility ROWs where feasible
- Implement the Project's Migratory Bird Habitat Conservation Plan:
    - Minimizing habitat fragmentation to the maximum extent possible
    - Conducting environmental training of Mountain Valley personnel and inspection of construction and restoration activities
    - Restricting maintenance activities to outside of the breeding/nesting season
- Implement the Project's Exotic and Invasive Species Control Plan during construction, operation, and maintenance of the Project
    - Avoiding introduction of exotic/invasive species in organic materials brought on-site during construction by thoroughly cleaning equipment prior to mobilization to Project area
    - Establishment of equipment cleaning stations to thoroughly wash all equipment before transporting it to the next construction spread (wash stations will not be on USFS lands unless provisions are made for the collection and proper disposal of the water, soil, and debris generated by the washing)
    - Restricting use of mulch and straw bales for sediment control devices to only those that are certified weed free
    - Conducting selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operation of the Project
    - Topsoil will be stripped from the full width of the construction ROW and will be stored separate from other soils
    - Committing to using only USFS requested seed mixes during all restoration efforts (as requested by the USFS, the primary goal of seed mixes used on the JNF will be to stabilize disturbed slopes, with a secondary goal [which may involve a second seeding application] of developing high-priority wildlife habitats)
    - Minimizing the time bare soil is exposed during construction to reduce the opportunity for exotic/invasive plants to become established

- Contaminants
    - Implementing the Project-specific Spill Prevention, Control, and Countermeasure Plan
    - Instituting preventive measures such as personnel training, equipment inspection, and refueling procedures to reduce likelihood of spills
    - Prohibiting the parking, storage, or servicing of construction equipment, vehicles, hazardous materials, fuels, chemicals, lubricating oils, and petroleum products within a 100-foot radius of any waterbody
    - Prohibiting the mixing, loading, or cleaning of herbicides within 200 feet of private land (unless agreed upon with the private landowner), riparian corridors, open water wells, or other sensitive areas
- Entrapment
    - Installation of wildlife escape ramps in the pipeline trench approximately every 50 feet during construction
    - Where consistent, use wildlife fences in coordination with escape ramps as a deterrent on the edges of both sides of the ROW along segments of the Project that will cross portions of the JNF
- Sediment and Erosion Control
    - Implementing the Project-specific Erosion and Sediment Control Plan
    - Maintaining surface and ground water quality using appropriate erosion control practices and best management practices
    - Complying with FERC's Upland Erosion Control, Revegetation, and Maintenance Plan (May 2013) and the FERC Wetland and Waterbody Construction and Mitigation Procedures (May 2013)
    - Installing erosion control measures prior to earth disturbance activity
- Sensitive Rare, Threatened, or Endangered Species Habitat
    - Implementing the Project-specific Karst Management Plan to protect and minimize impacts to karst, karst-like features, and caves
    - Committing to tree clearing activity outside of June-July to minimize impacts to non-volant, juvenile bats
    - Abiding by all time-of-year-restrictions for in-stream construction in waterbodies containing rare, threatened, or endangered aquatic species
    - Co-locating the pipeline with existing Mystery Ridge Road to the extent practicable to avoid further fragmenting wildlife habitat
    - Using all existing roads or pathways to the pipeline before considering construction of new access roads
    - Following the recommendations in the General Blasting Plan should blasting occur on USFS lands

- Collecting seeds from discovered rock skullcap plants for planting upon completion of construction activities

Tree clearing is proposed to occur in winter on JNF, which will reduce potential direct impacts to avian species that only use the area for summer breeding. The Project schedule is dependent upon obtaining all necessary authorizations, which will then dictate when Project tree-clearing activities can begin. Mountain Valley will begin tree-clearing activities as soon as allowed, which could be as early as November 2017. In that case, the majority of clearing will be completed by March 31, 2018. However, because of uncertainty associated with the Project's dependency on authorizations, and in order to estimate potential impacts as realistically as possible, the following clearing schedule is assumed for preparation of impact assessments:

- January to March 2018 – 167 miles
- April to May 2018 – 101 miles
- August to November 2018 – 32 miles

This schedule is based on the following assumptions: a clearing rate of 762 linear meters (2,500 feet) per day and clearing crews working 6 days per week with no clearing on standard federal holidays. If clearing begins earlier than January, then a greater portion of the Project will be cleared during winter 2018, meaning that actual impacts to migratory birds will be less than assumed for this discussion. In addition, Mountain Valley is committed to the following clearing restrictions for identified areas along the Project:

- Areas within 8 kilometers (5 miles) of Indiana bat hibernacula or within 0.4 kilometer (0.25-mile) of northern long-eared bat hibernacula will be cleared before March 31, 2018, or after November 15, 2018
- Identified loggerhead shrike suitable habitat will be cleared before March 31, 2018 or after July 31, 2018
- No clearing of any areas along the Project will occur between June 1 and July 31

Additional avoidance and minimization measures, and mitigation measures that will benefit locally rare aquatic species include:

- For all wild trout stream crossings, Mountain Valley will abide by the in-stream construction restriction from October 1 – March 31
- For coldwater stream crossings, Mountain Valley will abide by the in-stream construction restriction from September 15 – March 31 in West Virginia and March 1 – June 30 in Virginia
- Mountain Valley has committed to fish relocations at all perennial stream crossings in Virginia

Pipeline construction will be completed by December 2018 with a target in-service date for the Project of December 2018.