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Comments: To Objections Reviewing Officer

Helena-Lewis and Clar

The USDA Forest Service has released its Revised Forest Plan and related documents for the Helena-Lewis and Clark National Forest (hereafter the Forest). The objection period opens on May 21, 2020 and runs through July 20, 2020.

Herein I will argue that the Forest has done a commendable but nevertheless objectionable job of advising stakeholders, the larger public, and policy makers about risk to the persistence of forested lands under its management. While the Forest has come a long way since it issued documents in preparation for the scoping period, it has fallen short of reporting requirements set out in the Administrative Practices Act, the National Forest Management Act, and the National Environmental Policy Act.

I have previously commended the Forest for its candor in reporting specifically on the risk and consequences of seedling/sapling (hereafter seedling) mortality in hotter and drier post-fire conditions. I stand by those post fire-specific, commendations, with important exceptions to be detailed below, and, in fact, those commendations set a base for my objections.

Herein, despite those commendations, I will document that the Forest has, however unintentionally, seriously misled stakeholders, the larger public, and policymakers at all levels, by misrepresenting the state of the forest it manages. This misrepresentation exists when the Forest says that, at some point in the future, [ldquo]sites[rldquo] on the forest it manages may shift to a novel ecosystem. This statement is a misrepresentation because that forest has already become a novel ecosystem, seems on a climate- and management-driven path to an even more novel ecosystem, and that an increasingly novel ecosystem will be forcing the Forest into novel management actions. This matter is of such considerable material interest to present and future generations of stakeholders, present and future members of the public, and present and future policymakers that I object to the Forest[rldquo]s misrepresentation and consequent failure to provide clear and whole cloth reporting about it..

I will also make a case that, while the Forest has done a commendable job of providing scattered bits and pieces of information specific to post-fire seedling mortality, and thus post-fire risk of forest persistence, I will herein document that this same and pervasive scattering of important bits of information has considerable potential to mislead and even confuse stakeholders, the larger public, and policymakers at all levels about the challenge to the Forest[rldquo]s stated intent of managing to maintain or sustain a popular status quo that the Forest frequently depicts in terms of resilience and integrity. I think and I think others will agree that risk does exist for misleading or even confusing stakeholders and others about plausibility of maintaining or sustaining a popular status quo of forest persistence/resilience. This too is of such considerable material interest to present [mdash] and future

[mdash] generations that I object to the Forests failure of clear, coherent, and whole cloth reporting about it.

Moreover, I will demonstrate herein that, in contrast to coherent, clear, whole cloth disclosure, the Forest has unnecessarily and arbitrarily scattered information of clear material interest to present and future generations into bits and pieces that arbitrarily obscure forest conversion to a novel ecosystem.

I hope this comment on commendations and objections will help the Forest add clarity that is currently lacking.

To begin with an example of the commendable, the Forest offers these three factual and informative observations:

[ldquo]Human activities such as fuel burning, industrial activities, land use change, animal husbandry, and agriculture lead to increases in ambient greenhouse gases (GHG[rsquo]s), which contribute to the [ldquo]greenhouse effect[rdquo] (Melillo, Richmond, & Yohe, 2014). Warming temperatures are the most certain consequence of increased carbon dioxide in the atmosphere (Halofsky et al., 2018a).[rdquo]

[ldquo]Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive (J. E. Halofsky et al., 2018b)[rdquo]

[ldquo]As a cornerstone, the Plan relies on desired condition envelopes that are informed by the natural range of variation (NRV), but also incorporate adjustments that reflect possible future conditions, such as allowing for more nonforested plant communities.[rdquo]

These three above excerpts from FEIS Chapter 3 Part 1 commendably serve to document a sequence of connected actions linking greenhouse gas emissions to warming temperatures, the warming temperatures[rsquo] effect on the ecosystem [mdash]including shift to a novel ecosystem increasing favored by drought tolerant species [mdash] and agency response via new and novel management actions. This description of connected progressive change forced on an ecosystem by climate change is therefore illuminating, informative, and fully consistent with requirements of the Administrative Practices Act, the National Forest Management Act, and the National Environmental Protection Act.

Trouble is, the Forest has somehow decided [mdash] after lengthy deliberations requiring months-long delay in release of recent documents [mdash] not to present the three informative paragraphs as shown above.

Instead, the first paragraph is presented on page 304 of FEIS Chapter 3 Part 1, the second paragraph is on page 170 FEIS Chapter Chapter 3 part 1, and the third paragraph on page 227 FEIS Chapter Chapter 3 part 1.

This is just one of unnecessarily and arbitrarily disjointed disclosure of matters of material interest to stakeholders, the larger public, and policymakers.

While the Forest might argue that I cite these examples out of context, it is my argument here that the Forest itself has first cited them out of context. Alas, this is part of a consistent pattern repeated again and again. In fact, this very pattern is evident in the pages devoted to commendations in my first response , #44589, submitted on June 21, 2020; i.e., even a cursory review of those commendations will show that I had to pull together widely scattered bits and pieces of information in order to set a basis for those commendations.

To be clear, I stand by those commendations, and by my remark that the Forest has told it like it is. Those commendations were based on the Forest's candor about the specific risk to future timber output specifically originating with post-fire seedling mortality. This candor, albeit scattered in bits and pieces, did put the Forest in the unpopular position of challenging a popular hope of forest sustainability, and thus being the bearer of bad news about the future of timber output and associated livelihoods. I said and still see that candor as commendable.

However, and it's a big however, the story of climate-driven risk to forests must be described in whole cloth, not in unnecessarily and arbitrarily scattered bits and pieces. Commendable though it may be to provide the scattered bits and pieces, that approach effectively, almost as if by design, raises completely unnecessary and arbitrary barriers to accessibility by stakeholders, the larger public, and policymakers.

This is especially objectionable when, in fact, the Forest has indeed demonstrated capability for at least approaching an integrated, whole cloth description. The Forest approached a more contextual report in its disclosure in the specific case of risk from seedling mortality spanning pages 169-173 of the FEIS Chapter 3 Part 1. It was in these 5 continues pages that, to its great credit, the Forest has volunteered a key bit of information on p. FEIS p 171; [ldquo][hellip] forest resilience is dependent on tree regeneration.[rdquo]

However, even this bit of information was unnecessarily and arbitrarily isolated from the equally key and plainly connected piece of information on p6 of FEIS Appendix J. Climate and Carbon, that [ldquo]It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems). It is even possible that large disturbances and site-specific shifts could occur within the planning period.[rdquo]

All in all, the Forest has come a long way, and yet, it still has a long way to go.

So far, by scattering important bits and pieces of pieces of information willy-nilly, the Forest has effectively even if unintentionally, unnecessarily, arbitrarily and capriciously deprived stakeholders, the larger public, and policymakers at all levels that the forest it manages has already become a novel ecosystem not just on [ldquo]sites[rdquo] but across the forested lands as a whole, that it will inevitably become an even more novel ecosystem, and that it will trigger increasingly novel management actions as changing climate pressures persist.

I object to this totally unnecessary, arbitrary, and capricious scattering of information that is of clear material interest to stakeholders, the larger public, and policymakers.

There[rsquo]s an especially compelling problem when the Forest says, on p. 6 of FEIS Appendix J. Climate and Carbon, that [ldquo]It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems).[rdquo]

The reference to [ldquo]sites,[rsquo] although realistic enough in its own way, fails to advise stakeholders, the larger public, and policymakers that the ecosystem as a whole is, already, a novel ecosystem that will become even more novel and will lead to novel management actions.

I object to the Forest[rsquo]s failure to report, in whole cloth, that the ecosystem as a whole is, now, already, a novel ecosystem that will become even more novel and will lead to novel management actions.

Again, I hope this comment and objection will help the Forest add clarity that is currently lacking [mdash] and all but absent in the largely vacuous draft Record of Decision.

1- Already a novel ecosystem : A broad-brush depiction

Draft ROD Need for Change p.4 - [ldquo]The 1986 Forest Plans for the Helena and Lewis & Clark National Forests were prescriptive, inflexible, and redundant with law, regulation, and policy; as a result, they impeded efficient management of the Forests[rsquo] resources. At more than 30 years old, these plans exceeded the 10-15 year duration of plans intended by the National Forest Management Act. In addition, over the last 30 years, the social, economic, and ecological conditions across the Helena [ndash] Lewis and Clark National Forest have changed [hellip][rdquo]

While the above-noted change of [ldquo]ecological conditions[rdquo] may have arisen for more reasons than one, the noted change of these conditions in the recent 30 years does suggest an already novel ecosystem.

