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Notice of Objection to the Final Land Management Plan for the Nantahala and Pisgah National Forests

Objector Contact Information:

We are filing this objection to the Final Land Management Plan for the Nantahala and Pisgah National Forests, the Final Environmental Impact Statement, and Draft Record of Decision on behalf of **Hugh Irwin and Janice Irwin**. James Melonas is the Responsible Official for Land and Resource Management Plan and Ken Arney is Responsible Official for Species of Conservation Concern.

I designated Hugh Irwin as the lead objector on behalf of **Hugh and Janice Irwin.**

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Hugh Irwin has been directly involved in the Nantahala and Pisgah plan revision process since it began. He has participated throughout the planning process as a representative of The Wilderness Society but also as an interested individual. Hugh and Janice both use Nantahala and Pisgah National Forests extensively and often and have a stake in how it is managed. Hugh Irwin has provided extensive comments on planning issues throughout the planning process on behalf of TWS. Hugh and Janice Irwin filed extensive comments to the Draft Plan and Draft EIS on their own behalf (filed June 29,2020; submission receipt received).

We as individuals have been very interested in and provided Draft Plan/Draft EIS comments on NRV and Spectrum models used in the planning process as well as discrepancies in assumptions between the models; the lack of use of Best Available Scientific Information in the models and in analysis in the DEIS; the failure to assure ecological sustainability; the failure to adequately address old growth issues and the old growth network; the confusion of scale in the analysis of old growth issues; the use of false assumptions in effects analysis for project level effects on old growth; the use of invalid conclusions on cumulative effects; the allocation of Wilderness Inventory Areas and wilderness recommendations; the recommendation of Wild and Scenic Rivers; the allocation of NC State Natural Areas; the allocation of old growth; and allocation of priority conservation areas for biodiversity and rare species protection.

Despite extensive involvement in the Plan revision process we are not satisfied with the adequacy and accuracy of the models used for analysis in the EIS. We are also not satisfied that allocations in the Revised Plan based on these models adequately address ecological sustainability, biodiversity needs, the needs of rare species, climate change, the need to store carbon, adequate transportation planning, water quality issues, and soil conservation issues.

I. Statement of the Reasons for Objection:

The revised plan failed to address most of the concerns and issues we raised in comments on the following issues: NRV and Spectrum models used in the planning process as well as discrepancies in assumptions between the models; the lack of use of Best Available Scientific Information in the models and in analysis in the DEIS; the failure to assure ecological sustainability; the failure to adequately address old growth issues and the old growth network; the confusion of scale in the analysis of old growth issues; the use of false assumptions in effects analysis for project level effects on old growth; the use of invalid conclusions on cumulative effects; the allocation of Wilderness Inventory Areas and wilderness recommendations; the recommendation of Wild and Scenic Rivers; the allocation of NC State Natural Areas; the allocation of old growth; and allocation of priority conservation areas for biodiversity and rare species protection.

The root problem for all of these issues lie with the inaccurate and inconsistent assumptions and methodologies found within the NRV and Spectrum models that do not follow best available scientific information (BASI). These problems are detailed below.

a. Scale in Spectrum model vs Natural Range of Variation Model

Models used in the Nantahala-Pisgah EIS have been a controversial subject since well before the Nantahala-Pisgah Draft EIS was released. In the DEIS, the Spectrum model effectively excluded natural disturbance for future conditions. A very small level of natural disturbance was incorporated in the model, but acreage affected by this very small amount was reset to the age of adjacent forest after 1 decade. In contrast, the natural range of variation model (NRV) incorporated significant levels of natural disturbance taking forest to early seral. In contrast to the Spectrum model this forest is not set to the age of adjacent forest after a decade. The NRV model also seemed to count gap phase dynamic disturbance toward early seral transitions. Gap phase dynamics consists of small gaps consisting of single to multiple trees. In the ecological literature these gaps are considered a natural process within all aged forests that would not actually change structural class or succession stage.[1],[2] These problems in the models were extensively addressed in comments by conservation groups to the DEIS. For the FEIS, changes have been made in the Spectrum model for future conditions that incorporate at least some level of natural disturbance in a more realistic manner to make the future modeling more accurate. However, no changes have been made in the NRV model. The main issue in the NRV model is the failure to account for the scale of disturbances. The future Spectrum model uses a natural disturbance threshold of 0.5 acres and above – i.e., disturbances smaller than 0.5 acres are not recognized as contributing to early seral in the Spectrum model. This threshold used in Spectrum makes sense. It is argued that early seral patches of less than 0.5 acres are not beneficial for wildlife species needing early succession habitat. We are fine with this threshold being used for early seral habitat if it is consistently applied. However, disturbances of all sizes, particularly including small gap phase dynamics, appear to be counted as creating early seral in the NRV model.

The NRV model, built in ST-Sim/SynchroSim State and Transition software, is not spatially specific. However, important variables in the model are transition

[1] Runkle, J. R., 1985, Disturbance Regimes in Temperate Forests. In "The Ecology of natural disturbance and patch dynamics, Pickett, S.T.A. White, P.S. (eds.).- Orlando, Fla. (USA): Academic Press, 1985.- ISBN 01-255-45207. p. 17-33.

