Virginia Scientist-Community Interface
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Deficiencies in 2022 Draft Supplemental Environmental Impact Statement

Executive Summary

We strongly urge the US Forest Service to not allow MVP to cross the Jefferson National Forest (the No Action Alternative) based on our scientific analysis of the Draft Supplemental Environmental Impact Statement. In this comment, we:

- Illustrate several flaws in the Forest Service's 2022 DSEIS analysis of USGS paired gage turbidity measurements. Further, we present an independent analysis that demonstrates pipeline construction activities do in fact elevate downstream turbidity.
- Outline concerns regarding the misuse of RUSLE models, high levels of uncertainty in model results, and sole reliance on these results to inform erosion control planning.
- Criticize the DSEIS conclusion that it is "not likely" MVP will adversely impact the endangered candy darter in JNF.
- Discuss the potential impacts of MVP's proposed use of insecticides in JNF and stress the importance of USFS providing a more detailed description and assessment of this proposed project for cumulative effects analysis.
- Criticize the DSEIS conclusion that it is "not expected" MVP will threaten freshwater mussels when there has been no analysis of potential impacts to mussel host fish.

About this report: This independent analysis was completed by the Virginia Scientist-Community Interface (V-SCI). V-SCI is a volunteer organization dedicated to reviewing and synthesizing science related to environmental issues across the southeastern United States. We are happy to discuss our findings in more detail if we can be of greater service.

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1. Rationale and background

In December 2022, the US Forest Service (USFS) released The Mountain Valley Pipeline (MVP) and Equitrans Expansion Project Draft Supplemental Environmental Impact Statement (DSEIS) #50036. The DSEIS concerns MVP's proposal seeking approval for a natural gas pipeline across approximately 3.5 miles of Jefferson National Forest (JNF). Specifically, the DSEIS responds to the January 25, 2022 US Court of Appeals Fourth Circuit decision that vacated and remanded the Forest Service and Bureau of Land Management (BLM)'s decision to grant access to the MVP pipeline.

In this document, we review scientific evidence related to the Forest Service's response and assessment described in the DSEIS. Our group, called Virginia Scientist-Community Interface (V-SCI), is a volunteer-led group of early-career scientists who offer scientific support for environmental issues. Our group includes graduate students and postdoctoral scholars with expertise across hydrology, biology, climate change, resource management, and other science and engineering fields. Together, we have reviewed scientific evidence related to MVP for over two years and produced numerous public comments (found at our website: https://virginiasci.org/past-work).

2. Turbidity analysis

The Forest Service states that:

> "[t]he Fourth Circuit remanded the Forest Service "to consider USGS data and other relevant information indicating that the modeling used in the EIS may not be consistent with data about the actual impacts of the Pipeline and its construction."

The Fourth Circuit's directions to the Forest Service were based on findings that downstream turbidity was greater than upstream turbidity at the Roanoke River paired stream gages at Lafayette, Virginia (see V-SCI 2020; upstream = USGS 0205450393 ROANOKE RIVER ALONG ROUTE 626 AT LAFAYETTE, VA, downstream = USGS 0205450495 ROANOKE RIVER ABOVE ROUTE 11 AT LAFAYETTE, VA). In an attempt to address this requirement from the Fourth Circuit, the Forest Service conducted an independent review that "considers modeling and monitoring activities as they relate to erosion and sediment effects on surface water."

Here, we 1) discuss how the Forest Service's 2022 DSEIS analysis of USGS paired stream gage turbidity measurements is flawed and 2) present an independent analysis of USGS turbidity data using similar methods as those in the 2022 DSEIS that demonstrate construction activities do in fact elevate downstream turbidity.

2.1 The Forest Service's analysis of USGS turbidity in the 2022 DSEIS is deficient

2.1.1 Construction periods are not defined

In Table 4 of the DSEIS, the Forest Service presents USGS stream gages used in their analysis. They indicate the beginning of the monitoring period at these gages and the "construction start" date at these gages. However, construction occurred at these gages, and particularly at the Roanoke River gages, before 2019. **In fact, 2018 saw the majority of construction and land clearing activities (Wild Virginia, 2022), and it was this period (2018/05/01 - 2019/08/19) that was previously analyzed by V-SCI in 2020 and cited by the Fourth Circuit. However, the Forest Service did not analyze this period, and instead states that construction only began in 2019.** Further, the dates of construction use in that previous analysis (2018/05/01 -2019/08/19) were taken from MVP's response to a previous comment about concerns related to sedimentation in the Roanoke River (see MVP Response to the Cristopulos Report, Geosyntec Consultants, Inc 2019). In addition, the current Forest Service 2022 DSEIS does not document when construction ended, which is important when performing a statistical analysis of the effects of construction on turbidity at these gages.

