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Little Hoover Commission
Public Hearing on the Forest Management Response to Tree Mortality
August 24, 2017

Thank you for the opportunity to provide information on behalf of the California Air Resources Board (CARB) on forest management in response to the tree mortality crisis. CARB has primary responsibility for protecting air quality in California. CARB regulates mobile sources of air pollution and greenhouse gas emissions, as well as monitoring the regulatory activity of California's 35 local air districts.

California's forests are at the nexus of our mission, as they support clean air and are a critical component of the State's climate strategy and our ability to mitigate and adapt to climate change. Addressing the tree mortality crisis and the overall health of California's forests will require the collaborative efforts of Federal, State, and local governments, as well as non-governmental organizations, industry, and private landowners. Timely action and proactive management will be essential to protect and maintain the capacity of our forests to store carbon and the many other essential ecological and economic services they provide. Under State law, CARB is responsible for making daily burn decisions throughout the State. Local air districts then make a final decision on where burning will take place on agricultural and forested lands, taking into account local information.

This statement is organized according to the specific topics listed in your invitation letter focusing on CARB's role. These topics include the following:

- Proposed 2017 Climate Scoping Plan and California's climate objectives for natural and working lands.
- California's forest ecosystems and their impact on climate objectives.
- Quantifying California's forest carbon and greenhouse gas flux.
- Status of models on air quality impacts of different forest management scenarios.
- CARB perspective on prescribed fire's role in forest management.
- CARB concerns about prescribed fire.
- CARB's updated smoke guidelines and how they affect the use of prescribed fire.
- CARB's work on increasing air quality monitors available for prescribed burns.
- Potential impact of more air quality monitors available for prescribed burns.

A. California's objectives for natural and working lands and the proposed 2017 Scoping Plan

In his 2015 State of the State address, Governor Brown called for policies and actions to reduce greenhouse gas emissions from agriculture and natural and working lands, which include forests, rangelands, farms, wetlands, and soils. The Legislature affirmed the role of natural and working lands in the State's Climate Strategy in SB 1386 (Wolk, Chapter 545, Statutes of 2016.)

This direction is reflected in the proposed 2017 Scoping Plan. The proposed Scoping Plan, drafted by CARB in consultation with other State agencies, recognizes the importance of forests in reaching our climate goals. The proposed Scoping Plan includes policies and programs that prioritize protection and enhancement of California's landscapes, including forests, and identifies the next steps to ensure management actions across California's natural and working lands are taken to increase the sequestration potential of those resources.

California's climate objective for natural and working lands is to maintain them as a carbon sink – achieving net zero or even negative greenhouse gas emissions and minimizing the net greenhouse gas and black carbon emissions associated with management, biomass utilization, and wildfire events, while simultaneously supporting a range of economic, environmental, and public health priorities. The proposed Scoping Plan includes an initial analysis of business-as-usual net carbon sequestration rates from natural and working lands, including forecasts to 2030 and 2050. This work is being done through a research contract with Lawrence Berkeley National Laboratory that is managed by the California Natural Resources Agency. The proposed Scoping Plan also calls for the development of an Integrated Natural and Working Lands Climate Change Action Plan by 2018. The Action Plan will lay out the path for achieving the objectives outlined in the proposed Scoping Plan, including the establishment of targets and policy and program pathways to meet the target with specific activities related to land protection, enhanced carbon sequestration, and innovative biomass utilization.

B. California's forest ecosystems and their impact on climate objectives

Warming temperatures, combined with the current overstocked conditions in California's forests, can result in larger more catastrophic wildfires. Such fires can result in a loss of stored carbon, along with other economic and environmental consequences, including air and water quality impacts. While not all of the stored carbon is in imminent danger of release to the atmosphere, recent trends indicate that significant pools of carbon in natural and working lands risk reversal to the atmosphere: an estimated 150 million metric tons of carbon was lost to disturbance over the period 2001-2010, with the majority – approximately 120 million metric tons of carbon – lost through wildland fire. While growing trees and other vegetation, as well as soil carbon sequestration, compensate for some of these losses, without proactive management, climate change itself is expected to further stress many of these systems and affect the ability of California's landscapes to maintain its carbon sink. There are ways to slow and reverse this trend, in concert with other productive and ecological objectives of land use, and the State will continue to rely on best available science to promote those actions.

