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Nantahala and Pisgah National Forests

Final Environmental Impact Statement

for the Land Management Plan

Appendix B. Analysis Methods

Front cover courtesy photo by Travis Bordley

Final Environmental Impact Statement
Nantahala and Pisgah National Forests
Appendix B. Analysis Methods

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Appendix B: Analysis Methods

In addition to the discussion in Chapter 3 itself, this appendix further describes the analysis process used for evaluations in the EIS. It includes assumptions, and a summary of tools, data used, and analysis steps by resource topic.

The following topics are included in this appendix:

Other resource topics have their own appendix for analysis methods.

- Appendix C documents the analysis of ecological sustainability including aquatic systems, terrestrial ecosystems, species groups, species, unique habitats and watersheds.
- Appendix D documents vegetation modeling methods.
- Appendix E documents the wilderness evaluation process.
- Appendix F documents the and wild and scenic rivers evaluation.

Further information for individual analyses can be found in the project record.

Mapping Methodology

Forest plan maps accompany this Environmental Impact Statement, including maps of the Management Area (MA) allocations for each Alternative.

Map layer data sources

Maps for Alternative A are the maps from the Amendment 5 of the Nantahala and Pisgah LMP, and use the management areas identified in the current plan.

Each of the management areas for the action alternatives is described below and the data source for its boundaries is identified.

These management areas are consistent for all alternatives (A, B, C, D and E):

- **Congressionally Designated Wilderness Areas** (Ellicott Rock, Joyce-Kilmer Slickrock, Linville Gorge, Middle Prong, Shining Rock and Southern Nantahala) were previously designated by Congress to perpetuate or enhance the natural, untrammeled, and undeveloped character of the area while providing opportunities for primitive and unconfined recreation or solitude. These are mapped using the Forest Service national database and all action alternatives match the areas in the current plan.
- **Wilderness Study Areas** (Craggy Mountains, Harper Creek, Lost Cove, Over□low and Snowbird) are designated by Congress to study their potential inclusion in the National Wilderness Preservation System. These are mapped using the Forest Service national database and all action alternatives match the areas in the current plan.
- **Designated Wild and Scenic Rivers** (Chattooga, Horsepasture and Wilson Creek) are those river sections designated by Congress to maintain their free-flowing status and outstandingly remarkable values. The portions that cross Nantahala and Pisgah National Forest lands are covered by this management area. These are mapped using the Forest Service national database and all action alternatives match the areas in the current plan.
- **Research Natural Areas** (Black Mountain and Walker Cove) were designated in 1933 and 1965 respectively, to provide a scientific research baseline for natural forest community conditions where physical and natural processes prevail without human intervention. These are mapped using the Forest Service national database and all action alternatives match the areas in the current plan.
- **The Cradle of Forestry in America** was recognized by Congress as the birthplace of forestry and forestry education in America. The site is managed for educational, interpretive, research and historical purposes. This mapped using the Forest Service national database and all action alternatives match the areas in the current plan.

These areas management were updated since the current plan, and consistent across all action alternatives:

- **Roan Mountain Management Area** is a group of mountains along the North Carolina and Tennessee border with rich temperate diversity, including unique ecological communities, plants and animals. This management area was mapped consistent with the previous forest plan with the exception of a few additional areas that contribute to the Highlands of Roan.

- **The National Scenic Byways** (the Blue Ridge Parkway, Cherohala Skyway and portions of the Forest Heritage Scenic Byway) are administrative designations recognized by the Federal Highway Administration, part of a larger network of scenic routes that exist throughout the country. The management area was mapped as the potentially visible foreground up to 1/4 mile on either side of the scenic corridors.
- **The Appalachian Trail** management area is a long-distance hiking trail established by Congress in 1968 and managed jointly between the US Forest Service, the National Park Service, the Appalachian Trail Conservancy and local affiliated ATC hiking clubs. The management area consists of those lands mapped as the potentially visible foreground up to 1/4 mile on either side of the ANST footpath and associated features.

The following management areas were modified between draft and final (Alternatives B/C/D and Alternative E) based on new information which came from comments, analysis and field research:

- **Special Interest Areas** are those most exceptional ecological communities that serve as core areas for conservation of the most significant and rare elements of biological diversity on the Forests. These areas are generally resilient and not in need of active restoration, although maintenance activities may be needed to maintain their integrity. Special Interest Areas were identified and mapped based on information submitted by the NC Natural Heritage Program in combination with FS knowledge. Areas that the Heritage Program has identified as 'Exceptional' were evaluated and mapped based on criteria established through an interdisciplinary process. These areas are consistent between Alternatives B, C and D, and were modified in Alternative E based on additional input and field review between the proposed and final plan.
- **Eligible Wild and Scenic Rivers** (see proposed plan for names and segment info) are those evaluated for possible inclusion in the National Wild and Scenic River System. They will be managed to retain their characteristics until further suitability studies or evaluation is completed. The proposed plan identified newly eligible stretches and their outstandingly remarkable values (see DEIS Appendix F), with one error corrected in the final, resulting in one fewer river being advanced in Alternative E.
- **Experimental Forests** (Bent Creek, Coweeta Hydrological Laboratory and Blue Valley) are jointly managed between the USFS Southern Research Station and the National Forests in North Carolina and serve as real-world laboratories for conducting long-term science and management studies. National datasets serve as the basis of the starting area and alternatives A-D are consistent. In Alternative E about 23 acres of land are added to the Blue Valley Experimental Forest to eliminate a sliver between the Experimental Forest and the Congressionally Designated Wilderness Study Area.
- **Heritage Corridors** includes congressionally designated National Historic Trails (the Trail of Tears and Overmountain Victory Trail), National Millennium Trails (Unicoi Turnpike), and other historic routes eligible for listing on the National Register of Historic Places. Ongoing research is improving the spatial accuracy of the location of these trails and more information was made available in September 2021 that influenced the mapping of the management area in Alternative E.

The size and configuration of these management areas varied depending on the theme of the alternative:

- **Ecological Interest Areas** include areas with a concentration of high-quality natural communities or high quality existing old growth and are generally less roaded than the Matrix and Interface. This management area was included in Alternatives C, D and E and was mapped largely to respond to those who desired fewer acres in Matrix.
- The **Backcountry** management area varies by alternative and was generally mapped to include large blocks of remote and unroaded lands inventoried primarily as Semi-Primitive Non-Motorized ROS, and consisting of at least 2,500 acres (unless adjacent to other areas managed for Semi-Primitive Non-Motorized or Primitive ROS).
- The **Interface** management area includes all Concentrated Use Areas (recreation sites with Development Scale 0-5), all National Recreation Trails, dispersed-developed campsites located along reservoir shorelines, and primary access routes to recreation sites on Federal Highway, State Road, and NFS Road (Maintenance Level 3-5) segments within one mile of Concentrated Use Areas. This management area is primarily consistent across action alternatives with the exception of the Big Ivy area and along the Highway 276 corridor on the Pisgah Ranger District.
- The **Matrix** management area includes the general forest area that provides connections between Interface, Backcountry, and other special designations. This management area varies by alternative depending on how adjacent management areas are mapped.
- **Recommended Wilderness** (lands recommended for inclusion in the National Wilderness Preservation System) varies by alternative, responding to those who seek different amounts of land in this type of management. Mapping of area boundaries are informed by parameters of the the wilderness evaluation (Appendix E), and are generally defined by roads, existing IRA and WSA boundaries, topographic features, and land ownership. The identification of different areas into alternative packages was dependent on the Wilderness Evaluation as well as the theme of the alternative. More information on differences between alternatives is contained the wilderness evaluation (Appendix E).

Displaying management areas

Viewing the MA allocation on a flat piece of paper (two-dimensional map) can be confusing where multiple MA prescriptions apply to the same piece of land. Lands with overlapping MA allocations are managed in accordance with all applicable MA plan direction and must comply with the most restrictive plan direction where there is a conflict. Therefore, the most restrictive MA was assigned where multiple management areas apply. The following guide was used in depicting how MAs should be displayed on hard copy maps within the land management plan.

	Management Area(s)
More restrictive ↑	Congressionally Designated Wilderness, Designated Wild and Scenic Rivers, Cradle of Forestry, Experimental Forests
	Recommended Wilderness
	Research Natural Areas
	Heritage Corridors
	Roan Mountain
	Appalachian Trail
	Backcountry
↓	National Scenic Byways

Less restrictive	Special Interest Areas
	Ecological Interest Areas
	Interface
	Matrix

For example, where the Appalachian Trail passes through Congressionally Designated Wilderness, the map will show the area as Congressionally Designated Wilderness although both sets of plan components apply. In another example, where a National Scenic Byway is adjacent to the Cradle of Forestry, the area is mapped as the Cradle of Forestry. In many places, the Special Interest Areas MA underlies other MAs, (i.e., Recommended Wilderness); however, management of these areas will still be consistent with management direction for both SIAs and the overlapping MA.

To avoid double counting acres that appear in multiple MAs, only the most restrictive acreage is used in MA acreage tables.

The Designated Old Growth Network is not a MA and overlaps multiple MAs.

Management area acreage by alternative

MA	Alt B Acres	Alt C Acres	Alt D Acres	Alt E Acres
Interface	67,145	55,207	66,984	65,893
Matrix	554,128	441,014	551,412	542,865
Backcountry	87,697	229,011	107,065	132,295
Ecological Interest Areas	0	79,557	26,007	22,195
Special Interest Areas not contained in other management areas*	29,376	27,055	30,572	45,924
Special Interest Areas total	102,650	102,650	102,650	118,810
Research Natural Areas	55	1,489	55	1,487
Experimental Forest	13,131	13,131	13,131	13,133
Appalachian National Scenic Trail	45,290	51,663	49,899	48,152
National Scenic Byways	23,314	20,983	23,771	21,851
Heritage Corridors	8,368	8,763	8,526	8,524
Designated Wild and Scenic Rivers	6,249	5,927	6,249	6,249
Congressionally Designated Wilderness	66,401	66,400	66,401	66,393
Wilderness Study Areas	26,816	26,816	26,816	26,816
Recommended Wilderness	126,334	11,193	74,173	49,098
Roan Mtn	9,233	9,233	9,233	9,316
Cradle of Forestry	6,072	6,072	6,072	6,072
Water	364	364	364	364

*Special Interest Areas are their own management area, unless they are contained within a management area that is more restrictive, and then their acreage is counted in as the more restrictive management area on a flat map. Both total acres and acres of the Special Interest areas not contained in other management areas are shown.

The acreage identified above was used as the analysis basis for the FEIS acreage described in Chapter 3 of the EIS. In September 2021, after the EIS was already underway and several analyses were complete, the Planning Team learned more refined information about the Trail of Tears National Historic Trail, which is actively being researched. Final maps were adjusted to reflect the new information. Acreage of the management area tables used for analysis numbers were not adjusted given this late change. Below is a summary of the net change in acres by management area.

Management Area	**Total Acreage Change**
Heritage Corridors	-2011 acres
Interface	+600 acres
Matrix	+1076 acres
Backcountry	-111 acres
Appalachian National Scenic Trail	+381 acres

Air

Ambient Air Quality Data. The ozone and fine particulate matter data are from monitoring locations that meet the Environmental Protection Agency (EPA) monitoring standards for the National Ambient Air Quality Standards (NAAQS). Either the North Carolina Division of Air Quality or the EPA Clean Air Status and Trends Network (CASTNET) gathered and conducted the quality control on this ambient air data. Visibility data is gathered by the USDA Forest data (analysis of the samples is funded by the EPA) following the Interagency Monitoring of Protected Visual Environments (IMPROVE) protocols. The internet links for the data are in the figure captions in the Affected Environment.

Total Deposition Data. The total deposition estimates are derived using statistical methods for the wet and cloud deposition, and both statistical and atmospheric dispersion model estimates for the dry deposition. The methods used are described in Sullivan and others (2010) and McDonnell and others (2018).

Potential Acid Neutralizing Capacity (ANC_p) and thresholds (ANC_t). McDonnell and others (2018) describe the steady-state water chemistry model, the data used to conduct the analysis, and assumptions. Using ArcMap, calculations used spatial data from the emds_v4_073118 database found in the Critical_loads.gdb geodatabase. Additional documentation is within the metadata for the coverage.

For this EIS, the variables described by McDonnell and others (2018) for the steady-state water chemistry model (an equation) where rearranged to solve for the acid neutralizing capacity (ANC) and the potential ANC (ANC_p) assumes there is no anthropogenic effect on the catchment:

$ANC_p = (BC_{Dep} + BC_W - BC_{Up} - S_{DepNat}) / Q$

where:

ANC_p = the potential ANC without anthropogenic sulfur deposition and no timber harvests in the catchments. The unit of measure is micro-equivalents per liter (ueq/L)

BC_{Dep} = the total amount of base cations (calcium + magnesium + potassium + sodium) minus chloride. The units of measure is micro-equivalents per meter squared per year ($meq/m^2\ yr^{-1}$).

BC_W = the annual rate of base cation weathering in the soil. Units of measure are $meq/m^2\ yr^{-1}$.

BC_{Up} = the annual rate of base cation uptake by trees if the catchment has been harvested. This has been set to 0 meq/m^2 yr^{-1}.

S_{DepNat} = the estimated natural deposition of sulfur from the atmosphere, which is 2.5 meq/m^2 yr^{-1}.

Q = the predicted runoff (m/yr)

The ANC_p results are continuous data and the subgroup of the Planning Team chose to place the results in categories, where the ANC_t value used in any subsequent calculations used the lowest value (10, 30, 50, or 100) in the following ranges (unit of measure is ueq/L):

>=10 - <30

>=30 - <50

>=50-<100

>=100

Best Available Science

Knoepp, J. D.; Vose, J. M.; Jackson, W. A.; Elliott, K. J.; and Zarnoch, S. 2016. High elevation watersheds in the southern Appalachians: Indicators of sensitivity to acidic deposition and the potential for restoration through liming. Forest Ecology and Management. 377: 101-117.

This peer-reviewed study relied upon repeated soil and water chemistry samples taken from one high elevation location on the Cherokee, Nantahala and Pisgah NFs. Southern Research Station staff utilized appropriate scientific methods to collect and analyze the field results. The authors discussed how timber harvesting may adversely affected base cation supplies and the range in lime application to increase soil pH.

Lawrence, G. B., and Huntington, T. G. 1999. Soil-Calcium Depletion Linked to Acid Rain and Forest Growth in the Eastern United States. USGS Water-Resources Investigations Report 98-4267. 12. https://doi.org/10.3133/wri984267

This publication described the effects of acid deposition on forest soils and there is a delayed response in watershed improvement because there is a slow release of previously stored sulfur in the soil with a decrease in atmospheric sulfur deposition.

Lawrence, G. B.; Sullivan, T. J.; Burns, D. A.; Bailey, S. A.; Cosby, B. J.; Dovciak, M.; Ewing, H. A.; McDonnell, T. C.; Minocha R.; Quant, J.; Rice, K. C.; Siemion, J.; and Weathers, K. 2015. Acidic Deposition along the Appalachian Trail Corridor and its Effects on Acid-Sensitive Terrestrial and Aquatic Resources. Results of the Appalachian Trail MEGA-Transect Atmospheric Deposition Effects Study. Natural Resource Report NPS/NRSS/ARD/NRR—2015/996. National Park Service, Fort Collins, CO.

The report includes soil and water chemistry and dynamic modeling results for locations on the Nantahala and Pisgah National Forests. The authors reported that stream acid neutralizing capacity can decrease as much as 50 ueq/L following storm events.

McDonnell, T. C.; Sullivan, T. J.; Cosby, B. J.; Jackson, W. A.; and Elliott, K. J. 2013. Effects of Climate, Land Management, and Sulfur Deposition on Soil Base Cation Supply in National Forests of the Southern Appalachian Mountains. Water, Air, & Soil Pollution 224, no. 10: 1–18. doi:10.1007/s11270-013-1733-8.

This peer-reviewed study relied upon field data collected in the southern Appalachians, including the Nantahala and Pisgah NFs. The field data were inputs into a biogeochemistry model that has

international acceptance. The methods used in the modeling analysis also has international acceptance. One of the modeling scenarios evaluated potential timber harvesting effects on soil base saturation and stream acid neutralizing capacity.

McDonnell, T. C.; Sloat, M. R.; Sullivan, T. J.; Dolloff, C. A.; Hessburn P. F.; Povak, N.A.; Jackson, W. A.; and Sams, C. 2015. Downstream warming and headwater acidity may diminish coldwater habitat in Southern Appalachian Mountain streams. PLOS One. DOI:10.1371/journal.pone.0134757.

This peer-reviewed study relied upon previously published estimates of stream acid neutralizing capacity and recently collected stream temperatures for the Southern Appalachians, including the Nantahala and Pisgah NFs. The authors utilized appropriate scientific methods for the statistical models and incorporating field results. The study identified locations on the Nantahala and Pisgah National Forests where the stream acid neutralizing capacity may be too low to support brook trout and the extent of suitable brook trout habitat if air temperatures remain the same or increases by 2 and 4 degrees Celsius.

McDonnell, T. C.; Sullivan; T. J. and Jackson, W. A. 2018. Atmospheric Deposition Effects: Modeling for Resource Management on Southern Appalachian National Forests. Final report prepared for USDA Forest Service, Asheville, NC. E&S Environmental Chemistry, Inc., Corvallis, OR. 66 pp.

This report updates a previous peer-reviewed publication using recently acquired water and soil chemistry data throughout the Southern Appalachians, including the Nantahala and Pisgah NFs. The field data were inputs into a biogeochemistry model that has international acceptance. The methods used in the modeling analysis also has international acceptance. The biogeochemistry model results provide hindcast and forecast estimates for soil base saturation and acid neutralizing capacity. Model outputs included base cation weathering estimates that were input, along with other landscape variables, to a regression model to predict base cation weathering (BCW) across the landscape. This study compiled a spatial geodatabase used in the Nantahala and Pisgah EIS. The BCW estimates along with other spatial estimates were used as inputs into the calculations conducted for the EIS. The steady state water chemistry analysis used in the report is an internationally accept method. The report also provides additional background information on how both acidification and timber harvesting effect base cation supplies.

McNulty, S. G.; Cohen, E. C.; Moore Myers, J. A.; Sullivan, T. J.; and Li, H. 2007. Estimates of Critical Acid Loads and Exceedances for Forest Soils across the Conterminous United States. Environmental Pollution, Air Pollution and Vegetation Effects Research in National Parks and Natural Areas: Implications for Science, Policy and Management, 149. 3: 281–92. doi:10.1016/j.envpol.2007.05.025.

This peer-reviewed publication presents the amount of nutrient base cations removed when harvesting only the bole (i.e. trunk) and bark.

Peterson, J.; Lahm, P.; Fitch, M.; George, M.; Haddow, D., and others. 2018. NWCG Smoke Management Guide for Prescribed Fire. National Wildfire Coordinating Group. Boise, ID. PMS 420-2/NFES 1279. 306 pp.

This report provides a scientific overview of how wildland fires affect air quality, and documents the current National Ambient Air Quality Standards.

Rice, K. C.; Scanlon, T. M.; Lynch, J. A.; and Cosby, B. J. 2014. Decreased Atmospheric Sulfur Deposition across the Southeastern U.S.: When Will Watersheds Release Stored Sulfate? Environmental Science & Technology 48, no. 17: 10071–78.

This peer-reviewed publication presents results from the Joyce Kilmer – Slickrock Wilderness (Nantahala National Forest). The authors estimated the release from the soil of previously stored atmospheric deposition of sulfur. The range is 2014 to 2028, with the predicted year as 2023.

Sullivan, T. J.; Cosby, B. J; Jackson, W. A; Snyder, K. U.; and Herlihy, A. T. 2010. Acidification and Prognosis for Future Recovery of Acid-Sensitive Streams in the Southern Blue Ridge Province. Water, Air, & Soil Pollution 219, no. 1–4: 11–26.

This peer-reviewed study relied upon field data collected in the southern Appalachians including the Nantahala and Pisgah NFs. The field data were inputs into a biogeochemistry model that has international acceptance. The methods used in the modeling analysis also has international acceptance. The publication describes accepted methods to estimate the total sulfur deposition from the wet, dry, and cloud/fog components. McDonnell and others (2018) provide the data sources for the southern Appalachian estimates, including the Nantahala and Pisgah NFs.

Urbanski, S. P. 2014. Wildland fire emissions, carbon, and climate: emission factors. Forest Ecology and Management. 317: 51–60.

This peer-reviewed publication provided the most recent prescribed fire emission factors for the United States and they are the most accurate, reliable, and relevant for the Nantahala and Pisgah NFs.

Climate

The affected environment is characterized based on climate and resilient landscape characteristics. Climate is analyzed based on indicators of observed and modeled climate variables (temperature and precipitation), with an emphasis on evaluating departure from historical conditions. Resilient landscape characteristics are analyzed in terms of indicators of local connectedness and landscape diversity, which is measured in relative terms to the surrounding region. Environmental consequences are discussed through a meta-analysis of peer reviewed literature describing effects on key resources, which are broadly defined around resource areas of emphasis in the LMP.