2.1.2 Turbidity events >50 FNU used in analysis are not defined

In Table 5, the Forest Service indicates pre- and post-construction turbidity events greater than 50 FNU, but these events are not defined. This, coupled with the lack of information regarding construction periods means that a thorough review of the Forest Service's analysis is unable to occur. Additionally, **for this analysis, the Forest Service used peak turbidity for these events, which likely does not fully capture the continuous effects of elevated turbidity in-stream.**

2.1.3 Peak turbidity for events >50 FNU is not in line with the Fish and Wildlife Service's application of the Newcombe and Jensen (1996) "severity of effect" (SEV) model and the Bull Trout Guidance in the 2022 Supplement to the Biological Assessment (MVP 2022)

The US Fish and Wildlife Service has stated that communication with Newcombe and Jensen confirms that their model, which calculates the "severity of effect" to salmonids based on the duration and concentration of suspended sediment is applicable to the MVP project's "aquatic Action Area". In the 2022 SBA, the Fish and Wildlife Service stated that "adverse effects to Roanoke logperch and candy darters in the following continuous exposure circumstances:

- Any time sediment concentrations exceed 148 mg/L over background.

- When sediment concentrations exceed 99 mg/L over background for more than 1 hour continuously.
- When sediment concentrations exceed 40 mg/L over background for more than 3 hours continuously.
- When sediment concentrations exceeded 20 mg/L over background for over 7 hours continuously.

These thresholds are chosen because continuous exposure to suspended sediment, even at relatively low concentrations, can have a negative impact on Candy Darters. However, the Forest Service aggregated turbidity data from USGS paired stream gages "into individual events that exceeded 50 Formazin Nephelometric Units (FNU)." This threshold was chosen "because it is the basis for State water quality standards for turbidity in neighboring West Virginia and North Carolina (Virginia does not have a water quality standard for turbidity)". **This is not in line with the Forest Service's application of the above continuous exposure methodology that is stated to be "both consistent with the best available science and appropriate for this Project." (MVP 2022)**

2.1.4 Statistical methods not clear

The Forest Service states it used a "regression approach", but they do not define their model, making their analysis unclear. The citation used for their statistical analysis, Grabow et al. (1998), is not currently available for review and is not a widely cited article for a "regression approach". A different article by Garry L. Grabow published in a 1999 edition of the NCSU Water Quality Group Newsletter indicates that an analysis of covariance (ANCOVA) is the "regression approach" likely used by the Forest Service, but this is not at all clear in their description of their analysis.

2.1.5 MVP analysis of USGS monitoring data not available for analysis

The Forest Service states that "Mountain Valley provided its own analysis of the USGS monitoring data (MVP 2022e), concluding that the USGS data could not corroborate the RUSLE2 modeling." This indicates that MVP's own analysis shows that turbidity following or during (it is not clear) construction is greater than RUSLE2 estimates. However, this analysis, which "does not corroborate the RUSLE2 modeling" and is appendix L of the 2022 SBA, is fully redacted. In a FERC filing, MVP argues that appendix L, which contains MVP's own analysis of USGS turbidity data that does not agree with RUSLE2 modeling, was redacted because "its extensive focus on sensitive species location and related confidential information" (see supplemental attachment 1). **MVP should provide the methods and results of this analysis, and can easily do so without divulging the location of sensitive species.**

2.1.6 The Forest Service does not compare real-world USGS monitoring data to RUSLE2 modeling estimates, as directed to by the 4th Circuit Court

The Forest Service argues that RUSLE2 modeling is "not meant to be validated by USGS or other monitoring data". The Forest Service also cites the RUSLE2 documentation (USDA 2008) and states that "[t]he most important part of RUSLE2's validation is whether RUSLE2 leads to the desired erosion control decision, not how well RUSLE2 estimates compare to measured data." However, the full quote from the RUSLE2 documentation states:

> "The most important part of RUSLE2 validation is whether RUSLE2 leads to the desired erosion control decision, not how well RUSLE2 estimates compare to measured data. **Validation certainly involves evaluating RUSLE2's accuracy, but many other considerations are also important in judging how well RUSLE2 serves its stated purpose** (emphasis added).

For example, a model could perfectly compute erosion, but if the resources required to use a particular model exceed available resources, the model is invalid, (i.e., it does not serve its intended purpose)." Thus the Forest Service misrepresented the RUSLE2 documentation, incorrectly asserting that RUSLE2 modeling cannot be compared to real-world data, despite the 4th Circuit Court direction.

The RUSLE2 model documentation also suggests that model estimates are useful for analyzing individual storm events, stating "[a]lthough RUSLE2 is not intended to estimate erosion from individual storms, its accuracy for individual storm event erosion estimates may be comparable to estimates from complex, process-based models. **RUSLE2 is better for estimating individual event erosion than is commonly assumed."**(emphasis added).