An example of this change seems strongly suggested [hellip] [ldquo]However, some dry forest sites may convert to nonforested plant communities for a substantial amount of time, or permanently, following fires, especially in xeric settings or where no nearby seed source remains (Rother & Veblen, 2016); (Stevens-Rumann et al., 2017). Such an example has already occurred in the northern Big Belts GA, where a severe fire in the 1980[rsquo]s (followed by a reburn decades later) resulted in conversion of some ponderosa pine sites to grasslands.[rdquo]

So we have at least this one example of conversion to non forest, in the Forest[rsquo]s own word, [ldquo]already.[rdquo]

Such change is further suggested as consistent with a broader pattern. in FEIS chap 3 part 1, p. 148, the Forest disclosed that, [ldquo]increasing rates for forest decline have been concentrated in the western U.S. where extended droughts have coupled with increasingly high temperatures to create increasingly stressed and vulnerable forests (Cohen et al., 2016).[rdquo]

A plausible path to an increasingly novel ecosystem

FEIS Chapter 3 part 1 p. 210[mdash][ldquo]If climatic temperatures continue to increase, there may be changes in vegetation where there is a shifting from more mesic (moist) plant associations to more xeric (dry) communities that are better adapted to the drier sites. As a result, it is expected that bare ground would increase within these plant communities as rangeland sites become drier during extended periods of drought (Pellant, Abbey, & Karl, 2004).[rdquo]

FEIS Chapter 3 part 1 p. 220 [mdash] [ldquo]It is possible for climate change to impact resource use within a short timeframe, which could change the suitability and utilization of forage. For example, there have been periods of increased summer temperature and decreased summer precipitation over a 15- to 20-year planning period which would indicate that the potential for changes in the suitability and utilization of forage within a grazing allotment may change within a planning period.[rdquo]

These changes, like changes in timber output, are of material economic interest to stakeholders, the larger public, and policy makers, including material economic impact on livelihoods.

Novel management actions

FEIS Appendix J Carbon and Climate p 4 [mdash] [ldquo]As a cornerstone, the Plan relies on desired condition envelopes that are informed by the natural range of variation (NRV), but also incorporate adjustments that reflect possible future conditions, such as allowing for more nonforested plant communities.[rdquo]

FEIS Chapter 3 part 1 p 277 [mdash] [ldquo]As the agency responds to climate change by new, different, or more land and vegetation management actions, those disturbances could provide suitable conditions for invasive plants.[rdquo]

Alternatively, to avoid forest conversion to non forest, novel management action could consider that, "The challenge for managers will be to consider the balance between retaining current species and encouraging colonization by new species.[rdquo] Chris D. Thomas Phillipa K. Gillingham. The performance of protected areas for biodiversity under climate change. Biological Journal of the Linnean Society, 1 July 2015, Pages 718[ndash]730

2 - Already a novel ecosystem [mdash] risk of seedling mortality, regeneration failure, and lost resilience

Already a novel ecosystem

page 172 FEIS, Chapter 3, Part 1 statement that, [ldquo]However, some dry forest sites may convert to nonforested plant communities for a substantial amount of time, or permanently, following fires, especially in xeric settings or where no nearby seed source remains (Rother & Veblen, 2016); (Stevens-Rumann et al., 2017).[rdquo]

Importantly, the Forest then immediately goes on to say, [ldquo]Such an example has already occurred in the northern Big Belts GA, where a severe fire in the 1980[rsquo]s (followed by a reburn decades later) resulted in conversion of some ponderosa pine sites to grasslands.[rdquo]

What we see above is a description of risk climate-driven deforestation, with non-negligible potential for affecting the young of this generation and of future generations to come.

On a plausible path to an even more novel ecosystem

This topic was already covered in the commendations cited my communication of June 21 #44589. However, it's worth repeating the the Forest's own forward-looking heads-up comment on FEIS Appendix J Carbon and Climate p.4 ; [ldquo]Plan direction, which emphasizes ecological integrity and resilience, will be critical to minimizing the undesirable effects of these increasing and interacting stressors. Nevertheless, managers and the public should expect climate change to drive changes on ecosystem structure, function and composition in the coming decades.[rdquo]

And on a path to novel management actions

Novel management action might include, as suggested on FEIS Appendix J Carbon and Climate p.2 , [ldquo][hellip] allowing for more nonforested plant communities.[rdquo]

3- Already a novel ecosystem : a more fire-driven ecosystem

Chapter 3 Part 1 FEIS

<<https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd743366.pdf>>

P 85 Chapter 3 Part 1 FEIS [mdash] [ldquo]The Forest has experienced an increase in large fires over the last two decades.[rdquo]

P 129 Chapter 3 Part 1 FEIS [mdash] [ldquo]Large fires have occurred across the plan area since 1940. The decade that saw the most acres burned was 1980-1989, during which over 500,000 acres burned on the HLC NFs. Acres burned and the number of large fires appears to have increased since 1980, as shown in Figure 4. The increase in burned area may be in part due to 1) fuel buildup caused by fire exclusion (especially in low severity regimes), 2) climatic conditions, 3) the influence of a warm/dry climate on vegetation, fire behavior, and effectiveness of suppression, 4) recent fire policies that have allowed natural fires to burn, and 5) more complete recordkeeping processes. The increase in acres burned is consistent with other observations in the northern Rockies. Westerling and others (2006), attribute increase in wildland fire frequency over the last twenty years to alterations in fire regimes due to climate changes.[rdquo]

P 363 Chapter 3 Part 1 FEIS [mdash] [ldquo]In recent years, fires have occurred with increasing frequency, size, and severity.[rdquo]

Likely to become an even more novel, more fire-driven ecosystem

P120 Chapter 3 Part 1 FEIS [mdash][ldquo]Under all alternatives, in addition to smoke emissions from land management activities, climate change would affect smoke emissions. Decreasing snowpack, earlier spring time conditions and snow melt, and longer, warmer fire seasons would increase the frequency and area burned by wildfires.[rdquo]

P 130 Chapter 3 Part 1 FEIS - [ldquo]A comparison with fire acreages burned and modeled climate periods shows that stand replacing and mixed severity fires were at the higher end of their range in terms of the percent area burned during warm and dry climate periods. This may indicate that in the future, with expected warm and dry conditions, acres burned may be at the upper end of the NRV.[rdquo]

P 131 Chapter 3 Part 1 FEIS - [ldquo]Of all the ongoing and foreseeable future actions that have the potential to affect fire, especially unwanted wildfire, climate change is likely to be the single most important factor. Regardless of alternative, the effects of climate change would likely combine with some of the effects that result from implementing the alternatives, to produce cumulative impacts. In general, the fire seasons are expected to become longer, large wildfires are expected to occur more often, and total area burned is expected to increase (J. E. Halofsky et al., 2018a).[rdquo]

FEIS Chapter 3 Part 1 p 170 - [ldquo]Studies of potential effects of climate change on fire and insects/disease suggest the following may occur across the western U.S (J. E. Halofsky et al., 2018b): longer fire seasons, more days of high fire danger, increased frequency of ignitions, more frequent large fires, more episodes of extreme fire behavior, and increased average annual area burned; and elevated levels of native insects because they are able to migrate to new environments at a faster rate than trees. Mid-elevation forests are projected to have a high risk of climate-induced increase in fire, and increases in the area burned by fire are likely in lower and middle elevations of mountainous areas[rdquo]

There was no necessity of scattering these above paragraphs across widely-spaced pages. Together, they convey matters of such high material concern that stakeholders, the larger public and policymakers should not have to dig, dig, and continue digging to pull bits and pieces together for themselves. The Forest has somehow, even if inadvertently, decided to make it difficult for all concerned to get a coherent depiction of an ecosystem being forced into novel conditions, even if only just from increasingly novel fire.

Novel management actions in response to new, novel conditions

Thinning has a long history in forest management. It has been standard practice where management employs pre-commercial and commercial thinning of densely planted, closely-spaced seedlings following logging operations.

It has become a novel application when and where employed to reduce risk of fire in a hotter, drier world. The Forest is already planning this novel application of a traditional technique.

4 - Already a novel ecosystem [mdash] Timber harvest, logging

Already a novel ecosystem

FEIS Chapter 3 Part 1 pp 273-274 - [ldquo]Land use and land-cover change has undoubtedly been the underpinning for the successful establishment of invasive plant species (C. G. Parks et al., 2005). Locally, the rate of establishment and spread has been influenced by timber harvest, road building, grazing, and recreation. Most of these activities began on a large scale in the 1950s and 1960s on the HLC NF.

