

Data Submitted (UTC 11): 4/8/2024 4:00:00 AM

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Comments: The Telephone Gap Integrated Resources Project (TGIRP) Preliminary Environmental Assessment (EA) provides comprehensive analytic detail on many topics. However, even with all that detail, I find many conclusions potentially flawed, perhaps fundamentally flawed, because the EA assumes that the Telephone Gap landscape, and its associated forest, is similar to the rest of the forests on the GMNF, and because needed actions for the TGIRP are derived from the dated 2006 Forest Plan, a time when climate change wasn't even a component to land stewardship thinking in any detail. In reality, the TGIRP project area is uniquely different and includes some of the rarest forest development, habitat and soil conditions within the GMNF.

The first rarity is that this section of the GMNF is underlain by the only calcareous bedrock found within the bulk of the GMNF ownership, outside of its small ownership in the Taconic Mountains in the southeast region of Vermont. The TGIRP sits at the junction of the Taconic mountains, which have enriched calcareous bedrock, and the Greens Mountains, which are acidic without calcareous enrichment (E. H. Thompson and E. R. Sorenson 2000 Wetland, Woodland, Wildland A Guide to the Natural Communities of Vermont). Most of this slightly enriched rock is mapped in the northern third of the TGIRP, but given the difficulties in precisely locating types of bedrock folded together, and the natural communities we find in the soil overlaying that bedrock, the enrichment is likely to affect much of the TGIRP soil and thus ecology (Ratcliffe, N.M., Stanley, R.S., Gale, M.H., Thompson, P.J., and Walsh, G.J., 2011, Bedrock geologic map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 sheets, scale 1:100,000 accessed via Google Map 4-6-24). Management of rich forest brings challenges and opportunities, even without the added challenge of how climate change will act upon the forest.

The second rarity is that much of the second growth forest within TGIRP is exceedingly old compared to other second growth stand ages within Vermont, and probably even New England. The Figure 2 graph on page 37 of the EA shows an older age structure unlike nearly any other Vermont forest. As we know much of this region was stripped of its original forests; only .3% of New England's forests are 150+ years old (Kellest et al. 2023 Frontiers in Forests and Global Change), often in steep areas that were very hard to log using older technology. One such forest found within the TGIRP is set aside as the 297 acre The Cape Research Natural Area. However, to develop a forest age structure shown in Figure 2 over an easily accessible second growth forest made up of thousands of acres over 100 years of age, with areas large enough to be labeled stands of 150+ years of age, is simply unheard of. Many of our wilderness areas will eventually reach that stage, but TGIRP already represents an investment of 3-5 generations in allowing a second growth hardwood forest to simply recover from its earlier removal but without permanent conversion. Almost no parcels in Vermont have had an ownership and management history that combine in this way. The precautionary principle should be followed as we decide harvest prescriptions before we potentially irretrievably alter or even destroy that investment of time.

WHY DOES THIS GEOLOGIC LOCATION AND MANAGEMENT HISTORY MATTER?

First, unmanaged time does matter for second growth forests. As the Landscape Assessment for TGIRP stated on page 11: "Stands that have generally remained unmanaged since land abandonment have the greatest potential to develop old growth conditions over the next 100 years." As outlined above, this area has many acres that meet this condition, and seeing how these forests respond to climate change on some substantial portion of acreage will be important for understanding how management changes forests. Once any stand is managed under any of the presented alternatives, we lose that continuity of past time investment and any possibility of that these stands actually become ecological old growth forest. From my perspective as an ecologist the fact that these forests have matured to very old ages during a time when the invasive species load in the wider landscape was at a minimum is very critical history we cannot ever repeat. We know there are likely stands outside suitable forest lands that could also have this continuity of time, but there is no way to know where those sit in the

landscape other than they largely represent steep lands and thus ecologically a poorer, more stressed example of the natural community, and most likely less rich example, as most rich soils are generally downslope of steep areas.