The Forest Service also states that:

> "[b]ecause RUSLE2 is not designed to be validated with in-stream water quality monitoring data, it is not possible to conclusively determine if the USGS data and other relevant information are consistent with the modeling."

But the RUSLE2 documentation state "If users understand how RULSE2 works regarding individual storms and representing historical events and they have the expertise and other resources to apply RUSLE2, then RUSLE2 is valid in these applications if these RUSLE2 users consider RUSLE2 estimates to be useful." This indicates that properly trained individuals with the appropriate expertise can apply RUSLE2 in this way if they choose to.

Lastly, while the Forest Service argues that "RUSLE2 is not designed to be validated with in-stream water quality monitoring data", the Forest Service states that MVP did exactly that when "[b]aseline field embeddedness surveys were completed on multiple streams in March and April 2020 to ground truth the RUSLE2 sedimentation model predictions" (Fisheries and Aquatic Resources Specialist Report) at the "request of the agencies" (MVP 2022). If the Forest Service believes that embeddedness surveys performed by MVP to "ground truth the RUSLE2 sedimentation model predictions" are applicable, then the Forest Service should also consider and compare USGS data to RUSLE2 estimates.

2.2 Independent analysis of USGS paired turbidity data finds that downstream turbidity greater than upstream turbidity during construction on the Roanoke River at Lafayette, VA

We analyzed 5-minute turbidity (FNU) data from two paired stream gauges on the Roanoke River (Table 1). Data was downloaded from the USGS' National Water Information System (NWIS) using the R package dataRetrieval (De Cicco et al., 2022) . All available data was downloaded for each site. Because USGS data undergoes extensive QA/QC, erroneous and incorrect data, often caused by debris or sensor malfunction, is removed. From this raw, 5-minute dataset, a new dataset was created where each time-step had a value for both sites (n = 495581 for both sites). In an effort to recreate the Forest Service analysis in the 2022 DSEIS as closely as possible, this dataset with no missing values was filtered to only contain values >50 FNU (see Table 1; supplemental data).

To understand the effects of construction activities, we relied on a timeline for spread G which contains the Roanoke River at Lafayette, VA USGS gages, that was assembled by Wild Virginia (2022) based on inspection reports from Virginia Department of Environmental Quality (DEQ), McDonough Bolyard Peck, Inc., and Mountain Valley Pipeline, LLC. (see Figure 3 in Wild Virginia 2022 for timeline). Because this timeline provides specific construction activities, we included the construction activities "clearing" and "backfilling" as factors in our analysis.

We used an analysis of variance (ANOVA) to analyze the difference between upstream and downstream turbidity during documented construction in the vicinity of the Roanoke River at Lafayette, VA. This gage was chosen for analysis because 1) it was cited in the 4th Circuit Court of Appeals, and 2) it was analyzed by the Forest Service in the 2022 DSEIS. We used R Statistical Software (R Core Team 2021) to perform the ANOVA, and then we computed estimated marginal means using the emmeans R package to examine the differences between upstream and downstream gages during different periods of construction. The dataset and R script used in this analysis are provided as supplemental data.The ANOVA model formula was as follows:

turbidity   site * clearing * backfilled

We found that downstream turbidity was significantly greater than upstream turbidity (15.8 ±3.22 FNU) when both clearing and backfilling was occurring in the vicinity ($p > 0.0001$). There were no significant differences between upstream and downstream turbidity during any other combination of construction periods (Figure 1). These results show that construction activities elevate downstream turbidity. Further, this analysis did not examine the differences in duration of various elevated turbidity events such as those indicated as leading to "adverse effects to Roanoke logperch and candy darter" (MVP 2022).

3. RUSLE2 modelling deficiencies

Both RUSLE and RUSLE2 soil erosion models can inform erosion control planning and best management practices (BMPs), but only when the models are applied carefully, and the results are cautiously interpreted alongside other tools. The current DSEIS states MVP exclusively relied on RUSLE models to plan its BMPs and erosion control devices in the JNF. However, **MVP misused these models in multiple ways that generate high uncertainty in their results** as presented in the DSEIS and Hydrologic Analysis of Sedimentation for the Jefferson National Forest Report of Findings (Hydrologic Report, Geosyntec Consultants, Inc 2020). **MVP failed to incorporate other tools to offset this uncertainty or make any significant updates in its 2022 DSEIS to improve their erosion control planning**. Additionally, although the DSEIS repeatedly claims the RUSLE model's results are only a "conservative planning and analytical tool to identify areas with increased potential for sedimentation" (pg 38) and "are not meant to be validated by USGS or other monitoring data" (pg 42), our analysis of USGS turbidity data in section 1 of this document illustrates **RUSLE modeling alone did not lead MVP to implement adequate BMPs and erosion control measures.**