On path to becoming an even more novel ecosystem

FEIS Appendix J Carbon and Climate p. [mdash] [ldquo]Climate-driven failures in species establishment further reduce the ability of forests to recover carbon lost after mortality-inducing events or harvests.[rdquo]

[ldquo][hellip] ability of forests to recover carbon lost after mortality inducing events or harvests.[rdquo]

[ldquo].. or harvests.[rdquo]

So far as I could determine, this is the Forest[rsquo]s sole disclosure that post-logging regeneration of forest can be as difficult as it is post-fire. I ran searches of FEIS Chapter 3 and FEIS Appendix J for any reference to [ldquo]post-logging[rdquo] and found none. I ran searches of those documents for [ldquo]post-harvest[rdquo] and found none.

So, while the Forest did provide many scattered bits and pieces of information about risk of seedling mortality, thus failure of regeneration, and thus even a reduced timber output, is has, however inadvertently, made a decision to evade the risk of [ldquo]Climate-driven failures in species establishment[rdquo] after harvests a.k.a logging.

It is even more objectionable that the Forest's most explicit disclosure about effects of timber harvest a.k.a logging is isolated, relegated to a section on invasive plants, a topic I'll return to in due course.

Despite these recognized risks, the Forest plans to increase timber output during the lifetime of the Forest Plan, citing employment for present-generation adult livelihoods.

* Draft ROD P 15 [mdash]Forest products (primarily from timber harvest) will contribute approximately \$29.7 million in labor income (\$23.7 million more than currently contributed under the 1986 Plans) and 616 jobs.

* Draft ROD P 22 -Under alternative F, the Forest expects to produce an estimated average sawtimber volume of 20-35 million board feet per year over the next decade. With a higher budget or other opportunities to increase capacity (i.e., shared stewardship or other partnered efforts), the annual amount of timber volume could increase to approximately 38 million board feet per year.

Given the plausible risk of post-harvest seedling mortality in hot, dry soils, and consequent failure of forest regeneration, the Forest certainly seems to present an unrealistically cheerful outlook when asserting, on p. 44 of its draft Record of Decision that, [ldquo]The higher timber harvest levels under Alternative F versus alternatives B/C/D provides the Forest's sustainable share of products and uses demanded by the public, with a higher probability of improving and restoring vegetation for future generations than alternative B/C/D.[rdquo]

Novel management action

Given what the Forest knows and has disclosed [mdash] albeit in scattered bits and pieces [mdash] about seedling mortality post-fire, a plausible post-harvest management action would be allowing post-harvest conversion to non-forest for future generations. At a minimum, risk of post-logging seedling mortality and, thus, regeneration failure, raises questions about feasibility of the Forest's oft-cited intent to manage for resilience, which is defined in the Glossary of the Forest Plan, p. 232 as, [ldquo]the ability of a community to avoid alteration of its present state by a disturbance (Helms 1998).

5) Already a novel ecosystem : old growth

Already a novel ecosystem

FEIS Chapter 3 Part 1 P 220 - [ldquo]The average size of remaining old growth patches on all land ownerships are likely less than they were in the more recent past, particularly in areas where large patches were fragmented by harvest or development patterns.[rdquo]

FEIS Chapter 3 Part 1 P 244 - [ldquo]Old growth is likely less abundant today than it was historically, whereas snags and coarse woody debris are likely similar to historic conditions.[rdquo]

FEIS Chapter 3 Part 1 P 401 - [ldquo]Old growth is likely less abundant today than it was historically, whereas snags and coarse woody debris are likely similar to historic conditions.[rdquo]

On a path to an even more novel ecosystem

Old growth is at risk if seedling mortality prevents establishment of a next generation forest. And, similarly to the seedlings, old growth is mentioned for its [ldquo]key[rdquo] ecological importance:

FEIS Chapter 3 Part 1 P 214 [mdash] Old growth, snags, and downed wood are structural components of forested vegetation that have been identified as key ecosystem characteristics for the HLC NF forest plan revision. The abundance, location, condition, and management of these attributes were raised as issues internally and externally.

Alas, the Forest will face as much of challenge in providing for [ldquo]old growth on the landscape[rdquo] as it will have with seedlings, thanks to increasing heat and drought expected throughout the Northern Rockies (e.g., Halofsky et al 2018).

Insofar as I could determine, the Forest makes only one passing reference to this risk among 380 references to old growth. That passing, fleeting disclosure was in FEIS Chapter 3 Part 1 P 224 [mdash] [ldquo]To the extent that future forests may be at-risk to climate change, drought, and megadisturbances, old growth structures are also at risk.[rdquo]

Any definition of old growth will include old trees, including tall ones . Indeed, tall old trees are what the public has in mind when thinking of old growth. Those trees are indeed at risk.

McDowell and Allen (2015) found that [ldquo]Drought and heat-induced tree mortality is accelerating in many forest biomes as a consequence of a warming climate, resulting in a threat to global forests unlike any in recorded history,[rdquo] and that, [ldquo]Plants that are tall with isohydric stomatal regulation, low hydraulic conductance, and high leaf area are most likely to die from future drought stress. Thus, tall trees of old-growth forests are at the greatest risk of loss.[rdquo]

The risk of old growth loss, coupled with the risk of loss associated with seeding mortality, indicates a twofold risk to the Forest[rsquo]s oft-stated intent to manage for forest resilience, including future timber output. But nowhere does the Forest disclose this combination of physical risks indicative of shift to a novel ecosystem.

That said, McDowell and Allen have not been alone in finding risk to tall, old trees. Stovall et al (2019) have also reported findings suggesting that [ldquo]future persistent drought may cause widespread mortality of the largest trees on Earth.[rdquo]

Equally of interest, Xu et al (2018) report that, [ldquo]While some studies have shown that large trees are more vulnerable to drought than smaller trees, others found that small trees are the more vulnerable.[rdquo]

In examining the evidence, Xu et al found that trees both large and small are vulnerable to drought, and that, [ldquo]Both local-scale and regional-scale data are consistent in showing that forests with medium canopy height (around 18 meters) showed the greatest resistance to severe drought.[rdquo]

Xu et al (2018) thus confirmed the earlier Choat et al (2012) evidence of mortality risk at both ends of age/size spectrum; [ldquo]Mortality is often skewed towards young trees but recent evidence suggests that large, old trees are also vulnerable^{30,31}. [rdquo]

All of which indicates that, for economic as well as for ecological reasons, it seems apparent that stakeholders, the larger public and policymakers need to know of this twofold risk of a novel ecosystem where persistence of trees at both ends of the age spectrum may not be assured.

With trees at both ends of the age/size spectrum at risk, the forest as a whole is at risk. Indeed, as the Forest itself says in FEIS Chapter 3 Part 1, p 170, [ldquo]There is a body of science that indicates there are risks to the persistence of forests presented by climate change, drought, and disturbances.[rdquo]

At a time when the young recognize growing threats to their future lives and livelihoods, climate-driven risk to the

persistence of forests (e.g., Coop et al 2020, pdf uploaded earlier) has gained a new and rising urgency. It is of material interest, then, that the Forest specifically cites future generations in FEIS Chapter 3 Part 1 p.216 ;[rdquo]Old growth on the NFs will be managed to provide the foregoing values for present and future generations.[rdquo]

Given what[rsquo]s known, this may be difficult indeed. This difficulty raises questions about feasibility of the Forest[rsquo]s oft-cited intent to manage for resilience, which is defined in the Glossary of the Forest Plan, p. 232 as, [ldquo]the ability of a community to avoid alteration of its present state by a disturbance (Helms 1998).