Regulatory Framework

No applicable legal or regulatory requirements or established thresholds exist for climate, climate change, or its effects on resources. The 2012 Planning Rule and Final Directives requires an assessment of climate change and integration of this information in development of plan direction that addresses ecological sustainability on national forests (36 CFR 219.8(a)(1)(iv); 36 CFR 219.6(b); Forest Service Handbook 1909.12.3; Forest Service Handbook 1909.23.1).

Methodology, Analysis Process, and Key Indicators

The affected environment is characterized based on climate and resilient landscape characteristics. Climate is analyzed based on indicators of observed and modeled climate variables (temperature and precipitation), with an emphasis on evaluating departure from historical conditions. Resilient landscape characteristics are analyzed in terms of indicators of local connectedness and landscape diversity, which is measured in relative terms to the surrounding region. Environmental consequences are discussed through a meta-analysis of peer reviewed literature describing effects on key resources, which are broadly defined around resource areas of emphasis in the LMP. Detailed descriptions of the methodology, analysis process, and key indicators are presented below.

Key indicators:

- Climate
    - Temperature – average annual daily maximum and minimum temperature
    - Temperature – number of days per year with average daily maximums greater than 90F
    - Temperature – number of days per year with average daily minimums less than 32F
    - Precipitation – average annual total precipitation
    - Precipitation – average number of dry days per year
- Landscape resilience
    - Local connectedness
    - Landscape diversity
- Environmental consequences
    - Biological diversity
    - Forest health
    - Plant communities
    - Animal communities
    - Extreme weather
    - Water resources
    - Recreation

Analysis Area and Scale

Due to the nature of climate change and its effects, this section utilizes multiple geographic and temporal scales. The geographic analysis unit is typically forest-wide, though some analyses required consideration of issues at larger or smaller geographic scales, including those that encompass the entire Southern Appalachian region. Due to the long-term effects of climate change, temporal analysis periods typically extend beyond the life of the plan with mid- or end-of-century being the most commonly used in this report, and it the scientific literature about climate change.

Data

This climate summary is based on climate models originally developed for the United Nations Intergovernmental Panel on Climate Change, downscaled by Pierce et al.[1] and available from the USDA Southeast Climate Hub's Climate by Forest tool, which is an adaptation of the National Oceanic and Atmospheric Administration's Climate Explorer.[2] The Climate by Forest tool produces graphs and tables showing historic and future projected conditions for two possible greenhouse gas emissions scenarios.[3] The climate data considered in this report are based on both historical observations and future projections:

Historic climate— For all observed data, the gray bars are plotted with respect to the 1961-1990 mean using Livneh et al. dataset.[4] The black line shows gridded historical observations.

Future climate — The modeled future climate projections are Localize Constructed Analogs (LOCA) downscaled from the Coupled Model Intercomparison Project Phase 5 (CMIP5) model realizations. This includes the hindcast (historical) and the projected (future) climate for the RCP4.5 (low) and RCP8.5 (high) emission scenarios. Each year, the range is defined by the highest and lowest model values for that year across all 32 models and the central line represents the weighted mean across all models.[5,6]

How the results are produced—The results summarized in this section represent an analysis area defined by a bounding box surrounding the Southern Blue Ridge Mountains ecological subsection (SBRM - M221Dc[7]). Data are retrieved dynamically from a NOAA-funded site at Cornell University (DeGaetano et al.[8]).

Best Available Science

These results represent the best available scientific information for evaluating climate, but limitations must be understood to make meaningful interpretations:

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[1] Pierce, D. W., D. R. Cayan, and B. L. Thrasher, 2014: Statistical downscaling using Localized Constructed Analogs (LOCA). Journal of Hydrometeorology, volume 15, page 2558-2585. http://loca.ucsd.edu/~pierce/IEPR_Clim_proj_using_LOCA_and_VIC_2016-06-13b.pdf

[2] U.S. Federal Government. 2018. U.S. Climate Resilience Toolkit Climate Explorer. [Online] https://climate-explorer2.nemac.org Accessed August 8, 2018.

[3] U.S. Forest Service. 2018. U.S. Climate By Forest (adaptation of Climate Resilience Toolkit Climate Explorer). [Online] http://climate-by-forest.nemac.org Accessed August 8, 2018.

[4] https://www.esrl.noaa.gov/psd/data/gridded/data.livneh.metvars.html

[5] Taylor K. E., Stouffer R. J., Meehl G. A. (2012): An overview of CMIP5 and the experiment design. Bulletin of the American Meteorological Society, 93, 485-498, doi:10.1175/bams-d-11-00094.1.

[6] Sanderson, B.M. and M.F. Wehner (2017): Weighting strategy for the Fourth National Climate Assessment In: Climate Science Special Report: A Sustained Assessment Activity of the U.S. Global Change Research Program [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 644-653.

[7] Keys, J.E.; Cleland, D.T.; McNab, W.H. 2007. Delineation, peer review, and refinement of subregions of the conterminous United States. Gen. Tech. Report WO-76A. Washington, DC: U.S. Department of Agriculture, Forest Service. 11 p.

[8] DeGaetano, A.T., W. Noon, and K.L. Eggleston (2014): Efficient Access to Climate Products in Support of Climate Services using the Applied Climate Information System (ACIS) Web Services, Bulletin of the American Meteorological Society, 96, 173–180

Accuracy and precision— One may assess model performance by comparing model reconstructions of the historical period with historical observations. For this evaluation, the envelope of model realizations used to reconstruct historical conditions aligned very well with the gridded historical observations themselves (Figure 1 and 2). The same models that produced accurate historical reconstructions were used to develop climate projections based on specific emissions pathways. By using results from multiple models (i.e., model agreement/uncertainty), this analysis incorporates a diversity of scientific approaches to modeling the climate system. This analysis is agnostic about how best to represent the physics of the coupled ocean and atmosphere, its sensitivity to greenhouse gases, and resultant climate changes that emerge at a regional level or at the scale of analysis used here. The methods used here are not concerned with examining precise conditions in a specific year in the future. Instead, we analyze a weighted average of model results to provide general guidance about trends and trajectories that are well-supported by modeling studies.

The accuracy of model results relates most closely to future emissions, which themselves will be determined by future human decisions. Human decisions about greenhouse gas emissions cannot be accurately modeled, so the Climate by Forest tools adopts two emissions pathways that are frequently used in climate science.

Each interpretation section in this report addresses these characteristics of accuracy and precision. There are other limitations of these data that are inherent to the systems, models, and assumptions used to develop them that are not readily assessed, but should be considered contextually as these are considered alongside other sources of information, including findings from peer-reviewed literature and local expertise.

Reliability—The results presented in this report are based on peer-reviewed science being widely applied within the National Climate Assessment. [9]

Relevance—Relevance is assessable through geographic and indicator considerations. The Climate by Forest tool summarizes results at the ecological subsection scale, which is not perfectly coincident with the boundaries of our area of interest (i.e., NPNFs), but given the coarseness of the climate data and other sources of uncertainty, the selected subsection (Southern Blue Ridge Mountains – M221Dc) provides a representative sample that can be reasonably applied to the area of interest as a whole and represents areas that, at least historically, have similar climates. While there are additional climate variables that are relevant to the mission and operations of the NPNFs, the selected attributes cover the major physical variables of temperature and precipitation and give sufficient insight into potential influences on resources and management activities.

Carbon

Regulatory Requirements

No applicable legal or regulatory requirements or established thresholds exist for management of forest carbon or GHG emissions. The 2012 Planning Rule and Final Directives requires an assessment of baseline carbon stocks and a consideration of this information in management of the national forests (Forest Service Handbook 1909.12.4).

[9] https://science2017.globalchange.gov/downloads/

Data

The affected environment section summarizes the Forest Carbon Assessment for the Nantahala and Pisgah NFs (Dugan and McKinley 2018). The carbon assessment draws largely from two recent U.S. Forest Service reports: the Baseline Report (USDA Forest Service 2015) and the Disturbance Report (USDA Forest Service, in review). Together they provide the best available quantitative assessment of forest carbon stocks, harvested wood products stocks, and the factors that influence carbon dynamics on the N-PNF. The primary sources to evaluate potential future conditions and the impacts of climate change on forest carbon dynamics were the Resource Planning Act (RPA) assessment (USDA Forest Service 2016) and a regional vulnerability assessment (McNulty et al. 2015). These reports incorporate advances in data and analytical methods and collectively represent the best and most relevant scientific information available for the Nantahala and Pisgah NFs. These resources were explicitly selected for their consistent reliance on Forest Inventory and Analysis (FIA) data, which contains statistically valid sampling of ground-truthed monitoring data. They also use validated (peer-reviewed) modeling tools that integrate current remotely sensed and high-resolution products (e.g., Healey et al. 2018) with FIA data (Dugan et al. 2017; Dugan and McKinley 2018).

Key indicators:

- Carbon pools (carbon stocks) and carbon uptake
- Natural and human-caused influences on carbon stocks and carbon uptake

Scale

The spatial scale of this analysis includes the forested lands of the Nantahala and Pisgah National Forests (NPNFs). The NPNFs was administratively combined with the Uwharrie and Croatan National Forests to form a single administrative unit, the National Forests in North Carolina (NFs in NC). Therefore, some of the model results presented here, including estimates of carbon stocks and impacts of disturbances and other factors, are available only for combined NFs in NC or at the regional scale. The Nantahala and Pisgah NFs accounts for about 80 percent (about one million acres) of the forested area in the NFs in NC. [10] Thus, the available information is a reasonable representation of the carbon trends and factors impacting carbon on the Nantahala and Pisgah NFs.

Relative to the contribution of all the world's forests to carbon flux, the influence of the NPNFs is extremely small, so a meaningful analysis at the global scale is not practical. However, national and regional factors related to forests' influence on carbon dynamics are included here to provide context for the nature of the local effects of Nantahala and Pisgah NFs.

The temporal scale for analyzing carbon socks and emissions focuses on the expected lifespan of the plan (10-15 years). However, this report includes analysis and discussion beyond this expected lifespan to provide context for potential forest carbon dynamics and factors influencing these dynamics in the future. Considering factors beyond the plan period is important because this plan covers only part of the life cycle of the forest.

[10] This estimate is derived from the most recent FIA survey data available in FIA EVALIDator (https://apps.fs.usda.gov/Evalidator/evalidator.jsp).

The Forest Service is committed to using the best available information to support management decisions. In general, this means relying upon sources that are data-driven, locally calibrated, and consistent over both time and space. However, estimates of future carbon stocks (i.e., stored carbon) and their trajectory over time remain unclear because of uncertainty from the multiple interacting factors that influence carbon dynamics. These factors include environmental changes and changes in climate that affect the health, productivity, and diversity of forests. Although advances in research have helped to account for and document the relationship between GHG and global climate change, it remains difficult to reliably simulate observed temperature changes and distinguish between natural or human causes at smaller than continental scales (IPCC 2007).

Fire

Fire Prioritization Analysis Methods

Ecological Need

Our intent was to develop a model to determine the highest ecological need for recurrent fire. The following steps were incorporated to develop the highest ecological need across the landscape.

- We utilized the six most fire adapted ecozones modeled across the southern Appalachians: Pine-Oak/Heath, Shortleaf Pine-Oak, Dry Oak, Dry-Mesic Oak, Dry-Mesic Oak, High Elevation Red Oak, and Mesic Oak.
- On a grid system of 30 by 30 foot pixels the modeled ecozone was weighted with a value based on its fire return interval with a greater value to those types with the shorter fire return interval. The values given are as follows:

Ecozone	Maintenance Return Interval	Weighting
Shortleaf Pine	3-7	6
Pine Oak Heath	3-7	6
Dry Oak	7-12	4
Dry-Mesic Oak	15-20	2
High Elevation Red Oak	20-25	1
Mesic Oak	23-27	1

- A neighborhood analysis was completed via spatial analyst across a 100 acre area to derive the sum of all the weighted values within any individual neighborhood. It was decided to use 100 acres as the neighborhood size to represent the smaller burn blocks. While average prescribed burns are 5-6 times larger than 100 acres, this process provides flexibility to aggregate larger blocks with adjacent similar burn priorities as well as identifies smaller areas with a great need to burn.
- For the 100-acre neighborhood analysis there are 4840 pixels. Thus the summed value for any single neighborhood could vary from 0 within an area with none of the above fire adapted ecozones to 29,040 for a 100-acre block with only pine-oak/heath or shortleaf pine-oak or a combination of the two.
- This analysis was completed across the Nantahala-Pisgah National Forest as well as all lands within the surrounding ecozone modeled area.

- A map of the neighborhood analysis was created with the raster classified and symbolized by the following categories:

Fire Need	100 Acre Block Value	Map Color
Moderately High	10,000 - 12,500	Yellow
High	12,500 - 17,500	Brown
Very High	17,500-29,040	Red

- The map visually displays across the landscape where the greatest need for maintenance or restoration of fire adapted plant communities.

Community Protection

The objective is to identify the national forest lands in western North Carolina where risks of wildfire could threaten local communities. We considered several methods to estimate these lands and landed on the following approach.

- Use the Southwrap data layer for risk assessment; WUI_Risk. This layer uses a 30m x 30m pixel size and assign a risk rating to each pixel based on housing density and flame length. The values range from -9 to 0, where -9 is the highest risk and -1 is the lowest risk, and 0 is no risk.
- Region 8 Staff produced a High Risk Map by selecting Gridcodes -9 through -6 and then buffered the areas out 3 miles. This is considered the wildland urban interface and called NC_High_Risk_WUI_3mo_Buffer on the map product.
- An estimate of priorities for national forest lands to be in a condition that protects adjacent communities was made using a refinement of the Southwrap data. A neighborhood analysis using a moving circular window of a three mile radius and the focal statistic function that summed the Southwrap risks numbers and assigned a value to each pixel based on the combined risks within the window.
- The national forest ownerships were extracted from this layer. The summed values for the pixels classified into five classes using the natural breaks classification method. The five categories of risks are: very high, high, moderately high, moderate, and low. This classification used the “jenks natural breaks” to determine breakpoints.
- A visual check of how well the protection status was made using a layer from Ward & Shipley (R8 Fire) of polygons with high risk factors (-9 to -6). There were several high risk areas immediately adjacent to areas classified as “low”. To compensate for this, the breakpoint from moderate to low was adjusted in order to classify more lands as “moderate”. This classification of national forest lands now appears consistent with Southwrap and Region 8 assumptions.
- The raster layer was converted to polygons and acreages were determined for each category and mapped.
- The refinements for NF ownerships are estimated as follows:

(Note: Adjustments made to the moderate and low breakpoints are shown below. The assumption made for the adjustment: If the lands are with the WUI and High Risk polygons were adjacent to lands classified as “low,” these lands should be reclassed as “moderate.”

NF Lands Risk Rating	Acres	Map Color
Very High	4467	Red
High	58513	Orange
Moderately High	181333	Yellow
Moderate	726263 (385228 ac previous)	Blue
Low	72484 (413520 ac previous)	Gray

Natural Disturbance

See Appendix D, Vegetation Modeling Methods.

Designated Old Growth Network

Assumptions. The following assumptions were developed to expand and evaluate the designation OG networks for each alternative.

- Ecozones provide the basic unit (coarse filter) that captures the range of geophysical land features that cross moisture and elevation gradients. Ecozones were derived primarily using geophysical features and then incorporated vegetation references to estimate and map the potential natural vegetation (Simon, 2013).
- Larger patch sizes provide "the stage or arena" by having greater diversity of ecozones within a contiguous area, thereby allowing for a range of micro-climates and conditions that support the various habitat needs of plants and animals. By providing greater diversity of types and amounts of ecozones within a contiguous area, larger patch sizes provide connectivity and continuity across moisture and elevational gradients and among ecozones, allow for greater resiliency and recovery from disturbances and provide refugia for plant and animal species that were displaced by the disturbances. Larger scale heterogeneity is needed to incorporate the biodiversity in all phases of disturbances and succession across the range of patch types and sizes (White, et al, 2015). This is measured by calculating the distribution of patch sizes for the network.
- Patch sizes of 100 acres or more are more likely to capture the range of elevational gradients and ecozone diversity desired in a network. The Nantahala and Pisgah NFs have landscapes in which larger contiguous tracts of habitat remain and should use different criteria than in fragmented habitat where many species and vegetation types exist in remnants of habitat that are altered and surrounded by intensive land uses. (Margules and Pressey,2000).
- Representativeness of ecozones is a key factor in developing the network. Representativeness is calculated as the proportion of each ecozone in the network is comparable with the proportion of each ecozone forestwide.
- Redundancy is another key factor where an ecozones occurs repeatedly over the landscape and in widely separated areas. This is measured by calculating the amounts of ecozones in the network across ranger district boundaries.
- Finer filter elements can complement the coarse filter and be used to compare networks. For this analysis, the proportion of occurrences of Threatened or Endangered species, species of conservation concern, and rare habitats are calculated for comparisons.

- Efficiency is important such that the network is adequate to provide the arena for old growth development in the size and location but to have least impact on other multiple uses and ecological, social, or cultural desired conditions. It is important for the credibility of conservation planning that conservation goals are seen to be achieved in a way that minimizes, as far as possible, forgone opportunities of competing interests (Margules and Pressey,2000). This was evaluated by having fewer acres in management area group 1 in the network.
- Connectivity with other FS lands outside the network. Management areas that emphasize passive management would eventually contribute to old forest conditions in the future. These lands could provide larger, contiguous patches that are desired to increase the diversity of ecozones and across moisture and elevational gradients. These areas are patches called Old Forest Trending.
- Connectivity with other lands beyond the FS boundaries. Lands that are owned by other entities could contribute to old forest conditions. Where these lands are adjacent or near the FS boundary, then larger patches of old forest can develop over time. This is called the All Lands analysis.

Designated OG Networks evaluated in the Draft Environmental Impact Statement

Four networks were evaluated in the DEIS, one for each of the Alternatives A through D.

- Alt A: The large and medium patches in the existing OG network were examined and refined to clean the data best. Small patches on each ranger district were accumulated. The small patches were then combined into one layer with large and medium patches. This layer became the basis of comparison among the alternatives from the existing designated OG network. (Map Alt A Designated OG Network)
- Alt B: This layer is the designated OG network (Alt A) excluding the 6 patches as described in Alternative B (Chapter 3). Patches were modified to provide the needs for other resource conditions, and that, the patches may have been designated without consideration of the entire OG network. (Map Alt B Designated OG Network)
- Alt C: This layer has the designated OG Network (Alt A) combined with an inventory provided by Mountain True during the revision process (NGO Inventory). The NGO inventory was integrated with Alt A network by dissolving any overlap among the patches. (Map Alt C Designated OG Network)
- Alt D: This layer has the designated OG network (Alt B) combined with a partial dataset of the NGO inventory. The partial NGO inventory was integrated with Alt B network by dissolving any overlap among the patches. (Map Alt Designated OG Network)

Between Draft and Final EIS: Procedure for expanding the Designated OG Network for Alternative E

Procedures that follow systematic conservation planning principles (Kukkala and Moilanen, 2013) were used to adjust and expand the designated OG network that “sets the stage” or the “arenas” (Beier and Brost, 2009) for future old growth development over time. That network would be comprised of the geophysical land features that explain much of the biological variations of ecological systems (Anderson, et al, 2014). The network would be an adequate sample of the geophysical features that cross moisture and elevation gradients. The network would be inclusive, comprehensive and assure all the geophysical land features are adequately represented in the network. Also, the network would be efficient such that old growth values could be achieved in the future with the least amount of area to accommodate

other land management desired conditions and objectives (Margules and Pressey,2000). The following procedure summarizes the general approach used to modify the network. Additional documentation is available in the project record.