Based on our review of MVP's modeling procedures, we strongly urge the USFS to reconsider their acceptance of the modeling results described in the Hydrologic Report and DSEIS. Also, because JNF is a unique and challenging area to model with RUSLE methods, we also recommend that the **modeling should be reviewed by a third-party expert who is familiar with leading-edge RUSLE modeling research and implementation.**

Below, we summarize our concerns with MVP's use of the RUSLE models described in the DSEIS and the Hydrologic Report. Readers can find more technical details about our concerns with the Hydrologic Report's RUSLE modeling methods in our previous comment for the 2020 DSEIS ("MVP sedimentation analysis fails to sufficiently mitigate water quality impacts within the Jefferson National Forest") and academic journal articles that are attached to this comment.

3.1 Models are unfit for the complex terrain of JNF and fail to incorporate additional tools

The RUSLE models are calibrated using thousands of real-world measurements from many locations. This means the model is most accurate in places where there has been data collected to inform the mathematical relationships between climate, soils, topography, and soil erosion. Model developers have warned about the limitations of the model and encouraged users to interpret results with great caution, especially in areas where the model was not calibrated (USDA, 2008). As acknowledged in the Hydrologic Report, the RUSLE models are not calibrated in the MVP disturbance area in JNF, or in

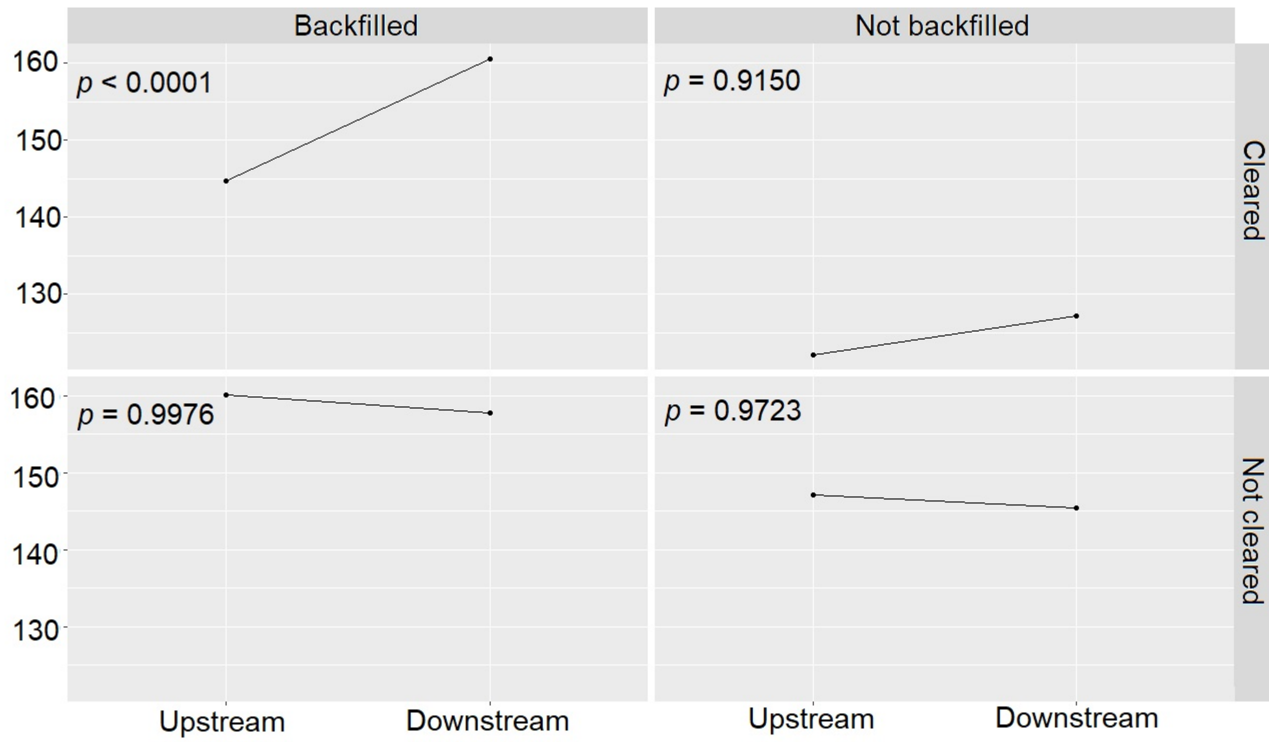

Figure 1. Interaction plot for estimated marginal means at upstream (Roanoke River along Route 626 at Lafayette, VA) and downstream (Roanoke River above Route 11 at Lafayette, VA) gages during clearing and backfilling construction activities.