6 - Already a novel ecosystem [mdash] overall reduced forest growth

Already a novel ecosystem since 1950, as slower forest growth reduced forest carbon stocks

FEIS Chapter 3 Part 1 p. 19 - [ldquo]The modeled effects of variability in temperature and precipitation on carbon stocks has varied from year-to-year, but overall, climate since 1950 has had a negative effect on carbon stocks in the HLC NF relative to other factors (Fig. 10). Warmer temperatures can increase forest carbon emissions through enhanced soil microbial activity and higher respiration (Ju, Chen, Harvey, & Wang, 2007; Melillo et al., 2017), but warming temperatures can also reduce soil moisture through increased evapotranspiration, causing lower forest growth (Xu et al., 2013).[rdquo]

Plausibly on path to even more novel ecosystem

FEIS Appendix J Carbon and Climate P 23 - [ldquo]Elevated temperatures may increase soil respiration and reduce soil moisture through increased evapotranspiration, which would negatively affect growth rates and carbon accumulation (Ju et al., 2007; Melillo et al., 2017). Modeled results of recent climate effects using the InTEC model indicate that years with elevated temperatures have generally had a negative effect on carbon uptake in the HLC NF (Figure 10).[rdquo]

FEIS Appendix J Carbon and Climate P 23 - [ldquo]Growing sites on the HLC NF are generally moisture-limited. Therefore, warm/dry climatic periods generally result in slower growth.[rdquo]

FEIS Appendix J Carbon and Climate P 23 - [ldquo]Thus, it will be important for forest managers to continue to monitor forest responses to these changes and potentially alter management activities to better enable forests to

better adapt to future conditions.[rdquo]

All the above raise questions about feasibility of the Forest[rsquo]s oft-cited intent to manage for resilience, which is defined in the Glossary of the Forest Plan, p. 232 as, [ldquo]the ability of a community to avoid alteration of its present state by a disturbance (Helms 1998).

Novel management actions

Combined climate-driven risk of seedling mortality, old growth mortality, reduced overall forest growth, and younger generation concern about future lives and livelihoods might plausibly hasten demand/need for amendment of the Forest[rsquo]s 2020 Forest Plan, with new FEIS and ROD. Amendment of a Forest Plan is infrequent enough to be at least somewhat a novelty.

7 - Already a novel ecosystem - invasive plants

Already a novel ecosystem

FEIS Chapter 3 Part 1 Pp 273-274 - [ldquo]Land use and land-cover change has undoubtedly been the underpinning for the successful establishment of invasive plant species (C. G. Parks et al., 2005). Locally, the rate of establishment and spread has been influenced by timber harvest, road building, grazing, and recreation. Most of these activities began on a large scale in the 1950s and 1960s on the HLC NF.

FEIS Chapter 3 Part 1 p 44 - [ldquo]Species of invasive annual grasses are extremely competitive, crowding out native vegetation, and have exhibited the ability to rapidly expand in multiple habitat types. Once annual grasses establish, they present a direct threat to ecosystem function by decreasing native plant community diversity, altering fire return intervals, diminishing the quality of wildlife habitat, and reducing livestock carrying capacity. Species such as downy brome (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), and ventenata (*Ventenata dubia*) are present or have been recently found in the plan area.[rdquo]

An increasingly novel ecosystem

FEIS Chapter 3 Part 1 P - 170 - [ldquo]Whether it is invasive species, drought, uncharacteristic wildfires, elevated native insects and disease levels, unusually high forest densities, or some other agent or combination of agents

that serves to stress trees and forest ecosystems; recent research suggests that climate change will likely exacerbate those stressors and [ldquo]stress complexes[rdquo] will manifest themselves (J. E. Halofsky et al., 2018b).[rdquo]

FEIS Chapter 3 Part 1 P 261 - [ldquo]Roads increase access to sensitive habitats and can fragment habitat, thus, providing an avenue for invasive plant species. [ldquo]

FEIS Chapter 3 Part 1 P 272 - [ldquo]Measurement Indicators

The following are indicators used for the analysis of invasive species:

- [bull] Acres of timber harvest, measured as a qualitative correlation between acres treated or harvested and the potential for ground disturbance at risk for weed invasion.

- [bull] Areas suitable to motorized road and trail use, measured as miles of roads and motorized trails that could serve as pathways for invasive plant introduction and spread.

- [bull] Acres affected by management changes to livestock grazing, measured as a qualitative assessment of potential changes in disturbance from livestock grazing projects and practices.

- [bull] Acres disturbed by fire activity, measured as acres burned by prescribed or wildfire events.

FEIS Chapter 3 Part 1 P 276 - [ldquo]Changes to the landscape with warmer temperatures, associated drier conditions, and more severe or frequent droughts, may lead to more frequent fires and may increase the ability of invasive plants to out-compete native plants in the future.[rdquo]

FEIS Chapter 3 Part 1 P 276 - [ldquo]Invasive species will continue to have a presence on the HLC NF landscape, with existing infestations and continual introductions of new invaders.

FEIS Chapter 3 Part 1 P 277 - [rdquo]Warmer temperatures, and associated drier conditions, more severe or frequent droughts, and more favorable conditions for wildland fire may increase the ability of invasive plants to establish and out-compete native plants. These changes may provide more opportunities for invasive plants to gain an advantage over native species and spread within and beyond the HLC NF[rsquo]s boundaries. This potential effect is common to all alternatives.

FEIS Chapter 3 part 1 p 277 [mdash] [ldquo]As the agency responds to climate change by new, different, or more land and vegetation management actions, those disturbances could provide suitable conditions for invasive plants.[rdquo]

All the above, and perhaps especially the FEIS Chapter 3 Part 1 p. 44 observation that, [ldquo]Once annual grasses establish, they present a direct threat to ecosystem function,[rdquo] raise questions about the Forest[rsquo]s oft-mentioned intent to manage for resilience, which is defined in the Glossary of the Forest Plan, p. 232 as, [ldquo]the ability of a community to avoid alteration of its present state by a disturbance (Helms 1998).

It also raises questions about the state of the Northcentral Montana forests we are handing to today[rsquo]s young, and to future generations.

Novel management actions; i.e., actions that were not required before the increasing influence of invasive plants

FEIS Chapter 3 Part 1 P 88 - [ldquo]Invasive plants are often treated using an integrated approach, with a combination of control methods that include mechanical, biological agents, and herbicides.[rdquo]

FEIS Chapter 3 Part 1 P 278 - [ldquo]Targeted objectives for invasive plant control are an administrative change that promotes measurable objectives and accountability to the program toward reaching desired conditions.[rdquo]

8 - A review

I believe that I[rsquo]ve herein presented a defensible, clear and coherent [mdash] albeit detailed [mdash] whole cloth depiction of already novel Northcentral Montana forest ecosystem on a path to even more novel conditions that are, in some cases, already demanding novel management actions. I also believe that stakeholders, the larger public, policymakers and the youth who will inherit this ecosystem will not find anywhere near so clear and coherent, whole cloth depiction in the Forest[rsquo]s Record of Decision or Forest Plan.

To its credit, on page 170, Chapter 3, part 1 of the FEIS, the Forest does cite a critical consideration when quoting J. E. Halofsky et al (2018b). [ldquo]Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive.[rdquo]

This above quote from Halofsky et al is rich in meaning for the novel forest scenario:

Their reference to changes in [ldquo]abundance[rdquo] of species alone suggests a novel forest (with fairly clear implications for timber output).

Their reference to changes of [ldquo]distribution[rdquo] of species alone suggests a novel forest

Their reference to changing competitiveness of [ldquo]drought tolerant[rdquo] species suggests a novel forest.

Moreover, the above FEIS page 170 reference to J.E. Halofsky et al (2018b) follows on the heels of a similar Forest disclosure on FEIS page 168, indicating that [ldquo] [hellip]management within that context may be important to reduce the potential for forest decline and/or ease transitions into new, more resilient states (Cohen et al., 2016; Golladay et al., 2016; J. Halofsky & Peterson, 2016; Millar & Stephenson, 2015).[rdquo]

These references to Golladay et al and to Millar & Stephenson are particularly interesting. So it is unfortunate that, while the Forest did quote directly from Halofsky et al, it somehow decided, during extended consideration requiring months of delay, not quote directly from either Golladay et al or Millar & Stephenson.

For example, Golladay et al contend that, [ldquo]traditional approaches to forest conservation and management will be inadequate given the predicted scale of social-economic and biophysical changes in the 21st century. New approaches, focused on anticipating and guiding ecological responses to change, are urgently needed to ensure the full value of forest ecosystem services for future generations. These approaches acknowledge that change is inevitable and sometimes irreversible, and that maintenance of ecosystem services depends in part on novel ecosystems, i.e., species combinations with no analog in the past.[rdquo]

While the Forest does make one, lone reference to Golladay et al in FEIS Chapter 3, it evades a fuller disclosure when it fails to quote their highly informative references specific to [ldquo]inevitable[rdquo] change.

And while the Forest does refer to Millar and Stephenson, it somehow decided after lengthy consideration including months of delay not to directly quote their own reference to [ldquo]inevitable[rdquo] change; [ldquo]Although thresholds are likely to be approached in the future, and changes are inevitable, the actions we take now in temperate forests can ease and guide transitions, diminishing effects to forest ecosystems and human societies.[rdquo]

Inevitability of change is something that all concerned need opportunity to consider.