[2] Lorimer, C.G., 1980. Age structure and disturbance history of a southern Appalachian virgin forest. Ecology, 61(5), pp.1169-1184.

probabilities that take forest from older states, including old growth, to an early seral state. These transition probabilities are in turn derived from disturbance return intervals. The FEIS, process papers, and FEIS appendices do not disclose how the return intervals used in the NRV model were derived from the scientific literature. However, it appears that return intervals more appropriate to gap phase dynamics than to larger disturbances were used in the model. Most of the ecological literature cited in the EIS and associated documentation concerns gap phase dynamic scale disturbance. There is no rationale provided for linking values found in the literature for gap phase dynamics with the return intervals and transition probabilities used in the model. Significantly, the return intervals used in the model are consistent with gap phase dynamic disturbance rather than larger disturbance.

b. Role of scale in disturbance return intervals and transition probabilities

Disturbance transition probability is an important variable in the NRV model and determines how much of the forest transitions from one state to another (e.g. from old growth to early seral) due to natural disturbance. The scientific literature shows that disturbance return interval and transition probability depend on the size of disturbance[3],[4]. The NRV model cannot be accurate unless these scale issues are accounted for in the model. Since the Spectrum model for future conditions sets a disturbance threshold of 0.5 acres, this would be the appropriate scale to set disturbance size in the NRV model. In the FEIS model outputs from Spectrum for future conditions are compared with model outputs from the NRV model for past reference conditions so the scale of disturbance incorporated in both models should be consistent to make model comparisons valid.

Transition probabilities are calculated from disturbance return intervals with the formula: Disturbance Transition probability = 1/return interval

c. **Natural Disturbance in the Ecological Literature Focusses on Gap Phase Dynamics**

The scientific literature is clear that natural disturbance is dominated by gap phase dynamics consisting of single and multiple trees. We have reviewed dozens of journal papers and book chapters documenting scientific studies on natural disturbance patterns. These sources, including sources cited in the Nantahala-Pisgah EIS and process papers, are unequivocal in documenting that historical presettlement natural disturbance consisted predominantly of small disturbances from gap phase dynamics. This is particularly the case with mesic forest (e.g. cove hardwood, northern hardwood, Spruce fir). Below are typical statements in the literature relating to mesic forest:

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[3] Seymour, R.S., White, A.S. and Philip, G.D. 2002, Natural disturbance regimes in northeastern North America—evaluating silvicultural systems using natural scales and frequencies. Forest Ecology and Management, 155(1-3), pp.357-367.

[4] Runkle, J. R., 1985, Ibid.

"The close agreement in general between observed canopy composition and that predicted from sapling composition in gaps, whether or not a Markov procedure was used, helps substantiate the impression that in these moist protected sites the primary forces of forest regeneration are small disturbances, on the order of single tree gaps, rather than the large-scale catastrophes which are important in many other places."[5]

"Because the match between observed and predicted canopy composition is fairly good for the mesic stands studied, a disturbance regime dominated by small gaps seems sufficient to account for the present canopy composition; i.e., the existence of occasional large-scale disturbances is not a necessary component of the regeneration cycle for these stands."[6]

"The old-growth forest is comprised of stable, all-aged spruce and fir populations." …"Natural disturbance in the southern Appalachian spruce-fir forest is predominantly in the form of small, wind created tree-fall gaps."…"Canopy gap areas were less than 160 m2 (Fig. 6) and gaps 40 to 80 m2 were most frequent."[7]

However, the scientific literature is also clear that the dominance of gap phase dynamics as a disturbance driver is not limited to just mesic forest (the references to Central Hardwood region below includes the Southern Appalachians).

"*Each was found to have a wide range in tree age typical of uneven-aged stands, even for tracts as small as 0.1-0.5 ha (Fig. 4). Evidence of uneven-aged stand structure was found not only for mesic sites dominated by shade-tolerant species but also for a drier ridge site originally dominated by chestnut (Area 4, Fig. 1) and for the chestnut component of a high-elevation oak-chestnut site (Area 5, Fig. 1).*[8]

"In the Eastern Deciduous Forest Formation, disturbance regimes are dominated by localized events that remove relatively small portions of the forest canopy, increasing growing space and resource availability for residual trees."[9]

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[5] Runkle, J.R., 1981. Gap Regeneration in Some Old-growth Forests of the Eastern United States. Ecology. 62.4. pp. 1041-1051.

[6] Runkle, J.R. and Yetter, T.C. 1987. Treefalls revisited: gap dynamics in the southern Appalachians. Ecology, 68(2), pp.417-424.

[7] 1985. Busing, R.T. Gap and stand dynamics of a southern Appalachian spruce-fir forest. University of Tennessee Doctoral Dissertation.

[8] Lorimer, C.G., 1980. Age structure and disturbance history of a southern Appalachian virgin forest. Ecology, 61(5), pp.1169-1184. Lorimer, C.G., 1980. Age structure and disturbance history of a southern Appalachian virgin forest. Ecology, 61(5), pp.1169-1184.

[9] Buchanan, M.L. and Hart, J.L., 2012. Canopy disturbance history of old-growth Quercus alba sites in the eastern United States: examination of long-term trends and broad-scale patterns. Forest Ecology and Management, 267, pp.28-39.

"Thus, canopy gaps provide the mechanism for forests to develop a complex size and age structure indicative of older stands."[10]

"Therefore, though the Central Hardwood Region exhibited the highest release frequency (n = 227) and shortest disturbance return interval (WMRI of 1.96 years), the relativized factors revealed the region experienced one of the lowest levels of large gap-scale disturbance."[11]

"gaps in cove hardwoods were more than twice as large (192.8 m2) as gaps in mesic oak (90.4 m2) and xeric oak forests (72.2 m2), (p ¼ 0.0145)"[12]

