Docket No. APHIS-2012-0030

Biotechnology Regulatory Services
USDA, APHIS
4700 River Road
Riverdale, MD 20737

July 5, 2017

Re: Draft Environmental Impact Statement: ArborGen, Inc Petition (11-019-01p) for Determination of Non-regulated Status for Freeze Tolerant Eucalyptus Lines FTE 427 and FTE 435 (Docket No. APHIS-2012-0030)

Center for Food Safety (CFS), the International Center for Technology Assessment, and Foundation Earth submits the following comments on APHIS's proposed deregulation of Genetically Engineered Freeze Tolerant Eucalyptus.

INTRODUCTION

ArborGen Inc. has petitioned the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) seeking nonregulated status of Genetically Engineered Freeze Tolerant Eucalyptus lines designated 427 and 435 (GE Eucalyptus), and APHIS has now prepared a draft Environmental Impact Statement (EIS) and preliminary plant pest risk assessment (PPRA). Pursuant to the April 21, 2017 Federal Register Notice, 82 Fed. Reg. 18,759, and the May 19, 2017 Federal Register Notice, 82 Fed. Reg. 22997, the Center for Food Safety (CFS) submits the following comments.

CFS is a nonprofit, public interest organization with a mission to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture, while also promoting and protecting regenerative, sustainable agriculture.[1] CFS represents over 850,000 members, who reside in every state across the country. For over two decades, CFS has been the leading U.S. public interest organization working on the issue of GE organisms and their oversight. Part of its mission is to ensure that novel genetically engineered organisms that could adversely impact public health, agriculture, and the environment are adequately analyzed and properly regulated. CFS has a major program area specific to GE organism oversight and numerous staff members—scientific, policy, campaign, and legal—whose work encompasses the topic. CFS staff are recognized experts in the field and intimately familiar with the issue of GE organisms, the inadequacy of their oversight, their risks, and their adverse impacts. CFS has also specifically worked on the application of genetic engineering to industrial forestry, including on this GE Eucalyptus.

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[1] *See generally* www.centerforfoodsafety.org

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Foundation Earth is a national nonprofit, public interest advocacy organization whose mission is to foster an earth-centered world view. Its focus includes economic models, technology, education, health, and the legal system.

The International Center for Technology Assessment (ICTA) is a nonprofit, nonpartisan organization committed to providing the public with full assessments and analyses of technological impacts on society. ICTA is devoted to fully exploring the economic, ethical, social, environmental, and political impacts that can result from the applications of technology or technological systems.

COMMENTS

The proposed approval is fundamentally flawed in numerous ways. As an initial matter, APHIS should not move ahead with this process until and unless it completes the long-overdue and much needed new regulations for all GE organisms. Specifically in regard to this proposal, the corresponding draft Environmental Impact Statement (EIS) and Preliminary Plant Pest Risk Assessment (PPRA), the agency must go back and begin again. The analysis of alternatives to the proposed action only inadequately considers two alternatives —full approval and denying the petition—and fails to consider or analyze numerous reasonable alternatives. The agency's purpose and need for the proposal is flawed and overly-narrow. The agency fails to adequately analyze many direct, indirect, and cumulative impacts, and wholly fails to consider many others. Its treatment of direct, indirect, and cumulative impacts is contrary to the evidence and arbitrary and capricious. APHIS fails NEPA's mandates of providing high quality, accurate scientific analysis and relevant data, including scientific and baseline data, and does not present accurate and complete information to allow informed decisions. It fails to disclose and discuss opposing scientific views at relevant points. It fails to acknowledge and analyze scientific uncertainties where appropriate. It improperly relies on incorrect data and assumptions at places. It improperly relies on different forms of direct and indirect mitigation. At times APHIS relies on factors Congress did not intend it to consider and fails to apply the agency's statutory authority. It fails to analyze the reasonably foreseeable results of its decision. In short, APHIS has failed to take a "hard look" at the impacts of its proposed decision. The agency's proposed decision is contrary to sound science and arbitrary and capricious. As such the proposed decision is contrary to the agency's statutory mandates pursuant to the Plant Protection Act, the National Environmental Policy Act, and the Administrative Procedure Act.

I. APHIS Should Delay Any Consideration of GE Eucalyptus Until It Finalizes Its New GE Organism Regulations

As the agency is well aware, concurrent with this comment period was the public comment period for APHIS's revised 7 C.F.R. Part 340 regulations for GE organisms under the Plant Protection Act, which will govern genetically engineered trees such as GE Eucalyptus. Those regulations finally will implement the PPA of 2000 and are long overdue, with numerous delays and restarts. The agency itself has, in that process and elsewhere, explained that those new regulations are necessary in order to properly implement its statutory authority and to better address the novel risks of current and future GE organisms, such as the subject of this action. This approval of GE Eucalyptus is an unprecedented one, marking APHIS's first-ever proposed commercial approval of a GE forest tree. FTE 427 and FTE 435 and their progeny are GE organisms that raise long term, novel risks of invasiveness, pest and disease proliferation, water usage, adverse impacts to wildlife and biodiversity, and widespread paradigm shifting of industrial monoculture forestry methods, among other impacts. In short, it is precisely the sort of analysis and decision-making that should be halted and considered anew pursuant to the future regulations, which were revised to tackle precisely this sort of challenge. APHIS should not push ahead and rush such an unprecedented decision before the new regulations are final, especially after the agency itself has repeatedly underscored the need for updated regulations. To grant approval otherwise would be inconsistent with APHIS's statutory duties and contrary to sound science.

Improper Scope of the Action Area

There are several fundamental flaws that belie the entire proposal, rendering APHIS's analyses and consideration of the impacts arbitrary and capricious and failing to consider important aspects of the issue. Among those flaws is APHIS's improper scope for its assessment. The scope of APHIS's s "Action Area" for the proposed action is fundamentally flawed.

APHIS's approval of the GE Eucalyptus is not restricted in any way. It is a nationwide approval, with no geographic or temporal restrictions. APHIS is not proposing any future assessment or re-approval of the decision. If approval is given, ArborGen (or anyone) is free to sell, plant, grow, ship or otherwise disseminate these GE trees anywhere in the United States, without limitation.

The geographic range of Eucalyptus plantations in the U.S. is presently limited to areas where winter temperatures do not fall to levels that severely damage or kill these freeze-susceptible trees. These GE Eucalyptus trees are engineered to be freeze-tolerant, meaning ArborGen's intended purpose is to extend the geographic range of Eucalyptus plantings into colder regions where the non-genetically engineered counterparts would not survive. Therefore, APHIS must assess the potential environmental and plant pest risk impacts of GE Eucalyptus in all areas where it could conceivably be grown, now and in the foreseeable future.

The sole legitimate criterion for determination of this "action area" is the biological viability of GE freeze-tolerant Eucalyptus. USDA issues Plant Hardiness Zone maps that divide the country into regions based on average low winter temperatures. These maps are widely used by farmers and gardeners in choosing appropriate crops/plants, and their planting schedules, so as to avoid unacceptable injury or death due to freezing temperatures. On this basis, APHIS's action area should include, at a minimum, all areas in USDA Plant Hardiness Zones 8a or higher, for the following reasons. First, ArborGen conducted eight field trials of GE Eucalyptus at three sites in Zone 8a, and two additional trials at a single site on the border between Zones 8a and 8b (Petition at 106-107). Despite moderate to severe damage from freezing temperatures at these sites, in most trials GE Eucalyptus had notably higher survival and regrowth than the non-GE controls. ArborGen noted that even severe damage would not preclude commercial cultivation of GE Eucalyptus in such areas for use as biomass for bioenergy (Petition at 107).

Second, the range in which GE Eucalyptus is biologically viable will almost certainly expand over time. Increasing temperatures over just the past two decades have substantially shifted plant hardiness zones to the north, including the Plant Hardiness Zone 8b in which ArborGen has indicated GE Eucalyptus would be "preferably planted" (Petition at 4). This expansion can be clearly seen by comparing USDA's 1990 Plant Hardiness Zone map, reproduced below, with the corresponding 2012 map (Figure 1, dEIS at 3). The current potential for biologically viable plantings in Hardiness Zone 8a, and climate change-induced warming over the foreseeable future,[2] together argue for expansion of the action area to encompass, at a minimum, Hardiness Zones 8a and higher.

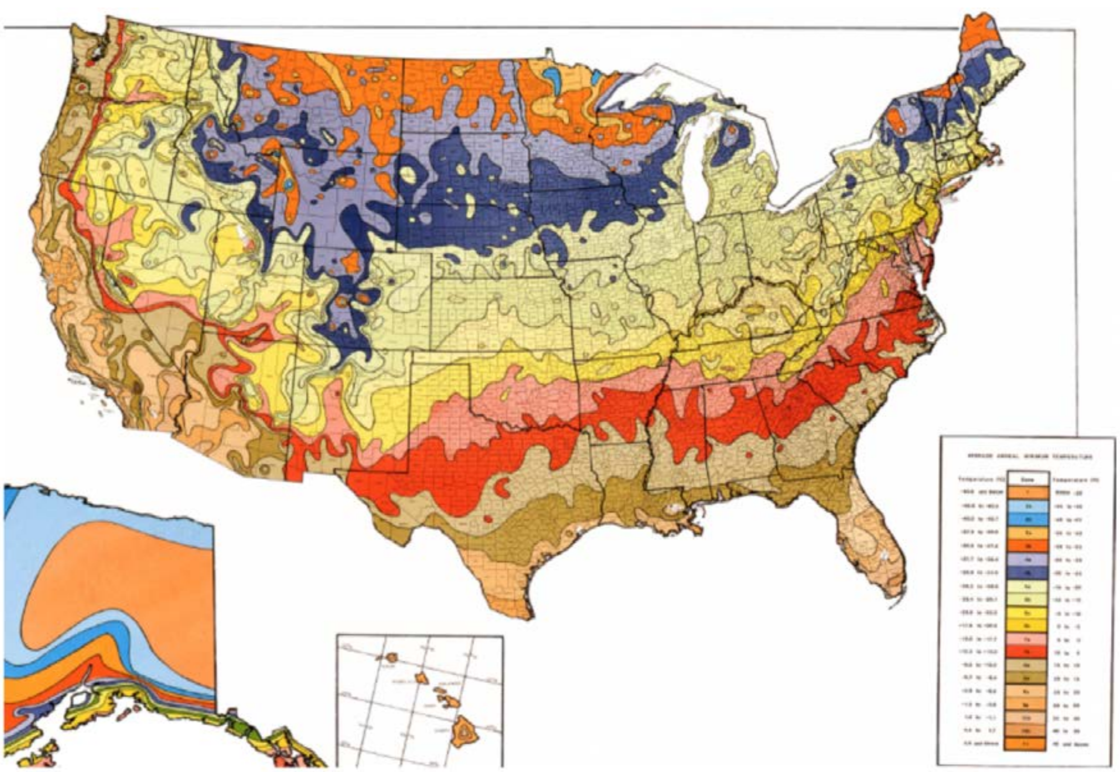
Not only does APHIS entirely exclude Zone 8a from the action area, it does not even assess impacts in all Zone 8b and higher regions, as it had initially proposed to do, where the biological viability of GE Eucalyptus is undisputed (see Figure 16, dEIS at 111, reproduced below). For instance, ArborGen notes

[2] Ingram, K., Dow, K., Carter, L., Anderson, J., (eds.) 2013. Climate of the Southeast United States: Variability, change, impacts, and vulnerability. Washington DC: Island Press; Fei, S., Desprez, J.M., Potter, K.M., Jo, I., Knott, J.A. and Oswalt, C.M., 2017. Divergence of species responses to climate change. *Science Advances 3*(5): e1603055.

that the Pacific Coast from San Francisco northward into Oregon is climatically suitable for GE Eucalyptus (Petition at 219), but APHIS fails to assess impacts in this extensive region. APHIS also arbitrarily excludes Zone 8b regions in southern California, Arizona, New Mexico, Washington, Arkansas, North Carolina, Nevada and Utah (PPRA at 5). Southern Florida is also illegitimately excluded from the action area. Some exclusions are made on the basis of purportedly inadequate precipitation for commercial GE Eucalyptus plantings, but this ignores the fact that Eucalyptus could be irrigated as are so many other crops in those regions.