And, similarly to the Golladay et conclusion that [ldquo]traditional approaches to forest conservation and management will be inadequate given the predicted scale of social-economic and biophysical changes in the 21st century,[rdquo] Millar and Stephenson conclude that, [ldquo]Whereas in recent decades, promoting resilience has been a widespread goal of forest management, the increasing pressure of chronic and acute disturbances is pushing many temperate forests toward and over resilience thresholds,[rdquo] and go on to report that [ldquo]The changes could range from minor shifts in forest structure (e.g., tree density and ages) and species compositions to major transformation of vegetation types, some resulting in novel ecosystems relative to recent centuries.[rdquo]

The Forest has also somehow decided not to quote Millar and Stephenson on triage as a plausibly necessary management action; [ldquo][hellip]triage exercises will almost certainly be necessary.[rdquo]

Moreover, while the Forest makes passing references to the similar paper by Millar, Stephenson, and Stevens (2007) in Appendix J Climate and Carbon, it somehow decided, during extended consideration requiring delays, not to quote their conclusion that, [ldquo]Priority-setting approaches (e.g., triage), appropriate for rapidly changing conditions and for situations where needs are greater than available capacity to respond, will become increasingly important in the future.[rdquo]

Triage is thus cited twice in documents the Forest cites, and yet the Forest somehow elects not to disclose for stakeholders and larger public that it has been the subject of serious scientific consideration. Perhaps worse, the Forest will find that I referred specifically to triage in comments submitted during or shortly after the scoping period

To its discredit, the Forest makes no mention of an utterly plausible and possibly inevitable shift to novel ecosystems in the draft ROD, Appendix J Climate and Carbon, or in either Part 1 or Part 2 of FEIS Chapter 3.

Likewise, there is no mention of priority setting via triage in the draft ROD, Appendix J Climate and Carbon, or in either Part 1 or Part 2 of FEIS Chapter 3.

To its credit, the Forest does say, on page 4 of Appendix J Climate and Carbon, that,[ldquo]It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems).[rdquo]

But framing the problem as merely [ldquo]possible[rdquo] strips important meat from the bones by failing to disclose scientists[rsquo] opinions of possibly [ldquo]inevitable[rdquo] change, and, adding to the problem, failing to disclose potential demand for giving some priority to triage.

These are issues that stakeholders, the larger public, and policymakers at every level need to know. Withholding them from public view deprives stakeholders, the larger public, and policymakers of opportunity to let the implications sink in, even if the Forest has no immediate intention to implement them.

Because triage, for example, will certainly generate controversy, it is far better to bring them this potential forest management strategy into discussion now than to kick it down the road to some future management action.

In another example of this objectionable lack of explicit disclosure, stakeholders, the larger public, and policymakers at every level also need to know what the Forest knows about assisted migration as a possible strategy for effecting a novel forest where persistence of today[rsquo]s familiar (especially conifer) forest is no longer achievable.

However, the Forest only makes quick, brief, passing mention of assisted migration, on page 181, FEIS Chapter 3, Part 1 : [ldquo]For example, assisted migration actions may not necessarily mean moving plants far distances, but rather moving genotypes, seed sources, and tree populations to areas with predicted suitable climatic conditions with the goal of avoiding maladaptations (Williams & Dumroese, 2016).[rdquo]

That[rsquo]s it. One passing reference, one direct quote, period. Worse, there is not even one other passing mention of assisted migration in FEIS Chapter 3, Part 2, or in Appendix J Climate and Carbon, or in the draft Record of Decision. The Forest[rsquo]s neglect of assisted migration exacerbates its arguably unintentional but effective evasion of fully admitting to a novel forest on a path to plausibly inevitable increasing novelty and requiring increasingly novel management actions.

Like triage, assisted migration has already been a topic of controversy, so it would give stakeholders and the larger public a heads-up if that topic is brought into discussion now instead of kicking the can down the road to some future management action.

There[rsquo]s all the more reason for explicit discussion of assisted migration when it appears in the body of literature developed so far by the USDA Forest Service itself. As a first example, consider Handler, S.; Pike, C.; St. Clair, B.; 2018. Assisted Migration. USDA Forest Service Climate Change Resource Center. <<<https://www.fs.usda.gov/ccrc/topics/assisted-migration>>>. These authors observe that, [ldquo]Assisted migration, human-assisted movement of species in response to climate change, is a general term that encompasses a variety of different potential actions, which have substantial differences in terms of risk, ecological implications, and policy considerations,[rdquo] and that [ldquo]Assisted migration may be motivated by a variety of different management goals and objectives.[rdquo]

They go on to say that, [ldquo]A land manager may first need to make decisions about which species are

appropriate to favor in a given area, and immediately go on to say that, [ldquo]In some cases, however, it is clear that climate change and other conservation challenges make the risk associated with doing nothing greater than the risk associated with intervening.[rdquo]

A second example is available via the USFS Forest Service Rocky Mountain Research Station[rsquo]s website on Climate Change and Assisted Migration <<<https://rnr.net/publications/assisted-migration>>>. This website allows Forest Service staff and others to [ldquo] [hellip] search more than 840 articles discussing assisted migration, climate change, and native plant transfer guidelines by author, title, subject, or keywords.[rdquo] In providing this service, the website [ldquo][hellip] provides a central foundation for collaboration in generating research questions, conducting studies, transferring and acquiring data, expanding studies to key species and geographic regions, and guiding native plant transfer.[rdquo]

A third example is available as part of a broader conference sponsored in part by the Forest Service; i.e., Browning, J. Comp. Proceedings of the 60th Annual Western International Forest Disease Work Conference; 2012 October 8-12; Tahoe City, CA. 1 USDA Forest Service, Washington, DC. 2 Northern Institute of Applied Climate Science, USDA Forest Service, St. Paul, MN. 3 USDA Forest Service, Pacific Northwest Region, Pendleton, OR. 4 USDA Forest Service, Northern Research Station, Delaware, OH.

One session of that conference was titled, [ldquo]Policy and strategy considerations for assisted migration on USDA Forest Service lands,[rdquo] and was co-authored by Forest Service personnel including Leslie A. Brandt, Douglas A. Boyce, and Louis R. Iverson. This Forest Service co-authored session on [ldquo]Policy and strategy considerations for assisted migration on USDA Forest Service lands[rdquo] reported that, [ldquo]Assisted migration has been defined as the movement of species, populations, or genotypes to places outside the areas of their historical distributions to maintain biological diversity or ecosystem functioning with changing climate (Richardson et al. 2009; Schwartz et al. 2012).[rdquo]

The above authors point out that [ldquo]Assisted migration changes the land management focus from past to future.[rdquo]

(Note that here again we see expression of need to consider the future, and not solely of the Northcentral Montana forest itself, but also of area[rsquo]s young Montanans, and, indeed, future generations. And, interestingly, as the Forest knows and reports in a fleeting, passing tidbit, past realities are no longer a reliable guide; on page 22 of Appendix J Climate and Carbon, the Forest cautions in passing that, [ldquo]disturbance rates are projected to increase with climate change (J. M. Vose et al., 2018), making it challenging to use past trends to project the effects of disturbance and aging on forest carbon dynamics.[rdquo])

The above three examples of Forest Service attention to assisted migration demonstrate an awareness that requires dissemination beyond the agency, to stakeholders and the larger public, who may be unaware. If that proves controversial, it[rsquo]s a needed controversy, and worth having upfront, giving all concerned some time to think it through.

All the above related directly and intimately to the future of trees that are currently of greatest immediate economic importance in Northcentral Montana : Conifers.

Conifers the economic backbone for the timber industry, jobs, and Forest management that takes the form of permitting harvest and logging. Their persistence is part and parcel to the Forest[rsquo]s oft-stated intent to manage for [ldquo]desired conditions,[rdquo] presumably persistence of conifers via [ldquo]resilience[rdquo].

Given past and current economic importance of conifers, it is highly relevant to review what the Forest tells readers on p. of FEIS Appendix J Carbon and Climate.