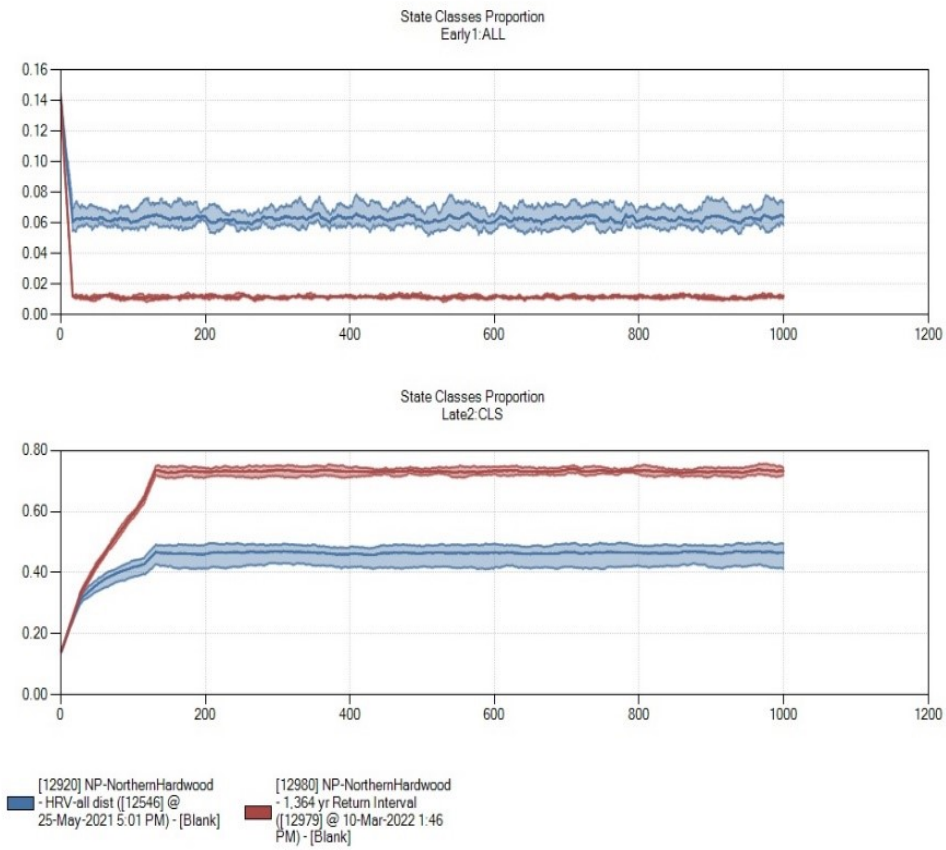
d. **Disturbance return intervals used in the NRV model are consistent with gap phase dynamics rather than a 0.5 acre disturbance threshold**

Disturbance intervals used in the Forest Service NRV model are consistent with or less than disturbance intervals for gap phase dynamics in the literature. Lorimer and White, one of the references cited in the NRV process paper, for example give an estimate of presettlement old growth (stands GT 150 years) for northern hardwoods in the northeast as 70-89%.[13] This high level of old growth in natural conditions is consistent with the sources cited above documenting the dominance of gap phase disturbance and old growth conditions. Lorimer and White also point out that this amount of old growth in northern hardwoods suggests a 1,364 year rotation period (disturbance return interval) for catastrophic wind and stand replacement fire. These disturbances would not be gap phase dynamics and would be consistent with larger disturbances of 0.5 acres and above used in the Spectrum model. The authors also suggest that smaller size disturbances (< 300 m2 = 0.074 acres) at disturbance intervals of 60-400 years would be consistent with the old growth levels documented in these northern hardwood forests.[14]

But the Forest's NRV model uses a disturbance return interval of 222 years for all disturbances that take old growth to early seral in the NRV model for northern hardwood. This is consistent with Lorimer and White's estimate of return intervals for gap phase dynamic disturbance but inconsistent with return intervals for larger disturbance. This is a case where the literature gave the Forest the clear option to choose a more appropriate return intervals for larger disturbance that would better fit the disturbance size used in

[10] Hart, J.L. and Grissino-Mayer, H.D., 2008. Gap-scale disturbance processes in secondary hardwood stands on the Cumberland Plateau, Tennessee, USA. In Forest ecology (pp. 131-146). Springer, Dordrecht.
[11] Buchanan, M.L. and Hart, J.L., 2012. Ibid
[12] Himes, J.M. and Rentch, J.S., 2013. Canopy gap dynamics in a second-growth Appalachian hardwood forest in West Virginia. Castanea, pp.171-184.
[13] Lorimer, C.G. and A.S. White. 2003. Scale and Frequency of natural disturbances in the northeastern US: implications for early successional forest habitats and regional age distributions. Forest ecology and management. 185(1):41-64.
[14] Lorimer, C.G. and A.S. White. 2003. Ibid.

Spectrum. These differences make significant differences as shown when NRV results are compared for key conditions below (early seral and old growth):



References in the NRV process paper are heavily weighted toward fire disturbance. NRV models for some xeric ecological types are heavily controlled by fire return intervals. A fire focus is perhaps warranted for these types. However, for mesic ecological types other disturbance factors (e.g. wind/weather/stress and optional1) play larger roles than fire within the NRV model. For ecological types intermediate between mesic and xeric, these non-fire factors also play significant roles. References for disturbance regimes that could be considered non-fire related consist of two papers by Lorimer, one paper by Lorimer and White, and a 2011 book edited by Greenberg and Collins on sustaining young forest communities. A 1994 paper by Morgan et al that is considered the foundational paper on historic range of variation is also referenced. [15] None of these references except the Lorimer papers, the Lorimer and White paper, and the Greenberg and Collins book even discuss non-fire disturbance patterns that would be specific to forests on the Nantahala-Pisgah. These references are sparse in any detail that

[15] USFS. 2015., National Forests in North Carolina Procedure for Estimating the Natural Range of Variation (NRV) Nantahala and Pisgah National Forests.

would tie non-fire return intervals to specific forest except for gap phase dynamics, and where values are specific as in the Lorimer and White return interval for northern hardwood, the NRV model uses return intervals more appropriate for gap phase dynamics than for larger disturbances. The Greenberg and Collins book contains a chapter that seems relevant to the question of natural disturbance by Peter White, Collins, and Wein: "Natural Disturbances and Early Successional Habitats". The abstract for this chapter states: "Although natural disturbance types and frequencies vary within the region, large stand-replacing natural disturbances have always been infrequent…". The chapter does not seem to provide sufficient detail to associate specific disturbance return intervals to ecological forest types.[16]

These references provide insufficient basis for the return intervals used in the NRV model. Where specific levels of disturbance are discussed in these sources, they are usually related to gap phase dynamic level disturbance. Where larger disturbance returns are contrasted to gap level returns, return intervals relevant to gap phase dynamics are used rather than larger disturbance return intervals as in the Lorimer and White reference to return intervals for both gap phase dynamics and larger disturbance. There is no rationale provided in the NRV process paper connecting the information contained in the references to return intervals used in the NRV model. There is not a coherent rationale provided for the return intervals used in the NRV model, and they appear to be based on gap phase dynamics rather than larger disturbance that would be consistent with the Spectrum model.