USDA Plant Hardiness Zones - 1990

http://planthardiness.ars.usda.gov/PHZMWeb/Images/USZoneMap.jpg



In short, APHIS acknowledges, as it must, that the GE Eucalyptus can potentially be grown and thrive in a tremendously wide zone of the United States, including a large area of the southeastern U.S., but also much of the southwest U.S., California, coastal areas of Oregon and Washington, Hawaii, and Puerto Rico. This exclusion is unacceptable, especially as some species of non-freeze tolerant Eucalyptus are already invasive in California and have long been a fire hazard in that state.

Despite acknowledging this, APHIS severely cabins its entire review – the assessment of impacts and associated data, mitigation, and other considerations – to areas where industrial pine tree plantations currently exist in U.S. forestry, in 204 counties, across seven states (area shaded in purple in Fig. 16 B, dEIS at 111, reproduced below). *See, e.g.* EIS at ES-4, 31, 110. The action area comprises parts of 5 Alabama counties, 53 Florida counties, 61 Georgia counties, 31 Louisiana counties, 9 South Carolina counties, and 25 Texas counties. (EIS at ES-4). Those counties total 131,168 square miles (EIS at 24). Then, even within those counties, APHIS further limited its entire analysis to land areas that are “currently planted to pine or naturally-regenerated plantation pine” (EIS at ES-4; *see* Appendix B).[3]

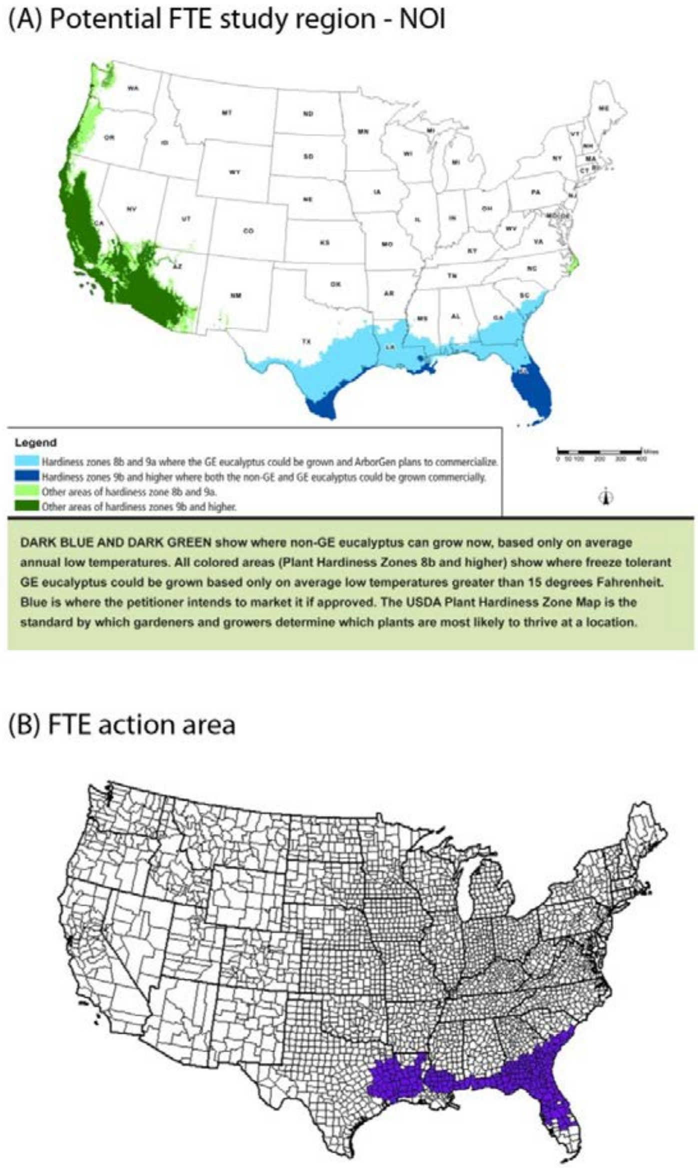


Figure 16. Potential FTE Study Region From the NOI Versus the FTE Action Area Considered in this EIS

[3] In most cases, APHIS’s analyses are cabined to just what is currently planted to pine (“planted plantation pine”), although confusingly in the cumulative impacts analysis APHIS expands the scope to include “naturally-regenerated plantation pine.” This is not a proper cumulative impact, *see infra*, but regardless, it shows that APHIS believes a broader scope is reasonably foreseeable. Admitting that GE Eucalyptus could be a substitute for naturally-regenerated plantation pine in addition to planted plantation pine almost doubles the action area (EIS at 188). However even that scope of action is far from legally adequate, *see infra*.

APHIS predicates this scope on an economic model that predicts where Eucalyptus plantations might be an economically viable land use when commercially cultivated as a source of wood pulp (EIS at 24), based on current economic factors. *See* Appendix B:

> While our projections are not meant to be precise predictions of the area of Eucalyptus adoption, they do demonstrate that under current conditions, a risk-neutral and profit maximizing land owner could choose to adopt Eucalyptus as a preferred land use. The extent of that adoption will depend on the future of market prices for various timber products, including new bioenergy products, and on the demonstrated productivity and certainty of production from available Eucalyptus seedlings. It is important to note that this work is based on the assumption that the behavior of returns for each of the land uses will remain unchanged into the future and that we did not explicitly address the effects of shifting timber supply on future market equilibrium.

Appendix B-42. Finally, in many cases, APHIS narrowed the scope of assessment even further to include only 10% of the land in those selected counties already dedicated to plantation pine, under the assumption that only 10% of pine plantations will switch to GE Eucalyptus and not more. *See, e.g.*, EIS at 150, 188.

APHIS's restriction of its analysis conflicts with basic principles of sound science assessment. The issue is not simply where current economic trends show GE Eucalyptus is most likely to be planted.[4] APHIS's proposed approval is not limited to only certain patches of ground where pine plantations currently exist in selected counties. NEPA does not allow such shortcuts. The Action Area is all regions of the United States where GE Eucalyptus is biologically viable. It violates NEPA to make environmental considerations, the primary purpose of NEPA, subservient to economic factors and considerations, which are meant to be secondary. Failure to analyze potential impacts of growing GE Eucalyptus in other places beyond the areas APHIS has assessed puts broad swaths of the country at jeopardy of unanalyzed risks – risks APHIS has failed to consider, let alone analyze. This approach downplays risks and fails to disclose the direct, indirect, and cumulative impacts of planting in those areas, even though they include harm to water resources, invasiveness, fire risks, pest and disease increases and more.

Finally, the action area is not just where GE Eucalyptus is intended to be planted, but where it can escape and grow. Past experiences with GE organisms show that they escape confinement time and time again to exist in unintended natural settings. GE trees like the proposed organisms create new and novel long-term types of invasive establishment risks. Constraining consideration of impacts to only selected parts of some counties that comprise only a fraction of reasonably foreseeable habitat does not constitute adequate analysis of the true nature of the proposed action. That type of assessment does not lead to informed decision making, rendering APHIS's decision arbitrary and capricious, in violation of NEPA's mandates.

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[4] Economic parameters are subject to rapid, unpredictable changes, such as trade agreements, congressional mandates, changes in administration and priorities, new technologies, and so on. See, for example, discussion of biofuel mandates (later in the text); and changes in tree plantation dynamics in Costa Rica: Jadin, I., Meyfroidt, P., Zamora Pereira, J.C. and Lambin, E.F., 2016. Unexpected Interactions between Agricultural and Forest Sectors through International Trade: Wood Pallets and Agricultural Exports in Costa Rica. *Land, 6*(1), 1; doi:10.3390/land6010001.

Improper Baselines

Another related fundamental flaw that belies APHIS's entire proposal is that APHIS's utilizes an improper baseline for its analysis: namely, APHIS uses existing industrial pine plantations as the comparison for the GE Eucalyptus. Comparing GE Eucalyptus plantations, to what is already an unsustainable, ecologically damaging activity, skews APHIS's consideration of the GE Eucalyptus's own adverse impacts, allowing the agency to downplay them by comparison, as only slightly worse in some cases, or equal to in other cases, environmental harms from pine plantations. This creates a misleading, colored assessment. It is not the case that the only place that GE Eucalyptus is being proposed for approval is in selected parts of 10% of existing industrial pine plantations and proposed for continued restriction beyond that. It is not the case that pine plantations are the only places GE Eucalyptus can thrive. Rather, GE Eucalyptus is being proposed for approval nationwide and can thrive over a much greater area than the one considered in the EIS. In some cases GE Eucalyptus will replace pine, but in other cases it may replace native forests, cropland, or other land uses. The baseline for the analysis fails to include any other land use, as explained above. But beyond that, it is also arbitrary for the agency to conclude and assume that existing pine plantations, even where they exist now, are the proper baseline for analysis. Without meaningful context, the determination of a proposal's effects is useless. The baseline for this assessment needs to consider the invasion and replacement of various healthy forest ecosystems by the harmful GE Eucalyptus trees, not merely assume those impacts will be not that bad since industrial forestry practices already exist.

Relatedly, APHIS also repeatedly uses non-GE Eucalyptus and data regarding it as its metric for the impacts of its proposed approval of GE Eucalyptus. This is arbitrary and capricious and contrary to sound science. The agency must assess the reasonably foreseeable impacts of the particular novel GE trees it is proposing approval for, not just generic impacts of Eucalyptus trees. The unknown risks to wildlife, for example, of these first-ever, unique commercial GE forest trees, could be very different than that of generic Eucalyptus. This is what the field trial process and data are for. Data illuminating the hydrological, fire hazard, biodiversity and other relevant factors pertaining to this issue should be collected from those test sites, rather than inventing theoretical baselines that have little relation to the action at hand. This is another improper fundamental baseline error that permeates APHIS's analyses.

Alternatives

Section 102(2)(E) of NEPA requires all agencies to study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. Regardless of whether an EA or EIS is prepared, NEPA requires that alternatives be given full and meaningful consideration. The Alternatives' analysis must be the "heart" of any EIS, and provide the public with a clear basis of choice among options. APHIS's alternatives' duties are more rigorous and comprehensive for an EIS as here than for an EA. APHIS must rigorously explore and objectively evaluate all reasonable alternatives, including the no action alternative, and, for alternatives that were not evaluated, discuss the reasons for their having been eliminated. In so doing, the agency must devote substantial treatment to each alternative considered in detail, including the proposed action so that reviewers may evaluate their comparative merits.

Here, APHIS only considers two alternatives: denying the petition or full, unrestricted nationwide approval. Courts have repeatedly held such binary analyses of alternatives to fail to comply with NEPA's mandates. Other alternatives needed to be considered and analyzed. Beyond that, APHIS fails to meaningfully consider even the two alternatives it included. The agency effectively equates the two alternatives in numerous ways, including their comparative impacts, by assuming: 1) an improper scope of the action to be limited to just a percentage of existing pine plantations in limited areas of seven states; and 2) an improper baseline of no action, industrial pine plantations, rather than native forests. This guts the discussion of meaning or clear choice, and improperly downplays the adverse impacts of the proposed action. Further, at times APHIS treats its proposed action as a *fait accompli* based on an inadequate and overly narrow purpose and need, making it appear as if the agency actually had no options other than the proposed alternative. This swapping of APHIS's and ArborGen's goals demonstrates that the entire alternatives comparison is just a façade, contrary to NEPA's fundamental purposes as action forcing and informing of agency decision making, not mere paperwork.