CARB recognizes that forest lands provide significant non-carbon environmental and public health benefits to the State, and that policy in the natural and working lands sector must balance carbon sequestration with multiple other land-use objectives and benefits. In many cases, efforts to protect and enhance forest carbon are also supportive of, and complementary to, other non-carbon objectives and benefits. However, there are non-carbon impacts that must also be considered. For example, fuel reduction efforts, whether through mechanical thinning or prescribed fire, may help protect remaining healthy trees by reducing the risk of catastrophic wildfire, but emissions from the transport and utilization of the removed biomass, or the prescribed fire itself, can have air quality impacts. That said, the close partnerships and coordination between Federal, State, and local agencies have been, and continue to be, effective in making progress toward workable solutions.

C. Quantifying California's forest carbon and greenhouse gas flux

Defining our objectives for natural and working lands and tracking progress toward meeting them requires methods to quantify the individual components of the Natural and Working Lands greenhouse gas inventory. In collaboration with the California Department of Forestry and Fire Protection, California Energy Commission, and the California Environmental Protection Agency, CARB commissioned a study in 2011 with the University of California at Berkeley to develop a data-driven approach to periodically estimate ecosystem carbon stocks and greenhouse gas flux associated with stock-change of forests and other natural lands, statewide.

Recent work has focused on estimating the 2001-2010 total carbon and carbon fluxes for California's forests. Initial results from this work show that for 2010, California's natural lands contained an estimated 898 million metric tons of carbon in above-ground live stock for all natural lands combined, with forests accounting for 892 million metric tons. In addition to above-ground live carbon stock, an additional 1,603 million metric tons of carbon exist in other pools, such as root systems, dead wood, and litter, included in the Natural and Working Lands inventory. CARB continues to expand the scope of the inventory using the most recent data available and, pursuant to SB 859 (Committee on Budget and Fiscal Review, Chapter 368, Statutes of 2016), will complete the Natural and Working Lands Inventory by the end of 2018.

From work on the inventory, it is increasingly clear that California's forest lands contain large quantities of carbon in the form of live vegetation, and that disturbance processes, such as wildfire, can have a large impact on forest carbon stocks and on the net exchange of carbon between forest lands and the atmosphere. From 2001 to 2010, CARB sees large declines in carbon stocks associated with the conversion of forested land to grasslands or to sparsely vegetated lands, with much of the conversion attributed to wildfire.

D. Status of models on air quality impacts of different forest management scenarios

CARB is aware of published research on the potential impacts of climate change on California's forest lands and fire regimes.^{1, 2, 3, 4, 5, 6} CARB is not aware of any analyses that have examined the potential impacts of forest management scenarios specific to California, either those outlined in the Forest Carbon Plan or in other documents, on the air quality of large areas or regions of the State. While CARB is not aware of any studies that specifically look at different forest management practices identified in State plans, we do know that trees can remove air pollutants and improve air quality, and through emission of volatile organic compounds, can also contribute to the formation of ozone. Determining the net effect of trees on air quality is complex, as multiple factors such as tree species, temperature, and climate play a role. For example, a model simulation conducted by the U.S. Department of Agriculture Forest Service of California's South Coast Air Basin suggests the air quality impacts of increased urban tree cover may be locally positive or negative with respect to ozone and that the net basinwide effect of increased urban vegetation is a decrease in ozone concentrations if the additional trees are low emitters of volatile organic compounds.⁷ Another Forest Service study conducted in 2013 ran computer simulations with local environmental data to examine the total amount of pollution removal in 2010 by trees and forests in the contiguous United States.⁸ The study estimates that in 2010, trees removed 17.4 million tonnes of air pollution, including nitrogen dioxide, ozone, sulfur dioxide, and particulate matter less than 2.5 microns. This study suggests California is one of three states with the greatest levels of air pollution removal by trees. One CARB-funded study