I recognize that the Landscape Assessment for TGIRP used Ecological Land Units (ELUs) to predict what forest types the different stands would originally have supported and thus their desired future. I also know that probably more of these stands would be northern hardwoods with a spruce and/or hemlock component originally, and both the stand data details and the Landscape Assessment show that there is an understory of spruce often present. However, there are also abundant clues that the predominance of northern hardwood within TGIRP is not a historical accident based on the cutting of spruce and thus lack of seed source, but rather a response to the fact that the forest here is enriched beyond the normal small stands of rich northern hardwoods found in coves and other pockets of enrichment typical throughout Vermont. Foremost among those clues is on page 8 of the Landscape Assessment, which states that evidence of calcium enrichment was found and that several sites of rich forests are higher in elevation than would be normal in the GMNF. The two prime examples would be The Cape, and the fen and forests on Blue Ridge. As I argued in my prior scoping comments (Roe, 1489- 19), the fact that the canopy map shows a high proportion of trees are over 100 feet high, which is atypical in normal second growth northern hardwoods, and probably indicates rich conditions over large areas of TGIRP.

Stand age is important because one compares the stocking levels, condition and species mix one sees in the field against either formal or informal models of where one would expect a particular stand to be at its presumed age. This would also be true when comparing what is growing in the herbaceous and shrub level of the forest with what one would expect in that natural forest community. Stand age is inherently part of determining if stewardship actions have been successful. In a situation like this where there are indications that richness may be a factor, age of a stand becomes critical because many of the normal assumptions about when the mean annual increment of growth is maximized, such as at 50-70 or 95 years in natural or managed stands respectively (see discussion on P24 of Landscape Assessment), no longer hold true. Rich hardwoods grow tall and fast for long periods. Therefore, the fact that the oldest stand at 161 years of age (145-13), when it should be showing signs of gap formation, is instead proposed for non-commercial cutting to create down wood and dead trees for late successional habitat purposes could be a result of either the stand age is wrong, or it is a rich site and it is simply still healthy and hasn't started the process of gap formation.

It is simply astounding, compared to the world of private lands forestry, how much data is available on the stands in TGIRP. Diameters down to a .1 inch at .1 inch increments, complete stems per acres and sample sizes of multiple hundreds of thousands of trees. Unfortunately, the data on stand age is old, its methodology somewhat unknown, and often with limited sample size. Based on discussion with GMNF staff, they have low confidence that the core samples taken were necessarily representative of the stands, they were few in number, and might even represent someone measuring what they thought was the oldest tree. This situation is unfortunate, given that so much of the GMNF plan is based on age class targets, and because how we judge whether a mature forest is old and thus represents a rare feature to be potentially preserved is age based. I have chosen to believe that it is more likely that someone aging trees knew a representative sample was important, and that our judgement that old stands are actually younger is just due to how rare it is that any of us have direct experience in rich second growth that is 150 years old.

If many of these stands are rich mature hardwoods, how they are harvested will matter immensely. More harvest intensity than relatively small group selection (gaps of one to two tree heights in diameter) or a variable density thinning that both keeps gaps this small and keeps total stand crown closure over 80% will be important to hinder invasive species. Because these are rich soil stands, probably their greatest threat to providing excellent timber is being captured by invasives, particularly buckthorn, honeysuckle and barberry because they are commonly found in the landscape, can grow in shade once established, and are easily transported by birds. (Managing Rich Northern Hardwood Forests published by The Nature Conservancy, undated but circa 2003, booklet attached, produced by a work group of foresters and ecologist familiar with the Taconic forests).

The following paragraph from something I wrote years ago is a precautionary tail that rich hardwood sites need to be considered sensitive sites where a light touch is rarely wrong. It cannot be emphasized too strongly that in a rich northern hardwood natural community the land use/management history will have a profound effect. Careful management will reward one with highly diverse stands and very high canopy tree basal areas on very tall trees. Poor management will result in a stand with dense invasive species, poor regeneration, and potentially a long term, if not nearly permanent, loss of high productivity. A property ownership line splitting a rich northern hardwood community provides real-life perspective (J. Roe, personal observation). On one side of the property line, a stand obviously had a long history of no or light harvest, was full of rich-site plant indicators, and was dominated by very large trees at high stocking levels. Immediately adjacent on the other ownership was a stand where the history was one of obviously relatively heavy harvest, very poor canopy closure and obvious high grading. That stand had no herbaceous rich-site indicator plants, and looked much more like a normal northern hardwood forest with very poor canopy structure. Both stands sat in a landscape of high soil enrichment, and yet their future potential could not have been more starkly different.