APHIS fails to consider and analyze numerous reasonable alternatives to the proposed action. NEPA requires APHIS to include a range of reasonable actions which might meet the goals of the agency by using different approaches to reduce the environmental impacts of the agency's action. Reasonable alternatives include those that are practical or feasible from a common sense technical and economic standpoint, rather than simply desirable from the standpoint of the applicant. Here, there were numerous other alternatives that need to be analyzed, including:

*delaying consideration until after the new Part 340 regulations are final and re-assessing under them;

*a more geographically limited approval, under permits or a partial deregulation or otherwise, to just the areas that APHIS analyzed (10% of the industrial pine plantation lands in the seven-state southeastern area);

* a more geographically limited approval, under permits or a partial deregulation or otherwise, to just the areas that are not sensitive to hydrological impacts, such as areas that are not "water limited or ecologically sensitive areas."[5]

*a temporally limited approval during which time more data related to risks are collected and analyzed as a precondition for re-approval;

*requiring particular forestry practices and mitigation, in order to minimize impacts;

*regulating in whole or in part under the agency's PPA noxious weed authority, in addition to the plant pest authority;

*approving only this particular event, and requiring further approval for any progeny that are produced by crossing with other lines or species of Eucalyptus, which may have different characteristics and risks.

Improper Purpose and Need

APHIS fails to comply with NEPA's purpose and need mandates. An agency's alternatives analysis should be a function of the purpose and need of the action under review. However, an agency may not define the objectives of its actions in such unreasonably narrow terms as to make consideration of alternatives a mere formality. But APHIS does exactly that here. Here, APHIS defines its "purpose and need" incredibly narrowly, as simply to respond to ArborGen's petition. EIS at 8. APHIS does not consider its statutory mandates under the PPA or NEPA and its purpose and need to comply with those. It does not consider its purpose and need to protect American agriculture, forestry, the public health and the environment in regulating GE organisms. It does not consider the overdue and needed new Part 340 regulations. NEPA requires that APHIS examine policy alternatives that take into account environmental values, but APHIS does not do that here. To the extent the purpose and need is not to address the current and future adverse

[5] Maier, C.A., Albaugh, T.J., Cook, R.I., Hall, K., McInnis, D., Johnsen, K.H., Johnson, J., Rubilar, R.A. and Vose, J.M., 2017. Comparative water use in short-rotation *Eucalyptus benthamii* and *Pinus taeda* trees in the Southern United States. *Forest Ecology and Management*, *397*:126-138 at 136.

impacts of these GE organisms, the purpose and need are unlawfully narrow and improper. Finally, APHIS improperly relies on the regulated entity's purpose and need.

The fact that APHIS has not complied with NEPA's processes and mandates is underscored by the fact that APHIS claims it is simply undertaking this EIS voluntarily, based on "public concerns," rather than any concern by the agency regarding significant environmental impacts. Not only does this admission show that APHIS has violated NEPA's procedural mandates, but also that they view the entire NEPA process as largely a façade. Beginning from such a flawed and biased purpose and need leads to a flawed assessment.

Environmental Impacts

APHIS fails to adequately analyze numerous significant environmental impacts. Among them:

**Wildfire risks*

Eucalyptus trees planted in plantations, naturalized or invasive in natural areas, and grown as ornamentals have been implicated in increased wildfire impacts in many locations around the world. In general, Eucalyptus trees are highly flammable, and in many locations deplete water resources, compound the effects of droughts and heat waves, and act synergistically with other flammable trees like pines, to facilitate destructive wildfires.[6] Impacts of the wildfires to people and communities include loss of property and life, health impacts from smoke inhalation and disruptions of health services, psychological distress, and more.[7] Environmental impacts of wildfires include death and injury of individual plants and animals; loss and degradation of habitat; population-level impacts; pollution of water by ash, silt, radioactive chemicals;[8] and more.

These documented impacts from real-life experiences must be considered by APHIS in the EIS because there are no actual data on parameters contributing to fire risks from GE Eucalyptus FTE 427 and 435 specifically, or even from other Eucalyptus species, in the southeast.[9] Instead, APHIS relies on

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[6] E.g., APHIS did not consider well-documented wildfire risks from Eucalyptus in Portugal: Frayer, L., 2017. Reeling from its deadliest forest fire, Portugal finds a villain: Eucalyptus trees. L.A. Times, June 20, 2017, http://www.latimes.com/world/europe/la-fg-portugal-Eucalyptus-fire-20170620-story html; Silva, J.S., 2016. Tasmanian blue gum (*Eucalyptus globulus)* in Portugal [presentation]. In-Tree Conference, 2 Nov 2016, Ascona, Switzerland; Mateus, P. and Fernandes, P.M., 2014. Forest fires in Portugal: dynamics, causes and policies. In *Forest Context and Policies in Portugal* (pp. 97-115). Springer International Publishing; Martin, A., Botequim, B., Oliveira, T.M., Ager, A. and Pirotti, F., 2016. Resource Communication. Temporal optimization of fuel treatment design in blue gum (*Eucalyptus globulus*) plantations. *Forest Systems 25*(2):09; Fernandes, P.M., Barros, A.M., Pinto, A. and Santos, J.A., 2016. Characteristics and controls of extremely large wildfires in the western Mediterranean Basin. *Journal of Geophysical Research: Biogeosciences, 121*(8): 2141-2157.

[7] Liu, Z., Murphy, J.P., Maghirang, R. and Devlin, D., 2016. Health and Environmental Impacts of Smoke from Vegetation Fires: A Review. *Journal of Environmental Protection 7*(12): 1860; Maleknia, S.D., Bell, T.L. and Adams, M.A., 2009. Eucalypt smoke and wildfires: Temperature dependent emissions of biogenic volatile organic compounds. *International Journal of Mass Spectrometry 279*(2):126-133.

[8] E.g., Campos, I.M.A.N., Abrantes, N., Vidal, T., Bastos, A.C., Gonçalves, F. and Keizer, J.J., 2012. Assessment of the toxicity of ash-loaded runoff from a recently burnt eucalypt plantation. *European Journal of Forest Research 131*(6):1889-1903

[9] "Because no or very little quantitative data regarding the fire risk of *Eucalyptus* within the FTE action area was available, FERA undertook a mathematical modeling approach using the Fuel Characteristic Classification System

mathematical modeling, even though there are few specific data to enter into the models, and models are based in part on unrealistic assumptions, such as the wishful notion that GE Eucalyptus plantations would be managed throughout the life of the stands to remove undergrowth, or that the trees would not be found outside of plantations in unmanaged situations in the future (DEIS at 225, and Appendix D). In spite of numerous data gaps and high uncertainty, APHIS concludes that the overall fire risk is about the same from GE Eucalyptus as it is from wildfire-prone planted plantation pine (e.g. dEIS at 113), which is an improper baseline, *see supra*.

APHIS must also consider cumulative impacts related to increased wildfire risks, including the positive feedback of fire on regeneration of Eucalyptus relative to other vegetation, and the increase in successful Eucalyptus seed germination and establishment after fires– impacts that increase likelihood of GE Eucalyptus naturalization and invasiveness.

**Impacts of naturalization and invasiveness, weediness of GE Eucalyptus FTE 427 and 435 and progeny*

There is remarkably little in the EIS on the issue of escapes of the GE Eucalyptus and its spread. APHIS fails to adequately analyze this significant environmental impact, besides alleging it is only a "long-term" risk. Yet NEPA does not include such temporal limitations. APHIS has a duty to analyze all impacts that are reasonably foreseeable, regardless of when they are expected to manifest.

APHIS determined in the PPRA, after a literature search and modeling, that FTE was predicted to have a ~1% chance of becoming a major invader, a ~27% chance of becoming a minor invader, and thus "not likely to escape, establish and cause harm" (PPRA at 26). This is a reckless conclusion and not based on sound science.

There are no data based on experiments with GE Eucalyptus FTE 427 and 435 for most of the biological and ecological parameters required to predict the likelihood that it will naturalize and become invasive (PPRA, Weed Risk Assessment, Appendix 4). Given all the unknowns, uncertainty in the modeled outcome is extremely high. In the face of potentially irreparable environmental, health, and socioeconomic harms that would occur if GE Eucalyptus becomes invasive, high uncertainty mandates that APHIS take a sounder approach and require more data. Instead, APHIS accepts the overall result of the weed risk assessment of "low risk," made meaningless by "high uncertainty," in the Weed Risk Assessment, and determines that as long as unrealistic voluntary mitigation measures are taken by those growing GE Eucalyptus now and long into the future (*see infra*), it is unlikely that GE Eucalyptus will become invasive and cause harm.

APHIS must take a harder look. For GE Eucalyptus to become invasive, it's progeny must "escape" cultivation, becoming naturalized as trees that grow and reproduce outside of managed plantations, and then spread into natural areas where it displaces native vegetation and disrupts ecosystems. The mechanisms by which introduced trees go through this process of becoming invasive are a subject of intense research, and point to concerns for GE Eucalyptus FTE 427 and 435.[10]

(FCCS)." DEIS at 112; "Because actual stand exam and surface fuel survey data for the FTE fuelbeds were lacking, these results and interpretations should be considered preliminary." DEIS at 225. Though the use of data from non-GE Eucalyptus is nonsensical where further testing of freeze tolerant GE Eucalyptus could provide more accurate data, the practice is understandable in the context of accidental wildfires that cannot be easily tested.

[10] Águas, A., Larcombe, M.J., Matias, H., Deus, E., Potts, B.M., Rego, F.C. and Silva, J.S., Understanding the naturalization of *Eucalyptus globulus* in Portugal: a comparison with Australian plantations. *European Journal of Forest Research:* DOI 10.1007/s10342-017-1043-6.

Progeny of GE Eucalyptus FTE 427 and 435 are included in the deregulation decision, so impacts of all foreseeable progeny must be included in the EIS, but they were not. In particular, APHIS must take into account the foreseeable sources of differences between GE Eucalyptus and its progeny that increase likelihood of invasiveness. More generally, APHIS completely fails to analyze or consider the risks of progeny and how they may differ from FTE 427 and 435. To fail to analyze the progeny risks, yet approve them anyway is arbitrary and capricious agency action.

Recent studies show that progeny of introduced trees often change over time as a result of epigenetic and genetic adaptations to local conditions, inter- and intra-specific hybridization with other introduced and/or native relatives, and other changes that make them more likely to spread. Moreover, introduced trees are sometimes initially less inhibited by pests, pathogens, and other co-evolutionary relationships that keep native vegetation from overtaking ecosystems. Stresses on ecosystems, such as previous disruptions from invasive species, changes in nutrient and light levels from natural and anthropogenic disturbances, and climate change, can make it more likely that introduced trees will become invasive.[11]

In addition to progeny that result from reproduction of GE Eucalyptus during its growth in plantations or in unmanaged areas, after deregulation these specific FTE lines can be used in breeding programs, resulting in new varieties that may have different characteristics, including different degrees of male sterility or none, or different characteristics that result in greater invasive potential.

For example, there likely will be strong evolutionary selection for the loss of male-sterility, so that progeny will make more seeds that express the GE freeze-tolerance trait. Silencing of genes that cause male-sterility so that flowers are self-fertile and can also pollinate related trees is likely to occur over time as trees encounter stresses.[12] Loss of male sterility may also occur in hybrid progeny that have different gene expression characteristics.

Even if GE male sterility is still effective in progeny, male sterility that prevents self-fertilization[13] is not an effective strategy for preventing naturalization and invasiveness.[14] In fact, some of the most problematic recently-invasive trees in the U.S. such as the ornamental Callery ("Bradford") pear are self-incompatible within a line, but over the years other lines with which they can mate were introduced into the same areas and they crossed freely to form intraspecific (within species) hybrids. The progeny of the successful crosses went wild, crossed with each other in many combinations, and are now taking over natural areas and

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[11] Hirsch, H., Richardson, D.M. and Le Roux, J.J., 2017. Introduction to the special issue: Tree invasions: towards a better understanding of their complex evolutionary dynamics. *AoB Plants 9*(3), plx014, doi:10.1093/aobpla/plx014.