Site	USGS station number	Location	Beginning of Record	End of record used for analysis	n of period of record	n of analyis
Roanoke River along Route 626 at Lafayette, VA	205450393	Upstream	2017-08-23	2023-01-10	544,858	16,559
Roanoke River above Route 11 at Lafayette, VA	205450495	Downstream	2017-08-23	2023-01-10	559,238	18,087

Table 1. Station name, USGS station number, beginning of data record at each station, end date of the record used for statistical analysis, number of 5-minute data points in the period of record, number of 5-minute data points were FNU was greater than 50 used in analysis.

any area with similar environmental features. Therefore, **the modeling results reported in the DSEIS cannot reliably inform MVP's erosion control decisions.**

Due to the limitations of the method, the RUSLE models should not be used as a sole factor in decision making, even for areas where the model was calibrated, as stated here:

> "Erosion-control planners should consider information generated by RUSLE2 to be only one set of information used to make an erosion control decision" (USDA, 2008).

MVP ignored this advice from model developers and solely relied on RUSLE in their erosion control planning in the JNF. **Additional methods to improve BMPs applied in JNF are pivotal to preventing catastrophic damage to the disturbance areas.**

3.2 Modeling is not applied at the correct scale

The Hydrologic Report defines the watershed based on the Hydrologic Unit Code- (HUC-) 12, which is not proper engineering practice or a reasonable definition to examine stream impacts that occur at a much smaller scale, rather than site-specific topography-based delineations. The HUC system is a nationally defined stream and river referencing system, in which specific watersheds are referenced by numerical codes. HUCs are simply stream "addresses," and are not intended to be units for hydrologic analysis. HUC-12 refers to the smallest-scale watersheds in the referencing system, 25,000 acres on average, compared with about 20 acres for a first-order stream watershed. **Averaging across the HUC-12 scale, rather than focusing on the smaller watersheds and individual streams, results in misleadingly low average sedimentation increases.** There is no justification for presenting any overall results at the larger HUC-12 scale and doing so obscures the greatest sedimentation impacts in smaller topographically defined watersheds.

3.3 Sedimentation estimates by RUSLE2 are too high to be accurately modeled in 39% of the project area

The Hydrologic Report acknowledges that RUSLE2 results are erroneous when estimated sedimentation is greater than 20 tons/acre/year, and that 39% of the study area had sediment yields of greater than this threshold (pg 19). The sedimentation rate calculated in RUSLE2 means 1) that there is excessive sedimentation expected in at least 39% of the study area that needs to be reduced to levels that are safe for water quality and 2) **the Hydrologic Report did not accurately model how excessive these sedimentation rates will be because RUSLE2 does not work well in areas with high sedimentation.** No justification is given for accepting these erroneous estimates except to say that they are "reasonable." According to the USDA (2008), "reasonable" just means not physically impossible.

3.4 Model calculations were oversimplified and do not account for steep terrain of JNF

The Hydrologic Report did not calculate all RUSLE and RUSLE2 parameters according to best practices. For mountainous terrain like JNF, MVP's calculation of the Slope Length (LS) factor in its models is of particular concern because it represents the impact of slope steepness on erosion and has a large impact on sedimentation predictions (USDA, 1997). The Hydrologic Report states that it uses the RUSLE methodology provided in Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE) (USDA, 1997). However, on page 104 of that document, using a formulaic approach in LS factor calculations is recommended (USDA, 1997). A formulaic approach means adjusting calculations based on topographical features, as opposed to a static approach of assigning values that do not change. A wide breadth of scientific literature has examined best practices to calculate the LS factor for different terrains, but MVP instead used static values that do not adjust for the slope of the terrain or account for increased erosion in steep terrain. **Since the formulaic calculation adjusts for slope, it is better adapted for steep-slope areas such as JNF.** In our 2020 comment, we provide more detail about how MVP's miscalculation of the LS factor systematically underestimates sedimentation in areas with slopes greater than 9%; MVP construction will routinely work along slopes well above 15% (see Tables 4.1-1, 4.1-2, and 4.1-3 in Dodds, 2017).

4. Candy Darter

On February 3rd, 2022, the Fourth Circuit vacated the 2020 U.S. Fish and Wildlife (FWS) Biological Opinion, stating that FWS "did not adequately analyze the environmental context for the Roanoke logperch and candy darter". The candy darter (*Etheostoma obsurnii*) is a freshwater fish found only in Virginia and West Virginia. Candy darters are critical for the local ecology, but they are listed as federally endangered. Habitat degradation, caused by sedimentation, stream acidification, or deforestation, is a major threat to this species survival. FWS was directed to evaluate the environmental baseline condition of the candy darter and its critical habitat, as well as the cumulative effects of future activities likely to occur within the area. We find no such comprehensive evaluation in the 2022 DSEIS. Here, we outline that (1) The DSEIS incorrectly concludes MVP waterbody crossings will not harm JNF candy darter habitat, (2) MVP sediment monitoring cannot accurately assess the impact of MVP on candy darters in JNF, and (3) MVP's impact on candy darters will extend beyond the issues discussed in the DSEIS, in particular when climate change and repatriation efforts are considered.