- Step 1: Begin with the network from the current plan (Alt A). Update this network to incorporate recent information from districts, such as patches identified in recent decisions, and small patches where old growth management is not aligned with current conditions on the ground.
- Steps 2: Add in other management areas where the desired conditions are compatible with the desired conditions for old growth (Designated Wilderness, Wilderness Study Areas, Recommended Wilderness, Research Natural Areas.
- Step 3: Add in designated Wild and Scenic Rivers corridors that are classified as Wild.
- Step 4: Incorporate spatial information from public comments describing areas of the forest that have been inventoried as having old trees (>150 yr) and observations of no human disturbances (Class A).
- Step 5: Incorporating NC Natural Heritage Program's Natural Heritage Natural Areas that have the following features:
    - Have a classification of Exceptional, Very High, or High
    - Have a description that some portion of the area has old growth character
    - Adjacent to a patch already identified in steps 1-4, thus enlarging the patch size to at least medium sized (100 ac)
    - Contributes to representativeness of ecozones that are under- represented in steps.
    - Ranked high in a scoring system, detailed in a process paper where weight was given to areas that one or more of the following features: high likelihood of existing old growth; adjacency to existing old growth patches thus increasing overall patch size; adjacency with management of other management areas compatible with accruing OG characteristics; adjacency with a conservation area across forest boundaries (land trusts, etc).
- Step 6: Discuss the adjusted old growth network footprint with the ranger districts and local land managers and adjust if the management for old growth conditions would create undo constraints for other needs in the area (ex: management in the Trail of Tears, needs for realignment of unsustainable trails, wildlife habitat management priorities, etc). (Map Alt E Designated OG Network)

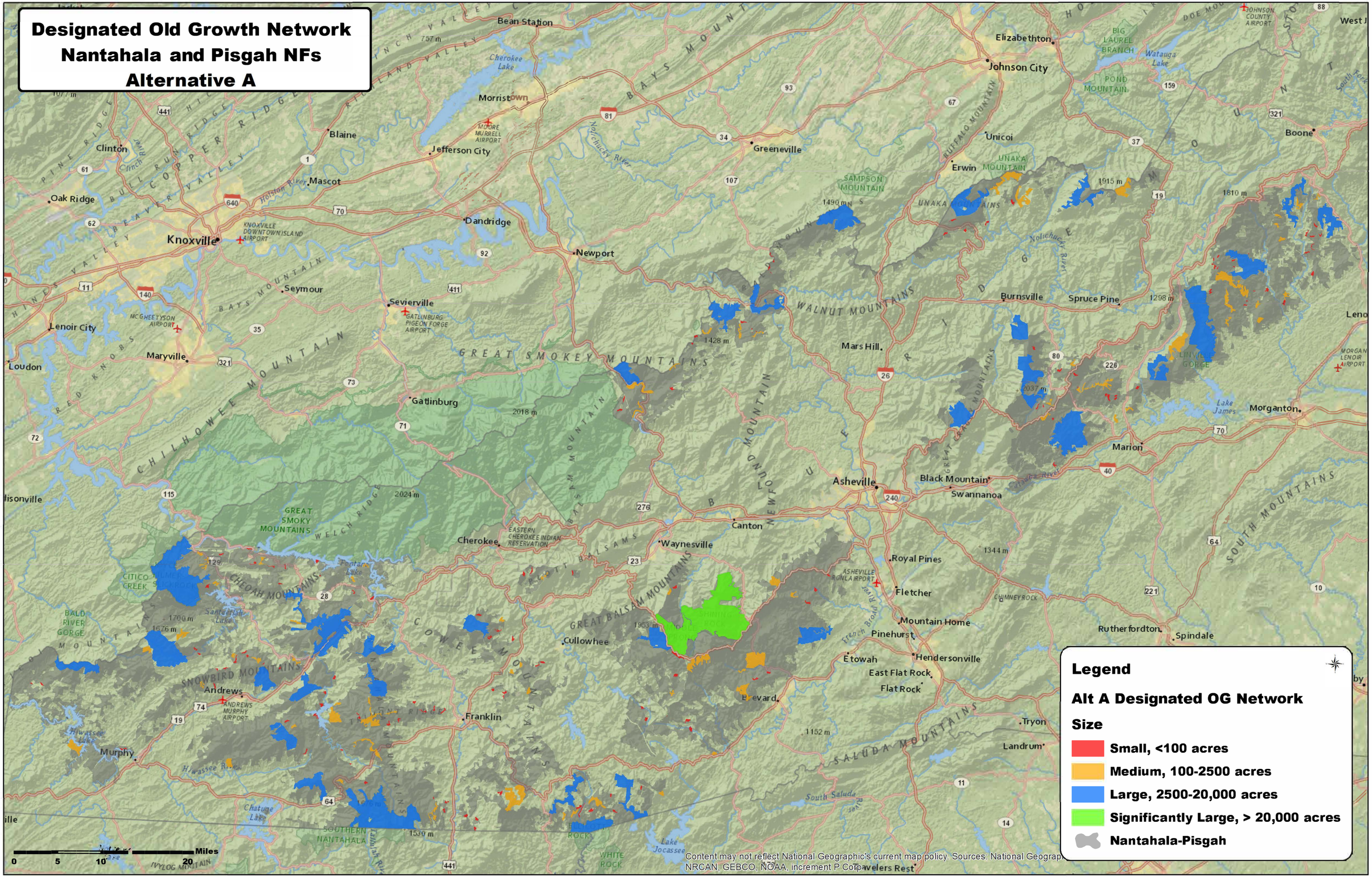
Data Sources

- Spatial Layer: Ecozones. Ecozones_Elim_1ac: This is the spatial layer of the ecozones modified to eliminate polygons that were less than 1 acres in size by using the eliminate command that would integrate the small acreages with adjacent polygons of larger sizes.
- Spatial Layer: FS Veg. The Forest Service Vegetation layer updated to year 2017 with information relevant to the plan revision.
- Temporal Data: Natural Range of Variation. Derived using Synchrosim software.
- Spatial Layer: Management Areas and Management Area Groups for each alternative.
- Spatial Layer: Geographic Areas for Alternative B
- Spatial Layer: Rare species occurances
- Spatial Layer: Unique habitat occurances

- Spatial Layer: Old Forest Trending. For the following management areas, the boundaries were dissolved to derive larger patch sizes.
    - Designated Old Growth Small, Medium, and Large Patches
    - Backcountry Management Area
    - Special Interest Areas Management Area
    - Research Natural Areas Management Area
    - Wilderness Study Areas & Recommended Wilderness Management Area
    - Roan Mountain Management Area except for Grassy Balds management portions
    - Inventoried Roadless Areas (incorporated into Backcountry in Alternatives B, C, and D)

- Spatial Layer: All Lands. The following lands were used to estimate connectivity beyond FS boundaries.
    - Regional land trusts including (2018 Managed Areas layer from the NC Natural Heritage Program)
        - Mainspring Conservation
        - Highlands Cashiers land trust
        - Conserving Carolina
        - Southern Appalachian Highlands Conservancy
        - Foothills Conservancy
    - North Carolina land trusts (See above)
        - The Conservation Trust of North Carolina (Beetree watershed)
    - National land trusts (See above)
        - The Nature Conservancy
        - The Conservation Fund
    - North Carolina State Parks Dedicated Nature Preserves
    - North Carolina Wildlife Commission NC Natural Heritage Natures Preserves
    - North Carolina Forest Service Dedicated Nature Preserves
    - North Carolina Plant Conservation Program Preserves
    - Adjacent National Forests (Sumter, Chattahoochee, and Cherokee) Wilderness
    - Adjacent Cherokee NF Inventory Roadless Areas

Designated Old Growth Network
Nantahala and Pisgah NFs
Alternative A



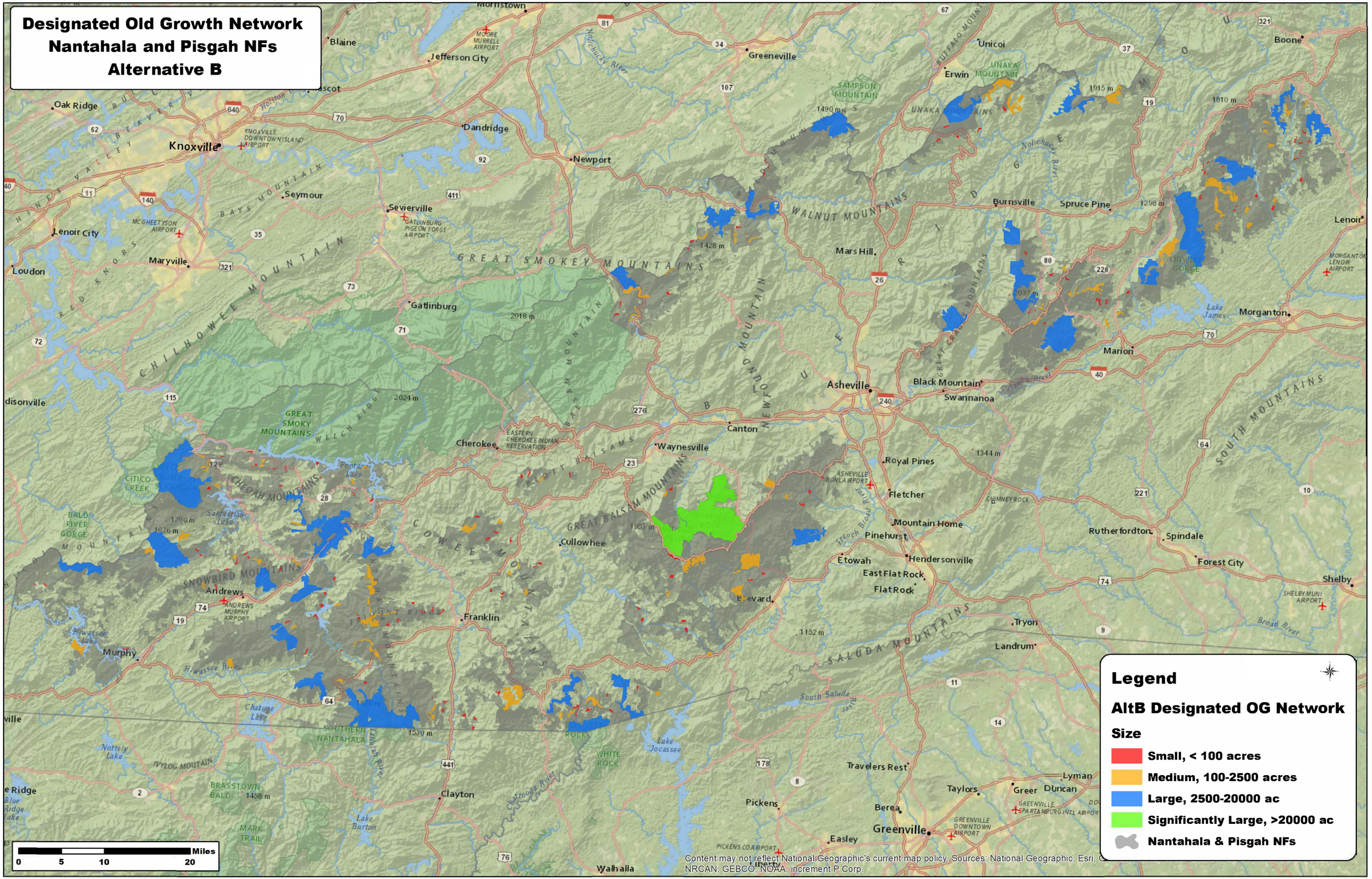
Legend

Alt A Designated OG Network

Size

- **Small, <100 acres**
- **Medium, 100-2500 acres**
- **Large, 2500-20,000 acres**
- **Significantly Large, > 20,000 acres**
- **Nantahala-Pisgah**

Designated Old Growth Network
Nantahala and Pisgah NFs
Alternative B



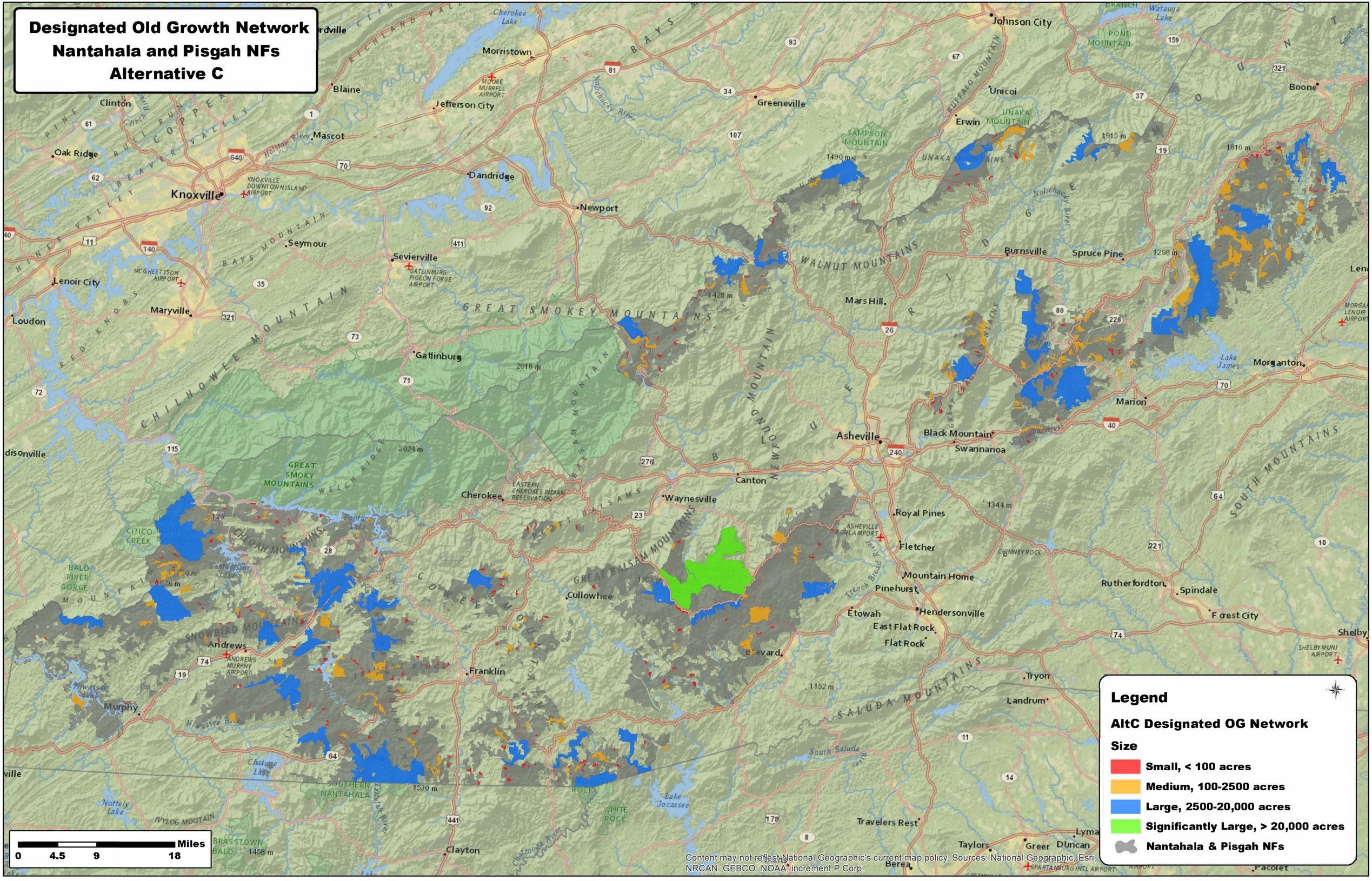
Legend

AltB Designated OG Network

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20000 ac
- Significantly Large, >20000 ac
- Nantahala & Pisgah NFs

Designated Old Growth Network
Nantahala and Pisgah NFs
Alternative C



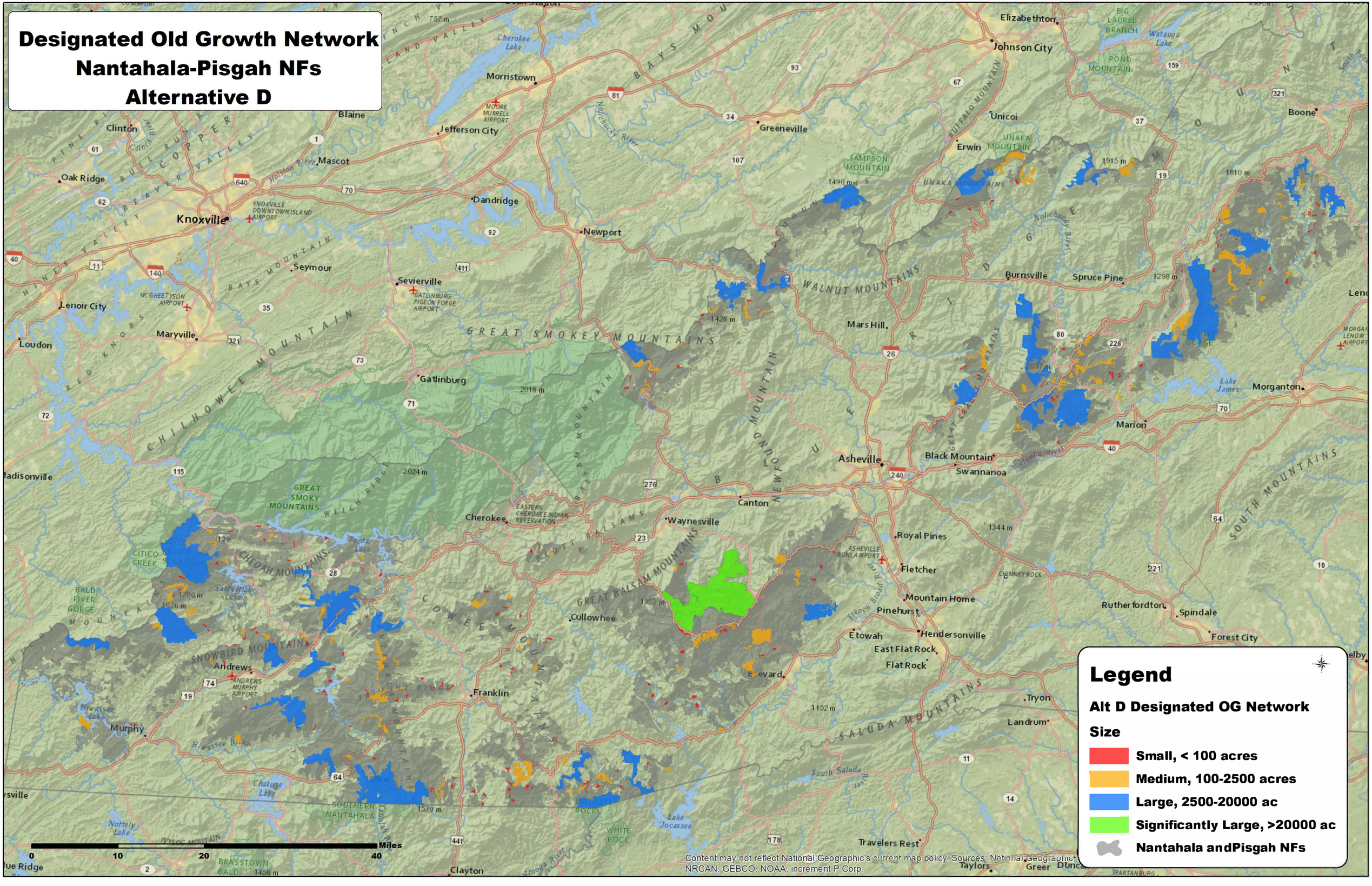
Legend

AltC Designated OG Network

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20,000 acres
- Significantly Large, > 20,000 acres
- Nantahala & Pisgah NFs

Designated Old Growth Network
Nantahala-Pisgah NFs
Alternative D

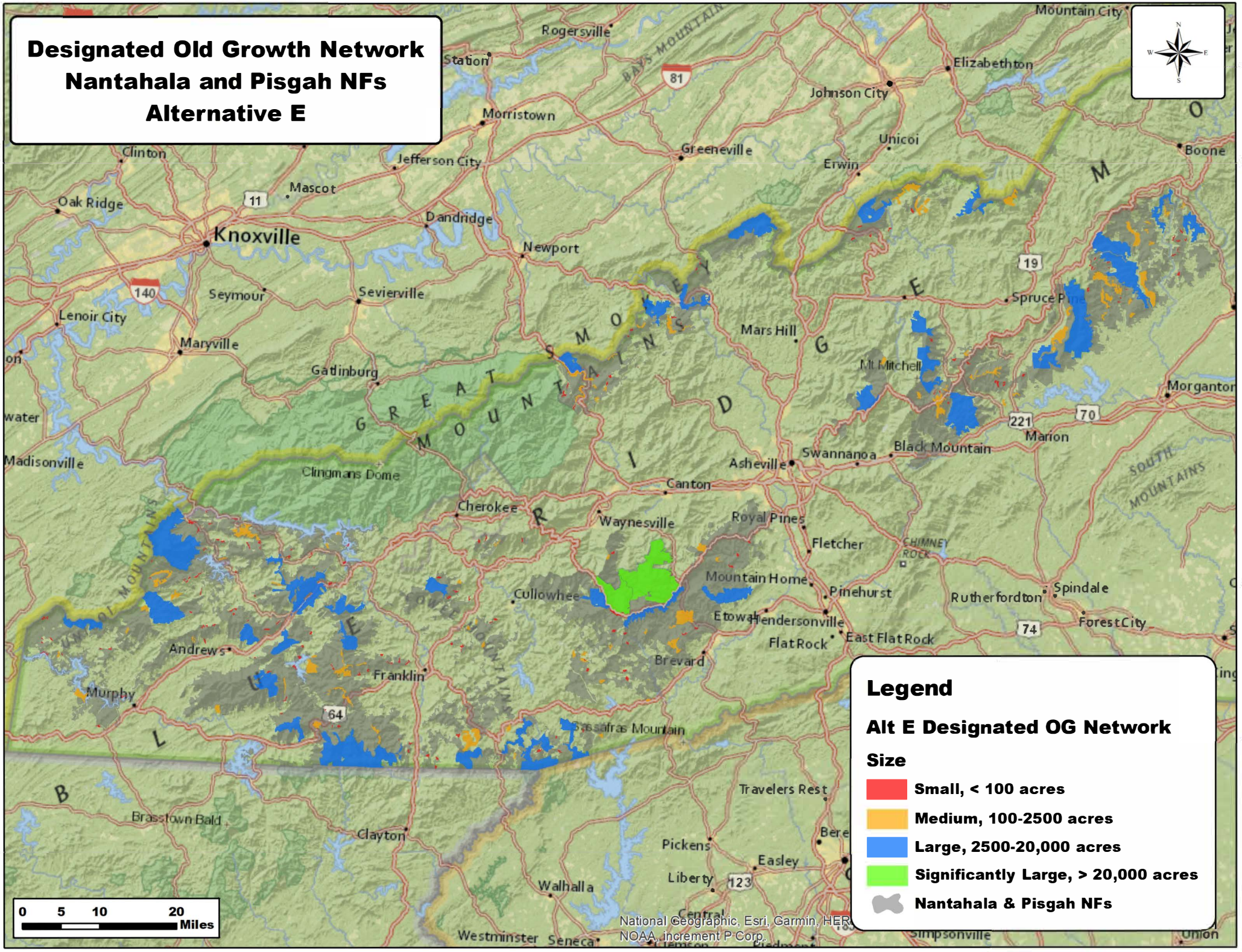


Legend

Alt D Designated OG Network

Size

- **Small, < 100 acres**
- **Medium, 100-2500 acres**
- **Large, 2500-20000 ac**
- **Significantly Large, >20000 ac**
- **Nantahala andPisgah NFs**