[12] Depicker, A., M. Sanders and P. Meyer, 2005. Transgene silencing. In: "Plant Epigenetics", Annual Plant Reviews, v. 19 (P. Meyer, ed.). Blackwell Publishing, Oxford, UK, pp. 1-32;
Kuvshinov, V., A. Anissimov and B.M. Yahya, 2004. Barnase gene inserted in the intron of GUS – a model for controlling transgene flow in host plants. Plant Science 167: 173 – 182.

[13] Note that APHIS is calling the two male-sterile FTE lines "self-incompatible" because they lack sufficient pollen to form fertile seeds, but they can be pollinated by non-engineered lines of the same hybrid and closely-related species to make seeds because the female parts of the FTE flowers are fully functional. See Crouch (2009) for more detailed information about self-incompatibility and male-sterility in Eucalyptus.

[14] Knight, T. M., Havens, K., & Vitt, P. (2011). Will the use of less fecund cultivars reduce the invasiveness of perennial plants?. *BioScience 61*(10): 816-822.

excluding native species.[15] Brazilian pepper tree in Florida is another example where hybridization of different varieties within the same species, introduced separately, increased invasiveness.[16] APHIS entirely failed to analyze these risks.

Indeed, invasiveness of hybrids in general is often enhanced relative to parents.[17] Even hybrids that initially are less fit can genetically contribute to subsequently successful invaders.[18] Introduction of a wide variety of different related trees over time into areas that GE Eucalyptus trees are growing, with which they can potentially hybridize, is foreseeable. The forestry industry reports that it is currently experimenting in the southeast with dozens of Eucalyptus species, including selected lines and novel hybrids closely related to GE Eucalyptus FTE 427 and 435.[19] There will likely be other GE Eucalyptus with different traits in field trials or commercialized in the southeast in the future, as well. ArborGen is now selling the non-GE parental line (EH1) of GE Eucalyptus for use in central and southern Florida,[20] which overlaps with the area that GE Eucalyptus can be grown.

Climate change and associated weather anomalies are likely to alter the flowering behavior of trees, including the time of the season flowers are open and available for hybridization.[21] Climate change is also

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[15] Culley, T. M., & Hardiman, N. A. (2009). The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree *Pyrus calleryana*. *Biological Invasions 11*(5): 1107-1119.

[16] Geiger, J. H., Pratt, P. D., Wheeler, G. S., & A. Williams, D. (2011). Hybrid vigor for the invasive exotic Brazilian peppertree (*Schinus terebinthifolius* Raddi., Anacardiaceae) in Florida. *International Journal of Plant Sciences 172*(5): 655-663.

[17] Gaskin, J.F., 2016. The role of hybridization in facilitating tree invasion. *AoB Plants 9*(1): plw079; Schierenbeck, K. A., & Ellstrand, N. C. (2009). Hybridization and the evolution of invasiveness in plants and other organisms. *Biological Invasions 11*(5): 1093; Abbott, R. J., J.K. James, R.I. Milne and A.C.M. Gillies, 2003. Plant introductions, hybridization and gene flow. Philosophical Transactions of the Royal Society of London, Series B. 358: 1123 – 1132; Wagner, N.K., Ochocki, B.M., Crawford, K.M., Compagnoni, A. and Miller, T.E., 2017. Genetic mixture of multiple source populations accelerates invasive range expansion. *Journal of Animal Ecology 86*(1): 21-34.

[18] Arnold, M.L., M.R. Bulger, J.M. Burke, A.L. Hempel and J.H. Williams, 1999. Natural hybridization: How low can you go and still be important? Ecology 80: 371 – 381.

[19] E.g., Hart, P.W., Johnson, J. and Paim, R., 2016. Status update on development of a Eucalyptus plantation program in the southeastern United States and higher elevations of southern Brazil. *TAPPI JOURNAL 15*(3): 148-155.
https://www.researchgate.net/profile/Peter_Hart6/publication/302886955_Status_update_on_development_of_a_Eucalyptus_plantation_program_in_the_southeastern_United_States_and_higher_elevations_of_southern_Brazil/links/575036fa08ae5c7e547a8d51.pdf; Forest Productivity Cooperative, 2016. US Eucalyptus Working Group 2016 Contact Meeting Overview [presentation]. http://fpcstorage.objects.cdn.dream.io/wp-content/uploads/2016/04/2016-FPC-US-Eucalyptus-Contact-Meeting-Overview-.pdf, accessed July 02, 2017.

[20] SuperTree seedlings: Superior Performance from ArborGen. 2017-2018 Product Catalog, http://supertreeseedlings.com/wp-content/uploads/2016/05/2017-2018-SuperTree-Seedlnigs-eCatalog.pdf, accessed April 28, 2017.

[21] Barbour, R.D., B.M. Potts and R.E. Vaillancourt, 2005. Pollen dispersal from exotic eucalypt plantations. Conservation Genetics 6: 253 – 257; Crouch, M. L., 2009. Comments to USDA APHIS on Draft Environmental Assessment for “Controlled Release of a Genetically Engineered Eucalyptus Hybrid”, https://www.regulations.gov/document?D=APHIS-2008-0059-0274; cited references within have also been submitted to this docket.

likely to change the range of particular Eucalyptus, bringing trees that were not previously within proximity into the range where they could potentially hybridize with GE Eucalyptus.

Increases in tolerance of freezing or other stresses from crossing with other related trees that have different mechanisms of freeze tolerance, or that express the inherited freeze-tolerance transgene differently, would extend the range of progeny, and potentially the area where invasiveness would be a concern.[22]

Trees that are selected to grow faster may be at higher risk of becoming invasive. Of particular relevance, experiments with fast-growing introduced loblolly pine in Brazil show that progeny of trees from the same line have different trajectories, some becoming invasive and others not, with little ability to predict the outcome.[23] The EH1 hybrid that gave rise to GE Eucalyptus FTE 427 and 435 was presumably selected for characteristics that make it a better pulp and biofuel tree than its parents, such as ability to grow faster than *E. grandis*.[24] The *E. urophylla* parent is reported to have contributed disease tolerance. In some combinations, these characteristics could enhance the ability of progeny to be weedier, i.e. more likely to become invasive.

APHIS assumes that mitigation measures to reduce the likelihood that GE Eucalyptus FTE 427 and 435 will become invasive and cause harm will be followed, such as maintaining management and oversight of plantations, including scouting for escaped trees and destroying them. However, abandonment of orchards and tree plantation occur in response to a variety of government policies, economic conditions, and other changes. Thus abandonment is difficult to predict and prevent, making continual management an arbitrary and capricious assumption.[25] APHIS is not requiring any monitoring, mitigation, or any other restrictions on use. Mitigation measures to prevent spread of GE Eucalyptus will have environmental, human health, and socioeconomic impacts in and of themselves that APHIS has not assessed.[26]

There is long experience with trying to control introduced invasive trees throughout the world, and it is a history of one failure after another. The only reliable way to prevent harm is to prevent introduction of potentially invasive trees in the first place. This is especially true of exotic trees that are introduced and planted widely in monocultures, as will be the case with GE Eucalyptus FTE 427 and 435.

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[22] For example, locations of Eucalyptus seedlings outside of plantations in Portugal are limited by frost and other environmental factors: Catry, F.X., Moreira, F., Deus, E., Silva, J.S. and Águas, A., 2015. Assessing the extent and the environmental drivers of *Eucalyptus globulus* wildling establishment in Portugal: results from a countrywide survey. *Biological Invasions 17*(11): 3163-3181.

[23] Zenni, R. D., da Cunha, W. L., & Sena, G. (2016). Rapid increase in growth and productivity can aid invasions by a non-native tree. *AoB Plants 8*, plw048.

[24] Bison, O., Ramalho, M.A.P., Rezende, G.D.S.P., Aguiar, A.M. and De Resende, M.D.V., 2006. Comparison between open pollinated progenies and hybrids performance in *Eucalyptus grandis* and *Eucalyptus urophylla*. *Silvae Genetica 55*(4-5): 192-196.

[25] Mateus, P. and Fernandes, P.M., 2014. Forest fires in Portugal: dynamics, causes and policies. In *Forest Context and Policies in Portugal* (pp. 97-115). Springer International Publishing;
Murray, P, 2000. Remarks by Senator Murray Introducing the Apple Orchard Diversification Act (S.2442), News Release, April 13, 2000; USDA National Agricultural Statistics Service, 2012. Citrus Abandoned Acres; South arolina Legislature, 2012. South Carolina, Code of Laws, Title 46 – Agriculture, Chapter 35 – Neglected or Abandoned Orchards. http://www.scstatehouse.gov/code/t46c035.php, accessed 11/27/2013.

[26] E.g. risks from attempts to eradicate escaped Ge Eucalyptus: Minogue, P. J., Lorentz, K. A., 2015. Eucalyptus Control in Natural Areas and Rights of Way [presentation], Aquatic Weed Control Short Course, May 5, 2015, University of Florida.

**Pesticides*

APHIS admits that GE Eucalyptus plantations will require pesticides, for various parts of the growing process, and to keep down likely pests and diseases. *E.g.*, EIS at 100, 177, 208, 228. Weed control treatments are not well developed for Eucalyptus and may be the greatest silvicultural challenge. Herbicide treatments used for pine culture are not appropriate for *Eucalyptus* plantations and new treatments must be developed to ensure adequate control of competing vegetation without seedling damage.[27] At the same time, APHIS declines to assess any of those reasonably foreseeable pesticide impacts of its proposed action. Instead, the agency repeats the mantra that pesticides are regulated and approved by EPA. *See, e.g.* EIS at 33, 116. This improper wholesale reliance on EPA violates NEPA. APHIS cannot rely solely on EPA's evaluation of effects under a separate statute to adequately fulfill its own NEPA obligations. Further, FIFRA analyses and standards are different than NEPA review. Compliance with FIFRA requirements does not overcome an agency's obligation to comply with environmental statutes with different purposes. APHIS admits that EPA will not undertake any of its own review specifically for these GE Eucalyptus uses, so they will go unassessed.

Additionally, APHIS documents the use of biocontrol agents to manage Eucalyptus pests and pathogens in California and elsewhere, and states that they will be required, in addition to pesticides, if GE Eucalyptus plantations are to be managed properly in the southeast. However, biocontrol agents carry risks to the environment,[28] which APHIS failed to consider or analyze. For example, studies pin the decline of charismatic saturniid moths in eastern U.S. forests on an exotic parasitoid fly intentionally introduced to control outbreaks of gypsy moth and browntail moth.[29]

**Soil Impacts*

APHIS did not examine specific data from GE Eucalyptus FTE 427 and 435 for impacts to soil in conditions particular to the action area. Root exudates, decaying roots, leaf and bark litter, and other plant parts from FTE 427 and 435 will be different from those of both non-GE Eucalyptus and other plants in the growing area, and may change soil dynamics in ways that impact biodiversity and subsequent land uses.[30]

Also, APHIS did not consider impacts from increased pesticide use on soil quality, including accumulation of pesticide residues and metabolites that may harm beneficial soil organisms to the detriment of the environment and human health.

Fast-growing GE Eucalyptus will deplete soil nutrients, leading to increased use of chemical fertilizers with deleterious impacts in the short and long term that APHIS must fully assess.

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[27] Stanturf et al 2013.

[28] Hajek, A.E., Hurley, B.P., Kenis, M., Garnas, J.R., Bush, S.J., Wingfield, M.J., van Lenteren, J.C., Matthew, J. and Cock, W., 2016. Exotic biological control agents: A solution or contribution to arthropod invasions? Biological Invasions 18(4): 953.

[29] Boettner, G.H., Elkinton, J.S. and Boettner, C.J., 2000. Effects of a biological control introduction on three nontarget native species of saturniid moths. Conservation Biology 14(6):1798-1806; Elkinton, J.S. and Boettner, G.H., 2012. Benefits and harm caused by the introduced generalist tachinid, *Compsilura concinnata*, in North America. BioControl, 57(2): 277-288.