Interestingly, within the TGIRP there may be a similar example, though I have never walked that site. There were a fair number of patch-cuts (clearcuts) made in northern hardwood stands in the 1990s. In all of the management alternatives in the EA these areas will undergo "growth enhancement" treatments. The hardwood stands in Compartment 142 south of The Cape are a good example. The 1990 patches sit in a group of stands that are all 159 years old with mean stand diameters of 12.5 inches and higher and high basal areas about 130 sq. ft. per acre. The patches currently have total basal areas of either 10 or 20 sq. ft. with mean stand diameters of 1 or 2 inches. These would be considered failed patch cuts as no one intends to cut an impressive maple stand to end up with 1" diameter trees after almost 35 years of new growth. Another stand that included red spruce (134-9) had a similar fate - after 37 years of growth the has a basal area of 10 with a mean diameter of 1". Because of their age and landscape position I would not harvest any of the old stands in Compartment 142, but I would also argue that even their proposed late successional enhancement under Alternative C & D is ill advised.

CLIMATE/CARBON ISSUES TO INCLUDE IN THE FINAL EA OR AN EIS

1. Red Spruce Long Term Viability: There is no acknowledgement in the EA that a USFS Northern Research Station General Technical Report NRS-173, (2018) raises serious issues about the wisdom of using the HMU objective laid out in the 2006 Forest Plan for mixed forest goals (which I raised in my prior comments (Roe 1489-7)) as the driving justification for some of the stand management choices. In fact, this report, in the EA cited as Janowiak et al. 2018, is actually used on P 55 of the EA as a source saying the management activities are anticipated to increase the adaptive capacity of the forest ecosystem to climate change. There is no question that seedling and young spruce have responded well to the decades of decreasing air pollution. The issue is whether focusing on a large-scale species diversification of crown species, at the cost of northern hardwoods forests, particularly maple which was deemed in the report as more likely to be stable in the fact of climate change. That doesn't mean don't release or encourage existing spruce understory if appropriate in the context of managing for hardwood species. It does mean not to use mixed wood from spruce as the driver and justification of the management actions.

2. Mature, Old Forests, and Large Trees Sequester More Carbon Than Any Harvest Regime: There are two conclusions in the EA that are incorrect. On page 60 the statement that carbon storage approaches a maximum potential has long been assumed, but a study specifically reviewing carbon flux in 519 studies, covering stands from 15 to 800 years old globally, found that carbon storage was positive for 75% of the stands over 180 years old and the chance of an old-growth forest being carbon neutral was only 10% (Luyssaert et al 2014 as cited in Anderson, M.G. 2019 Wild Carbon: a synthesis of recent findings. Northeast Wilderness Trust). On page 65 there is a statement "Over the long-term (50-100 years), timber harvesting (including clearcutting) does not typically have negative effects on total carbon storage." and among the cited studies is Nunery & Keeton 2010. The statement simply does not reflect what that 2010 study showed - the modeling demonstrated that among various harvest regimes, the unharvested forest always stored much more carbon than harvested forests over any time

frame, all the way out to 160 years. There is a huge literature developing around this issue and the Anderson article and a follow-up one (Anderson, M.G. 2021 Wild Carbon: Analysis of sequestration in old forests. Northeast Wilderness Trust) provide a succinct entry into it for anyone not familiar with the state of research. Finally, while it is hard to follow, the carbon analysis of the TPIRP harvest needs to compare the difference between carbon sequestered under each scenario with each other, not with the whole forest or the amount of ASQ not used, so to speak - showing it is a small percentage of total forest production is not demonstrating anything about carbon impact. (I also think that the EIS needs to incorporate the new research into their model and projections - I've attached the two Anderson articles for easy reference.)

1. Storage of carbon in Harvested Wood Products (HWP): The section on HWP carbon storage, EA page 64, needs to be checked for accuracy. The numbers used are wildly optimistic from other things I've read. It is literally impossible to say 91% of HWP are still being stored 10 years after harvest if the forest has anything close to the normal ratios of low quality pulp material, whose storage life is very short. Having 63 percent of HWP remain in use at 100 years also seems unrealistic.