4.1 DSEIS incorrectly concludes MVP will have minimal impact on JNF candy darters.

Since the Forest Service 2020 Final Supplemental Environmental Impact Statement (2020 FSEIS), a critical habitat for the candy darter was established and became effective on May 7th, 2021. The critical habitat is a geographic region designated as essential for the species survival. The candy darter critical habitat includes areas in the Jefferson National Forest (JNF) and overlaps considerably with the proposed pipeline and construction. It is thus vital that the Forest Service thoroughly evaluate the impact of MVP's pipeline and construction on the candy darter in the current DSEIS.

4.1.1 The MVP Stony Creek crossing can impact JNF candy darter populations and critical habitat

In the 2022 DSEIS, the Forest Service references the 2022 Supplemental to the Biological Assessment (SBA; MVP 2022) recommended determination for candy darter impact is "not likely to destroy or adversely modify" when considering the critical habitat within JNF boundaries. This determination is based on the technicality that "no candy darter critical habitat occurs in the JNF waterbodies crossed by the MVP". However, MVP's proposed pipeline does cross a critical habitat waterbody – Stony Creek – but the crossing lies just outside of the JNF boundary (roughly >0.5 miles, according to Figure 1 of the 2022 DSEIS). Candy darter habitat is reliant on connectivity and not restricted to national forest boundaries. Any portion of the candy darter range impacted by MVP could fragment important parts of their network. Critically, emerging scientific evidence is showing a larger existing and potential range for candy darters than previously thought. Research by McBaine et al., 2022 show a much larger natural range for candy darters and provide strong evidence that "families may use an entire stream network to complete their life history, with spatiotemporal variation in occupancy among life stages." This constitutes a major increase in the range previously considered and underscores the importance of habitat connectivity for species wellbeing. Thus it cannot be assumed that because the MVP Stony Creek crossing lies just outside of JNF boundaries it will have no impact on JNF candy darter populations. It is crucial that the Forest Service perform a thorough assessment of the impact of the Stony Creek crossing on candy darter populations. It is worth noting that when considering the entire 303.5 mile-long project, the 2022 SBA recommended determination of candy darter impact was "may affect, likely to adversely affect".

4.1.2 The MVP Kimballton Branch crossing within JNF will adversely affect candy darter critical habitat and potential local candy darter populations

Second, there is another waterbody crossed by MVP that does lie within JNF, Kimballton Branch. In the DSEIS the Forest Service argues that there is no concern because Kimballton Branch is not part of the critical habitat. However, Kimballton Branch directly feeds into Stony Creek, a designated critical habitat. Thus increased sediment or pollutants in Kimballton Branch will likely impact Stony Creek and the protected candy darter populations there. Additionally, just because the Kimballton Branch is not part of the federally designated critical habitat, it cannot be assumed that Kimballton Branch does not support candy darter fish at all. It would be prudent to assess whether there are candy darters in this area. Further, as the McBaine et al., 2022 study discussed above demonstrated, the candy darter range may be much larger than previously thought.

4.2 MVP sediment monitoring as presented in the DSEIS cannot be relied upon to accurately assess the impact on candy darters in JNF.

Starting in 2020, MVP began their own sediment monitoring in response to the 2020 FWS BO requirement. Several monitoring stations were brought online and have continually collected data. In the 2022 DSEIS, the Forest Service argues that these monitoring data show that sources of suspended sediment concentrations (SSC) in the tributaries that include pipeline are similar or lower than those that do not include the pipeline. Further, they state that when data from these monitoring stations during specific storms were examined, the maximum SSC difference calculated was below the FWS 3-hour 40mg/L threshold for adverse effects to candy darters. Together, the Forest Service thus concludes that the impact of MVP will be minimal in JNF. We find several issues with the Forest Service's conclusion given the provided data:

- The candy darter sediment monitoring watersheds are in areas where construction did not resume following the vacatur. As such, it is impossible to use this data to evaluate how pipeline construction will impact stream water quality, which is ultimately what is necessary to know in order to confidently conclude candy darters will not be adversely affected.

- The monitoring results are not provided. The detailed description of MVP's monitoring methodology, data, and analysis are in Appendix L of the 2022 SBA, which is fully redacted. It is necessary that MVP provide this information in order for it to be critically evaluated (see 2.1.5 for further discussion).