[30] Bernhard-Reversat F, Loumeto JJ, Laclau JP (2001) Litterfall, Litter Quality and Decomposition Changes with Eucalypt Hybrids and Plantation Age. http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers09-05/010027095.pdf. Accessed 18 Apr 2013

**Air Quality Impacts*

In addition to impacts of increased use of machinery on air pollution, using proper assumptions about extent of GE Eucalyptus plantations, APHIS must consider impacts of greater pesticide use, increased smoke from more frequent wildfires, and GE Eucalyptus-specific volatile organic compounds (VOCs).

**Water Impacts*

USDA Forest Service modeled potential impacts of GE Eucalyptus FTE 427 and 435 on water quantity within APHIS's overly-restricted action area and concluded that hydrological impacts would be limited to specific sites (Appendix C). The Forest Service did not have any published studies on water use by Eucalyptus of any kind in the southeast[31], and lacked water use data for GE Eucalyptus. Therefore, the agency used information from other kinds of Eucalyptus in other areas of the world to model hydrological impacts of GE Eucalyptus FTE 427 and 435 in relation to pine plantations, finding that GE Eucalyptus is likely to result in decreased water flow compared to pine in some locations and years. The study's authors state that "...results should be considered a first approximation until empirical data are available."

APHIS restricts its consideration of water quality impacts to increased sediment loading from production-related soil disturbance. However, APHIS must also assess impacts of water quality changes that result from increased pesticide and fertilizer use, GE Eucalyptus-specific leachates from leaves and other plant parts, ash and soil-loading from increased fires, and changes in concentrations of the full range of water components due to decreased water flow. Water contaminants can have impacts well beyond the streams where they originate that must be taken into account.[32]

Given the central role of water to all non-human and human life, APHIS must recognize high uncertainty, and require GE Eucalyptus-specific data on water quality and quantity impacts throughout the entire range that it can grow, while making the assumption that there will be wide adoption, before taking action on deregulation of GE Eucalyptus FTE 427 and 435.

**Pests and Diseases*

The freeze-tolerance of GE Eucalyptus FTE 427 and 435 is intended to permit the cultivation of a fast-growing cultivar suitable for plantations in a range of environments where commercially viable Eucalyptus has never been grown before in the US. Expansion of Eucalyptus plantings northwards would put GE Eucalyptus into proximity with crops and native vegetation it has never or only rarely been associated with. There is often uncertainty about the host range of even the better characterized insect pests and disease pathogens of Eucalyptus in its current growing range. With expansion northwards, Eucalyptus pests and diseases would encounter novel plant species in new environments, with clear potential for damage to crops and native plants whose susceptibility to these pests/diseases is currently unknown. These factors demand

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[31] A newly published study of water use by *Eucalyptus benthamii* in the southeast concludes that "…higher absolute water use by intensively managed Eucalyptus forests could have negative local-scale impacts on stream flow or ground water reserves in water limited or ecologically sensitive areas." Maier, C.A., Albaugh, T.J., Cook, R.I., Hall, K., McInnis, D., Johnsen, K.H., Johnson, J., Rubilar, R.A. and Vose, J.M., 2017. Comparative water use in short-rotation *Eucalyptus benthamii* and *Pinus taeda* trees in the Southern United States. *Forest Ecology and Management 397*: 126-138.

[32] For example, fertilizers and other agricultural chemicals are responsible for toxic algal blooms and "dead zones" in water bodies far from applications sites; e.g., http://healthygulf.org/our-work/protecting-water/dead-zone-and-mississippi-river.

an especially careful assessment of the pest/disease threats of GE Eucalyptus prior to any decision on its regulatory status.

APHIS's plant pest risk assessment of GE Eucalyptus is deficient in many respects, and fails to account for serious threats. Below we address:

1) Excessive reliance on uninformative field observations by ArborGen;
2) Improper geographic limitation of the risk assessment
3) Failure to assess threats from exotic Eucalyptus pests
4) Inadequacy of measures to prevent introduction of exotic Eucalyptus pests
5) Eucalyptus pests threaten other crops and plants
6) Freeze damage increases plant pest potential of GE Eucalyptus
7) Plant pests risks of abandoned GE Eucalyptus plantations
8) Improper reliance on best management practices

<u>ArborGen's field observations</u>
ArborGen did not conduct any controlled testing, either field or greenhouse-based, for the resistance or susceptibility of GE Eucalyptus trees to any particular pest or pathogen known to infest Eucalyptus, despite acknowledging that these are standard procedures in plant pathology (unless otherwise noted, see Petition at pdf 421-424, Attachments 1, 2A and 2B, for this discussion). Nor did ArborGen conduct such controlled tests on crops/plants that would be in proximity to GE Eucalyptus in the newly expanded range. ArborGen's primary purpose with its field trials of GE Eucalyptus was to assess performance. Even if pest and disease monitoring is an "incidental" and "infrequent" aspect of many forestry tree trials, as ArborGen maintains, a higher standard that includes controlled tests for susceptibility to major insect pests and disease pathogens is demanded prior to introduction of GE Eucalyptus into novel environments of the U.S.

Instead, ArborGen utilized a "general survey approach" involving visual observation of field trial trees at six-week intervals, requiring observers to identify a limited set of pests and pathogens (EIS at 169-176, Tables 13 & 14). ArborGen's observational "survey approach" to the plant pest risk assessment of GE Eucalyptus is unacceptable, and contrary to sound science, in several respects. First, most insect pests and diseases occur only sporadically; and if a particular pest or pathogen is simply not present at the field trial site, field observations provide no information on susceptibility. Second, it is well known that recently introduced plantations of Eucalyptus normally experience a disease-free "honeymoon period" for variable time periods, after which diseases do often occur.[33] Because ArborGen monitored GE Eucalyptus field trials for as little as eight months (Petition at pdf 424, Attachment 2A), it is not surprising that there were relatively few observations of diseases. Finally, ArborGen conducted monitoring at just 36 field trial sites in 17 counties of 7 states (Petition at 109, 175-193). These trials were clearly far too few in number, and far too clustered (6 counties were represented in Florida, but only one each Georgia, Louisiana and Texas), to gauge the potential plant pest risks, even in APHIS's artificially restricted "action area" of 204 southeastern counties.

These many deficiencies in the design and execution of ArborGen's pest and disease monitoring render the data practically meaningless, and underscore the necessity of controlled tests to assess the plant pest risk posed by GE Eucalyptus in the proposed expanded range. These same deficiencies also prevent any conclusion as to whether or not ArborGen's FTE427 and FTE435 GE lines pose a greater plant pest risk than their conventional counterpart.

[33] Burgess TI and Wingfield MJ (2017). Pathogens on the move: a 100-year global experiment with planted eucalypts. BioScience 67(1): 14-25.

Improper geographic limitation of the plant pest risk assessment

As discussed above in the "Improper Scope of the Action Area" section, GE Eucalyptus is biologically viable in a much broader area than portions of the 204 counties in 7 states that compose APHIS's action area. ArborGen collected no data – not even marginally useful field trial observations – on potential plant pest risks of GE Eucalyptus in the western and southwestern states of its potential range, Hawaii or Puerto Rico. As noted above, field trial observations were limited to just 17 counties of seven southeastern states. Likewise, there is no evidence of laboratory or greenhouse-based assessment.

APHIS's failure to require ArborGen to generate data on the plant pest risk potential of GE Eucalyptus in large portions of its possible range, or generate such data itself, is contrary to sound science, and of itself invalidates APHIS's conclusion that GE Eucalyptus is "highly unlikely to pose a plant pest risk" with proper management and oversight (PPRA at 42).

Failure to assess threats from exotic Eucalyptus pests

APHIS also impermissibly limits it assessment to Eucalyptus insect pests and pathogens that are already present in the United States (PPRA at 8; EIS at 169-176, Tables 13 and 14)[34], despite abundant evidence of accelerating introduction from abroad. For instance, although insect pests of Eucalyptus were unknown in California for a century, new pests have been detected in the state at a rate of nearly one per year since the first was detected in 1985.[35] Burgess and Wingfield (2017), cited above, describe how the global spread of Eucalyptus plantations has been quickly followed by establishment of their pathogens. They note that "plantations can act as 'magnets' for pathogens;" and that the disease-free "honeymoon period" after establishment of exotic Eucalyptus plantations – formerly several decades – has become increasingly shorter since the turn of the century. They attribute this accelerating invasion of Eucalyptus pathogens to the "basic failure of quarantine measures … due to lack of resources or poorly regulated pathways," noting that "calls to regulatory organizations to improve monitoring surveillance and quarantine have largely fallen on deaf ears." Pests are introduced via import of infested Eucalyptus wood products as well as infested live Eucalyptus plants. The increase in trade of live plants over the past decades has increased the importance of this pathway of introduction.[36] To give an idea of the scope of the threat, a USDA Forest Service assessment conducted at the request of APHIS identified 175 insects and 58 pathogens associated with Eucalyptus in South America alone as potential pests of concern.[37] APHIS concedes that "there are

[34] The only exception is Eucalyptus leaf spot (EIS at 172).

[35] Dahlsten DL, Rowney DL, Robb KL, Downer JA, Shaw DA, Kabashima JN (2002). Biological control of introduced psyllids on Eucalyptus. 1st International Symposium on Biological Control of Arthropods, January 2002.

[36] Liebhold AM, Brockerhoff EG, Garrett LJ, Parke JL, Britton KO (2012). Live plant imports: the major pathway for forest insect and pathogen invasions of the US. Frontiers in Ecology and the Environment 10(3): 135-143. Brasier CM (2008). The biosecurity threat to the UK and global environment from international trade in plants. Plant Pathology 57: 792-808. Roy BA, Alexander HM, Davidson J, Campbell FT, Burdon JJ, Sniezko R, Brasier C (2014). Increasing forest loss worldwide from invasive pests requires new trade regulations. Frontiers in Ecology and the Environment 12(8): 457-465.

[37] Kliejunas JT et al. (2001). Pest risk assessment of the importation into the United States of unprocessed Eucalyptus logs and chips from South America. Gen. Tech. Rep. FPL-GTR-124. Madison, WI: US Department of Agriculture, Forest Service, Forest Products Laboratory, Tables 8 and 9.

numerous potential pest organisms associated with *Eucalyptus* in South America that have a high likelihood of being inadvertently introduced into the United States…”[38]

APHIS fails to assess several of the 19 pest/pest groups associated with Eucalyptus in South America, and that pose a high or moderate risk potential if introduced into the United States on Eucalyptus wood products.[39] Moreover, Kliejunas et al. (2001) note that the 19 pest/pest groups they identified as having high or moderate risk potential are only “representative samples” of South American Eucalyptus pests that pose potential risks if introduced into the U.S., and that the list was constrained by availability of biological information.

In addition, APHIS fails to assess the threats posed by the likely introduction of exotic insect pests and disease pathogens from parts of the world outside of South America. Examples include many of the 100 phytopathogenic species of the extremely damaging genus of fungal pathogens known as *Phytophthora* (APHIS Phytophthora 2010), many of which are known to infest Eucalyptus.[40]

Inadequacy of measures to prevent introduction of exotic Eucalyptus pests

Further, APHIS’s conclusions as to plant pest risks from exotic Eucalyptus pests rely heavily on the efficacy of phytosanitary measures to prevent their introduction (PPRA at 12, 13, 14-15, 16, 19) and EIS (at 178, 180) (relying on 69 FR 2289-95 (2004)), which is questionable in light of the many studies which find that regulatory regimes around the world are doing a poor job of preventing the introduction of exotic plant pests.[41] Logs, lumber, and wood chips derived from tropical Eucalyptus species that potentially harbor one or more of the 19 groups of high or moderate risk Eucalyptus pests can continue to be imported into the U.S. without addressing their risks. Risks from South American pests are significant, and APHIS’s reliance is misplaced.