Designated Old Growth Network
Nantahala and Pisgah NFs
Alternative E
Legend
Alt E Designated OG Network
Size
Small, < 100 acres
Medium, 100-2500 acres
Large, 2500-20,000 acres
Significantly Large, > 20,000 acres
Nantahala & Pisgah NFs
0 5 10 20
Miles
National Geographic, Esri, Garmin, HERE, NOAA, increment P Corp.
Knoxville
Asheville
Gatlinburg
Cherokee
Waynesville
Canton
Clingmans Dome
Mt Mitchell
Mars Hill
Newport
Sevierville
Dandridge
Morristown
Greeneville
Johnson City
Elizabethton
Mountain City
Boone
Spruce Pine
Marion
Black Mountain
Swannanoa
Fletcher
Hendersonville
Brevard
Franklin
Andrews
Murphy
Cullowhee
Sassafras Mountain
Brasstown Bald
Clayton
Walhalla
Westminster
Seneca
Pickens
Easley
Liberty
Travelers Rest
Simpsonville
Union
Spindale
Rutherfordton
Forest City
Pinehurst
Mountain Home
Royal Pines
Flat Rock
East Flat Rock
Etowah
Oak Ridge
Clinton
Jefferson City
Mascot
Seymour
Maryville
Lenoir City
Madisonville
Unicoi
Erwin
Rogersville
Bays Mountain
Great Smoky Mountains
Blue Ridge
Unaka Mountains
Chimney Rock
South Mountains
Tower Mountains
81
11
140
19
221
70
74
64
123

Old Forest Trending Landscape
Nantahala and Pisgah NFs
Alternative A

Legend

Alt A OG Trending Landscape

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20,000 acres
- Significantly Large, > 20,000 acres
- Nantahala and Pisgah NFs

Miles
0 5 10 20

Old Forest Trending Landscape
Nantahala and Pisgah NFs
Alternative B

Legend

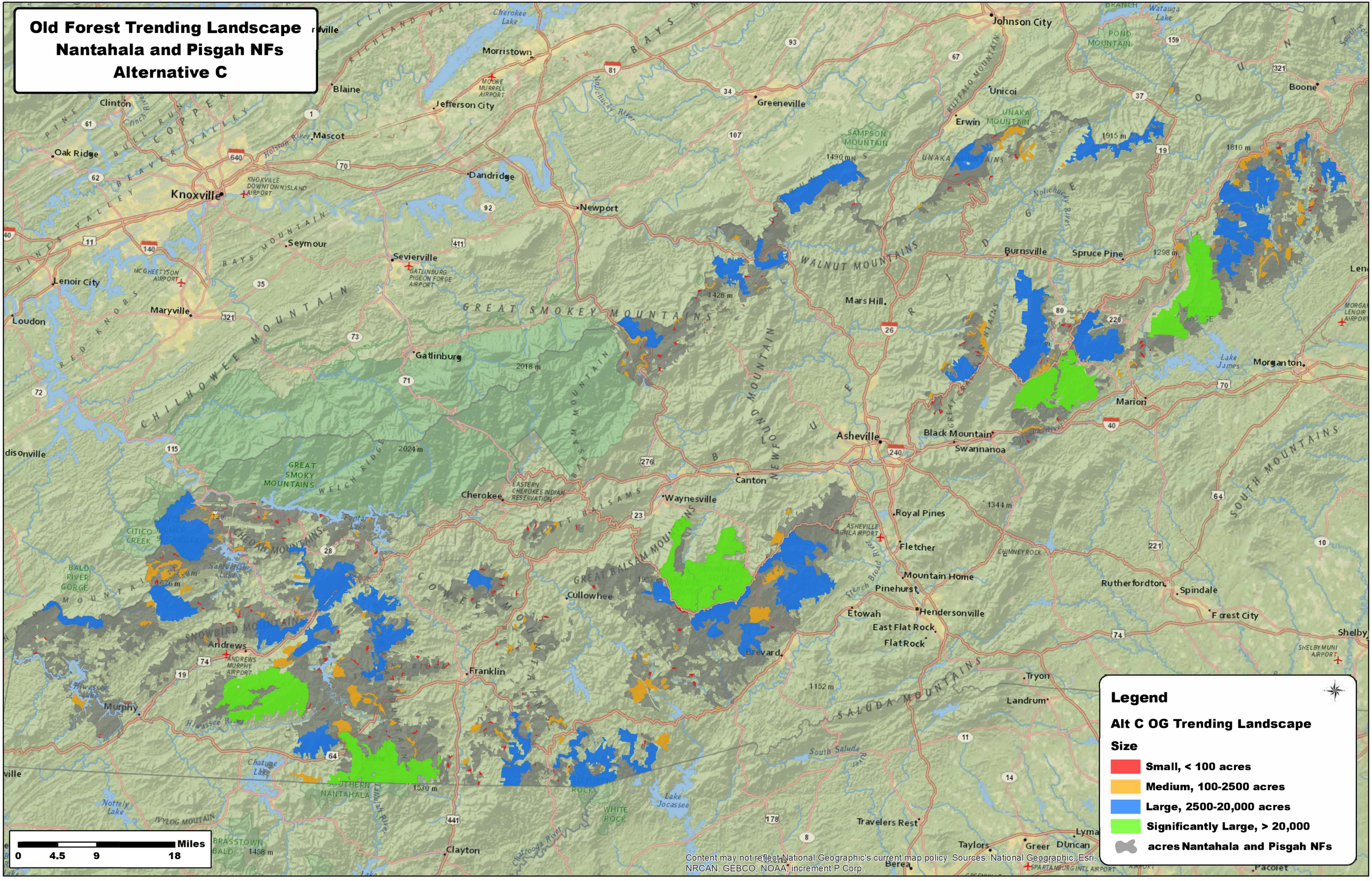
Alt B OG Trending Landscape

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20000 ac
- Significantly Large, >20000 ac
- Nantahala & Pisgah NFs

Miles
0 5 10 20

Old Forest Trending Landscape
Nantahala and Pisgah NFs
Alternative C



Old Forest Trending Landscape
Nantahala and Pisgah NFs
Alternative D

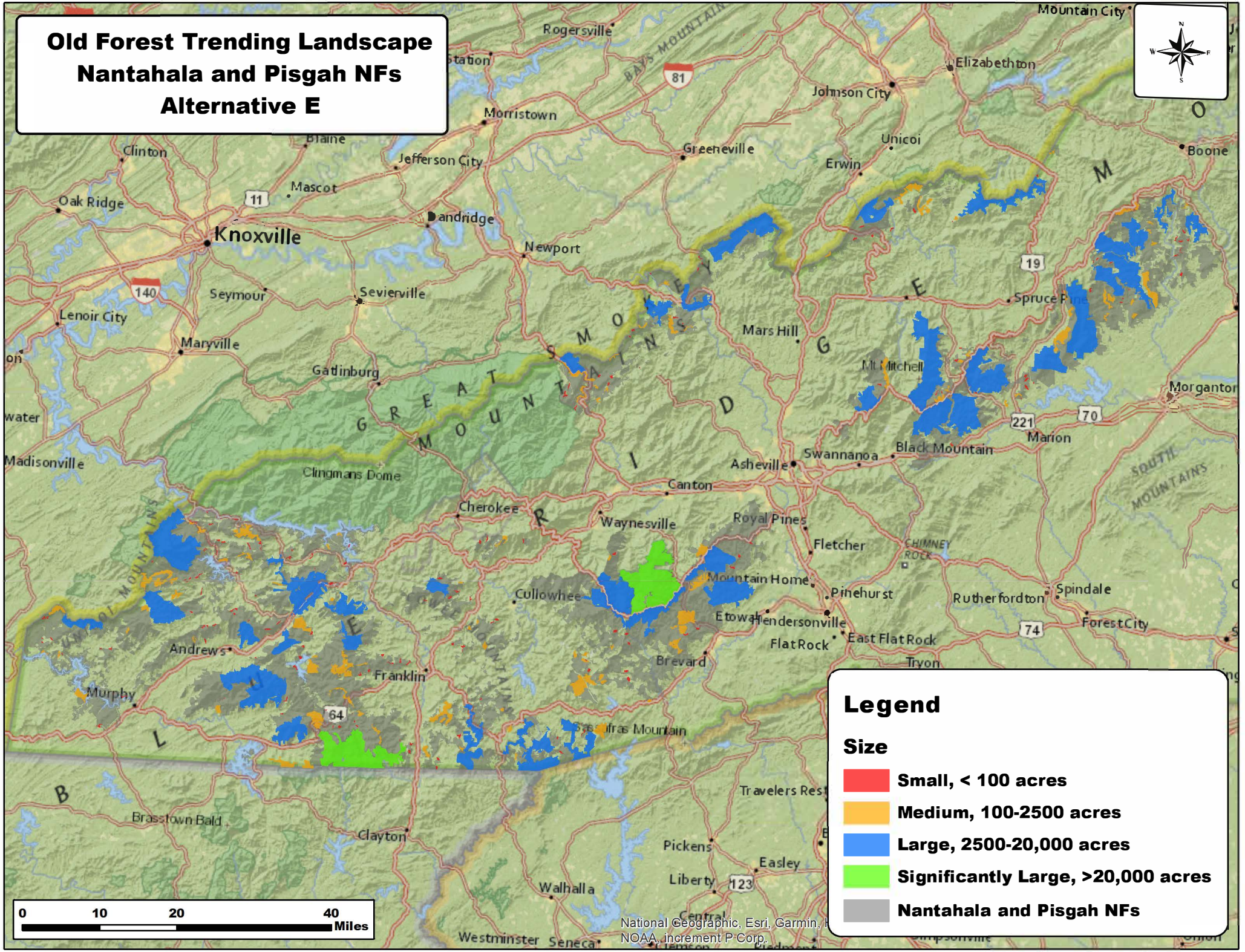
Legend

Alt D OG Trending Landscape

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20000 acres
- Significantly Large, >20000 acres
- Nantahala and Pisgah NFs

Miles
0 10 20 40


Old Forest Trending Landscape
Nantahala and Pisgah NFs
Alternative E
Legend
Size
Small, < 100 acres
Medium, 100-2500 acres
Large, 2500-20,000 acres
Significantly Large, >20,000 acres
Nantahala and Pisgah NFs
0
10
20
40
Miles
Knoxville
Asheville
Gatlinburg
Cherokee
Franklin
Andrews
Murphy
Brevard
Hendersonville
Pisgah Forest
Mars Hill
Mt Mitchell
Black Mountain
Swannanoa
Waynesville
Canton
Cullowhee
Sylva
Maryville
Sevierville
Newport
Morristown
Greeneville
Johnson City
Elizabethton
Mountain City
Boone
Spruce Pine
Marion
Morganton
Rutherfordton
Spindale
Forest City
Tryon
Flat Rock
East Flat Rock
Pinehurst
Fletcher
Royal Pines
Mountain Home
Etowah
Oak Ridge
Clinton
Lenoir City
Madisonville
Seymour
Jefferson City
Dandridge
Mascot
Blaine
Rogersville
Unicoi
Erwin
Clingmans Dome
Brasstown Bald
Clayton
Walhalla
Pickens
Easley
Liberty
Travelers Rest
Westminster
Seneca
Central
Tuckaseigee Mountains
Great Smoky Mountains
Blue Ridge
Bays Mountain
South Mountains
Chimney Rock
National Geographic, Esri, Garmin, NOAA, increment P Corp.

Old Forest Trending Landscape
Nantahala and Pisgah NFs
& All Lands
Alternative A

Legend

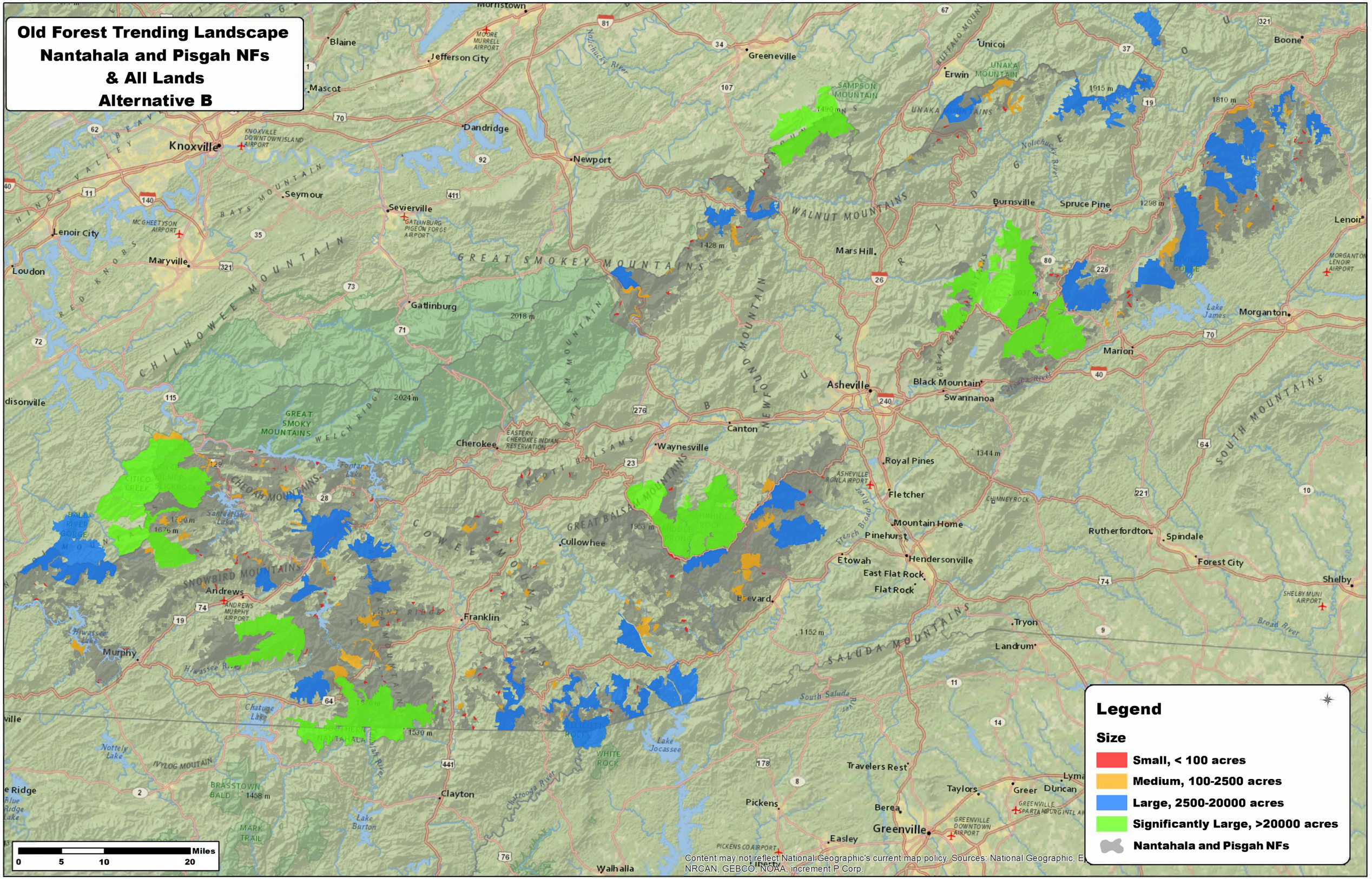
Alt A OG Trending Landscape All Lands

Size

- **Large**
- **Medium**
- **Significantly Large**
- **Small**
- **Nantahala and Pisgah NFs**

Miles
0 5 10 20

Old Forest Trending Landscape
Nantahala and Pisgah NFs
& All Lands
Alternative B



Legend

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20000 acres
- Significantly Large, >20000 acres
- Nantahala and Pisgah NFs

Old Forest Trending Landscape
Nantahala and Pisgah NFs
& All Lands
Alternative C

Johnson City
Morristown
Blaine
Jefferson City
Greeneville
Unicoi
Erwin
Boone
Oak Ridge
Knoxville
Mascot
Dandridge
Newport
Seymour
Sevierville
Lenoir City
Maryville
Loudon
Gatlinburg
Burnsville
Spruce Pine
Mars Hill
Marion
Morganton
Asheville
Black Mountain
Swannanoa
Canton
Waynesville
Cherokee
Cullowhee
Andrews
Murphy
Franklin
Clayton
Royal Pines
Fletcher
Mountain Home
Pinehurst
Etowah
Hendersonville
East Flat Rock
Flat Rock
Brevard
Rutherfordton
Spindale
Forest City
Shelby
Tryon
Landrum
Travelers Rest
Taylors
Greer
Berea
Pacolet

GREAT SMOKY MOUNTAINS
CHILHOWEE MOUNTAIN
BAYS MOUNTAIN
WALNUT MOUNTAINS
BLACK MOUNTAINS
BALSAM MOUNTAIN
GREAT BALSAM MOUNTAINS
SNOWBIRD MOUNTAINS
SALUDA MOUNTAINS
UNAKA MOUNTAIN
SAMPSON MOUNTAIN
POND MOUNTAIN
BUFFALO MOUNTAIN
RICHLAND VALLEY
BEAVER VALLEY
HINES VALLEY
BULLCOPE
RED KNOBS
IVYLOG MOUTAIN
WHITE ROCK

1428 m
2018 m
2024 m
1530 m
1458 m
1953 m
1915 m
1810 m
1298 m
1344 m
1152 m

Cherokee Lake
Watauga Lake
Lake James
Nottely Lake
Chatuge Lake
Fontana Lake
Santeetlah Lake
Hiwassee Lake
Lake Jocassee

Nolichucky River
French Broad River
Chattooga River
South Saluda River
Hiwassee R.