¹ Bryant, B. and A. Westerling (2012) Scenarios to Evaluate Long-Term Wildfire Risk in California: New Methods for Considering Links Between Changing Demography, Land Use and Climate. California Energy Commission final report CEC-500-2012-030. <http://www.energy.ca.gov/2012publications/CEC-500-2012-030/CEC-500-2012-030.pdf>

² Krawchuk, M. and M. Moritz (2012) Fire and Climate Change in California: Changes in the Distribution and Frequency of Fire in Climates of the Future and Recent Past (1911–2099). California Energy Commission final report CEC-500-2012-026. <http://www.energy.ca.gov/2012publications/CEC-500-2012-026/CEC-500-2012-026.pdf>

³ Shaw, R. et al. (2009) The Impact of Climate Change on California's Ecosystem Services. California Energy Commission final report CEC-500-2009-025-F. <http://www.energy.ca.gov/2009publications/CEC-500-2009-025/CEC-500-2009-025-F.PDF>

⁴ Westerling, A. et al. (2009) Climate Change, Growth, and California Wildfire. California Energy Commission final report CEC-500-2009-046-F. <http://www.energy.ca.gov/2009publications/CEC-500-2009-046/CEC-500-2009-046-F.PDF>

⁵ Fried, J. et al. (2006) Predicting the Effect of Climate Change on Wildfire Severity and Outcomes in California: A Preliminary Analysis. California Energy Commission final report CEC-500-2005-196-SF. <http://www.energy.ca.gov/2005publications/CEC-500-2005-196/CEC-500-2005-196-SF.PDF>

⁶ Lenihan, J. et al. (2005) The Response of Vegetation Distribution, Ecosystem Productivity, and Fire in California to Future Climate Scenarios Simulated by the MC1 Dynamic Vegetation Model. California Energy Commission, Final report CEC-500-2005-191-SF. <http://www.energy.ca.gov/2005publications/CEC-500-2005-191/CEC-500-2005-191-SF.PDF>

⁷ Taha, H. (1996) Modeling impacts of increased urban vegetation on ozone air quality in the South Coast Air Basin. *Atmos. Environ.* 30(20):3423-3430.

⁸ Nowak, D. et al. (2014) Tree and forest effects on air quality and human health in the United States. USDA Forest Service. https://www.fs.fed.us/nrs/pubs/jrnl/2014/nrs_2014_nowak_001.pdf

examined potential air quality impacts of an expanded bioenergy sector.⁹ The study notes that the State has enough bioresources to meet the goals of SB 1122 (Rubio, Chapter 612, Statutes of 2012) and the Governor's plan for renewable power, and that biomass could be a large contributor to the renewable portfolio standard for the State. However, if California is to meet the air quality goals for nonattainment areas like the San Joaquin Valley, it should minimize the impact of using biomass by utilizing advanced technologies like fuel cells for biogas and gasification systems for solid residue.

As part of meeting requirements contained in SB 859, CARB is acquiring sources and methods to model future changes in the composition and function (including carbon storage and loss) of forests and other lands under a variety of management scenarios and environmental conditions. Such model-generated outputs could feed into CARB's existing regional photochemical models in order to examine air quality impacts.