2. Intent of Executive Order 14072 to conserve mature and old forests: The current EA is essentially silent on this issue beyond acknowledging the work and providing a breakout of stands that meet the Region 9 definition of old growth, which total 691 acres, as part of the late successional enhancement alternative development. One focal intent of EO 14072 was to support nature-based climate solutions by carbon storage and increasing biodiversity in the US National Forests. The proposed Alternatives C&D were developed to specifically create structural diversity within stands where structural and diameter diversity is low, which in reality is a choice to prioritize biodiversity over carbon storage. For the next 30-50 years I would prioritize carbon storage because the TGIRP has so many vigorously growing large trees that will continue to store large volumes of carbon over that time span compared to any harvest regime, and that is the period of time where society has to do all it can to maximize sequestration and minimize emission of carbon dioxide if we are going to escape the worst effects of climate change. Given that the definition of old forest in the current 2006 Forest Plan is 120 years of age I would recommend no harvest of stands aged as 120 years or more.

3. Invasive Species: It seems from the data presented that the TGIRP has just a few places where populations have a foothold. As a matter of good stewardship these should be eliminated whether or not any harvest moves forward at this time. If the TGIRP does contain extensive areas of rich northern hardwood forest, or at least extensive enriched sites, then invasives species is going to be the greatest threat the forest health and the ability to be resilient to climate change. Earthworms and garlic mustard are killer threats to northern hardwood forests over the long term because of their effect on the mycorrhizal fungi, rhizosphere and decaying leaf litter, which are all such an important part of the northern hardwood ecosystem. The eggs and seeds are easily transported by vehicles so one of the mitigations that should be included is high pressure washing of all equipment that is used in the TGIRP for harvesting, or any other vehicle that drives into remote areas on woods roads, prior to their entry. The late successional enhancement harvest methods go a long way to reducing the chance of a new infestation compared to Alternative B. However, it needs to be clearly acknowledged that all harvests add soil disturbance, sun and stress to a forest, which greatly increases the risk of invasives compared to just letting the forest grow and age on its own.

There are additional reductions in opening size possible that will reduce the risk and still reach habitat goals. A .25 acre opening is better than .5, but most early successional species like chestnut sided warbler will still easily use 1/10 and 1/20 acre openings, and you will also get regeneration of all the northern hardwood species at 1/10 acre. The discussion in the EA about invasive species underestimates the challenges in controlling invasives after a harvest, particularly at an enriched site. It has been the bane of management in southern Vermont for a long time. The EIS needs to more thoroughly compare and contrast the challenges, mitigations and risks associated with different alternatives and different harvest methods and intensity. I would not recommend any even aged management at these sites unless it is associated with creating aspen birch early succession and oak plantings.

6. Does Stand Age Structure Actually Increase Climate Resilience: The EA lacks a detailed discussion about how

stand resilience is increased by management designed to increase stand age structure diversity, particularly in mature, healthy, possibly enriched stands dominated by maple, which is a species likely to be resilient to much of climate change (USFS General Technical Report NRS-173 2018). Much of the literature makes this assumption about age diversity, but I have seen less confirming data about that diversity and more about increasing species diversity. In this situation the goal was to increase that diversity by increasing the amount of mixed wood stands, but the spruce and hemlock are both species that have more climate risk associated with them than the sugar maple (NRS-173). There is no question late successional enhancement increases biodiversity, but the Final EA or EIS analysis needs to carefully document how age structure management increases climate resilience, versus the decrease in resilience associated with the various stresses caused by harvests, particularly methods that greatly reduce the carbon density and soil integrity of mature forests that have few invasives presently.

MISCELLANEOUS ISSUES TO ADDRESS IN FINAL EA OR THE EIS EA or the EIS

7. How do the harvest-based Alternatives meet the goals of the Diverse Backcountry: The 2006 Forest Plan designated most of the TGIRP as Diverse Backcountry, which is defined as an area where the forest will predominantly be 150 years old or more. I raised this question in detail in my previous scoping comments (Roe 1489-29) and the summation response was categorized as "reduce regeneration harvest of older stands." That was not the intent; the intent was to question how any of these harvests were compatible with Diverse Backcountry goals and ask for a detailed explanation. The EIS or final EA needs to specifically justify how the various treatments, other than choosing Alternative A and allowing the forest that is already predominantly over 100 years old continue to grow to reach 150 years of age, meet the 2006 Forest Plan. I would argue that the current Forest Plan explicitly planned TGIRP to be a place of late successional and old forest to build off of its current status as a rare second growth forest already well on its way to meeting that goal, as shown by Table 2 on page 37 of the EA, which is where I started this discussion of the EA. It is not an acceptable argument, in the face of climate change, spruce's lack of projected resilience, and the investment of 3-5 generations of time, to simply argue the management Alternatives are following Forest Plan Goal 2 to increase mixed wood, and then after that GMNF will let it mature to be a 150-year-old forest.