KNOXVILLE DOWNTOWN ISLAND AIRPORT
MCGHEE TYSON AIRPORT
GATLINBURG PIGEON FORGE AIRPORT
MOORE MURRELL AIRPORT
ASHEVILLE REGIONAL AIRPORT
ANDREWS MURPHY AIRPORT
SHELBY MUNI AIRPORT
MORGANTON LENOIR AIRPORT

EASTERN CHEROKEE INDIAN RESERVATION
CITICO CREEK WILDERNESS
SOUTHERN NANTAHALA WILDERNESS
BALD RIVER GORGE WILDERNESS

0 4.5 9 18 Miles

Legend

AltC OG Trending Landscape All Lands

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20,000 acres
- Significantly Large, > 20,000 acres
- Nantahala & Pisgah NFs

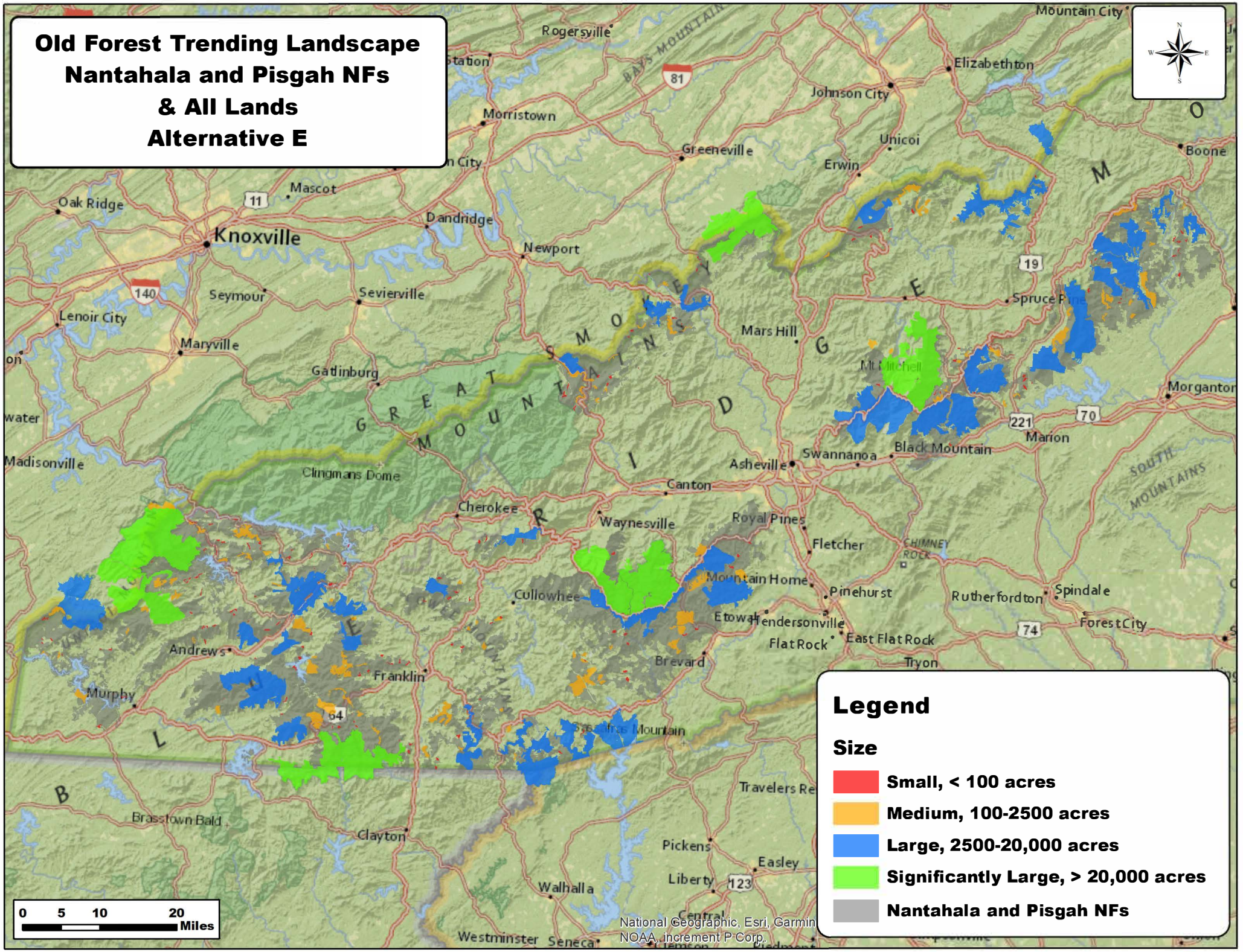
Old Forest Trending Landscape
Nantahala and Pisgah NFs
& All Lands
Alternative D

Legend

Size

- Small, < 100 acres
- Medium, 100-2500 acres
- Large, 2500-20000 acres
- Significantly Large, >20000 acres
- Nantahala-Pisgah NFs

0 10 20 40 Miles


Old Forest Trending Landscape
Nantahala and Pisgah NFs
& All Lands
Alternative E
Legend
Size
Small, < 100 acres
Medium, 100-2500 acres
Large, 2500-20,000 acres
Significantly Large, > 20,000 acres
Nantahala and Pisgah NFs
0 5 10 20
Miles
Knoxville
Asheville
Mountain City
Rogersville
Elizabethton
Johnson City
Morristown
Greeneville
Unicoi
Erwin
Boone
Oak Ridge
Mascot
Dandridge
Newport
Seymour
Sevierville
Lenoir City
Maryville
Gatlinburg
Mars Hill
Spruce Pine
Morganton
Marion
Black Mountain
Swannanoa
Madisonville
Clingmans Dome
Canton
Cherokee
Waynesville
Royal Pines
Fletcher
Mountain Home
Pinehurst
Rutherfordton
Spindale
Forest City
Hendersonville
Etowah
Flat Rock
East Flat Rock
Tryon
Brevard
Cullowhee
Andrews
Franklin
Murphy
Brasstown Bald
Clayton
Pickens
Easley
Liberty
Walhalla
Westminster
Seneca
Travelers Re
Great Smoky Mountains
Blue Ridge
Nantahala
Pisgah
South Mountains
Chimney Rock
National Geographic, Esri, Garmin
NOAA, increment P Corp.

Cultural Resources

Site density is a factor of determining the number of sites within a set number of acres. The result is determined by dividing the number of recorded sites into the total number of acres inventoried and surveyed at the professionally and legally complete level. This ratio reflects the number of acres that were surveyed to locate each site. The average site density for the Nantahala and Pisgah National Forests is 1 site located per 27.6 acres surveyed based upon current total acres surveyed (87,137) and total sites recorded (3152) to date.

Predictive modelling is a process to determine or estimate the number of sites expected or likely to be encountered and recorded within a given project area. Basically, predictive modelling compares the most common landscape variables associated with similar type sites across a similar landscape to project and estimate the number of sites located on a given acreage. The variables most often used are landform (topography), land slope and distance to water along with stream rank or order. Generally, flatter areas with higher stream orders would be considered highest probable site locations. There are some exemptions of course, for uncommon or rare site types, as well as for the differences found between pre-contact and contact period sites and historic and transportation and industrial type sites, an example of the latter being mines. These site types are most often referenced and found through archival research and land use documents.

Previously, topographic maps and aerial photographs were the most reliable sources used to determine topographic conditions and features including the common site location variables. However, data availability has greatly improved and its accuracy tremendously increased with the advent and development of LiDAR, Light Detection and Ranging. Landscape imagery and mapping detail with very high resolution is available and has dramatically enhanced topographic landscape analyses.

LiDAR data has been used to determine Management Area acreage site location probability based upon the associated variables. Coupled with known site locations potential impacts upon projected sites can be determined in order to compare effects of alternatives.

Recreation

Recreation Opportunity Spectrum

The desired Recreation Opportunity Settings for each management area was calculated through the use of GIS analysis. The foundation of this work started with the Nantahala and Pisgah National Forests ROS Inventory, which was completed in 2014 and followed the National ROS Inventory Mapping Protocol. As the ROS Inventory was mapped based on the physical, social, and managerial settings prior to the completion of management area mapping under the new Nantahala-Pisgah Forest Plan Revision, this data needed to be updated to reflect the desired conditions for the new management areas.

The first step to create the ROS desired conditions map was to update the Inventory to reflect land that was acquired after the Inventory was completed. Following this, the updated ROS Inventory was intersected with the management areas mapped across each alternative and new acreage counts were calculated; this was performed using the Intersect tool in GIS, which calculates the geometric intersection of multiple feature classes. The output dataset calculated the number of acres of each ROS setting by management area, which was used to describe the ROS desired conditions across all management areas.

Transportation and Access

To evaluate the amount of new road construction needed annually, numbers were reviewed from the ten-year period between 2001 and 2011, during which 12.5 miles of new system roads were constructed. With continued implementation of Alternative A, 6.0 total additional miles of road will likely be needed annually, including 1.2 miles of new road prism construction, 1.9 miles of existing road prism added to the system, and 2.6 miles of temporary road construction that is decommissioned after use.

From 2001 to 2011, 20.7 miles of road were obliterated, or about 2.1 miles annually. Comparable or increased decommissioning would be expected in the action alternatives because of objectives that call for restoring 20 miles of roads to natural contours in the next 10 years (TA-O-04) plus decreasing unneeded roads in backcountry (TA-O-06).

Projected miles of total road construction for the action alternatives are based on SPECTRUM modeling which estimated lands currently available and required for future vegetation management activities, the current transportation network, and operability criteria.

To accomplish Tier 1 objectives, it is assumed that current trends for transportation system management activities continue, where 6.0 total additional miles of road will likely be needed annually, including 1.2 miles of new road prism construction, 1.9 miles of existing road prism added to the system, and 2.6 miles of temporary road construction that is decommissioned after use. These roads would be constructed predominately to meet the needs of vegetation management and administrative-only use, where approximately 41 percent of all new roads added to the system will be Maintenance Level 2 and closed to the public, thereby limiting motor vehicle use, maintenance requirements, costs, and impacts to other resource areas.

Then, to accomplish Tier 2 objectives, additional road construction would be required, as shown in the Table below, assuming consistent needs annually over the modeling time period.

Table 1. Estimated Miles of Additional Road Construction Needed to Accomplish Tier 2 Objectives

	Alt B	Alt C	Alt D	Alt E
Total additional miles	5.4 miles	6.0 miles	5.3	4.1
Additional Total Miles of NFS Roads as New Corridor (annual)	1.1	1.2	1.0	0.8
New System Road on Existing Corridors (annual)	1.7	1.9	1.7	1.3
Additional Miles of Temporary Roads (annual)	2.6	2.9	2.6	2

Modelling projections show limited difference between action alternatives in terms of total projected road construction mileage. The primary difference between alternatives would be priorities for road construction location and road decommissioning sites based on management area direction. The Matrix and Interface MAs are the management areas most permissible in terms of new system road construction and it can be assumed that those are the management areas where most new system road construction would occur in support of management activities and providing recreational access to the Forests.

Historically, 20 percent of new system road construction occurs on new corridors, and 80 percent occurs as temporary roads or new system roads on existing corridors. Existing corridors are typically non-system, unauthorized road corridors that may have been used as temporary roads on past projects and remain on the landscape (unobliterated). Most new road mileage would consist of temporary roads not to be included in the Forest transportation atlas. All action alternatives include plan direction to remove temporary roads from service by decommissioning at the conclusion of the project. decommissioning activities would vary based on site specific needs, but could include removing drainage structures, access points, culverts, and signs, and restoring vegetation, contours, and natural drainage patterns.

Timber Suitability Analysis

Data Preparation:

For the FEIS, existing data (described in the two draft white papers N&P Plan Revision Suitability Analysis (June 2017) and Data preparation for Step Two of the N&P Timber Suitability Analysis was reviewed by the forest spatial coordinator. Certain shapefiles were recreated with newer data and included in the TimberSuitability.gdb on the T-drive, slopes greater than 70% (based on new Lidar). The two draft white papers were combined into this document.

Other files were considered acceptable with the one concern that the updated ALPS data would be without coverage in certain places. The forest spatial coordinator provided bookmarks to spot check some of these files. These files were also brought into the file geodatabase: TimberSuitability.gdb

Base Layer Used for Alternative E:

1) ALP Ownership: The most up to date ownership layer was downloaded and entered the file geodatabase on 5/7/2021: The file was called: NP_FS_Ownership contains 1,043,636 acres and 315 records. As in the previous alternatives, this was the starting coverage of the timber suitability analysis all other feature classes will be “Erased” from the ALPS Ownership layer sequentially.

Step 1 Factor and Category Data Preparation[11]

Ideas for categories to include in the four factors were developed from the handbook direction and supplemented/confirmed during Forest Plan IDT meetings.

Step 1 Factor 4: Land that is Non-forest Land (Non-forest) (FSH 1909.12 § 61.14)

Factor 4 refers to National Forest System lands that do not meet the definition of forest lands, meaning they have less than 10 percent occupied by forest trees, are currently developed for non-forest uses (i.e. administrative areas, powerlines, etc.), or are unimproved roads, trails, clearings, or streams greater than 120 feet in width. Refer to table A-1 for a summary of the categories included.

[11] Data preparation steps will follow the order of factors identified and used in the analysis. The order of factors was recommended by the Regional Planner during his review of earlier version of this process.

Table A-1: Summary of categories developed for use under Factor 4

Categories	Description	Data Source
Waterbodies	> 120 feet wide	GIS Analysis and Layer
Wildlife Openings	Openings, Perm/Semi-perm	WL Openings (Linear, Regular, Balds)
Balds, Improved Pasture		
Administrative Areas	Offices & Compounds	Old MA16 (including modifications)
Improved Roads	Fed, State, County, Muni, FS ROW	FS Infra Road Shapefile NCDOT Road Maintenance Shapefile
Railroads	ROW	NCDOT Railroad Shapefile
Concentrated Use Areas	Developed Recreation	Concentrated Use Shapefile - Rec
Powerlines	Major	Digitized Shapefile
Recreation Residences	Stony Fork, Highlands Rd, etc.	PSG Zone SU Shapefile Nan Zone SU Shapefile
Cemeteries	Not managed as forest	
Communication Sites	Pisgah, Frying Pan, etc.	
Mines/Quarries	Massey Branch & Harrison Quarries	
Nantahala Outdoor Center (NOC)		
NC Arboretum		
Snowbird Youth Center		
Pisgah Stables		
Marinas		
Outward Bound		
Fish Hatcheries/ Pisgah WL Center		

NFS System Roads:

Updated NFS roads data was used. This data was processed by the forest spatial data manager. The data layer was called: FS_Roads_Buffered. It contained 1,311 records and was buffered (each side of center line) based on traffic operational maintenance level. The FS_Roads_buffered was erased from the NP_FS_Ownership layer. The resulting layer was called: FS_OWN_E_FSRD2. After the acres were recalculated the layer contained 1,034,899 acres.

Oper_Maint_Level	Buff_Dist
1	10 feet
2	15 feet
3, 4	20 feet
5	30 feet

Railroads:

Railroads know by the NCDOT were buffered where they crossed National Forest ownership. Updated data (connect.ncdot.gov\resources\gis\pages\gisdata_layers.aspx) was pulled in early May 2021 by the forest spatial data manager. The NCDOT railroad spatial data did not contain ROW width information, so a buffer distance field was added to the shapefile that had been clipped by NP_FS_Ownership. Those railroads on NFS ownership were examined with imagery. Several measurements were taken using the ARCMap measure tool along the railroad length to produce an average ROW width. Average widths were used to populate the buffer distance field. The field was the ½ width calculation used in the buffer process for the railroad segment data. The file was named RR_Buffer and added to the file geodatabase.

The RR_Buffer file was erased from the FS_OWN_E_FSRD2 layer. The resulting layer was called: FS_Own_E_FSRD2_E_RR. After the acres were recalculated the layer contained 1,034,809 acres.

State Roads:

State roads were obtained from NCDOT (connect.ncdot.gov\resources\gis\pages\gisdata_layers.aspx) (called: StateRoads) by the forest spatial coordinator and clipped by NP_FS_Ownership to produce StateRoads_Clip. Based on the investigation during the draft EIS, the average ROW width for state road data clipped to the forest was 26 feet on a side. This layer was called: StateRoad_Clip_Buffer. It was erased from FS_Own_E_FSRD2_E_RR resulting in a layer called: FS_Own_E_FSRD2_E_RR_E_NCDOT. After recalculation of acres this layer contained: 1,032,037 acres.

Linear unit	26 feet
Side Type	Full
End Type	Round
Dissolve Type	All

Wildlife Openings:

The wildlife opening layer used in the draft EA timber suitability analysis was confirmed with the forest wildlife biologist as being up to date through e-mail 4/28/2021. This data (*wildlife_openings_balds_updated_NP_Minus GMRA*) was brought into the TimberSuitability.gdb as DEIS_Wildlife_Openings. Here is the summary of the work completed on this layer during the EIS analysis:

1) The Forest Biologist and Forest Ecologist/Botanist developed a combined wildlife opening and balds shapefile and was named *wildlife_openings_balds_updated_NP*.
2) *wildlife_openings_balds_updated_NP* was clipped to the *np_fs_own* layer and the Beech Creek Seed Orchard which is contained in the administrative sites layer was removed to reduce confusion. The final shapefile was named *wildlife_openings_balds_updated_NP_Minus GMRA*.

3) *wildlife_openings_balds_updated_NP_Minus GMRA* also includes hayfields which was determined after review by the Forest Special Uses Officer.

DEIS_Wildlife_Openings was erased from FS_Own_E_FSRD2_E_RR_E_NCDOT to produce a file called: FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO. After recalculation of the acres it contained: 1,029,391 acres.

Administrative Areas:

Then administrative layer was updated from the draft EIS version and reviewed to make sure it included the Beech Creek Seed Orchard, the Job Cor Sites, the Grandfather Fish Hatchery, Ranger District Offices, and Work centers. The layer was called Admin_Locations. It was subtracted from FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO to produce a file called: FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3. After recalculation of the acres it contained: 1,028,858 acres.

Concentrated Use Areas:

The shapefile from the draft EIS analysis was used for the Alt E timber suitability analysis because of the modifications in the layer to make it ready for Step 1 of the timber suitability process (potentially suitable). The draft shapefile was called: Concentrated_Use_Clip_JAR1. When exported to the file geodatabase it was renamed: Concentrated_Use_Data_Edited. The following are the details from the draft analysis:

Locally named "Concentrated Use Areas" were created by the developed recreation program manager who recommended the use of the *Admin_newMA* shapefile located in the Recreation/data folder within the plan revision GIS drawer.

1) The *Admin_newMA* shapefile was clipped to *np_fs_own* to reduce the coarse polygons present around lake features.
2) This file also included large areas that still meet the definition of forest land (FSH 1909.12 § 61.14) and areas that are removed due to area assignments that are non-suitable for timber production based on desired conditions (e.g. Cradle of Forestry) in Step 2.
3) Manual editing of the shapefile removed concentrated use areas or forested portions of concentrated use areas (Table A-2).
4) The new shapefile was named *Concentrated_Use_Clip_JAR1*.

Table A-2: Disposition of Concentrated Use Areas Requiring Modification.

Location	Action	Remaining in Shapefile
TSALI	Reduce	Polygon around Development
Cradle of Forestry	Drop	None – Separate MA Subtraction
Brown Mtn. ORV	Reduce	Trailhead & Parking
Wayehutta ORV	Drop	No parking area located
Jack Rabbit	Reduce	Camping and Parking
Beech Creek	Drop	None – Admin Area Subtraction
Cliffside	Reduce	Camping and Parking
Bridal Vail Falls	Reduce	Camping and Parking

VanHook Glade	Reduce	Camping and Parking
Black Mtn Camp Grd	Reduce	Camping and Parking
Lake Powatan	Reduce	Camping and Parking
Boone Fork	Reduce	Camping and Parking
Admin Areas	Delete	None – Admin Area Subtraction
Rocky Bluff	Reduce	Camping and Parking
White River Falls	Reduce	Camping and Parking
FID 247	Reduce	Camping and Parking
Cradle of Forestry	Delete	None – Separate MA Subtraction
Glenn Falls	Reduce	Camping and Parking
Joyce Kilmer	Reduce	Camping and Parking
FID 9 – Job Corps	Delete	None – Admin Area Subtraction
PSG Fish Hatchery	Delete	None
FID 8	Delete	None
Tusquitee Office	Delete	None – Admin Area Subtraction
Lost Cove Picnic Area	Reduce	Camping and Parking
FID 18 - Office	Delete	None – Admin Area Subtraction

This layer was erased from FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3 to produce a new layer called: FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU. After re-calculation of the acres it contained: 1,027,083 acres.

Special Uses and Powerline ROWs

Initial direction for special use areas on the forest was sought from the Forest Special Use Coordinator. Their recommendation included contacting the Pisgah and Nantahala Zone RIM coordinators who were tasked with creating a new layer containing forest areas under special use permits.

1) A new combined forest file, validated by Linda Randolph (Aiken) and Amber Vanderwolf, was named *S_R08_NFSNC_SpecialUseP*.
2) The layer was clipped by *np_fs_own* because one transmission line buffer (object ID 333) is mostly on non-NFS lands but does cross onto NFS in a few spots. The new shapefile was called *N_P_SpecialUses_ClipJAR2*.
3) Further review of the shapefile revealed that other transmission lines were not included in the layer. A second layer called *N_P_SpecialUses_ClipJAR* was created to digitize powerline ROWs that exist on NFsNC lands. A process was developed to systematically cover both forests and capture the powerline ROWs and other discernable features like cell towers installations.
4) The forest was reviewed in ARC Map with the scale window set to 1:25,000. In many cases, transmission line ROWs present a distinct visual character on the landscape (the straightest line regardless of topography) and at a fine scale view of imagery data the actual “line” can be identified. Where this was evident the line opening was digitized at the finer scale until it left the Forest property. The coarse (1:25,000) scale search was resumed from the starting location until the entire forest was covered. It was helpful to identify sections of the forest bound by state roads or other notable features and then scan an area systematically until all features were identified and captured with polygons.

5) Upon completion of the visual check of the forest ownership, the layers related to special uses were combined (*N_P_SpecialUses_Clip_JAR2* with *N_P_SpecialUses_Clip_JAR*) to get *N_P_SpecialUses_Merg_JAR*.
6) This new, combined layer was clipped by *np_fs_own* again to finalize the process.
7) The layer added to the model in the Draft EIS was called *N_P_SpecialUses_Merg_JAR_Clip*.
8) After exporting to the FGD for the Alt E timber suitability analysis the file name was switched to: SU_Powerlines. This layer was erased from FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU to create layer: FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU_E_SUP. After re-calculation of the acres this layer contained: 1,020,001 acres.

Waterbodies[12] [13]

1) The existing statewide layer *NHD_Waterbody* was clipped to the 18 county Nantahala and Pisgah forest area creating *NHD_Waterbody_County_Clip*.
2) *NHD_Waterbody_County_Clip* was clipped by the *np_fs_own* to eliminate waterbodies outside the FS Ownership. This process created *NHD_Water_Ownership_Int* shapefile.
3) Further examination of *NHD_Water_Ownership_Int* identified existing waterbodies not in the data. These were digitized and added to the *NHD_Water_Ownership_Int* shapefile (examples include the Highlands Country Club and several ponds on the Grandfather Ranger District).
4) FSVeg was queried for Forest Service Land Suitability Codes (LSC) 100, 110, 120, 125, and 140 (water, natural lake, reservoir, pond, and river respectively) and examined using recent imagery. The query returned six polygons which were assessed individually to ensure they met the opening definition within FSH 1909.12 § 61.14 (> 120ft in width). Two of the six polygons were added to the *NHD_Water_Ownership_Int* shapefile. Of the other four identified:
   a) One was less than 75 feet wide,
   b) Two were already in the *NHD_Water_Ownership_Int* shapefile
   c) One was a LSC coding error actually being a forested stand.
5) An additional waterbody was identified and added to the *NHD_Water_Ownership_Int* shapefile during review of the administrative sites layer representing the fish hatchery ponds on the Grandfather Ranger District.
6) The original shapefile was imported into as a feature class into the file geodatabase and re-named: NHD_Water_Ownership. This feature class was erased from the FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU_E_SUP to create a new file called: FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU_E_SUP_E_WB and after the acres were re-calculated it contained: 1,019,142 acres.