There are methodologies to scale the return intervals from gap phase dynamic studies to larger scales to get a prediction of return intervals for larger disturbances. Seymour et al provided a rationale and methodology to do this. They also reach the conclusion that larger disturbances have return intervals at least an order of magnitude greater than gap producing events.[17]. However, the scale issues relating to disturbance return interval is not discussed in the EIS, process paper, or any documentation we have seen. There is no discussion of the appropriate return interval to use in the NRV model based on the 0.5-acre threshold in Spectrum. The scale of disturbance used in NRV modeling is a fundamentally important factor to the accuracy of the model and to whether its results can be compared with any validity with Spectrum results, but this is not even discussed in the EIS and related materials.

To be clear, we are not making the case that disturbances of greater size than gap phase disturbance did not occur. The literature acknowledges that larger disturbances did occur and may have occurred within some dryer ecozones more often than in more mesic

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[16] White, P. S., B. S. Collins and G. Wein, 2011. Natural Disturbances and Early Succession Habitats, in Greenberg, C., B. Collins, and F. Thompson III (editors). 2011. Sustaining Young Forest Communities: Ecology and Management of Early Successional Habitats in the Central Hardwood Region, USA. 309 p.

[17] Seymour, et. al. 2002. Ibid.

ecozones. However, the EIS and process papers cite references to literature that primarily documents return intervals for gap phase dynamics not larger disturbances, without explaining how these are used to get return intervals for larger disturbances. Indeed, it appears that these return intervals were not adjusted from those that would apply in gap phase sized disturbance.

e. Landfire provides inadequate evidence and rationale for disturbance return intervals

The EIS, appendices, and process papers also reference Landfire and the biophysical settings (BpS) descriptions used in Landfire. The disturbance return intervals and probabilities in these biophysical model descriptions are consistent with those used in the Nantahala-Pisgah NRV model. However, there is no rationale within the BpS descriptions or other Landfire materials that give a scientific rationale for non-fire return intervals or probabilities. The references included in these descriptions are mostly concerned with fire disturbance, even though other disturbances (wind, weather, stress, a catchall disturbance "optional1", and in some cases insect/disease play larger disturbance roles in the model for BpS types such as cove hardwood, northern hardwood, and spruce-fir, and some more mesic oak ecozones than fire.

Even for fire, the BpS references only deal with general topics around fire occurrence. There is no discussion or explanation given for how fire return intervals are derived from the literature for the various BpS types. The single reference that does address fire frequency regimes is a paper that only addresses fire frequency intervals within broad regional delineations.[18] This paper also acknowledges that these broad fire patterns would be changed in fire sheltered sites such as "north slopes, mountain coves, ravines and steep sided stream valleys, and portions of the landscape where waterways block fires swept by prevailing winds"[19]. At least fire return intervals and probabilities in the BpS descriptions are adjusted to account for fire moderating effects within different BpS. Fire return intervals are extended for more fire protected BpS types although the rationale and scaling factors are not clear.

However, no references for pattern or recurrence of the non-fire disturbances are given in the BpS descriptions. The predominance of gap phase dynamics as disturbance events is acknowledged in many of these Landfire BpS descriptions for specific forest types, but there is no explanation for how non-fire disturbance return intervals documented in the BpS descriptions are derived and no literature relevant to non-fire disturbance is provided. The BpS papers, while acknowledging the dominance of gap

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[18] Frost, C. C. 1998. Presettlement fire frequency regimes of the United States: a first approximation, in Pruden, T. L. and Brennan, L. A., Prodeedings 20th Tall Timbers Fire Ecology Conference: Fire in ecosystem management: shifting the paradigm from suppression to prescription. Boise, ID. Tall Timbers Research, Inc.,Tallahassee, FL. p. 70-81.

[19] Frost,1998. Ibid.

phase dynamics in mesic systems, are unclear whether these smaller disturbances are included in disturbance return intervals or how these return intervals are established. However, the disturbance intervals for these non-fire disturbances are consistent with the literature for gap phase dynamics.

The process paper for the Nantahala-Pisgah NRV model does include references related to disturbance regimes as detailed above. Most of the references in the process paper deal with fire disturbances, but there are a few references that relate to non-fire disturbances. However, these references are primarily focused on gap phase dynamic disturbances. There is no discussion in the process paper about how this information on gap phase dynamics is used to calculate return intervals, but the disturbance return intervals used in the model are consistent with the return intervals in Landfire BpS papers and with references for gap phase dynamics. As detailed above, one of the references cited in the NRV process paper is the Lorimer and White 2003 paper that contrasts a potential 1,374 year return interval in northern hardwoods for larger wind and fire disturbances with a 60-400 year return interval for smaller gap phase disturbances[20]. The 222-year return interval used in the northern hardwood NRV model for all disturbances taking older forest to early seral is squarely in the range for gap phase dynamics and not larger disturbances. There seems to have been a realization in the process paper that the Landfire return intervals used as a basis for return intervals in the NRV model were not adequately justified in the literature. The references cited in the NRV process paper try to fill this void, but in doing so they highlight that the return intervals used in the model are not based on disturbance size consistent with disturbance size used in the Spectrum model.