[ldquo]As a cornerstone, the Plan relies on desired condition envelopes that are informed by the natural range of variation (NRV), but also incorporate adjustments that reflect possible future conditions, such as allowing for more nonforested plant communities. Specific best available scientific information (BASI) is cited in cases where the desired condition differs from the modeled NRV (see appendix H of the EIS). Desired conditions are consistent with concepts for increasing forest resiliency, such as promoting fire-resistant species, large trees, and lower stand densities. These conditions are appropriate for the anticipated life of the Plan (15 years), were extensively reviewed by forest specialists, and are consistent with the findings of expert reviews on similar efforts (Hansen et al., 2018; Timberlake, Joyce, Schultz, & Lampman, 2018). Moving towards these desired conditions would help ensure the maintenance of biodiversity, species habitat, and ecosystem services regardless of whether future conditions may change after the planning period. Management actions designed to mitigate the effects of drought are supported by the desired conditions, including the following described by Vose and others (2016):

- [bull] Implement structural changes by thinning or density management of planted forests;

- [bull] Favor or plant more drought-adapted species; and

- [bull] Manage for a diversity of species to reduce vulnerability to drought given uncertainty in future climate.

It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems). It is even possible that large disturbances and site-specific shifts could occur within the planning period. It is not possible to quantify desired conditions that reflect novel ecosystems, because predictions of species shifts in the literature are made at the broad scale using climate envelopes, and do not encompass site-specific conditions that would influence species persistence at the local scale. Further, it is not possible to predict or quantify potential megadisturbances, or broad-scale die-off events, although the risk of such events is noted. If such events do occur, or monitoring shows that species shifts are occurring within the plan period, it would be possible to amend the plan regarding appropriate desired conditions.[rdquo]

There are two key tidbits buried or camouflaged in the above. One is the mention of favoring fire resistant trees, presumably conifers. The other is mention of favoring or planting of drought tolerant trees, presumably conifers.

The mention of these two traits very strongly implies that, because there will inevitably be fire, and because there will inevitably be drought, desired future conditions based on persistence of conifers will plausibly hinge on conifers that are both fire-resistant and, also, drought tolerant.

For example, because of their thick bark, older ponderosa pine do have resistance to fire, as the Forest itself has mentioned. At the same time, they are among the tree species the Forest itself has identified as vulnerable to drought. The Forest might manage them for resistance to fire, but then lose them to drought, defeating the Forest[rsquo]s best efforts.

To prevent a very plausibly increasing conversion of forest to non forest, the Forest may have to look beyond conifers, to tree species known for dual fire-resistance and drought tolerance. As I suggested in the scoping period, this may require a hard look at the native Montana bur oak, which could confer a measure of resilience that conifers may simply be unable to achieve. This, however, would require some re-definition of desired future condition and, possibly, an amendment of the Forest Plan if conifer forest declines as expected.

And the problems there are proving difficult to solve. Few are as well positioned to understand and convey those difficulties than S&P, formerly Standard & Poor, a well known financial industry mainstay. Below, S&P conveys a message of persisting challenges that will in all likelihood force forests further down a path of shifting to novel ecosystems.

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[ldquo]The Extinction Rebellion protests and the passionate pleas of Greta Thunberg for world leaders in politics and industry to take action on what they describe as the unprecedented global climate emergency have brought

a greater sense of urgency to the energy transition.

[ldquo]There can be no doubt that the cycle of significant climate events is increasing and that emissions of CO₂ or greenhouse gases (GHGs) are rising at alarming rates. However, in a world where over 1 billion people still lack access to simple electricity and many more still live in poverty, the dual challenge of providing affordable clean energy and tackling the impacts of climate change remains complex.

[ldquo]Addressing the challenge of climate change will require us to find a balance between regulation and government policy, technology, and consumer behaviour. Government policy can come with unintended consequences and tends to use taxpayers[rsquo] money inefficiently.

[ldquo]The German Renewable Energy Policy or Energiewende, for example, has successfully grown renewable energy in the country from less than 4% in 1990 to 40% today, but has also meant high electricity bills. However, CO₂ emissions in Germany have been impacted by marginal dispatchable electricity coming from carbon-intensive lignite (low quality coal).

[ldquo]So has the Energiewende been a failure? Far from it. Without Germany effectively subsidizing the renewables industry, it would have not created the scale of demand that has seen technology and manufacturing processes bring down the cost of renewables to below the cost of thermal (oil, gas or coal) power generation.

[ldquo]Technology often needs a helping hand to gain momentum before it can compete with traditional fossil fuels. But policies cost money. We may have movements like Extinction Rebellion pushing for change, but we have equally passionate ones protesting about the cost of change, such as the gilets jaunes in France, or the protests in Iran, Ecuador and Chile over reductions in fuels subsidies and increases in transport costs.

[ldquo]Regrettably, consumers are strongly motivated by their personal welfare, which is determined by their disposable income or relative wealth. Lower energy costs over the last five years have resulted in an increase in energy consumption as the world economy has created wealth and jobs, leading to what I have previously described as consumer hedonism.

[ldquo]Taking away this privilege is hard, and with lower energy prices, technology will find it harder to compete with traditional fossil fuels and/or get the financing required.

Regulation and responsibility

[ldquo]However, there is a new pressure emerging that I call [ldquo]moral regulation[rdquo] or self-regulation. Corporations are coming under increasing pressure from shareholders to meet environmental, social and governance (ESG) standards, and are being punished for not addressing the impact of their businesses on society.

[ldquo]We have started to see this among International Oil Companies (IOCs) as their strategies, and more importantly capital, have moved away from high-intensity carbon fuels towards less carbon intensive gas and renewables, some even shifting towards becoming electricity suppliers.

[ldquo]At the same time, National Oil Companies (NOCs) are recognizing the risk of reliance on fossil fuels and potentially having stranded assets, and as such are looking to diversify their economies. Saudi Arabia[rsquo]s strategy to float part of Saudi Aramco in an IPO in order to raise funds to invest in its Vision 2030 is a case in point.

[ldquo]Technology and regulation need to work together effectively to help provide momentum in the right direction but without distorting market forces.

[ldquo]Today, subsidizing electric vehicles effectively benefits the wealthy who can afford them. Subsidizing the scrappage of old polluting vehicles instead would enable the less wealthy to be able to afford cleaner, more efficient, vehicles, which can have a bigger impact on emissions than increasing the number of EVs on the road.

[ldquo]A counter-argument could be, do EVs need subsidies to help give them the momentum to compete and bring down costs? Road transportation makes up 20% of global carbon emissions, so clearly it needs to be addressed, but electrifying transportation simply moves emissions up the supply chain to power generation, which today produces 40% of GHG emissions. The current trend towards the electrification of everything may not be the optimal solution.

Harnessing technology

[ldquo]Technology will need to provide a range of solutions to tackle the energy transition across the supply chain. Renewables will play a significant role both in liquid fuels and electrons.

[ldquo]The biofuels sector must avoid competing with land for food and adversely impacting ecosystems, by shifting its focus to transforming plant waste to biofuels, or converting used vegetable oils or tallow from animal fat, through bio-refining. This process can provide liquid fuels such as naphtha ([ldquo]bio to plastics[rdquo]), gasoil and, possibly most opportune, jet fuel, in order to decarbonize aviation which contributes over 1 gigaton of CO2 per year.

[ldquo]New renewable electricity has leapfrogged new conventional thermal power in terms of levelized cost of generation but needs to solve the problem of intermittency. In the short term, wind and solar challenge the economics of new combined cycle gas turbine (CCGT) plants and have pushed countries like China and Russia to focus on coal for base-load generation.

[ldquo]Compared with CCGT, traditional coal plants have less turndown, meaning they have to run at higher base-load when ample renewable energy is available. Clean coal power plant with carbon capture and storage (CCS) or use (CCU) can be efficient and have net zero emissions but the right incentives are needed to encourage investment in the technology.

[ldquo]Solving the problem of storing intermittent electricity generation continues to be a significant challenge. Diversifying away from battery storage (and electric vehicles) could be resolved by moving towards a hydrogen economy. When burned, hydrogen emits water, but it requires a lot of energy to produce.

[ldquo]Using renewable net-zero carbon energy to produce hydrogen at scale and in a distributed fashion can provide an affordable solution to first partially decarbonize natural gas, by blending in hydrogen. Hydrogen could then also be used in the road transport sector, in particular as a solution for heavy commercial road transport, in fuel cell vehicles, for which cost and infrastructure are the only current constraints.

Rethinking consumption

[ldquo]Using less energy is something we can and should all be doing today [ndash] adjusting our thermostats, buying fewer disposable goods and using more mass transport. Over time we need to recycle, reuse and, most importantly, reduce what we use.

[ldquo]Industry is looking at similar opportunities, such as reusing carbon dioxide in CO₂ to petrochemicals. Or reducing the need for energy intensive commodities such as steel and aluminum (even paper), where plastics can be used to lightweight durable products, or, if used responsibly, with the right policies and processes around recycling and reuse, in consumable product supply chains.