E. CARB perspective on prescribed fire's role in forest management

CARB is responsible for coordinating efforts to attain and maintain Federal and State ambient air quality standards in California. Prescribed burns can increase the difficulty of meeting those standards. However, prescribed fire can increase forest health and prevent catastrophic wildfire, which impacts public health, the economy, and the environment. Prescribed fire is used to mimic the low intensity fires that were prevalent in pre-settlement California. Many of California's forests are considered to be fire-adapted; that is, they evolved with fire and need fire to stay healthy. Frequent low intensity fire reduces ladder fuels, prevents a shift in species, and improves resiliency to wildfire, pests, and diseases. Ecologists have pointed to the lack of fire as one of the main reasons forests are now vulnerable to mega fires and tree mortality outbreaks. In order to protect property, air quality, and public health, prescribed burning must be carefully conducted in areas that surround undeveloped land because more people continue to relocate to these areas. In addition, helping communities understand the tradeoffs between prescribed fire and wildfires remains a challenge.

CARB works closely with local air districts and land management agencies to develop strategies that can increase the pace and scale of prescribed burning, while minimizing air quality impacts. Enhanced monitoring, smoke prediction tools, and effective communication are key elements for increasing the number of days on which burning occurs, the quantity of burn authorizations, and the size of burn projects. CARB has begun working closely with land management agencies and forest advocacy groups to develop an improved framework for smoke monitoring and communication, and to identify tools and resource needs to better monitor and predict smoke impacts and provide increased opportunities for prescribed burning. This also includes identifying impediments to fully utilizing the use of days that can accommodate burning and mechanisms to overcome those bottlenecks.

⁹ Dabdub, D. et al. (2015) Assessment of the emissions and energy impacts of biomass and biogas use in California. California Air Resources Board final report 11-307. <https://www.arb.ca.gov/research/apr/past/11-307.pdf>

At the policy level, coordination is accomplished with the land management agencies and local air districts at our joint Air and Land Managers meetings, which work toward broad based solutions to remove any impediments to the pace and scale of prescribed burning. At the technical level, the Interagency Air and Smoke Council works to implement tools such as the Prescribed Fire Information System (described in section G) and the Bluesky smoke modeling forecast. These tools help further the goals of forest restoration on a broad scale. CARB also participates in the efforts of the Fire MOU partnership, with the goal of bringing multiple agencies together to increase the use of prescribed fire in California; this partnership is comprised of more than 20 participating entities.

F. CARB concerns about prescribed fire use

Many areas in the State that are located adjacent to forests are designated nonattainment for federal PM2.5 and ozone air quality standards. Over 12 million Californians still breathe air exceeding these federal standards. Because smoke contains particulate matter, ozone-forming precursors, and air toxics, burning at large scales can affect regional pollution levels and local public health. Exposure to PM2.5 can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung and cardiovascular diseases, and reduce the body's ability to fight infections. Certain populations are especially vulnerable to the adverse health effects of PM2.5, including children, the elderly, exercising adults, and those suffering from asthma or bronchitis. Smoke and haze also affect visibility, which can impact tourism and recreation in some of the most pristine areas of the State. However, fires that burn under moderate weather and air quality conditions and are managed for resource benefits can produce significantly fewer emissions compared with unplanned fires that burn under extreme conditions.¹⁰

G. CARB's updated smoke guidelines and how they affect the use of prescribed fire

California's Agricultural Burning Guidelines (California Code of Regulations, Title 17, Section 80100) are implemented through smoke management programs adopted by local air districts and approved by CARB. The Guidelines are intended to provide a framework that accommodates increased opportunities for prescribed burning and agricultural burning, while minimizing smoke impacts on the public. To meet these goals, CARB relies on an integrated process that considers multiple elements. These elements include burn registration and planning, burn authorization, and public notification and enforcement. The burn authorization system regulates the "amount, timing, and location" of burn events, in consideration of appropriate weather and air quality conditions, and potential smoke health impacts to sensitive population groups.

¹⁰ Long, J.W., Tarnay, L.W. and North, M.P., 2017. Aligning Smoke Management with Ecological and Public Health Goals. *Journal of Forestry*, in press.