Importation of live Eucalyptus plants is subject to post-entry quarantine to guard against introduction of *Pestalotia disseminate* (the fungal pathogen that causes Eucalyptus leaf spot disease) and the leaf chlorosis virus, although imports from Canada, Europe, Sri Lanka and Uruguay are exempted (PPRA at 8, 17). However, the quarantine measures do not apply to any of the hundreds of other exotic insect pests and disease pathogens that are known to infest Eucalyptus. While infestation by other pests might be detected in quarantine, APHIS inspectors are only instructed to inspect for symptoms of these particular diseases,[42] and so may miss “small or cryptic pests or disease symptoms [that are] difficult to diagnose” (EIS at 207-208).

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[38] USDA (2004). Importation of Eucalyptus wood products from South America: Environnmental Assessment. Animal and Plant Health Inspection Service, USDA, January 2004.

[39] Kliejunas et al. (2001), vii to viii.

[40] USDA Phytophthora (2012). New Pest Response Guidelines: Phytophthora species in the environment and nusery settings. Animal and Plant Health Inspection Service, USDA, 2010.

[41] Liebhold AM, Brockerhoff EG, Garrett LJ, Parke JL, Britton KO (2012). Live plant imports: the major pathway for forest insect and pathogen invasions of the US. Frontiers in Ecology and the Environment 10(3): 135-143. Brasier CM (2008). The biosecurity threat to the UK and global environment from international trade in plants. Plant Pathology 57: 792-808. Roy BA, Alexander HM, Davidson J, Campbell FT, Burdon JJ, Sniezko R, Brasier C (2014). Increasing forest loss worldwide from invasive pests requires new trade regulations. Frontiers in Ecology and the Environment 12(8): 457-465.

[42] USDA Quarantine (2010). Postentry Quarantine Manual. US Department of Agriculture. First edition issued 2010.

APHIS concedes that "there are numerous potential pest organisms associated with *Eucalyptus* in South America that have a high likelihood of being inadvertently introduced into the United States…"; that many exotic pests can cause substantial damage to Eucalyptus; and that phytosanitary measures to prevent their introduction are inadequate (EIS at 177, 207-208). In view of this evidence, it is clear that exotic Eucalyptus pests will continue to invade the U.S. and become established in both GE and existing non-GE Eucalyptus plantations. APHIS's failure to assess these threats, and instead focus entirely on those Eucalyptus pests already found in the U.S., is thus arbitrary and capricious.

Eucalyptus pests threaten other crops and plants

The proposed deregulation of GE Eucalyptus would lead to a dramatic increase in Eucalyptus plantings, in most cases in new environments where Eucalyptus has never been grown before. This will inevitably lead to a correspondingly increased prevalence of Eucalyptus pests. While some Eucalyptus pests appear to threaten mainly Eucalyptus and related species, many others that have a broader host range could cause considerable damage to agriculturally important crops and/or native vegetation. APHIS's extremely cursory treatment of this important subject is incomplete, contrary to evidence before the agency, and dramatically downplays the reasonably foreseeable harms of deregulation.

APHIS finds that only one insect pest (the eucalypt weevil, *Gonipterus scutellatus*) and two disease pathogens (Eucalyptus rust, *Puccinia psidii*, and pink disease, *Erythricium salmonicolor*) would pose threats to plants other than Eucalyptus under the proposed deregulation (PPRA at 19, EIS at 179). In fact, many other Eucalyptus pests pose serious threats to scores of other plants, including agriculturally important crops. In an environmental assessment that APHIS itself conducted in 2004, the agency described many Eucalyptus pests likely to be introduced from South America in Eucalyptus wood products that have "broad host ranges," meaning the ability to infest plants other than Eucalyptus.[43] As discussed above, APHIS's failure to institute regulatory safeguards makes it more likely that these pests would be introduced and cause damage not only to Eucalyptus, but other plants as well.

Nevertheless, APHIS states that the "likelihood is low" that Eucalyptus pests would "affect other species," citing Kliejunas et al. (2001) (PPRA at 19). What Kliejunas et al. actually say is quite different. They warn that a number of the damaging organisms they identified would likely have greater adverse economic impacts on agricultural crops than on forestry or floriculture.[44]

APHIS relies repeatedly on the notion that damage from pests and pathogens of GE Eucalyptus would be limited to warmer, wetter areas (e.g. PPRA 14, 16), again citing Kliejunas et al. (2001); yet these USDA Forest Service risk assessors warn that: "climate alone should not be the deciding factor when considering potential impacts because it is not known how they [pests and pathogens] would react under United States conditions or how irrigation practices in the United States might influence pest epidemiology."

Pink disease is one of the most important diseases of Eucalyptus, and is known to infest 141 plant species in 104 genera. Already identified in the southeast, it would likely increase in prevalence with the proposed deregulation. Important agricultural crops that would likely be damaged include grapefruit, orange, apples, pears, figs and redbud (EIS at 167). If cultivation of GE Eucalyptus in Hawaii leads to introduction of this

[43] USDA (20040, op. cit., 5-6.

[44] Kliejunas et al. (2001), op. cit., p. 8.

serious pathogen there, it could result in damage not only to agricultural and ornamental crops, but also native plants, including those listed as endangered or threatened, or as candidates for listing.[45] APHIS provides no assessment of potential damage or losses from infestation of agricultural crops or native plants upon deregulation.

Eucalyptus rust, a fungal disease caused by *Puccinia psidii*, is found in Florida and Hawaii, and threatens not only Eucalyptus but other members of the *Myrtaceae* family worldwide, in addition to guava and an ornamental species of allspice (*Pimenta dioica*) (EIS at 167-168, http://www.apsnet.org/publications/imageresources/Pages/IW000023.aspx). Its host range is expanding in Florida and Hawaii,[46] and with new *Myrtaceae* species being discovered annually (https://en.wikipedia.org/wiki/Myrtaceae), its full host range is uncertain. Both parents of the GE Eucalyptus (*E. grandis* and *E. urophylla*) are known to be susceptible. Thus, GE Eucalyptus may have the potential to introduce this dangerous pathogen to new parts of Hawaii, or increase its prevalence where it is already found. Several threatened and endangered species in the *Myrtaceae* family are present within the potential range of GE Eucalyptus FTE 427 and 435 in the US and its territories, and risks of Eucalyptus rust and other pests and pathogens to these native plants must be examined in the EIS.[47]

APHIS fails to assess damages to non-Eucalyptus plants from the likely spread of the fungal pathogen *Ceratocystis fimbriata*, which causes canker disease, upon deregulation. This is one of the high risk potential pests identified by Kliejunas et al. (2001), who regard it as a greater threat to agriculture than to floriculture or forestry. It is viewed as as one of the most virulent and economically important vascular pathogens in many agricultural crops and forest trees.[48]

The Phytophthora genus comprises over 100 species of plant pathogenic fungi that count among the most destructive plant pests in the world.[49] Many species infest Eucalyptus and numerous other trees.[50] APHIS's extremely cursory treatment addresses only one species (*P. cinnamomi*), and completely fails to discuss the potential for increased *Phytophthora* presence promoted by GE Eucalyptus plantings to infest other crops (PPRA at 17). Elsewhere, APHIS discusses several other Eucalyptus-infesting *Phytophthora* species.[51] For instance, *P. boehmeriae* is known to infest GE Eucalyptus parent *E. grandis* and many other plants, including agriculturally important crops, that would likely suffer heavy losses under the proposed deregulation. *P. alticola* and *P. frigida,* first identified as new species in South Africa in 2007, infest both

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[45] Ibid.

[46] Glen M, Alfenas AC, Zauza EAV, Wingfield MJ, Mohammed C (2007). *Puccinia psidii*: a threat to the Australian environment and economy. Australasian Plant Pathology 36: 1-16.

[47] USDA (2004), op. cit.

[48] Baker CJ and Harrington TC (2004). Ceratocystis fimbriatica. CABI Crop Protection Compendium, CABI Publishing, updated 2004. http://www.public.iastate.edu/~tcharrin/CABIinfo.html. Montoya MM and Wingfield MJ (2006). A review of Ceratocystis sensu stricto with special reference to the species complexes C. coerulescens and C. fimbriata. Revista Facultad Nacional de Agronomía, Medellín, 59(1), 3045-3375. http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0304-28472006000100001&lng=en&tlng=.

[49] USDA Phytophthora (2010), op. cit.

[50] Rhoades CC, Brosi SL, Dattilo AJ, Vincelli P (2003). Effect of soil compaction and moisture on incidence of phytophthora root rot on American chestnut. Forest Ecology and Management 184: 47-54.

[51] USDA Phytophthora (2010), op. cit.

cold-tolerant Eucalyptus and acacias. *P. captiosa* and *P. fallax*, first identified in 2006, cause Eucalyptus dieback in New Zealand. Because these species are so recently known to science, their ability to infect other plants remains unknown.

This illustrates a general point. Pathogens limited to a narrow range of hosts where endemic can adapt to other hosts when introduced into a new environment, and can also expand their host range via interspecific hybridization.[52] Evolution of new species with increased virulence or broadened host range can occur rapidly. Pathogens that cause little damage to their host plants in their native range, due to co-evolution with their hosts, can become extremely serious pests as invasives. This may help explain why "almost all serious pathogens of eucalypts were first reported in exotic plantations outside the native range of these trees."[53] It also helps explain why phytosanitary regimes based on identification of particular problematic species are so often ineffective – identification of the invasive pathogen often occurs only after the disease it causes as an invasive has prompted scientists to study it.

Leaf-cutting ants (*Atta texana*) native to Texas and Louisiana could also become a much-increased threat with introduction of GE Eucalyptus. Colonies fostered by GE Eucalyptus plantations could also severely damage citrus trees, plum and peach trees, blackberry bushes and many other fruit, nut and ornamental plants, as well as several cereal and forage crops.[54] ArborGen detected these leaf-cutting ants in the vicinity of field tests carried out in Texas.

Botryosphaeria canker affect not only Eucalyptus, as APHIS acknowledges (PPRA at 14). At least one species not discussed by APHIS (*Botryosphaeria ribus*) can cause considerable damage to apple trees as well.[55] APHIS initially describes the eucalypt weevil (*Gonipterus scutellatus*) as feeding "exclusively" on Eucalyptus, even though it has also been found feeding on the stems of apples in orchards adjacent to Eucalyptus plantations (PPRA at 11).

Many other examples could be noted of Eucalyptus pests that are known to cause damage to other important plants or crops, which APHIS entirely failed to assess. However, it should also be noted that even when the available evidence suggests that a pest only infests Eucalyptus, there is considerable uncertainty. Newly introduced pests may infest hosts plants not present in their endemic region. Likewise, pests already present in certain parts of the U.S. could infest new hosts when introduced into new regions. As Kliejunas et al. (2001) note: "A thorough knowledge of which native or introduced species in the U.S. could be hosts is not available, but individual assessments may identify specific species."

Freeze damage increases plant pest potential of GE Eucalyptus

GE Eucalyptus trees damaged or killed by freezing temperatures would become more susceptible to infestation by a number of Eucalyptus pests. Examples include Eucalyptus canker and bot canker, and the fungal pathogen causing cryptosporiopsis leaf spot diseases, which infect via tree wounds and natural openings in the bark (PPRA at 14 -15). The eucalypt weevil causes "major problems" on freeze-damaged trees, particularly shoots. Eucalyptus longhorned borers also preferentially infest weakened and recently dead trees (PPRA at 12).

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[52] Brasier C (2000). The rise of the hybrid fungi. Nature 405: 134-135. Brasier (2008), op. cit.

[53] Burgess and Wingfield (2017), op. cit.

[54] Drees BM, Merchant M (2006). Texas leaf cutting ant. Texas AgriLife Extension, 2006. https://web.archive.org/web/20081015211736/http://citybugs.tamu.edu/fastsheets/Ent-1029.html.

[55] Kliejunas et al. (2001), op. cit.

Despite noting these increased plant pest threats to freeze-damaged trees, in its summary risk conclusion section, APHIS dismisses the problem based entirely on ArborGen's extremely limited field observations (Pest and disease susceptibility on freeze damaged trees, PPRA 18-19). But as discussed above, these observations were made at only a handful of sites in the southeast, and for extremely short periods. *See infra*. These field tests do not provide any information on injury-induced pest susceptibility, because in nearly all cases Eucalyptus pests simply did not happen to be present at the few field test sites in the brief periods of time they were conducted. See discussion of ArborGen's observations above.