GLOBAL ENERGY MIX SCENARIOS

[ldquo]We will continue to need fossil fuels in our energy mix for decades to come and as such, we need to ensure that the fossil fuels we do consume are of the lowest possible carbon intensity and impact on our planet. With the advent of big data and the Internet of Things (IOT) we can use things like blockchain technology to be able to track and monitor the impact of the carbon we consume. This would enable us to create carbon attributes

for the fossil fuels we produce, process and consume.

[ldquo]Today, gasoline and diesel have sulfur and other environmental specifications, and we should also have a specification for the energy (or carbon) used to produce gasoline, incentivizing use of the gasoline with the lowest energy intensity and making inefficient production uneconomic.

[ldquo]Likewise, the energy used to produce and transport natural resources such as gas and oil [ndash] and to liquefy LNG [ndash] can be measured. Again, by assigning a cost to the energy used we can create transparent tradable markets to incentivize use of only the least energy intensive hydrocarbons.

[ldquo]There are many uncertainties around the future of traditional fossil fuels but there are also many opportunities to make our supply chains more efficient and less energy intensive, to enable the world to achieve its objective of minimizing global warming to less than 2 degrees Celsius.

[ldquo]However, technology alone will not achieve this outcome. We will need well-thought through policies, socially responsible companies and investors, and consumer acceptance to changing behaviours and the cost increase of sustaining our planet for generations to come.[rdquo]

Plan? It needs amendment now

k National Forest Revised Forest Plan and FEIS, William Ivey, Forest Supervisor

Submitted June 21, 2020

The USDA Forest Service has released its Revised Forest Plan and related documents for the Helena-Lewis and Clark National Forest (hereafter the Forest). The objection period opens on May 21, 2020 and runs through July 20, 2020.

This comment will focus on five of the related documents - The Final Environmental Impact Statement (hereafter FEIS) Chapter 3 (Parts 1 and 2); Appendix J Carbon and Climate; Appendix B Monitoring Program, Appendix G Response to Comments, and the draft Record of Decision (ROD).

Although these five documents mention many important environmental issues, this comment will largely focus narrowly on economic risk of physical damage to timber output and related supply chain and asset value losses as a consequence of warming and drying conditions which are, in turn, forced by increasing concentrations of atmospheric CO₂.

This comment will include objections related to the Forest's disclosure of that damaging risk. Those objections will be submitted separately in a subsequent upload.

In my comment earlier today, I forgot to include an concise statement of reasons for filing objection.

Here it is : The Helena-Lewis and Clark National Forest (hereafter the Forest) has effectively even if unintentionally deprived stakeholders, the larger public, and policymakers at all levels of clear understanding that Forest has already become a novel ecosystem, and has effectively even if unintentionally evaded explicit disclosure of how forest managed by the Forest will, inevitably, be an increasingly novel ecosystem requiring unprecedented management action.

First, however, I will take some time to say upfront that the Forest has been commendably candid in disclosing the specific risk of physical damage to timber output imposed by post-fire seedlings/saplings (hereafter seedlings) mortality. This mortality can prevent regeneration of forest after fire has come and gone, ergo the risk of physical damage to timber output.

In fact, this praise of the Forest's candor is a basis for the objection to come, and should be considered as a key component to the objection process.

That made part of the public record, it is important to recognize that the Forest's disclosures of physical risks associated with drought-driven seedling mortality are consistent with both NEPA and with the financial realm's recent and rising concerns about climate-related risk of physical damage to economically important supply chains, revenues, and asset values. For example, while many might imagine that NEPA requires disclosure of environmental but not economic harm, NEPA's specific reference to the "human environment" inescapably places it as law requiring disclosure of economic harm to supply chains, revenues, and asset values associated with timber output.

The extent of NEPA consistency with disclosure of financial risk is shown in the report by Task Force on Climate-Related Financial Disclosures: Technical Supplement : The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities June 2017, page 6: Physical Risks, where physical risks are attributable to "Chronic changes and more frequent and severe extremes of climate, and where physical risks are defined as "Increased business interruption and damage across operations and supply chains with consequences for input costs, revenues, asset values, and insurance claims<<<https://www.fsb-tcf.org/wp-content/uploads/2017/06/FINAL-TCFD-Technical-Supplement-062917.pdf>>>."

The Forest's disclosures of climate-driven physical risk to forest supply chains and asset values is so commendable because it serves as a necessary wake-up call for any stakeholder or member of the larger public who may be dependent these supply chains.

Indeed, on page 240, FEIS Chapter 3 Part 2, the Forest reports that "The availability of timber is important to local economies on the HLC NF." If for that reason alone, as the Forest both knows and reports, ongoing and future likely post-fire seedling mortality during warming and drying conditions will, as the Forest aptly indicates, lead to reduced availability of timber.

Given that risk, it is particularly important to note that the Forest's stated intent is to emphasize management for resilience, but the Forest does disclose that, in that context of intended resilience, "[hellip] forest resilience is dependent on tree regeneration."

Thus, seedling mortality translates to failure of regeneration and, importantly, to failure of the Forest's frequently stated intent to manage for resilience.

At this point, some definitions seem in order. The Forest provides 3 key definitions.

regeneration the renewal of a forest, whether by natural or artificial means. This term may also refer to a tree crop itself.

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<<https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd743204.pdf>>

resilience (ecology) the capacity of a (plant or animal) community or ecosystem to maintain or regain normal function and development following disturbance

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<<https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd743204.pdf>>

timber management the growing of, tending to, commercial harvesting of, and regeneration of crops of trees

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<<https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd743204.pdf>

In light of these definitions, it is of paramount importance the Forest explicitly informs stakeholders, the larger public, and policymakers at all levels about likely reduction of timber output where post-fire regeneration is no longer achievable. The Forest's references to shrinking timber output correctly frames this problem in economic as well as ecological terms. In doing this, the Forest honestly advises stakeholders, the larger public, and policymakers at all levels about the "difference it will make" to timber output where post-fire seedling mortality a.k.a., regeneration failure does occur on the Forest.

It may even be appropriate to praise the Forest for, as Greta Thunberg phrases it, "the maturity to tell it like it is."

It has to be said, however, that there are some errors of fact in the Forest's four continuous pages of disclosure about risk associated with seedling mortality. For example, on FEIS p 172, Chapter 3, Part 1, the Forest tells readers that, "Climate change may restrict dryland forest persistence by the end of the 21st century by reducing the likelihood of successful regeneration (Petrie et al., 2017);(Stevens-Rumann et al., 2017)."

In fact, Stevens-Rumann et al did not find that change change "may" restrict drylands forest persistence "by the end of the 21st century." What Stevens-Rumann unmistakably state in the abstract of their article that, already, as of 2018, "Results highlight significant decreases in tree regeneration in the 21st century." They repeated that basic finding in the text of the article, saying,"Less tree regeneration occurred across all forest types in the 21st century." The Forest's erroneous characterization of their findings thus implies uncertainty that does not exist.

Despite such errors, the Forest does include key findings that document risk arising from drought-driven risk of seedling mortality, and it does so in a largely coherent discussion spanning four pages. This is of considerable practical value for communities dependent on timber output who need a chance to ponder their children's economic future. For example, county planners need to know what the Forest knows about already established "decreases in tree regeneration" arising from seedling mortality. And policymakers at all levels can't be left in the dark.

However, despite what can arguably be called misleading but minor errors, the Forest has taken important steps toward illuminating stakeholders, the larger public, and policymakers about the risk specific to climate-driven post-fire seedling mortality as a factor damaging timber output.

Indeed, on page 240, FEIS Chapter 3 Part 2, the Forest reports that "The availability of timber is important to

local economies on the HLC NF."

All that said, and its importance mustn't be underestimated, I will raise several points which, taken together even if not individually, are objectionable. Put briefly, despite its candor specific to post-fire risk, the Forest otherwise falls well short of telling it like it is.

First, the commendations re disclosure of risk of failed forest persistence via post-fire seedling mortality

Forests are among many physical assets at risk from climate change. In the financial realm, these risks are now commonly defined as physical risk. Disclosure of physical risk driven by climate change has become an increasingly important topic in financial and economic circles.

Two examples suffice to make the point about climate-driven risk to physical assets.