That same Forest Plan Goal 2 also says it is appropriate to maintain northern hardwood sites that ecologically support these habitats. Walking in the TGIRP clearly shows that to be the case - mature forests of high stocking that are inordinately tall. The EA in various places emphasizes the need for management of TGIRP stands based on the risk that the timber will be past economic maturity and could be lost. Given this existing forest's attributes of large trees, this economic goal of the Forest Plan needs to be balanced differently and placed lower than the forest's ability to sequester large amounts of carbon. This is particularly clear since, as mentioned in the EA, during the next 15 years there will be relatively high amounts of wood harvested from the GMNF. As the Landscape Assessment makes clear in the discussion about cumulative mean annual increment, productivity in a forestry sense is all about the bole wood and its annual increment of growth. Ecologically, however, the health and productivity of the forest is all about the volume of wood that a tree and the forest as a whole adds, and the ability to move sugars to support the soil ecosystem, and the TGIRP forests are a long way from senescence. With a bit of luck, they won't be directly hit by a violent windstorm called a derecho, while they work to ameliorate the severity of future climate change driven weather.

CONCLUSION

I very much appreciate that Alternatives C and D were developed. They were responsive to the sentiment that the proposed action (Alternative B) was too aggressive and didn't adequately address climate change concerns. Alternative C&D are much better at incorporating ecological forestry and helping increase the biodiversity of mature forests. I also appreciate the openness and genuine helpfulness of the GMNF staff to get the public to understand a very complex document. A lot of good work went into this EA and my comments about what are its shortcomings from my perspective should not in any way detract from my real appreciation for all the work and thought that went into it.

Given what I know now, and how I balance the need for public forests, particularly ones with large trees, to play a lead role in carbon sequestration during the next 50 years, I decided the greatest public good would be Alternative A as the next phase of the TGIRP. If the GMNF staff does not agree with that choice then my balance point would be to create a new alternative based off of Alternative D, which is the existing alternative closest to my balance between simply let the forest mature and harvesting. My proposed alternative is outlined below. I also feel that the resources are so unique in the TGIRP that an EIS is warranted, unless the harvest is greatly reduced.

1. The EIS or final EA should address and analyze a new Alternative: The Forest Plan Goal 2 around maintaining northern hardwoods should be combine with the Forest Plan Goal 9 for Demonstration areas, in this case the late successional enhancement harvests. Use Alternative D as the base as it does a reasonable job of removing remote stands in areas likely to be enriched and supports water quality better than B or C. Then, from that base make the following adjustments:

- * No harvest of any stand older than 120 years of age, the definition of old forest in the current Forest Plan, so that the alternative is biased to retaining the largest trees which should grow for many years for carbon sequestration and undergo natural gap formation as the forest ages.
- * No harvest in the Pittenden Inventoried Roadless area.
- * No harvest of rich northern hardwood communities north of the Chittenden Town Forest.
- * Maintain the aspen/birch early succession goals, but place the clearcuts as much as possible in younger stands with maximum opening sizes of 3-10 acres, but totaling the same acreage.
- * Maintain the growth enhancement work in the old 1990's patch cuts.
- * Maintain the climate change planting work with oak
- * Instead of proactively removing hazard ash along the roads, do it when needed as a way to add downed wood into these stands.
- * Only use uneven aged harvest prescriptions outlined in the late successional enhancement techniques for harvest, except for the aspen/birch and climate planting work. Whenever possible, use small group selections, with explicit guidance on using a range of opening sizes from very small .1 acre to 1 acre with a one-acre opening being very rare and ones smaller than .5 acre very common, or variable density thinning with a bit more use of skips. The goal is to make sure a significant proportion of the stand does not have a disturbed floor or canopy, while making sure there are distinct areas of early succession. The wildlife, particularly birds, will respond better to a mix of distinct habitat types versus more uniform reduction of volume. These harvests should also have explicit downed wood and snag goals.
- * This alternative should be explicitly designed to meet the goals of the Diverse Backcountry of a forest that is 150+ years old.