[12] Much of the acreage contained in *NHD_Water_Ownership_Int* is related to differences in shoreline mapping around reservoirs on the National Forests.

[13] The LSC 150 and 160 (streams and wetlands) would be identified during the Riparian Areas analysis in Step 2.

Step 1 Factor 1: Lands on which Timber Production is Prohibited or Lands Withdrawn from Timber Production (FSH 1909.12 § 61.11)

Wilderness Areas:

For Alternative E, the finalized Management Area layer from T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Data\NP EIS.gdb\Alternatives was selected for the wilderness management area and a separate feature class was exported. It was called: Alt_E_Wilderness. This feature class was checked against the shapefile used in the Draft EIS TS analysis (T:\FS\NFS\NFinNorthCarolina\Project\SO\2013Revision\GIS\N_P_TP_Suitability_Classification\Screen1_Step2\Wilderness_N_P_Clip_JAR.shp). Differences were minimal (66,337ac vs 66,393ac). Alt_E_Wilderness was erased from FS_Own_E_FSRD2_E_RR_E_NCDOT_E_WLO_E_AL3_E_CU_E_SUP_E_WB creating the feature class: FS_Own_E_S1F4_E_W. After re-calculating acres, the feature class contained: 952,783 acres.

Wilderness Study Areas:

The wilderness study areas used in the Draft EIS TS analysis (T:\FS\NFS\NFinNorthCarolina\Project\SO\2013Revision\GIS\N_P_TP_Suitability_Classification\Screen1_Step2\Wilderness_Study_N_P_Clip_JAR.shp) were compared to the WSAs displayed in the finalized Alt_E_Management Area layer from T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Data\NP EIS.gdb\Alternatives. The Draft EIS WSA shapefile was larger than the Alt E data because in the Alt E data some of the WSAs were moved forward to recommended wilderness. It was decided that the DRAFT EIS WSA shapefile would be brought into the GDB as a feature class (DEIS_WSAs) and both the data sets would be erased from the Alt E TS analysis because there are small portions within the Alt E data that are outside the DEIS shapefile data. All original WSA's were removed during step 1 of the timber suitability analysis even if some were new recommended for wilderness in Alternative E. This retains some consistency with the DEIS alternatives and acknowledges that these areas were WSAs during the previous planning period.

The combined subtractions of Alt_E_Wilderness_Study_Areas and DEIS_WSAs feature classes from: FS_Own_E_S1F4_E_W created: FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA. After re-calculating acres, the feature class contained: 925,224 acres.

Inventoried Roadless Areas (IRAs):

The IRA data came originally from the following location and was added to the FGD: T:\FS\NFS\NFinNorthCarolina\Project\SO\2013Revision\GIS\base_data\plan_data.gdb\np_ira. It was renamed: IRAs. This feature class was erased from the FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA to produce: FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA_E_IRA. After acres were recalculated it contained: 804,090 acres.

The decision to remove IRAs from the Timber Suitable base was based on updated WO guidance received in the second half of 2017.

Wild River Segments (Designated):

Designated wild and scenic river segments were identified in

T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Data\NP EIS.gdb\Hydrography\N_P_DWSR_poly_class. From this feature class only, the wild segments were

selected and exported to their own feature class called: Desig_Wild_River_Segments. It was noticed that this export contained only one wild segment designated on the Chattooga. After consultation with the dispersed rec program manager another version with the correct designations was supplied and the above process was repeated. The new N-P_DWSR_poly_class was located here: T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Workspace\JasonRodrigue. The wild segments were exported to their own feature class and named: Desig_Wild_River_Segments2. This new feature class was erased from FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA_E_IRA to create: FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA_E_IRA_E_WildR2. After re-calculation of the acres this feature class contained: 803,432 acres.

Step 1 Factor 3: Lands on Which There is No Reasonable Assurance that Lands can Adequately Restocked within 5 years of Final Regeneration Harvest (FSH 1909.12 § 61.13).

FSVeg Site Index Data

Low site indices (Measured site indices less than 40 feet of height growth over a base age (usually 50 years)) was selected as a measure of Factor 3. The FS_Veg_02182021_NP_Only feature class was examined for use of the site index field. The feature class contained 244 records with some data improvements over the draft plan data but there was still needed updates in the future (i.e. SI 40 called for all of Linville George). The feature class was called: FSVeg_SI_L40_Alt_E. This feature class was erased from FS_Own_E_S1F4_E_W_E_AltEWSA_DEISWSA_E_IRA_E_WildR2 to create a new feature class: FS_Own_E_S1F4_F1_E_SI40. After recalculation of acres his feature class contained: 795,176 acres.

FSVeg Land Suitability Code 900 (Unproductive), Forest Type 99 (Brush Species) or Condition Class 15 (Non-stocked)

Due to the continued “out-of-date nature” of the site index field within the FSVeg Data, three other indicators in FSVeg of low stocking potential were examined (unproductive LSC, Forest Types, and Condition Classes).

A feature class was derived from the FS_Veg_02182021_NP_Only feature class and named *FSVeg_LAS_FT_CC_Alt_E.* The data was queried for Land Class Code 900 (unproductive), EV (forest type) 99 (brush species), and stand condition class 15 (non-stocked). The query resulted in 614 records being identified. Further analysis indicated that many of the records were identified as unproductive due to their association with non-timber production management areas like wilderness, Research Natural Areas, and the Appalachian Trail corridor (eg large parts of shining rock wilderness and areas around Linville Gorge that had recently burned (last 6 years) and likely needed updates in condition class as natural recovery occurs. These areas were left inside the analysis (erased) because in the case of the burns around Linville and Shining rock wilderness many of these areas are already removed or will be removed during this process.

FSVeg_LAS_FT_CC_Alt_E was erased from FS_Own_E_S1F4_F1_E_SI40 to created FS_Own_E_S1F4_F1_E_SI40_E_UnProd. This new feature class contained: 786,589 acres.

Step 1 Factor 2: Lands on which Technology to Harvest Timber is Not Currently Available without Causing Irreversible Damage (FSH 1909.12 § 61.12).

FSVeg Stand Data Representing Irreversible Damage

For the Alternative E analysis FSVeg data (FS_Veg_02182021) used was downloaded from the NFS GI tool on 02/18/2021 by the forest spatial coordinator. This data covered all four proclaimed national forests in NC so the data for the Nantahala and Pisgah was isolated and used (FS_Veg_02182021_NP_Only). This data was stored as a feature class in the GDB. National Forest Service land suitability class codes representing irreversible damage were examined in FSVeg. LSCs examined included 720, 740, 821, 824, 826. Codes selected represented the possibility for some overlap with other criteria within Factor 2. This ensured that duplicates would be captured but not double counted in the analysis. The analysis revealed that relevant data was only found in the 821, 824 and 826 codes. Codes 720 and 740 were not present in the version of FSVeg used during the analysis. The selected data was exported to a separate feature class called: FSVeg_Irr_Dam_Alt_E. It contained 531 records. This feature class was erased from FS_Own_E_S1F4_F1_E_SI40_E_UnProd to produce a new feature class called: FS_Own_E_S1F4_F1_F3_E_Irr_Dam. After recalculation of acres this feature class contained: 769,203 acres.

Table A-3: Land Suitability Codes* examined for inclusion in Step 1 Factor 3 (Lack of Technology)

Code	Definition
720	Irreversible Damage
740	Lacking Response Information
821	Steep Slopes
822	Inadequate Markets
823	ROW Needed
824	Sensitive Soils
825	Low Level Management
826	Physical Barriers
827	Road Costs Exceed Value

*USDA-FS Silviclutural Examination & Prescription Field Book R-8-MR 46, 2009.

Bogs Rock Outcrops

The Forest Botanist provided data which covered bogs and rock outcrops on the Nantahala and Pisgah National Forests. These three shapefiles were incorporated directly into the timber production suitability analysis.

1) Bogs – *All_NP_Bogs_suitability_analysis.shp* – This shapefile was exported to the FGDB as: DEIS_Bogs. After subtraction from FS_Own_E_S1F4_F1_F3_E_Irr_Dam the new feature class was called: FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs and contained 768,014 acres after they were re-calculated.
2) Rock Outcrops – *All_Final_NP_Rock_Outcrops_suitability_analysis.shp*– This shapefile was exported to the FGDB as: DEIS_Rock_Outcrops. After subtraction from FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs, the new feature class was called: FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO and contained 766,679 acres after they were re-calculated.
3) FEIS_Rare_Habitats – This data was provided in the spring of 2021. When reviewed against the previously delivered data parts of the older data was not included in so other determination was

made to include all three subtractions. After subtraction from FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO, the new feature class was called: FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO_E_RH and contained 764,912 acres after they were re-calculated.

Hydric Soil Ratings

Hydric soil information was obtained from the NRCS website based on the recommendation of the Forest Hydrologist/Soil Scientist. The NRCS data for just full hydric soil rating was selected and a shapefile (Hydric_Rating_selection) was created. During this process, the partially hydric soils rating was also examined for inclusion in the timber production suitability analysis. Based on conversations with the Forest Hydrologist/Soil Scientist, the partially hydric soils rating was described in a more coarsely mapped dataset and covered much larger parts of the landscape overlapping heavily with riparian areas that are scheduled to be removed in Step 2 of the Timber Suitability Analysis.

The feature class used in the Alt E TS analysis is called: All_Hydric. After subtraction from FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO_E_RH, the new feature class was called: FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO_E_RH_E_HSoils and contained 764,477 acres after they were re-calculated.

Slopes Greater Than 70 Percent

The forest spatial coordinator processed 2019 Lidar data and provided a feature class of slopes greater than 70%. This data is updated from the analysis in the draft EIS because it is now available for use. The feature class is called: Slope. Attempts to use this updated feature class to erase steep slopes from the step 1 feature class were met with errors. When the slope feature class was reviewed by the Nantahala zone spatial program manager errors in the geometry of the feature class were identified that needed to be fixed. Fixing the errors proved to be a long process (5 plus hours) and it was determined to fall back to the original slope dataset used during the draft EIS analysis: np_sloperclass_gk_70plus. This dataset was brought into the FGD. After subtraction from FS_Own_E_S1F4_F1_F3_E_Irr_Dam_E_Bogs_E_RO_E_RH_E_HSoils, the new feature class was called: Alt_E_TS_Step1_Final and contained 697,591 acres after they were re-calculated.

Step 2 Factor and Category Data Preparation

The starting point was designated as the end of Stage 1. The feature class: Alt_E_TS_Step1_Final and is saved in the FGB at: T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Workspace\JasonRodrigue\TimberSuitability.gdb\Output_Step1\Alt_E_TS_Step1_Final. As noted above the feature class contains 697,591 acres. This shapefile contains all national forest lands that were considered Tentatively Suitable according to Chapter 60 of the planning handbook.

The order of subtraction from the Tentatively Suitable acres will occur in the following order.

Part 1: Riparian and lake buffers

Part 2: USFWS Designated Critical Habitat

Part 3: Old Growth acres identified in Alternative E

Part 4: Alternative E Management Areas not suitable for timber production based on administrative decisions

Step 2, Part 1: Riparian and Lake Buffer Areas

The shapefile was generated based on work done by the forest wildlife biologist. A dataset was created by overlaying several versions of USGS Website (NHD data) to eliminate mapping inconsistences and lack of reliability of the flow/stream origin data fields in the NHD. It represents the most current fine scale mapping of streams available to date. The data was buffered a 100 feet per side for estimations of perennial streams and 50 feet per side on intermittent streams. This is layer is different from the draft EIS data for riparian buffers based on the increase in the stream buffer distance with plan standards for alternative E for intermittent streams (15 to 50 feet). A second layer containing a 100-foot buffer on the shoreline of reservoirs and waterbodies was also created using USGS NHD layers. This shapefile was called NHD_waterbody_buffer100.

The riparian buffer feature class called: StreamBufferRevised was brought into the FGD. This feature class was curated by the forest spatial data manager. The original data created by the wildlife biologist is located: T:\FS\NFS\NFinNorthCarolina\Program\2600FishMgmt\FISH_PROG\gis_data\ARCMAP PROJECTS\NP plan revision\stream habitat. After subtraction from Alt_E_TS_Step1_Final, the new feature class was called: Alt_E_TS_Step2_E+St+Buff and contained 650,238 acres after they were re-calculated.

The NHD_waterbody_buffer100_FS_Own shapefile contains 4,662 acres. It was brought into the FGD as a feature class called: NHD_waterbody_buffer_100. Subtraction from Alt_E_TS_Step2_E_St_Buff created a new feature class called: Alt_E_TS_Step2_E_St_Buff_E_WB_Buff. After re-calculation of acres the feature class contains 647,067 acres.

Step 2, Part 2: T/E Critical Habitats

The Forest Biologist identified the national level shapefile to critical habitat. It is called crithab_poly and is located: T:\FS\NFS\NFinNorthCarolina\Program\2600FishMgmt\FISH_PROG\gis_data\base_data\RareSpecies\CriticalHabitat\crithab_poly.shp. This file was clipped by the ALP_Ownership Layer, saved in the FGD, and called: NP_CritHab_Poly_Alt_E. An acres field was added to the shapefile and acres calculated (3,447 ac). The data contained habitat for Mountain Golden Heather, Spruce-fir moss spider, and Appalachian elktoe.

The NP_CritHab_Poly_Alt_E was removed from the Step2_Suitability_V3_E_Str2_WB to create a new feature class called: Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH. The layer contains 646,052 acres.

Step 2 – Ecozones Not Compatible with Timber Production: The pine oak heath, dry oak, spruce fir, floodplain, grassy bald, heath bald, and lakes were erased during the development of the Draft EIS alternatives. Based on comments received after the Draft EIS the suitability process was reviewed to ensure consistency with NFMA. NFMA does not require the removal of individual ecozones or community types from the suitability analysis. While the DEIS identified individual ecozones that were not suitable for timber production, the final suitability analysis did not remove ecozones from the lands suitable for timber production

Stage 2, Part 3: Designated Old Growth:

Alternative E: The feature class for alternative E old growth called OldGrowth_AltE was imported into the FGD. Its original location was: T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Data\NP EIS.gdb\Vegetation\

This old growth shapefile was erased from the Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH to create a new Alternative E specific suitability layer called: Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH_E_OG. This layer contains 567,465 acres.

Stage 2, Part 4: Management Areas not suitable for timber production based on administrative decisions

> *Special Note: A Washington Office review in the summer of 2017 resulted in Research Natural Areas being removed from stage 1 of the timber production suitability analysis. RNAs are in fact included in this portion of stage 2 and subtracted as part of the management areas not allowing timber production.*

Alternative E: The feature class containing the finalized management area data for Alternative E (newMa_altE_final) was brought into the FGD. Its original location was: T:\FS\NFS\NFinNorthCarolina\Project\SO\2020EIS\GIS\Data\NP EIS.gdb\Alternatives\

The management areas were reviewed for consistency with timber production. A new feature class was created by selecting the MAs within newMa_altE_final that were not suitable administratively in this alternative.

Alternative E management areas not suitable include:

Management Area
Appalachian Trail (4a)
Backcountry (3)
Cradle of Forestry (11)
Cultural/Heritage Corridors (4c)
Ecological Interest Areas (5b)
Experimental Forests (8)
Recommended Wilderness (6R)
Research Natural Areas (5R)
Roan Mountain (9)
Scenic Byways (4b)
Special Interest Areas (5a)
Water (w)
Wild and Scenic Rivers (4d) *
Wilderness (7)
Wilderness Study Areas(6)

*Just the wild river segments were erased. This was addressed separately from the other management at areas not suitable for timber production (see below).

This selection (minus the wild and scenic rivers) was exported as a new feature class called: AltE_MAs_AdminU_TP

AltE_MAs_AdminU_TP was erased from Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH_E_OG to create: *Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH_E_OG_E_MAsU_TP* and it contained 459,177 acres.

Eligible wild river segments were erased from the timber suitable lands using a selection from the feature class N_P_EWSR_poly_class that contained just the eligible wild river segments. This selection was exported to a new feature class called N_P_EWR_Segments_AltE in the FGDB. This new feature class was erased from *Alt_E_TS_Step2_E_St_Buff_E_WB_Buff_E_CH_E_OG_E_MAsU_TP* to create the final version of the timber suitable lands in Alternative E called: Alt_E_Final_TS_Determination. The records with acres less than 1 were reviewed and where they existed a slivers they were removed from the feature. This layer contained 459,175 acres.

Timber Production Suitability Classification

Land Classification Category	Alternative E
	Acres
A. Total National Forest System lands in the plan area	1,043,636
B. Lands not suited for timber production due to legal or technical reasons	346,045
C. Lands that **may be** suited for timber production (A-B)	697,591
D. Total lands **suited** for timber production because timber production is compatible with the desired conditions and objectives established by the plan	459,175
E. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the plan (C-D)	238,416
F. Total lands **not suited** for timber production (B+E)	584,461

Timber Production Suitability Classification by Alternative

Land Classification Category	Alternative A*	Alternative B	Alternative C	Alternative D
	---------- Acres ----------			
G. Total National Forest System lands in the plan area	1,042,060			
H. Lands not suited for timber production due to legal or technical reasons	339,014			
I. Lands that **may be** suited for timber production (A-B)	703,046			
J. Total lands **suited** for timber production because timber production is compatible with the desired conditions and objectives established by the plan	361,176*	405,657	321,670	409,337
K. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the plan	341,870	297,389	381,376	293,709

(C-D)				
L. Total lands **not suited** for timber production (B+E)	680,884	636,403	720,390	632,723
*Alternative A differs from the existing forest plan acres classified as suitable for timber production due to changes in the determination process under the 2012 planning rule.				

Analysis of Lands Potentially Impacted by Timber Operations

Objectives:

(1) To estimate those lands where harvest may occur, both now and in the future, based on plan revision alternatives, management area designations, our current road network, and areas where current harvest equipment can operate.
(2) To estimate tabular data differences by management area across the plan revision alternatives for areas both currently accessible and potentially available with future road building.
(3) The estimate quantities of lands both available and accessible that have commercially viable timber currently.

Assumptions:

- ✓ Available: The lands that meet current operability requirements of either aerial or ground based harvest systems in use in WNC and are administratively available for timber harvest regardless of the current USFS road network.
- ✓ Accessible: The lands accessed by the Nantahala and Pisgah's current road network that meet current operability requirements of either aerial or ground based harvest systems in use in WNC and are administratively accessible.
- ✓ General Equipment Accessibility Requirements: The reach of typical harvest systems from the existing road network based on the slope adjacent to the road.
    - Lands within ½ mile of existing roads (both sides)on slopes < 40 percent
    - Lands within ¼ mile of existing roads (downslope side) on slopes >40 percent (and up to 70%).
- ✓ Within the revised plan, the Matrix management area will contain the majority of the lands that are accessible or available for timber harvest over the planning period. Other management areas like Interface, backcountry and EIAs (when present), etc. will provide some lower level of harvest but may be limited in scope. The management areas included will vary whether accessible or available lands are being examined.
- ✓ Mature age classes, currently between 60 and 120 years and condition classes 6-10, 12, are likely to meet the overlapping objectives of compositional or structural restoration, wildlife habitat creation, and produce some commercially desired products. These may be either second growth or in some cases third growth.
- ✓ This estimate is intended for use to inform forest level planning at the 1 million acre scale, and not to predict or design harvest projects as those require more site specific analysis and consideration of fine scale information about the site and forest resources.

Spatial Process:

Background: This analysis took place during the DEIS and was finalized during the completion of the FEIS (Alt E); all alternatives, proposed management areas, a completed timber suitability analysis, Spectrum base data and the harvest equipment limitation data, were available for inclusion as needed. Spatial data from the SPECTRUM analysis unit derivation process for each alternative was used as the starting point for this analysis. The data contains the management area, age, forest type, condition class, both step 1 suitability and step 2 suitability and acres.

To identify those acres accessible currently, the above assumption of generally accessible requirements was developed spatially. A shapefile (*road_elev_diff_slopebrk*) was created of those lands accessible based on the distances from roads. It contained a field called "Access" that listed areas as current, moderate or was "blank".

There were 9,595 records that were blank within the "Access" field. These were populated with the "current" after visual inspection indicated that they were small cells of zero slope in the middle of patches of greater slope. The records with a "moderate" entry for the "Access" field included those slopes between 40 to 70 percent slope that were greater than the ¼ mile restriction for cable logging system but still within the ½ mile distance limitation for an existing road system, or up slope of the roads.

Because the *road_elev_diff_slopebrk* was large, containing over 800,000 records, two sub-datasets were exported. The first was called *road_elev_diff_slopebrk_exp_Current* and contained only the records that listed current in the access field. The second export was *road_elev_diff_slopebrk_exp_Moderate.* It was thought that by breaking up this large dataset it would be more manageable when it was used in combination with the Spectrum analysis unit dataset for each alternative.

Analysis Set-Up Description:

Part 1: That portion of National Forest land currently accessible via an existing Forest Service road (regardless of maintenance class) and is on a portion of the landscape within the equipment access limitations listed in the assumption section *General Equipment Accessibility Requirements*.

Part 2: That portion of national forest land that meets the same requirements as Part 1, but does not currently have road access currently. Accessing the acres within Part 2 would require road building (new specified roads or temporary roads).