<u>Plant pest risks of abandoned Eucalyptus plantations</u>

APHIS provides some minimal discussion of the invasive potential of abandoned Eucalyptus plantations, yet there is no assessment of abandoned trees as plant pest reservoirs. As described above, plantations of exotic trees act as "magnets" for plant pests, and the longer they exist the more pests they will attract and harbor. While there are few management options for many pests (as discussed above), others can be managed. However, abandoned trees will not be managed. Even if management practices were mandated to address active plantations, they would not apply to abandoned plantations. They will not be treated with pesticides, and there will be no breeding of pest-resistant stock or deployment of biological control organisms for abandoned Eucalyptus plantations. Lack of plant pest management will thus increase the prevalence of some Eucalyptus pests in abandoned GE Eucalyptus trees, including those that can infest and damage other trees and crops. Such abandoned plantations could become reservoirs for pests that would then radiate to infest other trees and crops.

One would expect many of the same pests that preferentially infest freeze- or insect-damaged Eucalyptus to also infest old weakened trees in abandoned plantations (see "Freeze damage increases plant pest potential of GE Eucalyptus" section above). In addition, the root rot fungus *Gymnopilus spectabilis* is especially associated with old Eucalyptus trees (PPRA at 16), and so would be more prevalent in abandoned plantations.

<u>Improper reliance on best management practices</u>

APHIS repeatedly dismisses the serious threats posed by Eucalyptus pests under the proposed deregulation by assuming that entirely speculative best management practices will be undertaken to address them (PPRA at 19 – 20, 39, 43, DEIS at 177 – 178). APHIS's conclusion is that the GE Eucalyptus is unlikely to pose plant pest risks is contingent: "as long as there is proper management and oversight of plantations as they are established and grown." (PPRA at 42). For instance, APHIS's response to the prospect of destructive insect damage to GE Eucalyptus is that "the landowners … would need to invest in control of these plant pests…" (PPRA at 19). But this is unlikely, since as APHIS notes pesticide use is "cost-prohibitive" in large-scale forestry operations (PPRA at 19); pesticides and/or biological control organisms may not be available or registered (PPRA at 19); and it is "difficult to achieve good coverage" with insecticides (EIS at 177), even when they are available and not judged to be too expensive. Relatedly, APHIS also fails to analyze or consider what impacts pesticide use might have, if and when they are used. Regardless, APHIS predicates its plant pest analysis and conclusions on management practices that the agency does not analyze, let alone require.

APHIS assumes that the high cost of pesticides makes it "likely that at some point breeding for pest- and disease-resistant selections would have to be made with these freeze-tolerant clones in order to find resistant clones as part of a mitigation strategy…" (PPRA at 19-20). This is likewise an entirely speculative "mitigation strategy," since who would do such breeding, for which pest(s), at what cost, and whether technically feasible, are all questions left entirely up in the air. It is improper for APHIS to rely on future speculative breeding as mitigation.

APHIS alternatively assumes that the great expense of pesticides will necessarily lead to introduction and establishment of biological control organisms for insect pests. This is also entirely speculative, as there are few if any biological control options for such pathogens (EIS at 177-178). To the extent any such biological control agents could be used, APHIS fails to analyze their cumulative impacts.

APHIS advises that "infested trees and wood should be buried or burned promptly" and "[r]emoval of infected trees may be warranted in some severe cases..." (EIS at 178), but imposes no conditions to such effect in the Preferred Alternative.

APHIS even engages in "speculative mitigation" with respect to its own potential activities, but appears uncertain of their efficacy:

> It is conceivable that sanitary measures may become more tightly regulated in the foreseeable future, which may delay the introduction of new pests and diseases into the action area, or the volume of imported products may become so great that numbers of introduced species will increase. (EIS 207-208)

Such vague, meaningless verbiage is improper and contrary to sound science, and it is arbitrary and capricious for APHIS to rely on it.

APHIS cites Gadgil et al. (2000) for the proposition that "successful management of diseases in Eucalyptus plantations can be achieved by a combination of plant quarantine measures, silvicultural practices and the use of disease resistant planting stock. All these measures would need to be put in place if Eucalyptus were to be planted on increasing acreages in the continental U.S." (PPRA at 39).

On the contrary, only APHIS deregulation is required for GE Eucalyptus to be planted on millions of acres in the U.S. No other measures are being required by any other agency or APHIS specific to this proposed approval. Instead, the agency can and should apply its broad authority to restrict and/or deny approval as needed to prevent plant pest risks, including requiring measures it deems needed. Because newly established exotic Eucalyptus plantations normally enjoy a pest-free "honeymoon period" of several years at least, it is entirely foreseeable that short-sighted managers would seek to maximize returns by minimizing pest/disease management expenditures. In addition, numerous critics have demonstrated the extremely leaky nature of "plant quarantine measures" implemented by APHIS and other plant pest regulators.[56]

APHIS appears to regard the PPRA and EIS as opportunities to write descriptive literature reviews and dispense forestry management advice. But APHIS is not writing review articles for the scientific literature, nor is it the agricultural extension service. Its role and duty is to conduct serious risk assessments based on its statutory obligations, and use them to guide important regulatory decisions to protect vital resources, such as the analysis and regulation of this unprecedented GE tree. As far as we can see, however, APHIS nowhere proposes a single restriction, or requires a single mitigation measure, to address any of the serious threats it describes in the PPRA and EIS, much less the ones it downplays or ignores. Thus, its entire discussion of these matters is entirely descriptive, speculative and ultimately pointless, rendering its decision arbitrary and capricious and contrary to the agency's statutory mandates.

[56] Brasier (2008), op. cit. Liebhold et al. (2012), op. cit. Roy et al. (2014), op. cit.

**Climate Change Impacts*

Climate change is foreseeable and likely to affect all other impacts of the deregulation of GE Eucalyptus in many ways,[57] yet climate change is ignored by APHIS in the DEIS. APHIS must not only examine the effects on climate change of approving GE Eucalyptus FTE 427 and 435, such as increased emission of greenhouse gases; they must also assess the role of climate change in causing or exacerbating plant pest risks, environmental, health and socioeconomic impacts. APHIS did not analyze or consider the effects of the proposed action on climate change, nor did it analyze or consider the impacts of climate change on the proposed action. NEPA requires the agency do both. For example, the range of GE Eucalyptus FTE 427 and 435 is likely to increase, impacting different environments.[58] The zone where other Eucalyptus varieties and species will overlap GE Eucalyptus FTE 427 and 435 will also change, increasing the risk of hybridization and thus naturalization and invasiveness. Weather is predicted to become more erratic and extreme, resulting in more droughts, for example, that will exacerbate hydrological impacts and fire risks. Increased fires may also increase the naturalization and invasiveness of FTE 427 and 435 with attendant harm to vegetation, wildlife, and biodiversity.[59]

**Impacts on Vegetation; Wildlife, including Pollinators; and Biodiversity*

The proposed approval will harm vegetation; wildlife, including pollinators; and biodiversity in numerous ways, but APHIS downplays those harms improperly by limiting the scope of its assessment and using an improper baseline of unsustainable pine plantations. In this way, APHIS skews its conclusions as to the likely biodiversity impacts, in severity and in scope. Instead APHIS at times equates the harm from no action to that of the proposed alternative. As elsewhere, such conclusions are arbitrary and capricious and contrary to sound science.

In the EIS, APHIS must consider impacts of GE Eucalyptus on vegetation, wildlife, and biodiversity within the entire area that it will be able to grow, including land uses other than pine plantations. Eucalyptus is not a genus native to the US, and many native plant, animal, fungal and microbial species will be unable to find suitable food, nest sites, germination sites and other habitat features within GE Eucalyptus plantations, or in natural areas that have been invaded by GE Eucalyptus.[60] Threatened and endangered species will be at particular risk from replacement of suitable habitat with inferior habitat, more frequent and intense wildfires, depletion of water resources, spread of pests and pathogens from plantations and naturalized or invasive GE Eucalyptus, management and mitigation activities, and other impacts.

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[57] Ingram, K., Dow, K., Carter, L., Anderson, J., (eds.) 2013. Climate of the Southeast United States: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

[58] Borenstein, S., 2017. Go west, young pine: US forests shifting with climate change. https://phys.org/news/2017-05-west-young-forests-shifting-climate html;
Fei, S., Desprez, J.M., Potter, K.M., Jo, I., Knott, J.A. and Oswalt, C.M., 2017. Divergence of species responses to climate change. *Science Advances 3*(5): e1603055.

[59] Meskimen, G. and Francis, J.K., 1990. *Eucalyptus grandis* Hill ex Maiden. Rose gum Eucalyptus. *Silvics of North America*, *2*: 305-312.

[60] E.g., Barlow J, Gardner TA, Araujo IS, Ávila-Pires TC, Bonaldo AB, Costa JE, Esposito MC, Ferreira LV, Hawes J, Hernandez MI (2007) Quantifying the biodiversity value of tropical primary, secondary, and plantation forests. Proceedings of the National Academy of Sciences 104: 18555–18560.

Also, GE Eucalyptus FTE 427 and 435 may provide some habitat requirements, but not others, with negative impacts for wildlife. For example, honeybees and other pollinators such as monarch butterflies will be attracted to the masses of nectar-producing flowers, but because of lack of pollen in male-sterile GE Eucalyptus FTE 427 and 435 and the absence of other flowering plants from intentional undergrowth suppression, pollinators may not be able to get adequate nutrition within the landscape.[61] Other effects of GE Eucalyptus on numbers and kinds of pollinators may impact nearby agriculture.[62]

In addition to analyzing impacts of Eucalyptus generally on vegetation, wildlife, and biodiversity inferred from studies of other species of Eucalyptus mainly in other countries, APHIS must consider GE-Eucalyptus-specific impacts for both FTE 427 and FTE 435. Transformation event-based regulation is required for meaningful risk assessments of GE organisms because every transformation event is unique and thus potentially has a novel phenotype that must be assessed to determine appropriate regulation.[63]

For example, unintended changes from the genetic engineering process or pleiotropic effects of the transgenes can affect any characteristic of FTE 427 or 435, must be carefully analyzed, and yet were not. Some of these unanticipated effects may result from insertion mutations caused by the transgenes, or other changes due to the genetic engineering process, that have been shown to be common.[64] Unintended changes in composition of root exudates, nectar secretions[65], or pollen[66]; enhanced ability of the trees to survive drought or other stresses; and any other compositional changes in tissues or changes plant capabilities must be specifically analyzed, because GE Eucalyptus will interact with pollinators including

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[61] Geslin, B., Gauzens, B., Baude, M., Dajoz, I., Fontaine, C., Henry, M., Ropars, L., Rollin, O., Thébault, E. and Vereecken, N.J., 2017. Chapter Four-Massively Introduced Managed Species and Their Consequences for Plant–Pollinator Interactions. *Advances in Ecological Research 57*: 147-199.

[62] Taki H, Yamaura Y, Okabe K, Maeto K (2011) Plantation vs. natural forest: Matrix quality determines pollinator abundance in crop fields. Scientific Reports 1. doi:10.1038/srep00132.

[63] NASEM, 2017. National Academies of Sciences, Engineering and Medicine: Preparing for Future Products of Biotechnology. Washington, DC: National Academies Press, ISBN 978-0-309-45205-2 | DOI: 10.17226/24605, available at http://www nap.edu/24605; NRC, 2002. National Research Council: Environmental Effects of Transgenic Plants - The Scope and Adequacy of Regulation. National Academy of Sciences, 2002. http://www.nap.edu/catalog/10258.html.