f. Disturbance return intervals are not independent of disturbance size

Most of the scientific literature on disturbance, especially in the Southern Appalachians and associated regions, relates to gap phase dynamics that consist of one to a few trees with a size on the order of 0.1 acres and less. Hart reports: *"Nonetheless, gap-scale disturbance studies from the central hardwood forests have typically found true canopy gaps to range from 30-140 m2 and expanded canopy gaps to typically range from 200-500 m2 (Barden 1980, 1981; Runkle 1981, 1982, 1990; Runkle and Yetter 1987;Clinton et al. 1993. 1994; Hart and Grissino-Mayer 2009; Richards and Hart 2011;Himes and Rentch 2013)."*[21] Note that 1 acre = 2,023.43 m2. For valid comparisons between Spectrum and NRV results, disturbance scales in the two models should be the same. Natural disturbance could be limited to the same scale used in the Spectrum model. However, it appears that this was not done, and instead scale considerations were not

[20] Lorimer, C.G. and A.S. White. 2003. Ibid.

[21] 2015. Hart, Justin L. Gap-Scale Disturbances in Central Hardwood Forests with Implications for Management. Ch. 2 in Greenberg, CH and BS Collins (eds.). Natural disturbances and historic range of variation: Type, frequency, severity, and post-disturbance structure in central hardwood forests USA. Managing Forest Ecosystems, 2015, Vol. 32. P. 39.

factored into return intervals. It is not valid to model disturbances 0.5-acres and above using return intervals and transition probabilities relevant for gap phase dynamics.

The literature is clear and overwhelmingly consistent in its implication that return intervals for larger disturbances would be greater than return intervals for gap phase dynamics. Runkle, suggests a lognormal distribution of disturbance sizes.[22] Seymour et. al. put the false assumption that scale can be ignored this way: *"Clearly, return intervals and areas disturbed are not independent, as is sometimes assumed. Gaps were small and frequent, as expected, whereas catastrophic fires and blowdowns were rare and highly variable in size."*[23] Seymour et. al. were focused on disturbance patterns in northeastern forests. However, their conclusions would apply to Southern Appalachian forests as well as NE forests. In fact, the argument could be made that gap phase dynamic disturbance played a greater role in the Southern Appalachians than the NE. Busing states: *"By contrast [with northern spruce-fir forests], large disturbance patches are relatively rare in the southern Appalachian spruce-fir. Fire is insignificant and small tree-fall gaps are the predominant form of disturbance*."[24] Cove forests, which do not have exact counterparts in the NE are also known for the dominance of gap phase dynamics.[25] So for at least some forest types, Seymour's conclusion about the dominance of gap phase dynamics over larger disturbance would apply and would be even more pronounced in the Southern Appalachians.

g. Vegetation modeling documented in Appendix D of the EIS fails to adequately explain methodology and fails to establish consistency between models being compared

Appendix D of the EIS purports to document the vegetation modeling methods used in the Spectrum and NRV models. However, this document leaves key pieces of the model unexplained and arguably obfuscates many key assumptions.

Under Methods, "Defining young forest" on p. D-12 through D-13 and "Conclusion" on p.D-13, the process for characterizing young forest is described. In the conclusion, young forest is defined as patches greater than 0.5 acres while gaps are between 0.25 and 0.5 acres; and small gaps are less than 0.25 acres. Only patches are used in the Spectrum model as young forest. Appendix D does not explicitly state which model this applies to.

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[22] Runkle, J. R., 1985, Ibid

[23] 2002. Seymour, R.S., White, A.S. and Philip, G.D. Natural disturbance regimes in northeastern North America—evaluating silvicultural systems using natural scales and frequencies. Forest Ecology and Management, 155(1-3), pp.357-367.

[24] Busing, R.T., 1985. Gap and stand dynamics of a southern Appalachian spruce-fir forest. University of Tennessee Doctoral Dissertation.

[25] Lorimer, C.G., 1980. Age structure and disturbance history of a southern Appalachian virgin forest. Ecology, 61(5), pp.1169-1184.

From the context and looking at values in the models, it is clear that this applies to the Spectrum model. One would expect that there would be an explanation of how this young forest threshold plays out in the NRV model. However, Appendix D is totally silent on this issue. Indeed, there is no discussion in Appendix D, the EIS, or within process documents about the assumptions about disturbance scale used in the NRV model. Indeed, the size threshold for young forest seems to have been made after the NRV model was completed. The NRV model was completed in 2014[26] while size threshold for young forest first appears in an August 2017 process paper[27]. This size threshold was further refined between the Draft EIS and Final EIS with patches (with a scale greater than 0.5 acres) being distinguished from gaps less than 0.5 acres and only patches being incorporated into the final Spectrum model taking forest to young seral (or young forest in the terminology of Appendix D)[28]. However, the NRV model was not adjusted between the Draft and Final. Indeed, there seem to have been no changes in the NRV models for past reference conditions after these models were completed in 2014 with no documented assumptions regarding the scale of natural disturbances. While the size threshold for patches may be warranted, BASI would require scale assumptions to be consistent if model outputs are to be compared.

Under the discussion of NRV in Appendix D, White et al are given as reference for the statement that "*The presettlement forest landscape was largely forested with dominant trees surviving to ages of 300-500 years. Mortality of canopy trees occurred at a low rate. Large stand-replacing natural disturbances were infrequent relative to tree lifespans, with return intervals in the 100s of years. Thus, the return intervals are longer than the current forests have existed (White, 2011)"*. This statement seems fine and is a fair summary of BASI of disturbance ecology. However, later on p.D-15 they seem to have used the citation above to set return intervals for mesic forest of 300+ years: "*The 1,000-year timeframe for NRV allows for return intervals of natural disturbances to occur. For fire adapted ecosystems, return interval for fires are shorter, within several years but severe fire disturbance rates that reset succession could occur within 25 years for some ecozones (e.g. dry oak). Conversely, mesic sites have stand replacement disturbance rates at 300 years or more."* This is a problem from two standpoints.