The Guidelines also stress the importance of coordination and cooperation with the land management agencies, local air districts, and other agencies through planning and contingency measures. CARB's Meteorology Section issues daily burn or no burn determinations for each air basin, based on meteorological and air quality conditions; local air districts may further refine burn determinations based on their local considerations and conditions. The meteorological criteria used to determine burn day status are based on climatologically seasonal average weather conditions. Unexpected decisions to deny burn authorization on a planned prescribed forest fire are typically weather driven and are collaboratively considered by CARB and the local air district, using the latest available meteorological data and weighing the trade-offs of completing or postponing the burn.

CARB also continues to develop specialized tools to aid in prescribed burning with our land management agencies and local air district partners. For example, CARB's Prescribed Fire Information Reporting System or PFIRS promotes a streamlined smoke management process to optimize the number of burn days available. PFIRS is a database-driven web interface intended to be a communication tool for air regulators, land managers, and the public. The system allows land managers, such as the U.S. Forest Service, State parks, and private industry, to input smoke management plans, ignition authorization requests, and completed acreage reports in order to comply with California's smoke management program regulations. The system also allows the information to be reviewed and authorized by local air districts and CARB.

H. CARB's work on increasing available air quality monitors for prescribed burns

CARB has already taken several steps to improve our smoke monitoring capabilities. This includes a significant increase in the number of mobile air monitors available for monitoring fires. As part of this effort, CARB has been working with local air districts to enhance their wildfire and prescribed fire monitoring capabilities through training programs and by making these mobile air monitors available to local agencies. Finally, CARB is evaluating new types of instruments, including low-cost sensors, that can allow more cost-effective and widespread monitoring.

CARB currently has 30 portable EBAMs (Environmental Beta Attenuation Monitors) that provide hourly data that can be used for smoke monitoring. In addition, CARB was successful in obtaining a U.S. EPA grant last fiscal year to purchase six additional EBAMS that can be deployed in partnership with local air districts to support smoke monitoring for prescribed burning.

CARB is currently evaluating a variety of real-time and near real-time instruments to assess their utility in measuring PM_{2.5} over a wide range of concentrations for wildland fire smoke monitoring in lieu of EBAMs. These Instruments need to be evaluated in a smoke chamber before being deployed in the field during a real-world wildfire event, to help characterize their accuracy and precision as compared to official monitoring standards. These monitors do not need to be "certified" to U.S. EPA standards, which is a lengthy and detailed technical procedure, but must be reliable and accurate to be useful in optimizing prescribed burn decisions. Satellites, web cameras, and computer

modeling also play an increasingly important role in strengthening our evaluation of weather, smoke, and fire information.

I. Potential impact of more air quality monitors available for prescribed burns

Additional resources and new technical tools for strategic air monitoring, modeling, and forecasting would improve the decision making process for planning, authorization, and tracking of prescribed burn projects. Air monitoring deployment, coupled with computer modeling simulations, can provide data for forecasting, identify areas at risk, support public/media outreach, and coordinate with all other agencies, local air districts and the public. Enhanced monitoring and better model data have already led to an increase in burn days and a more efficient authorization process. An example of the enhanced coordination and increased authorization efficiency is the Goliath prescribed burn project (806 total acres), which began on June 11, 2016 and completed on June 16, 2016. The project was conducted by the Sequoia and Kings Canyon National Park in coordination with the San Joaquin Valley Air Pollution Control District. In the past, the District would have restricted the project to a limited amount of acreage per day in an effort to meter the emissions released. In this project, the District provided the Park a multi-day burn time window without daily acreage restrictions. During the time period of the project, the Park and the District worked jointly to monitor the smoke, air quality, and visibility.¹¹ These efforts made the project successful, while minimizing the smoke and public health impacts. Organizing this type of effort would be nearly impossible without the support of the District and CARB, and the enhanced monitoring and modeling resources available.

¹¹ San Joaquin Valley Air Pollution Control District Governing Board Meeting, 2016. Item Number 9: Report on 2016 Wildfire Season and Air Quality Impacts.

http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2016/November/final/09.pdf