[64] Latham, J.R., A.K. Wilson and R.A. Steinbrecher, 2006. The mutational consequences of plant transformation. Journal of Biomedicine and Biotechnology 2006: article ID 25376; Wilson, A.K., J.R. Latham and R.A. Steinbrecher, 2006. Transformation-induced mutations in transgenic plants: Analysis and biosafety implications. Biotechnology and Genetic Engineering Reviews 23: 209- 235; Neelakandan AK, Wang K. 2012. Recent progress in the understanding of tissue culture-induced genome level changes in plants and potential applications. Plant Cell Reports 31: 597–620; Miguel C, Marum L. 2011. An epigenetic view of plant cells cultured in vitro: somaclonal variation and beyond. Journal of Experimental Botany 62: 3713–3725.

[65] Sala Junior, V., Celloto, V.R., Vieira, L.G., Gonçalves, J.E., Gonçalves, R.A. and de Oliveira, A.J., 2008. Floral nectar chemical composition of floral nectar in conventional and transgenic sweet orange, *Citrus sinensis* (L.) Osbeck, expressing an antibacterial peptide. *Plant Systematics and Evolution 275*(1): 1-7.

[66] Although apparently little or no pollen is produced in flowers of current FTE 427 and 435 in field trials, pollen production is foreseeable in progeny, as discussed, so must be considered in the EIS.

monarch butterflies, soil organisms, fungi, herbivores and other animals, and other plants, that could be harmed.[67]

**Endangered Species*

APHIS states that the agency has entered into formal consultation on the impacts of its action to dozens of ESA-protected species and their habitat, and will not make a final decision on the approval until that process is complete, which is the proper ESA process. Independent of that however APHIS has duties under NEPA to analyze reasonably foreseeable impacts to, *inter alia*, protected species. Here, APHIS's EIS suffers from the same shortcomings as in numerous other places. APHIS's overly-constrained scope of review of this action impermissibly curtails any analysis of impacts to protected species beyond those located in and around the pine plantation counties to which APHIS limited its review. APHIS should have included analysis and consideration of impacts to protected species in all regions the GE Eucalyptus can be grown.

**Biofuels*

APHIS relies on a USDA Forest Service model (EIS, Appendix B) to project demand for GE eucalyptus and locations where it may be planted, a model based on current prices in the hardwood pulpwood market (EIS at B-20). As noted elsewhere, markets can change dramatically, and projecting demand and acreage for GE eucalyptus for the next 30 years is fraught with uncertainties that greatly erode the predictive value of the model, particularly in the latter part of the projection period. However, even on its own terms the model is questionable. No attempt is made to account for demand for eucalyptus for bioenergy applications, which could sharply increase prices and likely area planted to GE eucalyptus far beyond model projections, and outside of the "action area."

ArborGen touts this market for its GE eucalyptus (e.g. Petition at 23), yet it is not explicitly modeled in Appendix B. One strong and rapidly growing bioenergy application is wood pellets, global demand for which is projected to more than double to reach 50 million tonnes by 2024 (from a 2014 baseline of just 23 million tonnes). Prices and hence demand for pulpwood and bioenergy applications are linked and must be considered together. Another major potential bioenergy market for GE eucalyptus is for cellulosic ethanol. The 2007 Renewable Fuels Standard includes quotas and subsidies for ethanol derived from cellulosic feedstock (Petition at 23), creating the potential for large demand and a lucrative market, but only assuming serious technical obstacles can be overcome (see below).

Like many bioenergy startups, ArborGen claims that bioenergy and other applications for GE eucalyptus will generate both environmental and socioeconomic benefits. As to climate change impacts, studies show vastly different impacts depending on whether forestry residues or whole trees are used, and when comparing medium-term vs. longer-term impacts. Using whole trees for wood pellets, for instance, creates more global warming gases (GWG) than using forestry residues. In addition, modelling shows that GWG emissions in various wood pellet scenarios exceed those of fossil fuels in the medium-term (through 2065 to 2075), and decline only thereafter. We cannot afford "solutions" to climate change that increase emissions over the next half-century, since serious and even catastrophic impacts are projected in this timeframe given current emissions' trends.

[67] Steinbrecher RA, Lorch A. 2008. Genetically Engineered Trees & Risk Assessment: An overview of risk assessment and risk management issues. Federation of German Scientists

The socioeconomic impacts of bioenergy applications of GE eucalyptus could well be negative, contrary to ArborGen's optimistic projections (Petition at 136-144). Despite quotas and subsidies, numerous initiatives to establish biorefineries for cellulosic ethanol have failed due to insuperable technical obstacles. In fact, because of these obstacles just 17 million gallons of cellulosic ethanol were produced in 2014, less than 1% of the 2014 target established by the 2007 Energy Independence and Security Act. In case after case, cellulosic biofuels startups established with substantial taxpayer funding have gone bankrupt without producing any significant quantity of cellulosic ethanol. The opportunity costs of federal and state subsidies for such boondoggle ventures is substantial. This casts great doubt on any potential socioeconomic benefits of ArborGen's GE eucalpyptus for cellulosic ethanol applications. If ArborGen or a company intending to use GE eucalyptus for cellulosic ethanol applications were to receive taxpayer subsidies, as so many other companies have, the likely failure of such venture would in fact have substantial negative socioeconomic impacts in terms of foregone opportunities at job creation and rural economic development. APHIS's treatment of this issue fails to consider or analyze these important factors.

**Human Health Impacts*

APHIS only considers a single human health impact in detail: the possibility that the pathogen *Cryptococcus gattii* will increase as a result of GE Eucalyptus approval. However, many other impacts on human health exist that should be addressed, including increased exposure to pesticides, air pollution from wildfires and machinery used in plantation management, and water contaminated with higher levels of pesticides and fertilizers. APHIS cannot ignore or downplay these potential health impacts by saying that other activities such as urbanization or agriculture have an even bigger effect on air quality, or that impacts are confined to small areas. Even impacts at a specific locale can affect the health of people near those sites.

Cumulative Impacts

APHIS's discussion of the potential cumulative impacts is wholly inadequate. Rather than analyze the cumulative impacts of the proposed action on various resources (water, air, soils, agricultural economy, wildlife, humans) when combined with other past, present, and reasonably foreseeable impacts to those resources, APHIS merely reiterated its conclusions as to direct/indirect impacts. Not only are many of those conclusions speculative, unsupported, or defying logic, merely restating these potential impacts does not equal a cumulative effects analysis.

A cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. A proper cumulative impacts discussion includes both an appropriate scope of impacts to the affected resource(s) and an adequately detailed/quantified discussion of those impacts. A discussion of only the direct impacts of a proposed action on the affected resource, without taking into account the combined effects that can be expected as a result of other present impacts, and other foreseeable projects, in addition to the proposed action itself, does not satisfy the requirements of NEPA. Moreover, agencies cannot provide general conclusions without the supporting objective data upon which such conclusions are based.

APHIS identified various resources that might be impacted by the proposed action, but they are identical to the categories of direct/indirect impacts evaluated. These sections suffer from the same fundamental flaws of improper scope (confined to merely a percentage of existing pine plantations, in 200 counties, in seven states, rather than everywhere the GE Eucalyptus is approved for and can be grown) and improper baseline (compared to existing industrial pine plantations rather than native forests).

More importantly, APHIS fails to even list in most cases, or provide any detail for, the past, present, and reasonably foreseeable impacts from other projects/actions on these resources, including by other agencies and private parties. APHIS must consider all impacts to each resource, and then assess the incremental impact of the proposed action along with those past/present/foreseeable impacts.

The further cumulative impacts APHIS entirely fails to consider, include future GE trees, GE grasses, or other novel GE organisms approved by APHIS. For example, there is at least one other GE tree, a GE pine, that APHIS allowed to be field tested and commercialized through a loophole in its oversight until it updates its regulations. Other impacts include: climate change resulting in increased likelihood of wildfires that promote spread of GE Eucalyptus, degraded air quality from increased wildfires, disturbances from production and mitigation methods resulting in greater likelihood of spread of GE Eucalyptus, success of GE Eucalyptus plantations leading to increased planting of GE Eucalyptus plantations because of economies of scale and other positive feedback mechanisms, increased conversion of natural forests to pine for bioenergy leading to increased planting of GE Eucalyptus so that the pathway exponentially increases environmental impacts.

The fact that a proposed action was developed in consultation with other agencies does not negate the possibility of cumulative impacts from that action on affected resources. APHIS's cumulative impacts analysis is merely a rehashing of its direct/indirect impacts section, it is based on unsupported, contradictory, and illogical conclusions. The EIS fails to actually identify what the cumulative impacts of its proposed revisions will be, when added to the past, present, and reasonably foreseeable impacts to various affected resources.

Socioeconomic Impacts

In its cost-benefit analyzes, APHIS fails to account for or analyze the substantially increased harm to the U.S. economy and forestry from increased transgenic contamination episodes or spread of the GE Eucalyptus. The failure to consider this important part of the problem means APHIS's baseline economic calculations of alleged benefits from approval are all incorrect and fail to account for this considerable cost and downside. APHIS also failed to consider or analyze economic harm from its proposal to traditional forestry industry displaced or replaced, or separately consider those interests from those of the GE industry, or distinguish them in the agency's scope of review and baseline. By cabining its analysis to only a pine-Eucalyptus partial replacement, APHIS also fails to include consideration of the economic costs of loss of natural forests for aesthetic and recreational purposes, displaced by increased GE Eucalyptus plantations. On a related note, increased agricultural runoff is largely responsible for algal blooms that wreak havoc on profits from fisheries and recreational operations. APHIS also fails to account for the risk of contamination of other forest products by GE Eucalyptus. Some prominent sustainability certification programs for forest products prohibit wood harvested from forests in which GE trees have been planted. APHIS did not consider socioeconomic impacts resulting from land owners not being able to obtain the benefits of certification for sustainable wood products if GE Eucalyptus trees become invasive in the US. Another agricultural impacts example is honey production, which is a GE-sensitive market. The socioeconomic impacts of potential transgenic contamination of honey by honeybees foraging in flowering GE Eucalyptus plantations or invaded natural areas was not considered by APHIS.[68]

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[68] In places where Eucalyptus is grown, it is a major source of nectar and pollen for honey production. See, for example, World Rainforest Movement 2015 Letter to Brazilian Biosafety Committee concerning authorization for commercial release of GE Eucalyptus; http://wrm.org.uy/actions-and-campaigns/urgent-ge-Eucalyptus-to-be-approved-in-brazil/.

Other socioeconomic impacts that must be considered are the effects of environmental degradation on communities in the regions where GE Eucalyptus are being grown. Costs to the many other end-users of water of degraded and depleted supplies were not assessed. Health costs of exposure to contaminated water and air, smoke from increased wildfires, truck exhaust and dust from production practices, and other impacts were not accounted for in the DEIS, including an analysis of social justice concerns.

Improper Mitigation

APHIS relies on improper forms of mitigation. Repeatedly and throughout, APHIS improperly relies on the timber industry's potential management practices of GE Eucalyptus in order to minimize or avoid environmental harm. Indeed, APHIS's fundamental conclusions about avoiding harm from invasiveness and escape and regarding harm from the spread of plant pests and diseases, about harm from pesticide usage with industrial Eucalyptus plantations, about overuse of water, and in numerous other areas, are all tied to and predicated upon unsupported assumptions about management practices by then-unregulated parties in the future. APHIS also relies on unanalyzed usage of pesticides and biocontrol agents as forms of mitigation. Like all other elements of an EIS, mitigation must be discussed in sufficient detail to ensure a fair evaluation of the environmental consequences. Broad generalizations are legally inadequate. Without such a discussion neither the agency nor the interested parties can properly evaluate the severity of adverse effects. It is not enough to have a conclusory or perfunctory description. Nor can the agency pretend it is not relying on mitigation, or failure to discuss mitigation that it is actually relying on. The effectiveness of any mitigation must be carefully analyzed. Monitoring and enforcement must be adopted and summarized where applicable for any mitigation.

Conclusion

For the foregoing reasons, APHIS' draft EIS, PPRA, and proposed approval of GE Eucalyptus is inadequate, failing to comply with the mandates of NEPA, the PPA, and the APA.

Submitted by:
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