- The data used by the Forest Service to make their conclusion is based entirely on data collected during individual storms. Storms result in atypical, and often unpredictable, conditions that cannot easily be extrapolated and cannot be used as a proxy for construction. At best, storms may only reflect acute and extreme exposures. However, continual low-level exposures can be just as harmful (Jimenez-Tenorio et al., 2007), and this cannot be assessed from the data available. Further, the methodology used by the Forest Service may not be in alignment with accepted continuous exposure analysis, if it is the same as that used for USGS stream gage data (see 2.1 for full discussion), but this cannot be determined because the analysis details were not provided.

In conclusion, the Forest Service relies on MVP's sediment monitoring to conclude the impact of MVP on JNF candy darters will be minimal. However, we find it is not possible to draw this conclusion with the data available. Further, the efforts described in the DSEIS cannot be critically evaluated due to a lack of transparency regarding MVP's methodology, data, and analysis.

4.3 MVP's impact on candy darters within JNF will extend beyond construction and stream crossings.

The Endangered Species Act prohibits any federal action that will jeopardize the future of an endangered species. Critical habitats for candy darter survival are found within JNF. With regards to MVP, there are many considerations beyond the specifics outlined in this comment and the DSEIS. We outline two here:

4.3.1 Candy darter habitat is highly vulnerable to impacts from climate change, including from sedimentation.

Climate change is widely expected to create substantial changes in hydrology, which in turn creates changes in sediment regimes. One of the major ways in which climate change impacts sediment delivery is through vegetation disturbance (Goode et al., 2012). Loss of vegetation, combined with increased precipitation and extreme events, means that climate change is likely to cause serious sedimentation events within the candy darter range. The Central Appalachian forests have many vulnerabilities related to climate change that are likely to result in increased sedimentation as well as nutrient export. A 2015 report on climate sensitivity prepared by the U.S. Department of Agriculture and the **U.S. Forest Service found that small riparian stream forests were "the most vulnerable ecosystems" to climate change**, with serious implications for forest-dependent wildlife. We include the following quotation from that report:

> "Projected increases in total precipitation in spring, intense precipitation events, and storm frequency are expected to lead to more runoff at that time of year, and a subsequent reduction in water quality arising from increased erosion and sedimentation (Liu et al. 2008, U.S. Environmental Protection Agency [EPA] 1998). Increased runoff also promotes flushing of nutrients (e.g., nitrogen and phosphorus) that build up in natural and disturbed ecosystems, thereby increasing the potential for downstream eutrophication and hypoxia (Peterjohn et al. 1996, Vitousek et al. 2010). Additional factors such as fire and insect defoliation exacerbated by climate change are also expected to increase runoff, erosion, and sedimentation." (page 178)

The report goes on to describe how climate change is also likely to decrease "the capacity of a stream system to dilute larger loads of nutrients." Based on the report, **we emphasize three points related to candy darter wellbeing under climate change:**

- Forests that provide bank stabilization, and temperature control for candy darters are highly vulnerable to climate change.
- Increased precipitation is expected at multiple times of year, including in spring, when the candy darter reproductive cycle is occurring.
- Climate change is driving temperature-sensitive aquatic species to migrate to higher elevation streams to access cold water refugia (e.g., Daigle et al., 2015). Darter species show high sensitivity to temperature change, and the potential for range expansion – into or within JNF land – as candy darters seek refuge in colder streams should be carefully examined.

The combined forest disturbance and precipitation changes make it highly likely that candy darter habitat will have increased baseline and storm-related sedimentation. The expected increase in sedimentation from extreme events cannot be evaluated independently of the vulnerabilities of riparian forests. Fragmentation of forests, such as by MVP, also contributes to decreased forest health and resilience to climate change stressors.

MVP's analysis of candy darter habitat should not only consider extreme events, but the combined stresses of vegetation disturbance and increased precipitation frequency. The assessment should also describe how these events, and MVP's impact, intersects with the candy darter life cycle.

4.3.2 The Forest Service should reconsider areas that are suitable for candy darter repatriation.

In new research by McBaine et al., 2022 there is new insight about areas suitable for repatriation, indicating that new surveys should be designed that incorporate the best available information about repatriation. Careful evaluation of repatriation potential is especially critical given the recent success in breeding candy darters at the USFWS White Sulphur Springs National Fish Hatchery (McCoy, 2022). On November 15th, 2022, the hatchery reported that the first captive-bred candy darters were released into the wild in West Virginia. Given this remarkable progress, suitable but unoccupied habitat should be carefully preserved to contribute to the ongoing species recovery. The experts at USFWS leading the repatriation should be included in determining whether and where MVP could negatively impact their efforts.

5. Pesticides

The 2022 DSEIS lists several "past, present, and reasonably foreseeable projects" in the HUC-10 watersheds that overlap the MVP route on NFS lands. These projects are included in the cumulative effects analysis to assess cumulative, measurable effects to several aspects of the environment, including soil, water quality, threatened and endangered species, and vegetation. These are listed in Table 10 in the 2022 DSEIS. Here, we comment on one specific item in Table 10: the use of insecticides to control the spread of the gypsy moth in the Sarton Ridge Vegetation Management Project. We outline concerns surrounding the use of insecticides and urge the Forest Service to require more details around the type, specific use, and necessity of insecticides.