First, a 300 year return interval is still within the return intervals for gap phase dynamics. Runkle and Jetter have made the case that gap phase dynamics is consistent with canopy tree ages seen in old growth forests. Dominant trees of 300-500 years are consistent with gap phase dynamic disturbances.[29] In fact White et al stress that disturbance is dominated

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[26] 2014. USFS. 2014. NRV Process Paper.
[27] Lewis, C., S.Bryan, G. Kauffman, J. Rodrigue, 2017. Identification of Canopy Gap and Early Successional Habitat Patches on the Nantahala and Pisgah National Forests.
[28] FEIS. Appendix D. pp. D-12 – D-13.
[29] Runkle, J.R. and Yetter, T.C. 1987

by small disturbances with larger disturbances being much less frequent[30]. Again, there is no attempt to specify the scale of disturbance being modeled in the NRV model even though the 300 years falls within disturbance ranges for gap phase dynamics[31],[32].

Second, the NRV models **do not** use return intervals of 300 years and greater, even for mesic forest. The longest return interval used in the NRV models is 229 years. See Table below derived from probabilities in the NRV models taking older forest to early seral.

Ecozone	Overall Return Interval for Reset Event
Spruce-Fir	220
High Elev Red Oak	111
Northern Hardwood	229
Cove	211
Mesic Oak	141
Dry-Mesic Oak	216
Dry Oak	98
PineOakHeath	66
Shortleaf Pine Oak	78
Floodplain Forest	129

* Calculated from probabilities used in the NRV models

These disturbance return intervals are all significantly less than the 300 years stated in Appendix D, and they are much more consistent with gap scale disturbance than return intervals for larger disturbance.

Appendix D discusses how disturbances for recent past and near future were derived and how they used this for natural disturbance levels in Spectrum[33]. Recent past disturbances were estimated using Lidar, data from wildfires, Rx fires, and insect/disease to determine levels of patch formation levels over 5 decades. Different scenarios discussed for how to use this data are different ways this data from 5 decades could have projected the levels

[30] White et al, 2011

[31] Runkle, J. R. 1982. Patterns of Disturbance in Some Old-Growth Mesic Forests of the Eastern North America. Ecology. 63.5. pp. 1533-1546.

[32] Busing 2005

[33] Appendix D, pp D-15 – D-23.

of patch formation into the future, e.g. incorporating increasing levels of disturbance due to climate change. However, in the end, the Forest Service used Scenario 1 in Spectrum, which just repeats the patch formation they had documented for 50 years over the 200 year Spectrum run. They also eliminated some of the more severe wildfire occurrences as "outliers".

The bottom line is contained in Table 9, p. D-19. These are the patches (GT 0.5 acres) over 5 decades that are repeated in Spectrum for levels of natural disturbances (patches greater than 0.5 acres).

Table 9: Acreage of young forest patch estimated over 5 decades.

Decade	1	2	3	4	5
Patch (Ac)	1752	1654	1960	2372	3923

Note that these are values for patches per decade, so to compare with return intervals in the NRV model, which applies disturbance every year, you would divide by 10. This yearly disturbance would range from 165.4 to 392.3 acres/year.

Converting this to disturbance return intervals: Total acres on Nantahala-Pisgah divided by disturbance/year = approx. 1,000,000 acres/ 165.4 or 1,000,000 acres/ 392.3 acres/year = 6,046 – 2,549 year return intervals. This would be in line with larger disturbance having at least an order of magnitude greater return interval than gap phase dynamics. Compare this to disturbance return intervals of 66 years to 229 years used in the NRV models. The significant differences between levels of disturbance used in the NRV model vs those used in the Spectrum model consisting of greater than an order of magnitude are not justified or even discussed in Appendix D or elsewhere in the EIS documents.

The lack of any rational justification for these differences is further emphasized by the treatment of specific types of natural disturbance. It is generally recognized that impacts from storm events are increasing with climate change. This increase of storm impacts with climate change is acknowledged in the EIS. However, disturbance levels for the comparable wind/weather/stress in the NRV models are dramatically less than disturbance levels from storms in Spectrum.

Appendix D[34] documents that storm disturbance levels of 600 acres in a 17-year time period (2002-2019) as input for wind disturbance in Spectrum. This would be a disturbance level from wind of 600 acres/17 years = 35.3 acres/year of wind disturbance

[34] EIS, Appendix D, p. D-18

taking forest to early seral. That is a return interval on Nantahala-Pisgah NF of 1,000,000 acres divided by 35.3 acres/year = 28,329 year return interval for wind and storms and a transition probability of 0.0000353. In the NRV table of probabilities, Wind/Weather/Stress has transition probabilities in various ecozones ranging between 0.005 to 0.002 – return intervals of 200-500 years for Wind/Weather/Stress in the NRV model. The Spectrum model uses disturbance levels for wind that are orders of magnitude less than those used in the NRV model despite the fact that storm and wind disturbance is expected to increase in the future, not decrease.[35]

h. Use of Best Available Scientific Information Requires Reference to Relevant Information relating to the Appropriate Temporal and Spatial Scales

Planning Directives (FSH 1909.12) specify criteria for accuracy, reliability, and applicability for Best Available Scientific Information:

1) Accurate information estimates, identifies, or describes "the true condition of its subject matter".
2) Reliable information is precise and unaffected by random error. Appropriate scientific methods, including study design assumptions, analytical approach, and conclusions, should be well-referenced and described, with citations to relevant credible literature.
3) Relevant information is that which pertains to the issues under consideration and relate to the appropriate temporal and spatial scales.[36]

While scientific literature is cited in the EIS and some associated Planning documents, the models and model comparisons of Spectrum and NRV models fail these BASI criteria on all three criteria:

1) While each model may have validity as a stand-alone model with its own assumptions, the comparison of models does not estimate, identify, or describe the true conditions between future and NRV conditions because the assumptions within the models differ dramatically between models and model different metrics.
2) Appropriate scientific methods were not utilized. Specifically, the study design did not attempt to standardize study design assumptions so that comparisons were comparable (apples to apples). Further, assumptions, analytical approaches, and conclusions were not well-referenced and described. The EIS and associated materials documented references without anchoring these to the assumptions and methodology used. When the references are closely examined, they do not support the assumptions and methodology actually used in the models.
3) Temporal and spatial scales were ignored between models, and these scales varied wildly between models. While assumptions around temporal and spatial scale were disclosed for the Spectrum model, these issues were undocumented for the

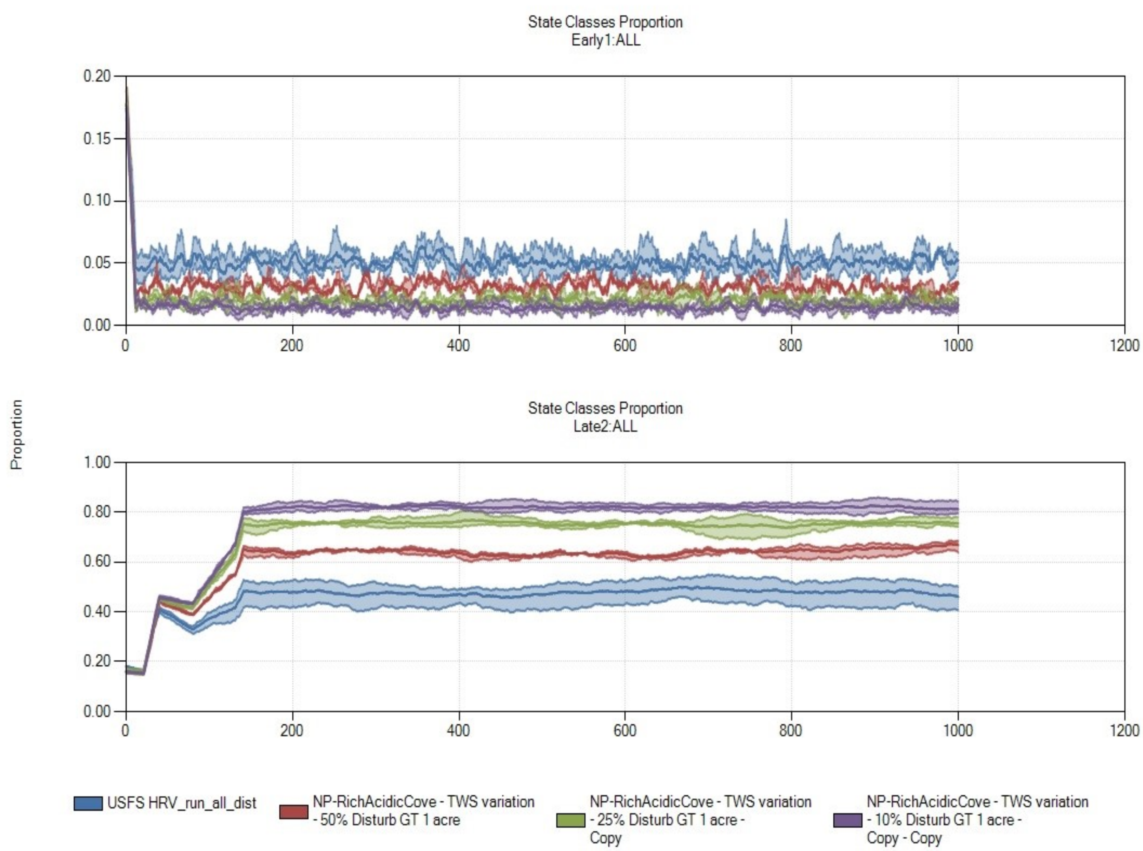
[35] From the Spectrum model Excel spreadsheets, a 10-year period for 600 acres of disturbance appears to have been used in Spectrum.

[36] Esch , Bryce E., Amy E.M. Waltz, Tzeidle N. Wasserman, and Elizabeth L. Kalies. Using Best Available science Information: Determining Best and Available. 2018. Journal of Forestry. 116(5):473-480.

NRV model, and the spatial and temporal scales used in the NRV model differed significantly from the Spectrum model.

i. NRV results based on reasonable adjustments for disturbance size

If "disturbance regimes are dominated by localized events that remove relatively small portions of the forest canopy"[37] and "the primary forces of forest regeneration are small disturbances"[38], this suggests that a range of values less than 50% of what was used in the NRV model is most appropriate. We have used the ST-Sim/SynchroSim software and the Forest Service NRV model to calculate old growth and early searal for cove hardwood ecozone (or BpS) over the 1,000-year model runs using transition probabilities in the range of 50% and less of what the Forest Service used. The Forest Service model with original transition probabilities is shown for reference. For the comparison model runs, transition probabilities in the Forest Service model were multiplied by proportional multipliers (0.5; 0.25; 0.1) to scale the transition probabilities to 50%; 25%; and 10% of transition probabilities used by the Forest Service. All other variables were kept the same in the model.



[37] Buchanan, M.L. and Hart, J.L., 2012. Ibid
[38] Runkle, J.R., 1985. Ibid.

We cannot say for certain which of the adjusted results would be more accurate. However, the scientific literature clearly supports this adjusted range. The use of words such as “predominate” and “dominated by” in relationship to the balance between gap phase dynamics and larger disturbances suggest an adjustment amount of at least 50%. However, an adjustment to 10% is not unreasonable in light of the dominance of gap phase dynamics. Indeed, Seymour et al state: “Evidence demonstrates convincingly that such forests were dominated by relatively frequent, partial disturbances that produced a finely patterned, diverse mosaic dominated by late-successional species and structures. In contrast, large-scale, catastrophic stand-replacing disturbances were rare, **returning at intervals of at least one order of magnitude** longer than gap-producing events.”[39] (emphasis added) Again, Seymour is discussing NE forests but this relationship would be expected to be even more pronounced in the Southern Appalachians based on the literature.