Note: From this point to the end of the document an "Alt E Update" line was added to each step to document how this analysis was updated to incorporate Alternative E.

Pre-processing:

Data Prep: The *road_elev_diff_slopebrk_exp_Current* shapefile contained data for non-Nantahala and Pisgah Ownership. It was clipped by the np_own_2017 and re-named *road_elev_diff_slopebrk_exp_Current_NP_Clip*.

Alt E Update: The update for Alternative E began at pre-processing for consistency with the Alt E Timber Suitability Analysis update. Specifically, because updates to the land ownership data occurred between draft and final EIS. This work was completed in the FPR IDT's file geodatabase workspace (2020EIS). The land ownership file used for Alt E was called: *NP_FS_Ownership* (location

= Alt E Spectrum FGD). The ownership clipped access data produced for Alt E was called: Road_Slope_Own_Clip.

Part 1: Accessible Lands

Alternative A: The NP_SPECTRUM_AU_Alt_A Shapefile was "identitied" with the *road_elev_diff_slopebrk_exp_Current* to produce *Alt_A_SPECTRUM_Road_Slope_Current_INT.* This shapefile had unnecessary fields removed. Acres were re-calculated. This shapefile contained almost all the NFS lands present. It was noticed that there were records with a combination of zero in both the slope field and the access field. This represented those areas of the forest that did not have a current access opportunity. To simplify the dataset to just those areas that currently had access, the records with "current" in the Access field were selected and exported to a new shapefile called: *Alt_A_SPECTRUM_Road_Slope_Current_INT_Just_Current.* From this shapefile, the ArcMap Erase tool was used to better develop a representation of the acres that are available for all types of harvest (water bodies and stream buffers, TES critical habitat and old growth areas were removed)(Table 1).

Table 1: Erase Tool Intermediate steps for Alternative A

Shapefile Name	Acres Re-calculated?
Alt_A_SPECTRUM_Road_Slope_Current_INT_Just_Current_E_CH	No
Alt_A_SPECTRUM_Road_Slope_Current_INT_Just_Current_E_CH_E_WB	No
Alt_A_SPECTRUM_Road_Slope_Current_INT_Just_Current_E_CH_E_WB_E_St	No
Alt_A_SPECTRUM_Road_Slope_Cur_INT_Jst_Cur_E_CH_E_WB_E_St_E_OG	Yes

The data contained in *Alt_A_SPECTRUM_Road_Slope_Cur_INT_Jst_Cur_E_CH_E_WB_E_St_E_OG* was further refined by removing those acres that were determined to be un-suited for timber production during stage 1 of the timber production suitability analysis[14]. In total this analysis should remove all physical and legal harvest exclusion factors from the accessible lands as well as riparian areas, critical habitat, and old growth (as recognized by the relevant alternative). Refer to the document titled "Potentially Operable Lands data for the website" after completion of this document to obtain the final file names associated with data reported in the DFP, DEIS, and FEIS.

Alternative B: The original intent was to use the ARCMap Identity Tool to combine the NP_SPECTRUM_AU_Alt_B_MA Shapefile with the *road_elev_diff_slopebrk_exp_Current_NP_Clip* as was done in the work for Alternative A. ArcMap was unable to complete the Identity in this manner due to the number of records in each shapefile. In order to approximate a dataset that approximated the combination, NP_SPECTRUM_AU_Alt_B_MA Shapefile, which is the Spectrum analysis unit base data set, was clipped by the *road_elev_diff_slopebrk_exp_Current_ND_Clip to create Alt_B_SPECTRUM_Road_Slope_Current_Clip.* This shapefile contains the fields with data for MA, acres, but does not include the slope related fields from the *road_elev_diff_slopebrk_exp_Current_NP_Clip shapefile*. This was deemed acceptable for the analysis as site specific slope was not needed for this analysis, whether it was accessible or available being key for the analysis.

From *Alt_B_SPECTRUM_Road_Slope_Current_Clip,* water bodies and stream buffers, critical habitat and old growth was removed using the erase tool (Table 2).

Table 2: Erase Tool Intermediate steps for Alternative B

[14] Refer to Appendix B of the Revised Nantahala and Pisgah Forest Plan EIS for more information about the timber production suitability analysis, stages 1 and 2.

Shapefile Name	Acres Re-calculated?
Alt_B_SPECTRUM_Road_Slope_Current_Clip_E_CH	No
Alt_B_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB	No
Alt_B_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St	No
Alt_B_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG	Yes

The data contained in Alt_B_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG was further refined by removing those acres that were determined to be un-suited for timber production during stage 1 of the timber production suitability analysis. In total this analysis should remove all physical and legal harvest exclusion factors from the accessible lands as well as riparian areas, critical habitat, and old growth (as recognized by the relevant alternative). Refer to the document titled "Potentially Operable Lands data for the website" after completion of this document to obtain the final file names associated with data reported in the DFP, DEIS, and FEIS.

Alternative C: The same process used for Alternative B was completed for Alternative C given that the datasets were similar in size. In order to complete the combination of the data the NP_SPECTRUM_AU_Alt_C_MA Shapefile was clipped by the *road_elev_diff_slopebrk_exp_Current_ND_Clip to create Alt_C_SPECTRUM_Road_Slope_Current_Clip.* This shapefile contains the fields with data for MA, GA, acres, but does not include slope.

From *Alt_C_SPECTRUM_Road_Slope_Current_Clip* water bodies and stream buffers, critical habitat and old growth was removed using the erase tool (Table 3).

Table 3: Erase Tool Intermediate steps for Alternative C

Shapefile Name	Acres Re-calculated?
Alt_C_SPECTRUM_Road_Slope_Current_Clip_E_CH	No
Alt_C_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB	No
Alt_C_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St	No
Alt_C_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG	Yes

The data contained in Alt_C_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG was further refined by removing those acres that were determined to be un-suited for timber production during stage 1 of the timber production suitability analysis. In total this analysis should remove all physical and legal harvest exclusion factors from the accessible lands as well as riparian areas, critical habitat, and old growth (as recognized by the relevant alternative). Refer to the document titled "Potentially Operable Lands data for the website" after completion of this document to obtain the final file names associated with data reported in the DFP, DEIS, and FEIS.

Alternative D: The same process used for Alternatives B and C was completed for Alternative D given that the datasets were similar in size. In order to complete the combination of the data the NP_SPECTRUM_AU_Alt_D_MA Shapefile was clipped by the *road_elev_diff_slopebrk_exp_Current_ND_Clip to create Alt_C_SPECTRUM_Road_Slope_Current_Clip.* This shapefile contains the fields with data for MA, GA, acres, but does not include slope.

From *Alt_C_SPECTRUM_Road_Slope_Current_Clip* water bodies and stream buffers, critical habitat and old growth was removed using the erase tool (Table 4).

Table 4: Erase Tool Intermediate steps for Alternative D

Shapefile Name	Acres Re-calculated?

Alt_D_SPECTRUM_Road_Slope_Current_Clip_E_CH	No
Alt_D_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB	No
Alt_D_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St	No
Alt_D_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG	Yes

The data contained in Alt_D_SPECTRUM_Road_Slope_Current_Clip_E_CH_E_WB_E_St_OG was further refined by removing those acres that were determined to be un-suited for timber production during stage 1 of the timber production suitability analysis. In total this analysis should remove all physical and legal harvest exclusion factors from the accessible lands as well as riparian areas, critical habitat, and old growth (as recognized by the relevant alternative). Refer to the document titled "Potentially Operable Lands data for the website" after completion of this document to obtain the final file names associated with data reported in the DFP, DEIS, and FEIS.

Alternative E: The same process used in Alts B, C, and D were used for Alt E. In order to approximate a dataset that reflected the combination, *Alt_E_Spectrum_AU_Base_PSuit_FSuit_MgmtA3*, which is the Spectrum analysis unit base data set, was clipped by the Road_Slope_Own_Clip *to create Alt_E_SPECTRUM_Road_Slope_Current_Clip.* This shapefile contains the fields with data for MA, acres, but does not include the slope related fields from *Road_Slope_Own_Clip*. This was deemed acceptable for the analysis as site specific slope was not needed for this analysis, whether it was accessible or available being key for the analysis.

From *Alt_E_SPECTRUM_Road_Slope_Current_Clip,* water bodies (*NHD_waterbody_buffer_100*) and stream buffers (*StreamBufferRevised*), critical habitat (*NP_CritHab_Poly_AltE*) and old growth (*Old_Growth_AltE*) were removed using the erase tool (Table 2).

Table 2: Erase Tool Intermediate steps for Alternative B

Shapefile Name	Acres Re-calculated?
Alt_E_Spectrum_Road_Slope_Current_Clip_E_CH	No
Alt_E_Spectrum_Road_Slope_Current_Clip_E_CH_WBB	No
Alt_E_Spectrum_Road_Slope_Current_Clip_E_CH_WBB_SB	No
Alt_E_Spectrum_Road_Slope_Current_Clip_E_CH_WBB_SB_OG	Yes

The data contained in Alt_E_Spectrum_Road_Slope_Current_Clip_E_CH_WBB_SB_OG was further refined by removing those acres that were determined to be un-suited for timber production during stage 1 of the timber production suitability analysis. In total this analysis should remove all physical and legal harvest exclusion factors from the accessible lands as well as riparian areas, critical habitat, and old growth (as recognized by the relevant alternative). Refer to the document titled "Potentially Operable Lands data for the website" after completion of this document to obtain the final file names associated with data reported in the DFP, DEIS, and FEIS.

Part 2: Available Lands

For each alternative, the file representing the current access dataset was Erased from each alternative's complete Spectrum analysis unit dataset. From the resulting data, TES critical habitat, waterbody buffers, stream buffers, and alternative relevant old growth patches were also Erased. As with Pat 1 of this analysis, the data was set to display only the stage 1 timber suitable acres (less the technical and legal factors). By removing part 1 from the original forest wide Spectrum analysis unit data, the remaining data contains all lands that are not accessible. With the content of the data, both the step

one timber production suitability and the management area designations we should be able to remove all those lands that would not receive any timber harvest for any reason.

- ✓ Alt A: NP_SPECTRUM_AU_Alt_A ERASE road_elev_diff_slopebrk_exp_Current_NP_Clip = Alt_A_Un_accessed_E_Current ERASE NP_CritHab_Poly = Alt_A_Un_accessed_E_Current_E_CH ERASE NHD_waterbody_buffer100_fsown = Alt_A_Un_accessed_E_Current_E_CH_E_WB ERASE NHD_30_merge_100 = Alt_A_Un_accessed_E_Current_E_CH_E_WB_E_ST ERASE AltA_DesOG_ patches_June_2018 = Alt_A_Un_accessed_E_Current_E_CH_E_WB_E_ST_E_OG This shapefile had acres re-calculated and then was exported to MS excel to be pivoted to display acres that are step1 timber suitable by management area.
- ✓ Alt B: NP_SPECTRUM_AU_Alt_B_MA ERASE road_elev_diff_slopebrk_exp_Current_NP_Clip = Alt_B_Un_accessed_E_Current ERASE NP_CritHab_Poly = Alt_B_Un_accessed_E_Current_E_CH ERASE NHD_waterbody_buffer100_fsown = Alt_B_Un_accessed_E_Current_E_CH_E_WB ERASE NHD_30_merge_100 = Alt_B_Un_accessed_E_Current_E_CH_E_WB_E_ST Erase AltB_DesOG_modLarMed_small = Alt_B_Un_accessed_E_Current_E_CH_E_WB_E_ST_E_OG. This shapefile had acres re-calculated and then was exported to MS excel to be pivoted to display acres that are step1 timber suitable by management area.
- ✓ Alt C: NP_SPECTRUM_AU_Alt_C_MA ERASE road_elev_diff_slopebrk_exp_Current_NP_Clip = Alt_C_Un_accessed_E_Current ERASE NP_CritHab_Poly = Alt_C_Un_accessed_E_Current_E_CH ERASE NHD_waterbody_buffer100_fsown = Alt_C_Un_accessed_E_Current_E_CH_E_WB ERASE NHD_30_merge_100 = Alt_C_Un_accessed_E_Current_E_CH_E_WB_E_ST Erase AltC_Des_OG_Large_Med_Small_Partner = Alt_C_Un_accessed_E_Current_E_CH_E_WB_E_ST_E_OG. This shapefile had acres re-calculated and then was exported to MS excel to be pivoted to display acres that are step1 timber suitable by management area.
- ✓ Alt D: NP_SPECTRUM_AU_Alt_D_MA ERASE road_elev_diff_slopebrk_exp_Current_NP_Clip = Alt_D_Un_accessed_E_Current ERASE NP_CritHab_Poly = Alt_D_Un_accessed_E_Current_E_CH ERASE NHD_waterbody_buffer100_fsown = Alt_D_Un_accessed_E_Current_E_CH_E_WB ERASE NHD_30_merge_100 = Alt_D_Un_accessed_E_Current_E_CH_E_WB_E_ST Erase Alt_D_DesOG_Mod_largemed_PortionPartner = Alt_D_Un_accessed_E_Current_E_CH_E_WB_E_ST_E_OG. This shapefile had acres re-calculated and then was exported to MS excel to be pivoted to display acres that are step1 timber suitable by management area.
- ✓ Alt E: Alt_E_Spectrum_AU_Base_PSuit_FSuit_MgmtA3 ERASE Road_Slope_Own_Clip= Alt_E_Un_accessed_E_Current ERASE NP_CritHab_Poly_AltE = Alt_E_Un_accessed_E_Current_E_CH ERASE NHD_waterbody_buffer100 = Alt_E_Un_accessed_E_Current_E_CH_WBB ERASE StreamBufferRevised = Alt_E_Un_accessed_E_Current_E_CH_WBB_SB Erase OldGrowth_AltE = Alt_E_Un_accessed_E_Current_E_CH_WBB_SB_OG. This last shapefile had acres re-calculated.

Part 3: Accessible and available acres that are assumed to currently contain merchantable wood products.

Originally, in preparation for the reporting of data in the DEIS, the shapefiles at the end of part 1 & 2 were exported to MS Excel and the fields containing the data mentioned below were analyzed using

sorts and pivot tables. The final numbers were published in various places both in the draft plan appendix and the DEIS. During the DFP/DEIS comment period the public and partners were interested in spatial data that represented the numbers that were published for operability in the draft documents. A final spatial analysis was completed with data published on the NFsNC outward facing website that included files that contained the final numbers from the tables.

The analysis from both a tabular and spatial data set were the same with sorts and pivot tables in MS Excel and selections within the feature dataset spatially. Refer to the published website spatial data document for names and location of data that corresponds to the numbers published in the DEIS alternatives and for Alternative E.

The Part 3 analysis used FSVeg data that was contained within the Spectrum Analysis units shapefiles and connected to the outputs created during Parts 1 and 2 of this analysis. The age data was sorted to identify stands with ages between 60 and 120 years of age and with a condition class of 6 – 10, and 12. These represented the pole through sawtimber size classes in moderately or stocked conditions according to the USDA Forest Service Southern Region Field Book. These criteria were used to filter out a dataset of stands that may be considered commercially viable and within either the available or accessible groupings described above in parts 1 and 2.

Final Assembly of Data for the Draft Forest Plan, DEIS, and FEIS

Completion of parts 1 and 2 of this analysis identified acres in total that were accessible or available for this analysis in each management area. Acreages reported on Table B-2 in the Draft Revised Forest Plan and Table 173 in the draft EIS correspond with those management areas that allow for timber harvest (in some form from timber production to just restore composition conditions). For the currently **accessible** data this was considered the majority of the management areas in the action (B, C, D, E) alternatives that had road access (Matrix, Interface, backcountry, Experimental forests, Roan, Cradle of Forestry, SIAs, EIAs, and the corridor management areas). In Alternative A this included 1a, 2a, 3b, 4a, 4d, experimental forests and the Cradle of Forestry. Again, timber harvest would be for the purposes of meeting management area desired conditions. For example, the forest service would anticipate there being a relatively low need to implement timber harvest in an SIA unless there were composition issues that could be addressed. With the **available** data, management areas that allowed for future road construction and timber harvest were included. This reduced the management areas included down to Matrix, Interface, EIAs and Experimental forests for the action alternatives (B, C, D, E). For Alternative A the management areas selected stayed the same.

Final Note: The data layers that result in the acres reported in operability tables in the DFP, DEIS, and FEIS are identified in the project record document: “Potentially Operable Lands data for the website”.

Minerals and Energy

Analysis - Leasable Minerals

Estimated range of potential ground disturbance of leasable mineral activity during the 15 year of Revised Plan

The first step to estimate the potential ground disturbance for leasable mineral activity during the 15 years of the Revised Plan was to access the permitted mines website of the North Carolina Division of Energy, Mineral and Land Resources (DEMLR) and sort the data for the 18 counties with the Nantahala and Pisgah NFs lands (North Carolina Division of Energy, Mineral and Land Resources, 2018). The data for the 18 counties then was sorted for permitted mines for minerals on non-federal lands that would be hardrock leasable minerals on National Forest System lands. The 18 counties total 4,795,099 acres includes 1,042,797 of NFS lands and 3,752,302 of non-NFS lands. The permitted mines for hardrock type minerals are all on non-NFS lands and total 7,005 acres. The 7,005 acres of permitted mines is less than 1/5th of one percent (0.186%) of the 3,752,302 of non-NFS lands.

The second step is to make an estimate of ground disturbance during the 15 years of the Revised Plan for the NFS lands that would not be in an existing or potential mineral withdrawal under each alternative. For most of the Nantahala and Pisgah NFs, 1/5th of one percent of the area is used to estimate the upper end of potential ground disturbance for leasable mineral development (mines). This estimate is conservative considering that 1) mine permitting on non-NFS lands is less burdensome than on NFS lands, 2) NC DEMLR permitted acres (7,005 acres) is larger than NC DEMLR bonded acres (1,133 acres) because the permitted acres includes buffers. For the portion of the Forest with Backcountry, AT, SIAs and EIAs where road construction is severely restricted or not allowed, 1/20th of one percent of the area is used to estimate the upper end of potential ground disturbance for leasable minerals development (mines). The total acres of potential ground disturbance for leasable mineral development (mines) is increased by 5% to estimate mineral exploration that would be outside of, and in addition to, exploration within the area of mineral development (mines).

The lower end of potential ground disturbance for leasable minerals is 0 acres. Under the current Forest Plan so far there has been no ground disturbance for leasable minerals. Also, under all alternatives the private sector would initiate proposals for leasable mineral exploration or development. If, for whatever reason, the private sector would not initiate any proposals on the N&P NFs during the 15 years of the plan, then the lower end of potential ground disturbance would be 0 acres.

Gaps in Data

Assessing the potential impact of Forest Plan alternatives on leasable mineral resources has major gaps in data compared with assessing potential impacts on surface resources. Surface resources, like vegetation, are accessible at the earth's surface, and so, the Forest has an inventory of vegetation, including timber, across the one million acres of the Nantahala and Pisgah NFs. But leasable mineral resources in the earth's subsurface are not readily accessible, and so, the Forest does not have an inventory of leasable mineral resources beneath the one million acres of the Nantahala and Pisgah NFs.

In the 1970's and early 1980s the U.S. Geological Survey conducted mineral potential studies of Wilderness and Wilderness Study Areas (WSA) designated by Congress in the Eastern Wilderness Act of 1975. These decades-old studies would need to be updated in light of 1) changes in the types of minerals needed to meet 21st century demands for critical minerals, 2) advances in mineral prospecting and exploration technology, 3) advances on mineral deposit modeling, 4) advances in mineral extraction and processing. These mineral potential studies which are the most detailed mineral studies on the Forest are in Wilderness and Wilderness Study Areas in which leasable mineral exploration and development are not allowed. If up-to-date and detailed mineral potential studies were available for the hundreds of thousands of acres of Forest outside the Wilderness and WSA, it would be useful information to integrate into the Revised Plan process. The lack of up-to-date and detailed mineral potential studies comparable to the USGS studies of Wilderness and WSA is in contrast to the modern inventories of surface resources used in the Revised Plan process.

Even if up-to-date mineral potential studies for the entire Forest were available, mineral potential is not an inventory of mineral resources in the vast subsurface beneath the Forest. A timber inventory would sample for the physical presence of trees, and then, for sufficient timber volume to be considered as a commercial timber stand. Similarly, a mineral resource inventory would sample for the physical presence of ore grade mineralization, and then, for sufficient ore volume to be considered as a commercial mineral deposit. The available information that is closest to this type of mineral resource inventory is the Mineral Resources Data System (MRDS) which has mineral site records including present and past mines, prospects, and occurrences along with related geologic, commodity, and deposit information (U.S. Geological Survey, 2013a). The MRDS has about 200 records of mineral sites on the Nantahala & Pisgah NFs. However, the vast majority of these records are pre-1960 prospects or small mines which ceased production. The MRDS data is very useful because it does have records of the physical presence of mineralization as well as some mineral deposits that in the historic past were commercial mineral deposits. The MRDS provides valuable data that could be used as part of designing a mineral resource inventory project, that is, an exploration project.

But the MRDS is not a mineral resource inventory of commercial mineral deposits on the one million acres of the Nantahala and Pisgah NFs comparable the timber inventory of commercial timber stands.