5.1 Different insecticides have drastically different effects on environment

Insecticide products vary widely in relation to the types of "active ingredient", with broad categories including organophosphates, pyrethroids, and carbamates (U.S. EPA CADDIS Vol. 2 Insecticides). Each active ingredient can have drastically different effects on the surrounding environment, wildlife, or human health. Each insecticide will also have different chemical properties, such as solubility, which will differently affect how far it will travel through rivers, streams, runoff, etc., as well as differently affect levels of bioaccumulation in wildlife that may consume sprayed vegetation. Each insecticide will also exhibit varying neurotoxic effects on wildlife and human health. It is thus impossible to assess the cumulative effects of MVP's use of insecticides without knowledge of the types of insecticides that MVP would use to treat gypsy moth outbreaks. Additionally, the application method of use, such as aerial spraying, will dramatically influence the harmful effects of the insecticide, but the DSEIS does not provide any such details. **Given the variety of insecticide types and potential environmental harms, it is vital that MVP specify the insecticide type, brand, active ingredient, and application method so that the potential harmful effects can be fully assessed.**

5.2 Alternative non-chemical management methods must be evaluated

Many alternative methods to chemical pest management are available, effective, and often essential. These include weeding, mulching, or setting traps. Indeed with respect to gypsy moths, many best management practices, including research from the USFS (Kauffman et al., 2017), recommend pheromone-baited traps or mating disruptions with synthetically-made female moth scents. In Kauffman et al., 2017 they explain that, "because pheromone traps are highly effective at locating and delimiting newly established populations, every one of these projects has been successful at eliminating gypsy moth from previously uninfested regions." While some of these non-chemical approaches may be best used preventatively, **it is critical the Forest Service fully evaluates alternative pest control strategies and their effectiveness in the face of potential environmental harm from insecticides.**

6. Mussels

The 2022 DSEIS states that the threatened freshwater mussel Atlantic Pigtoe (Fusconaia masoni) is not expected to be affected by pipeline development. This determination appears to be based on the lack of occurrence of adult mussels "at or downstream of the MVP pipeline crossing of Craig Creek or any other MVP pipeline stream crossings, or in the Action Area (which includes upland sedimentation effects)" (MVP 2022; DSEIS pg 53). This determination was based on the 2021 Species Status Assessment (US Fish and Wildlife Service 2021) for the Atlantic Pigtoe and does not include any more recent species updates. We are not confident that MVP has addressed all potential threats to the Atlantic Pigtoe mussel, particularly in regards to the complex life cycle of this species.

6.1 Impacts on Atlantic Pigtoe host fish has not been addressed

Freshwater mussels have a complex life cycle that often involves their larvae attaching to the gills or fins of a host fish in order to successfully transform into a juvenile mussel. This is both a vulnerable part of the freshwater mussel life cycle and an important one. Freshwater mussels are thought to have evolved their reproductive timing to match that of the migration and movement of their host fish, which is usually associated with host fish spawning (Kat 1984). As sedentary animals, freshwater mussels rely on the movement of their larvae-infested fish host within the stream system in order to maintain populations within the stream. Members of the Cyprinidae family likely serve as the primary hosts for this mussel species including Bluehead Chub (*Nocomis leptocephalus*), Creek Chub (*Semotilus atromaculatus*), Mountain Redbelly Dace (*Chrosomus oreas*), Pinewoods Shiner (*Lythrurus matutinus*), Rosyside Dace (*Clinostomus funduloides*), Satinfin Shiner (*Cyprinella analostana*), Swallowtail Shiner (*Notropis procne*), and White Shiner (*Luxilus albeolus*; Eads and Levine 2011). With the exception of the Pinewoods Shiner and White Shiner, the native ranges of all these fish species span the proposed project area (USGS; https://nas.er.usgs.gov/). Freshwater fish such as these species are susceptible to elevated sedimentation rates, with the potential for their feeding and reproduction to be affected (Burkhead et al. 1995). Further, noise pollution from anthropogenic sources can interfere with the movement and health of fish (Popper and Hastings 2009). Given the elevated sedimentation rates and the noise pollution and human activity associated with pipeline construction, it is possible that Atlantic Pigtoe host fish health and movement will be affected. This could hinder the yearly reproduction of the Atlantic Pigtoe mussels and result in lower juvenile recruitment for this species. **In the 2022 DSEIS, MVP does not address these potential impacts on non-endangered native fish species that may serve as a host fish for the threatened Atlantic Pigtoe, and thus are missing a critical portion of their No Effect assessment.**

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