Insurance Journal - Report Calls for Regulators to Tackle 'Systemic Risk' from Climate Change

Climate change is a systemic risk with wide-ranging potential physical impacts, according to a new report that also serves as a call-to-action [hellip]

<<<https://www.insurancejournal.com/news/national/2020/06/04/571111.htm>>>

Investors Are in a Race to Find the Best Models of Climate Risk

Many consultants now offer portfolio-wide assessments of physical climate risks that companies face. Who should you rely on?

<<<https://www.advisorperspectives.com/articles/2020/06/12/investors-are-in-a-race-to-find-the-best-models-of-climate-risk?>>>

Given these above concerns about physical risk to assets of economic importance, I strongly commend the Forest's specific and coherent disclosure that human-caused climate change is a threat to post-fire persistence of forests, specifically via drought effect on seedling mortality.

Seedlings are, after all, the basis of hope for a persisting forest, and drought is an increasingly well-understood cause of tree mortality across age classes - including seedlings.

Drought thus poses physical risk to an economically important physical asset if only by posing risk to seedlings. As the Forest correctly remarks on p. 171 FEIS Chapter 3 Part 1, "[hellip] forest resilience is dependent on tree regeneration."

The basics of post-fire seedling mortality are straightforward enough. Drought sets forests up for fire, then kills seedlings when it persists after fire has come and gone. To the Forest's great credit, it provides a coherent, four-page disclosure of the specific and growing risk that droughts' impact on seedlings can force forests' conversion to treeless acreage at least on some sites.

For example, the Forest cites Millar and Stephenson (2015), who mention specifically that "Serious thresholds are crossed when forests convert to vegetation types without trees." Thus, it becomes important to report, as the Forest does report, seedling mortality poses risk of damage to future timber output, thus to an economically important supply chain, and thus to the future economy - which would of course involve threat to jobs and communities dependent on persistence of timber output.

To its credit, the Forest does report that it may not be able to produce its predicted benefits of persisting timber output. For example, in FEIS chapter 3, part 2, on page 247, the Forest reports that, "As described in the Terrestrial Vegetation section, risk exists for extensive tree mortality events and regeneration failures to a greater degree than predicted in the modeling, which are unquantifiable in time and space. Therefore, there is also a risk that predicted timber volumes and associated economic outcomes may not be achieved."

Also on page 247, FEIS chapter 3, part 2, the Forest advises the public that, "It is also possible that continued drought (and/or associated large disturbances) may cause shifts to nonforested vegetation types on some of the driest lands, and thus the lands suitable for timber production and/or volume outputs could decrease."

Then, on page 284, FEIS chapter 3, part 2, the Forest advises the public that "Future warm and dry climates, as well as disturbances, may pose risks to forests in terms of growth, mortality, and regeneration potential; such factors could affect timber outputs."

The Forest raises similar caution about meeting its stated objectives in FEIS Appendix J. Climate and Carbon, Supplemental Information, page 4, advising stakeholders and the larger public that, "Plan direction, which emphasizes ecological integrity and resilience, will be critical to minimizing the undesirable effects of these increasing and interacting stressors."

Then, to its great credit, the Forest immediately adds that, "Nevertheless, managers and the public should expect climate change to drive changes on ecosystem structure, function and composition in the coming decades."

The Forest's stated risks to meeting "desired future conditions" including forest resilience are repeated on page 6 of FEIS Appendix J. Climate and Carbon, Supplemental Information. "It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems)."

And it is entirely appropriate that the Forest would immediately add that, "It is even possible that large disturbances and site-specific shifts could occur" not only "in the coming decades" but even "within the planning period."

With that said, the Forest assures stakeholders that, "If such events do occur, or monitoring shows that species shifts are occurring within the plan period, it would be possible to amend the plan regarding appropriate desired conditions."

?Regarding possibility to amend the plan "if" such events occur, it's worth noting that such events have occurred, including on the Forest itself.

On page 172 FEIS, Chapter 3, Part 1, the Forest does inform any careful reader that, "However, some dry forest sites may convert to nonforested plant communities for a substantial amount of time, or permanently, following fires, especially in xeric settings or where no nearby seed source remains (Rother & Veblen, 2016); (Stevens-Rumann et al., 2017)."

Importantly, the Forest then immediately goes on to say, "Such an example has already occurred in the northern Big Belts GA, where a severe fire in the 1980's (followed by a reburn decades later) resulted in conversion of some ponderosa pine sites to grasslands."

With that conversion noted, it's well worth noting that the same trend has become evident elsewhere - including within Montana.

For example, the DEIS for the Custer-Gallatin National Forest in southern Montana reports on page 151 that, "Indeed, the ponderosa pine systems of the pine savanna ecosystems have experienced high rates of cover type conversion due to recent fires. In Ashland, for example, in the 1990s approximately 219,214 acres were classified with forest cover. In 2012 approximately 116,708 acres were classified as forested. The net change is

an almost 50 percent reduction of the forest cover from what occurred in the 1990s (U.S. Department of Agriculture 2014)."

It seems very likely that all concerned would agree that reduction of some 107,000 acres of forest cover is no light matter, whether ecologically -or economically, via damage to timber output.

Another example of lost forest cover has surfaced in northwestern Montana. There, as reported in *Ecohydrology* January 2020, after the Chippy Creek Fire, "[hellip]vegetation in the catchment has shifted from almost exclusively mixed conifer forest to sagebrush scrubs and grasses."

<<<https://onlinelibrary.wiley.com/doi/10.1002/eco.2170>>> Here again, we see damage to hopes of timber output

One would hope that the Forest will not how unintentionally evade the relevance of these two studies simply because they have occurred elsewhere than the Forest

As one more example, Davis et (2019,) whose PNAS study the Forest cites at least three times, conducted a study of post-fire failure of seedling regeneration across the western US, including Montana. Davis et al found that fire in a context of climate change "is leading to increasingly fewer opportunities for seedlings to establish after wildfires." They say, "Here we demonstrate that dry low-elevation *Pinus ponderosa* (ponderosa pine) and *Pseudotsuga Menziesii* (Douglas-fir) forests in the western United States have crossed a critical climate threshold for post-fire tree regeneration."

The language of "have crossed" a critical threshold conveys an immediacy requiring a re-think of timber output sustainability and, with that, a sense of immediacy requiring a rethink of how soon an amendment to the Forest Plan must occur.

In a news release, lead author Kimberley Davis is quoted as saying, "Ponderosa pine and Douglas fir are two of the most dominant tree species in the western U.S., and they are critical for the regional forestry industry<<https://www.eurekalert.org/pub_releases/2019-03/tuom-uss031219.php>>." So, here we see further disclosure of damage to future timber output and an economically important supply chain, consistent with concerns expressed by the Task Force on Climate-Related Financial Disclosures.

Considering all the above, it was very important to all concerned that the Forest reports, on pp. 172-173, FEIS Chapter 3, Part 1 that, "The risk of changing regeneration dynamics is not limited to dry forests."

Laying out the risk of damage to moist forests, the Forest goes on to report that, "Several studies have found that

post-fire seedling establishment of moist and subalpine forests may decline due to drought and wildfire (Andrus et al., 2018; Harvey, Donato, & Turner, 2016; Stevens-Rumann et al., 2017).

As in dry forests, the basics for moist forests are straightforward enough. Even in moist forests, drought sets forests up for fire, then kills seedlings when it persists after fire has come and gone. This is particularly true when, as the Forest knows full well, periods of drought coincide with periods of heat - the "hotter drought" scenario so well documented since 2005. (I sent numerous pdfs of this documentation in the scoping period and I'm assuming no need to upload them again in the objection period.)

While none of the above need imply complete eradication of forest persistence on the Forest, there is cause enough for concern that it will make a significant dent, effectively leaving a shrunk forest in its wake. By its references to "reduced timber output," the Forest has done a public service in indicating rather explicitly that risk of a such a dent in the extent of forest cover does indeed exist.

Hence, as the Forest bravely reports, "It is possible that at some point in the future, the desired conditions as currently outlined in the 2020 Forest Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems). It is even possible that large disturbances and site-specific shifts could occur within the planning period."

This passage serves to alert all concerned about the immediacy of an important risk, and the possible immediacy of need to amend the Forest Plan.

Repeat: "It is even possible that large disturbances and site-specific shifts could occur within the planning period."

All in all, in discussing risk of physical damage specific to timber output from post-fire seedling mortality, and associated risk to regeneration and resilience, the Forest has taken an important and courageous step forward in an important disclosure of damaging climate-driven physical risk likely for, in the language of NEPA, "the human environment" as well as the non-human environment.

Expect a subsequent installment of this object prior to July 20, 2020