A 0.5-acre disturbance threshold is justifiable for the Spectrum model. A half-acre size threshold was considered the minimum gap size for beneficial effects to wildlife in the EIS. This rationale as a threshold makes sense. We do not disagree with a 0.5-acre disturbance threshold. However, it is not valid to compare the Spectrum results, for example for old growth, with NRV results that incorporated a different scale of disturbance. At the very least, this issue is not addressed in the EIS and associated materials when there is an absolute need to address scale issues. Studies of gap phase dynamics are simply cited as reference without any rationale that connects these small-scale disturbances to larger disturbances and the return intervals used in the model. Gap phase dynamics is universally assumed in the literature to not change the fact that forest remains old growth after these disturbances[40], [41]. But if larger disturbances are modeled as though they have the same return intervals as gap phase dynamics, this fundamentally distorts the model. The problems here are multiple. First, results from a model with a 0.5-acre disturbance threshold for future conditions might be appropriate if it were being compared with an NRV model with a 0.5 acre disturbance threshold based on scientifically based probabilities for 0.5-acre disturbances. However, this is not the case. Instead, future Spectrum model results using a 0.5-acre disturbance threshold are being compared to an NRV model with an undefined disturbance threshold apparently using scientific literature for disturbance sizes on the order of 0.1 acres. Although best available science was used (valid scientific literature was cited as references), this information was not used appropriately in a scientifically defensible manner.

II. Demonstration of the Link Between Our Prior Substantive Comments and Content of Objection

[39] Seymour et al. 2002 Ibid. p. 357.
[40] Runkle, J.R., 1981. Ibid
[41] Lorimer, C.G. and A.S. White. 2003. Ibid.

We brought up and discussed in detail these issues in comments to the Draft Plan and DEIS: NRV and Spectrum models used in the planning process as well as discrepancies in assumptions between the models; the lack of use of Best Available Scientific Information in the models and in analysis in the DEIS; the failure to assure ecological sustainability; the failure to adequately address old growth issues and the old growth network; the confusion of scale in the analysis of old growth issues; the use of false assumptions in effects analysis for project level effects on old growth; the use of invalid conclusions on cumulative effects; the allocation of Wilderness Inventory Areas and wilderness recommendations; the recommendation of Wild and Scenic Rivers; the allocation of NC State Natural Areas; the allocation of old growth; and allocation of priority conservation areas for biodiversity and rare species protection.

All of these issues relate directly to discrepancies in model assumptions and inaccuracies in the NRV and Spectrum models and in invalid comparisons between outputs of these models. To be clear, there are other issues in the Plan and EIS. These are covered very well in another objection I participated in as a TWS staff filed today by the Southern Environmental Law Center on behalf of The Wilderness Society, MountainTrue, Defenders of Wildlife, and Sierra Club. However, the modeling errors and problems are the origin, at least in part, of these other issues. The modeling issues deserve further emphasis in a separate objection. However, it is unclear under Region 8 practices whether I will be allowed to participate in objection resolution meetings to resolve these issues. I helped identify many of the modeling issues. Before the DEIS was completed and released I approached Forest Service staff to try to explain the problems and issues in the models and to try to get remedies before the DEIS came out. After the DEIS came out, I had further discussions with Forest Service staff to reiterate these concerns and to seek further insight into the model assumptions and methodology. I obtained Synchrosim software, and when the Plan came out and we obtained the NRV models themselves, I got into the mechanisms of the NRV model and ran the NRV models myself to confirm the problems I had suspected. I also examined Spectrum spreadsheets that were provided with the plan materials to verify that the assumptions within Spectrum are scientifically inconsistent with those used in the NRV model.

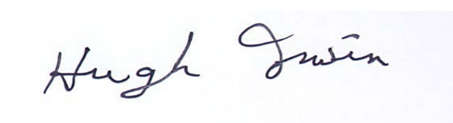
This objection is to make sure that I have a seat at the table for resolution discussions that will discuss the models and issues on which the models depend. I have consistently pointed out to Forest Service staff and others the conceptual errors and problems in the models for at least 5 years and should be at the table for discussions of the details of modeling and other problems in the Plan and FEIS resulting from the models. I should also be at the table for discussion of remedies for these problems.

III. Suggested Remedies

The NRV models for reference conditions and the Spectrum model for future conditions are fundamental to almost all the analysis contained in the EIS. This analysis in turn is the basis on which the Plan rests. The analysis in the EIS can not be accurate and relevant unless these models are redone to address problems, conceptual consistencies, and scientific inaccuracies in the models. The EIS has to be based on BASI. These changes would result in significant changes in the Plan. At minimum, the Forests must:

1) Correct incorrect and flawed assumptions in the models, particularly related to inconsistencies in disturbance levels between the models. The NRV model must more accurately represents NRV disturbance patterns that have spatial and temporal scales consistent with the Spectrum model. The Spectrum model must incorporate reasonable levels of natural disturbance that are consistent with NRV models and BASI. The models must give an accurate, coherent, and coherently consistent picture of past, present, and future conditions.
2) Accurate models will have important implications for the Forest Plan, particularly around allocations of WIAs, old growth, Natural areas, allocation to Ecological restoration, matrix, and other allocations. Accurate models will also have important implications for plan components. The implications of accurate modeling and the picture it gives of the past, present, and future must be incorporated in the Plan.
3) Alternately, the Nantahala-Pisgah Partnership provided a resolution of the social tradeoff between a broad set of different interests. If the models are not redone, the Partnership proposal could provide a resolution that would be an acceptable resolution of these social compromises.

Sincerely,



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