The lack of a mineral resource inventory on the N&P NFS comparable to timber and other surface resource inventories puts mineral resources at great disadvantage in considering trade-offs between alternatives and in assess effects on mineral resources vs effects on surface resources. Commercial mineral deposits on the N&P NFs are scarce, hidden beneath the earth's surface, and hard to discover.

Mineral exploration and development would occupy relatively small portions of the N&P NFs (less than a fraction of 1% of the N&P NFs). If the locations of the undiscovered mineral deposits were known, then the Revised Plan alternatives could be designed to consider and accommodate mineral exploration and development on less than a fraction of 1% of the N&P NFs.

But the locations of scare, undiscovered mineral deposits are not known. Mineral deposits suitable for commercial development may occur at any depth in the subsurface. A comprehensive inventory of mineral resources for any one site would require drilling and core sampling to at least 10,000 feet depth below ground surface. Mineral deposits vary in lateral extent, and some valuable mineral deposits may have a lateral extent of a few hundred feet or less. So, in order to responsibly manage the federal mineral estate, large areas of the N&P NFs would need to be available to search for the few needles in a haystack. The first stages of the search covers large areas and involves little or no ground disturbance, such as desktop analyses of existing geologic data and new mineral deposits models; reconnaissance surveys and sampling; and geophysical surveys. The next stage of the search narrows down to selecting one or more sites for subsurface exploration such as drilling or trenching. It is at this stage that the mineral company would apply for a BLM prospecting or exploration permit. If the exploration is successful, then the mineral company would apply for a BLM mining permit. Even though hundreds of thousands of acres of the N&P NFs would be available to search and explore, the potential ground disturbance from mineral exploration and development of scarce mineral deposits would be less than a fraction of 1% of the N&P NFs.

The Forest Service Mineral Program Policy includes: Ensure the integration of mineral resource programs and activities with the planning and management of renewable resources through the land and resource management planning process, recognizing that mineral development may occur concurrently or sequentially with other resource uses. Ideally, the Plan Revision would provide the flexibility and allow the adaptation needed to accommodate discovery of valuable mineral deposits. The Forest Service provides such flexibility and adaptation for surface resources, for example, if a T&E species or a heritage resource is discovered in an area, then the management for the area would be adjusted to accommodate the T&E species or heritage resource. Whether the Revised Plan components are sufficient to provide the flexibility and allow the adaptation needed to responsibly manage the federal mineral estate is unclear and uncertain.

Best Available Scientific Information - Leasable Minerals

Source of mineral resource information used include the North Carolina Geological Survey, North Carolina Division of Energy, Mineral and Land Resources, and U.S. Department of Interior agencies such as U.S. Geological Survey and Bureau of Land Management.

Analysis - Renewable Energy

The analysis used spatial data in a GIS project. The analysis used information from the 2005 report by the National Renewable Energy Laboratory (NREL) and U.S. Forest Service that identifies and evaluates the potential for solar and wind energy resource development on NFS lands, including the NFS lands in North Carolina (National Renewable Energy Laboratory Report, 2005). The analysis used wind speed at 50 m and Wind Power Class 4 and above as high potential areas for wind energy as was used by the 2005 NREL report.

The analysis used the areal distribution of Management Areas in the current Plan and action alternatives based on Forest Service GIS spatial data.

Best Available Scientific Information - Renewable Energy

Sources of information used include the 2005 report by the National Renewable Energy Laboratory (NREL) and U.S. Forest Service that identifies and evaluates the potential for solar and wind energy resource development on NFS lands, including the NFS lands in North Carolina (National Renewable Energy Laboratory Report, 2005). Sources include more recent information from the National Renewable Energy Laboratory on 80 m wind speed in North Carolina. Other data sources include the U.S. Energy Information Administration.

Analysis - Energy Requirements and Depletable Resource Requirements

The method to determine energy requirements and depletable resource requirements was to use available FS data that provided a basis for estimates of energy requirements and depletable resource requirements.

Estimates of mineral materials requirements (crushed rock aggregate, rip rap, etc.) to construct and maintain roads, developed recreation sites, trailheads, and other facilities were based on information from Forest Engineering Staff.

Gaps in Data (Energy Requirements and Depletable Resource Requirements)

There is a lack of data on fossil fuel consumptions required for major parts of the Forest recreation program. Fossil fuels are consumed to construct, operate and maintain the Forest recreation infrastructure spread across 1.1 million acres of mountainous terrain. The Forest accomplishes this recreation workload using not only Forest labor, vehicles, and equipment but also a variety of other means using non-Forest labor, vehicles and equipment, such as:

1. The Forest issues service contracts to provide and maintain public access along hundreds of miles of roads and trails and associated bridges, and to construct, operate and maintain campgrounds, horse camps, boat launches, waterfalls access facilities, trailhead parking lots, restrooms, and other recreation infrastructure.
2. The Forest has Participating Agreements with a variety of organizations which supply labor, vehicles and equipment to construct, operate and maintain the recreation infrastructure.
3. The Forest issues Special Use Permits to outfitters guides, concessionaires, and others who supply labor, vehicles and equipment for recreation services.
4. The Forest has Volunteer Programs for individuals and organizations who supply labor, vehicles and/or equipment to construct and maintain recreation infrastructure and provide recreation services.

There also is a lack of data on fossil fuel consumptions required for other Forest activities such as, 1) prescribed fire operations, 2) wildfire suppression, 3) helicopters and fixed wing aircraft used in fire management, insects and disease surveillance and monitoring, and flood and wind storm damage assessments, 4) in-State and out-of-State transportation of fire fighters from FS and other agencies to fight wildfires on the Forest.

Best Available Scientific Information - Energy Requirements and Depletable Resource Requirements

Sources include available FS data that provided a basis for quantitative estimates of energy requirements and depletable resource requirements. Fossil fuel consumption for recreation on the Nantahala and Pisgah NFs is based on estimates using numbers of visits and mileage travelled in the FY 2008 and FY 2013 Forest's Visitor Use Reports as part of National Visitor Use Monitoring (USDA-Forest Service).

Vehicle fuel economy data is based on:

Sivak, M. and Shoettle, B., 2017, On-road fuel economy of vehicles in the United States: 1923-2013, Report No. SWT-2017-5, March 2017, University of Michigan Sustainable Worldwide Transportation, pp10. http://umich.edu/~umtriswt/PDF/SWT-2017-5.pdf

Analysis - Reserved and Outstanding Mineral Rights

The data used to assess the subsurface ownership is a GIS subsurface layer and shapefile (NC_Nat_Psg_Surface-Subsurface_Rights) obtained from R8 RO on June 7, 2013.

For the Nantahala & Pisgah NFs the subsurface ownership shapefile has an attribute table listing 205 tracts with outstanding or reserved mineral right where there is less than 100% federal mineral ownership. For the 205 tracts, the attribute table column for recorded acres (deed acres) has a total 125,714 acres.

In ArcMap, a calculation was made to determine the GIS acres for each of the 205 tracts. A column of these GIS acres was added to the attribute table. The GIS acres of subsurface ownership have a total of 102,523 acres. The GIS acres total of 102,523 acres is 23, 191 acres less than the recorded acres total of 125,714 acres.

The potential effects (referred to a “dual potential effects on surface management and private mineral rights operations”) would be most adverse in management areas where roads are prohibited or severely restricted, such as in Recommended Wilderness areas or Inventoried Roadless Areas. An indicator of the potential for conflict is the degree of restrictions or prohibitions that the alternatives place on roads or federal leasable minerals. The alternatives vary in the extent to which they create dual potential effects on surface management and private mineral rights operations.

Gaps in Data (Reserved and Outstanding Mineral Rights)

One possible explanation for this difference is that the reserved or outstanding mineral rights on some tracts may apply only to part of tract. There are multiple tracts where the difference between recorded acres and GIS acres is greater than 1,000 acres. The existing information is insufficient to provide a reasonable estimate on the extent of current subsurface ownership Forest-wide. This lack of reliable information affects not only consideration of private mineral rights (subsurface ownership; reserved and outstanding mineral rights) but also consideration of federal mineral ownership on the tracts with unclear or unresolved mineral rights status. It likely would be time-consuming and costly, particularly if attorney’s opinion is sought, to remedy the insufficient information for the entire Forest. However, verifying the subsurface ownership status would be less time consuming for the limited number of tracts in Recommended Wilderness subject to ROR in Alternatives B and D.

Best Available Scientific Information - Reserved and Outstanding Mineral Rights

The analysis used the Forest Service GIS subsurface ownership data which is based on FS Lands Status records of tracts subject to reserved and outstanding mineral rights at the time of tract acquisition. Verification of the accuracy or currency of the FS Lands Status records is beyond the scope of the analysis. Verification of the accuracy or currency of the FS Lands Status records is conducted on a case-by-case basis when needed as part of Plan implementation.

Social and Economic Resources

Spatial and Temporal Context for Effects Analysis

The economic analysis area consists of 18 counties in western North Carolina that are adjacent to, or in the immediate vicinity of the Nantahala and Pisgah NFs. These 18 counties are Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Swain, Transylvania, Watauga, and Yancey. The largest counties, in terms of land area, are Buncombe, Burke, Haywood, Macon, and Swain County all with more than 500 square miles. Cherokee, Graham, Jackson, Macon, McDowell, and Transylvania Counties have the greatest number of National Forest System acres.

The revised Land Management Plan (LMP) temporal boundaries is 20 years so the effects are expected to last for at least 20 years or until a revised LMP is available or amendments are created.

Socioeconomic Indicators

Social and economic characteristics of the analysis area are described by the following indicators. Many of these indicators will then be used to explain the effects of the alternative management scenarios. For example, estimates of job and income contributions to the local economy by alternative are one way to understand socioeconomic impacts of different management alternatives on the local economies surrounding the Nantahala and Pisgah NFs.

- Demographics: Population, Age
- Economy: Income, Median Earnings, Non-labor Income, Employment, Unemployment
- Public Values
- Benefits to People: Ecosystem Services

Economic Methodology

Economic impact analysis estimates the role of NFS resources, uses, and management activities on employment and income in the communities that surround the Nantahala and Pisgah NFs.

Economic contribution to the 18-county analysis area was estimated with input-output analysis using the IMPLAN (IMpact analysis for PLANing) modeling system (MIG 2016). The modeling system allows the user to build regional economic models of one or more counties for a particular year and estimates the economic consequences of activities, projects, and policies on a region. IMPLAN uses Forest Service data on expenditures and resource uses to estimate the economic consequences of Forest Service management. Quantitative inputs (e.g., animal unit months, recreation visits, and Forest Service and Department of Interior payments to counties) were obtained from Forest Service program areas for this analysis. The model for this analysis used the 2016 IMPLAN data, which is the latest available dataset.

Input-output analysis represents linkages between sectors in an economy. IMPLAN not only examines the direct contributions from the analysis area but also indirect and induced effects. Indirect employment and labor income effects occur when a sector purchases supplies and services from other industries in order to produce their product. Induced effects are the employment and labor income generated as a result of spending new household income generated by direct and indirect employment. For example, visitors to FS managed land spend money on accommodation and food. Accommodation and food service businesses buy supplies from other businesses. The employees of these firms spend their earnings on a variety of goods and services. These transactions result in direct, indirect, and induced effects, respectively, in the regional economy.

Potential economic impacts are assessed using the model, and therefore results, are specific to the analysis area chosen. Results for individual forests and grasslands in an area cannot simply be summed together to get meaningful regional or state contribution results because of overlapping economic areas of influence. Similarly, results cannot be easily disaggregated into smaller analysis units as appropriate analysis areas must be evaluated. The 18-county analysis area used in this analysis follows that selected and presented in the assessment. (Assessment, 2014).

Economic Analysis Spreadsheet Tool (FEAST) (USFS 2018) developed by the U.S. Forest Service Inventory and Monitoring Institute in Fort Collins, Colorado. This tool uses a Microsoft Excel workbook as an interface between user inputs and data generated using the IMPLAN input-output modeling system (MIG 2016).

The FEAST analysis assesses the economic impacts of the resource outputs projected under each alternative. Resource outputs in this context are the amount of a resource (forest products, AUMs, recreation visits, etc.) that would be available for use under each alternative.

Regional economic impacts are estimated based on the assumption of full implementation of each alternative. The actual changes in the economy would depend on individuals taking advantage of the resource-related opportunities that would be supported by each alternative. If market conditions or trends in resource use were not conducive to developing some opportunities, the economic impact would be different from the estimates in this analysis.

In addition to jobs and income supported by management of the National Forest, a third result from the analysis, value added, is reported in the FEIS. This was added based on comments from the public on the DEIS. Value added is a measure of the contribution to the Gross Domestic Product, GDP, a commonly reported indicator of the national economy.

Social Methodology

Forest management and planning issues are most often presented in terms of commodity uses (tangible goods), rather than by the peoples' interests and values (intangible goods) towards natural resources (Rolston and Coufal 1991). Therefore, in many cases, social indicators are described in terms of the effects that result from changes to natural resources. For example, changes in resource availability can potentially result in changes in the amount and quality of available resources, such as recreation hiking trails. However, according to Brown and Reed (2000) the less tangible interests and values of people are often the driving force behind forest planning and management debate.

Describing the Social Impacts of the forest plan includes understanding the values or interests held by individuals or groups that are affected by or interested in natural resource issues (stakeholders). Stakeholders base their desires in FS resources, resource uses, and management actions on the interests and values they hold. Oftentimes these values are put forth as an individual's or group's focus of interest, the basis for the agenda they bring forth, and/or determines what an individual or group finds valuable in contributing to their quality of life. Social impacts use potentially affected stakeholder groups to reflect the concerns of stakeholders and potential effects to them.

There is considerable complexity involved in understanding the interests and values of stakeholders; in part, due to the fact that individuals and groups can embrace multiple interests. At times these interests can be in conflict with each other and it is up to that individual or group to prioritize their interests in order to address the natural resource issue. Therefore, the social impacts of the analysis area are based on the interaction of the identified interests with estimated changes to resource availability and uses. Indicators, such as acres, have been identified to help guide the assessment of values. The analysis is primarily qualitative. However, quantitative measures, such as acres available for recreation are referenced, as appropriate.

The framework for the social analysis employs generalities. Area residents and Nantahala and Pisgah NFs visitors have diverse preferences and values that may not be fully captured in the description of social consequences. Nevertheless, the general categories are useful for assessing social impacts based on particular forest-related interests.

Additional Assumptions for the Economic Impact Analysis

Resource specialists projected annual resource outputs based on the best available information and professional judgment. The purpose of the social and economic analysis is to compare the relative impacts of the alternatives. Changes in use levels were estimated using professional judgment. However, actual changes in use are difficult to predict.

Recreation Economics

Total annual recreation visits obtained from the National Visitor Use Monitoring Program (NVUM)[15] suggest more than 5 million recreational visits annually to Nantahala and Pisgah NFs NF (Table 2). Recreation visits on the Nantahala and Pisgah NFs are assumed to be distributed among visitor types according to the patterns observed on the entirety of the National Forest of North Carolina—the primary sampling unit for NVUM. The distribution of visitor type (i.e., local or non-local visitor) and use type (e.g., was the visit wildlife-related?) are used to estimate visitor spending (Table 3). Average visitor expenditures by type are reported for the entirety of the National Forests of North Carolina and were obtained from the NVUM program (White 2017). Wildlife and fish-related visits—this includes hunting, fishing and wildlife viewing as the primary activity during the visit—is reported separately since the Forest Service has a variety of policies and management efforts aimed at conserving wildlife habitat and wildlife populations. Although the analysis of this plan revision did not require it, this would allow reporting of outcomes related to these investments. In this analysis, separate reporting allows the relative contribution of this visit type to be illustrated.

[15] The National Visitor Use Monitoring survey provides estimates of national forest visitation, sampling visitors at four site types, including wilderness sites. Approximately one-third of visitors sampled completed a survey about their spending behavior related to their national forest visit. Information gathered through the National Visitor Use Monitoring survey is used to develop estimates about recreation on national forests such as the number of forest visits, participation in recreation activities, spending profiles for visit types (day/overnight, local/nonlocal), and the economic contribution of national forest recreation on local communities (Hjerpe, Holmes and White, 2017). The economic contribution of recreation visitors, along with other programs, to the Nantahala and Pisgah NFs is presented in the effects analysis.

A new round of NVUM estimates were completed between DEIS and FEIS. These updated recreation visitation estimates were used for the analysis in the FEIS. NVUM reports an increase in total recreation visits to the Nantahala and Pisgah NFs over the previous survey round. Relative to the results reported in the DEIS there are less wildlife-related visits and a larger portion of those visits are from local visitors. This partly drives the changes in estimated economic impacts relative to those reported in the DEIS.

Table 2. Annual Recreation Visits

Segment	Non-Local Visitors			Local Visitors			Total Annual Visits
	Day	Over-night on FS	Over-night off FS	Day	Over-night on FS	Over-night off FS	
Non-Wildlife Related	488,694	244,347	635,302	3,371,989	146,608	0	4,886,940
Wildlife Related[A]	13,403	5,361	26,806	209,087	10,722	2,681	268,060
Share of Total Visits	10%	5%	13%	70%	3%	>1%	5,155,000

[A] Wildlife and fish-related recreation includes viewing wildlife, fishing, and hunting as the primary activity during visit.

Source: USFS, 2020

Table 3. Spending Profiles by Trip Segment Type, Dollars Per Party Trip

Segment Spending Profiles	Non-Local Visitors			Local Visitors		
	Day	Overnight on FS	Overnight off FS	Day	Overnight on FS	Overnight off FS
Non-Wildlife Related	$76.19	$396.45	$801.20	$24.98	$180.52	$293.73
Wildlife Related	$73.80	$349.20	$547.40	$47.40	$222.10	$240.30

Source: White, 2017

The economic impact analysis examines the economic significance of outdoor recreation on the Nantahala and Pisgah NFs to the analysis area economy and includes the effects of spending by all visitors, both those who reside in the analysis area and those who do not. The analysis shows the size and nature of economic activity associated with these recreational experiences to show contribution to the local economy.

Minerals Economics

Currently a minerals materials contract for crushed stone exists on Nantahala and Pisgah NFs. The five year contract allows the purchaser to buy and extract up to 250,000 short tons/year of crushed stone at $.20/ton. This contract has been renewed several times. The quantities removed are not expected to differ between alternatives. However, in practice the actual quantity extracted varies from year to year. Potential energy and non-energy minerals, including leasable hardrock minerals, are discussed in the Minerals and Energy section of the EIS. Economic impacts, in terms of jobs and income, of mineral potential are not estimated in this document.

Timber Economics

The timber analysis examined economic activity of stumpage flowing through logging companies, sawmills, firewood sales, and other wood products. Baseline information on the average annual volume (cubic feet) cut and estimates of harvests anticipated under the alternatives were provided by the Nantahala and Pisgah timber specialist based on vegetation modeling (see the terrestrial ecozone section of the EIS for more). Table 4 provides the estimated annual forest product volumes available, by alternative. Details of how these numbers were developed may be found in the Forest Plan timber calculations suitability appendix (Plan Appendix B).

The economic impact analysis used the average across action alternatives of the estimated annual forest product volumes. Estimated differences across alternatives given these modeling approaches is minimal and actual resource use will fluctuate based on local and global market conditions. Therefore, an average was used to represent the economic significance of the timber program, showing the size and nature of the economic activity associated with action alternatives. This allows comparison to the no action alternative, as well as other resource programs on the forest, and avoids implying there are meaningful differences across alternatives. Alternative E is also reported separately in the FEIS, although this again should not imply a meaningful difference from other action alternatives.

The direct effects were estimated using direct response coefficients developed from a national Timber Mill Survey conducted by the University of Montana's Bureau of Business and Economic Research (Sorenson et al, 2016[16]). These timber response coefficients are broken into multi-state regions and are considered more accurate than those available from IMPLAN. The indirect and induced effects were generated by the IMPLAN model.

The DEIS assumed that only a portion of the timber harvested was processed within the 18-county analysis area. This was based on information from the USDA Forest Service Forest Inventory and Analysis Timber Product Output Database. The FEIS refines this general assumption and the results of the analysis show the impact when all timber harvested is processed within the 18-county analysis area.

Table 4. Estimated Annual Forest Product Volumes, by Alternative

Forest Product	Alternative A	Alternative B		Alternative C		Alternative D		Alternative E	
	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
Harvest-Softwood Sawtimber (CCF)	3,657	7,948	12,530	7,310	12,403	7,914	12,515	5756	12625
Harvest-Softwood Pulp (CCF)	386	9,468	15,134	8,695	15,018	9,420	15,127	7125	15100
Harvest-Hardwood Sawtimber (CCF)	8,858	11,109	31,513	11,291	32,412	11,092	31,238	12441	32185
Harvest-Hardwood Pulp (CCF)	2,280	14,642	42,775	14,915	43,739	14,558	42,479	17694	40848
Posts (CCF)	54	54	54	54	54	54	54	54	54

[16] Sorenson, C., C. Keegan III, T. Morgan, C. McIver, M. Niccolucci. 2016. Employment and Wage Impacts of Timber Harvesting and Processing in the United States. Journal of Forestry, 114(4) 474-482.

Forest Product	Alternative A	Alternative B		Alternative C		Alternative D		Alternative E	
	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
Fuelwood (CCF)	1,310	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640

Source: Nantahala and Pisgah NF resource specialists.