Shelby Livingston
California Air Resources Board
1001 I St.
Sacramento, CA 95814

June 15, 2018

Re: Comments on Draft Outline of the California 2030 Natural and Working Lands Climate Change Implementation Plan

Dear Ms. Livingston,

We write to you as current and emeritus university researchers working on issues of agricultural mitigation of greenhouse gas emissions in California. We are pleased to see the state of California embracing natural and working lands strategies to achieve the state's needed and ambitious 2030 greenhouse gas emissions reduction target.

Our work gives us the benefit of understanding the body of academic work on climate change mitigation potential in California agriculture and the hands-on experience of working with farmers on the practical implications of changes in farm management. With that expertise in mind, we offer the following comments on the draft outline of the California 2030 Natural and Working Lands Climate Change Implementation Plan (NWL Plan). Thank you for your consideration.

1. Scenarios Modeling: Developing Baseline, Conducting Scenarios for Agricultural Conservation Management

There are serious limitations of the CALAND model[1] for quantifying the potential for agriculture to reduce GHG emissions, and as a result, the agricultural community may not engage wholeheartedly in activities that could benefit the state's mandate for climate change mitigation. We believe that that the state of California must put additional effort into informing the agricultural baseline and scenarios modeling necessary for the plan.

We propose that the state agencies involved in the development of the NWL Plan solicit feedback from agricultural industry stakeholders to develop baseline conservation management acreage totals as well has high and low acreage scenarios for potential adoption. Establishing a baseline of acres currently under conservation management in the state (i.e. how many acres are currently under management with cover crop, compost, reduced tillage, hedgerows/buffer strips etc.) is critical to inform the plan moving forward, including scenarios modeling.

The Natural Resource Conservation Service (NRCS) of USDA in California works with farmers and ranchers on all the management activities for agriculture outlined in the Appendix. CA NRCS along with U.C. Cooperative Extension, the California Association of Resource Conservation Districts (CARCD), the top 5 commodity crop associations and other agricultural partners can inform the development of the baseline (e.g. what percent of your members or farmer clients grow cover crops? conduct reduced tillage? apply compost? On how many acres? etc.). They can also provide guidance on high and low scenarios for the adoption of management practices to increase carbon sequestration and reduce greenhouse gas emissions overall.

[1] CALAND includes limited agricultural management practices and applies the same GHG mitigation potential to these practices across the entire state for its scenario modeling based on only two papers from the literature in California on agricultural climate change mitigation. Further, CALAND does not model nitrogen cycling, including nitrous oxide GHG emissions that arise from fertilizer application and soil processes.

Given the limitations in the CALAND model, the COMET tool should also be run on the high and low conservation management acreage scenarios to establish a range of impact from changes in farm management, and to assess the differences in outputs between CALAND and COMET. Consideration of different soil types across the state is essential since GHG emissions are highly influenced by properties such as clay content and compaction. This will better inform the plan and the state's policies moving forward to support the plan's emission reduction target.

Recommendations:

- Work with agricultural stakeholders, including CA NRCS, U.C. Cooperative Extension, CARCD and other agricultural organizations, to develop baseline and high and low scenarios acreage estimates.
- This group can also help identify opportunities to leverage wider adoption and provide tangible and actionable items to reach the proposed high adoption scenarios.
- Compare outputs between CALAND and COMET tools and describe potential impact of the scenarios models on GHG mitigation given different modelling approaches. We suggest avoiding taking an average of the two outputs because that will unnecessarily obscure differences between the two tools.
- Submit the CALAND model and related technical documents for peer review.

2. **Strategies: Include agricultural management strategies to reduce nitrous oxide emissions; Include Healthy Soils Program practices**

The draft outline includes several key agricultural management practices (see Appendix) for reducing greenhouse gas emissions and improving carbon sequestration in soils and woody biomass. However, there is one notable exclusion and that is the role of reducing the quantity and improving management of synthetic nitrogen fertilizer to reduce potent nitrous oxide emissions while simultaneously increasing soil organic matter and related carbon storage.

We were surprised that the state has not included this important strategy for agriculture because the reduction and improved management of nitrogen fertilizers offers a permanent reduction in greenhouse gas emissions and is the most important leverage to decrease nitrous oxide emissions which are a sizeable proportion (20 percent of total GHG emissions) from agriculture. Peer-reviewed studies conducted in California on these issues are quite clear: the reduction of nitrogen-based synthetic fertilizers offers one of the best and permanent GHG emissions reduction strategies in agriculture. See below for more literature on this issue.

The state must include reduction strategies in its plan to credibly address greenhouse gas emissions and reduction potential from agriculture. The inclusion of fertilizer-based strategies will also expand the number of farmers and the total acreage the state may reach as the vast majority of California farmers and ranchers use synthetic fertilizers. There is also considerable opportunity for multiple co-benefits of including N fertilizer reduction strategies that improve water and air quality in our rural communities, which is also consistent with other state policy efforts, including those aimed at addressing nitrate leaching and improving access to safe drinking water.

Additionally, the NWL Plan does not include all of eligible practices in the Healthy Soils Program. These practices are in the COMET-Planner tool and have been vetted for their ability to improve carbon sequestration and reduce greenhouse gas emissions overall. We suggest

expanding the list of practice activities in the NWL Plan to include the full suite of Healthy Soils Program practices.

Lastly, we encourage the state to move towards a full accounting of practices, including life cycle assessment, to better understand the full impacts and opportunities that agricultural baseline and reduction strategies offer, and to clarify potential tradeoffs in other sectors, such as transportation.

Recommendations:

- Include nitrogen fertilizers reduction strategies in the NWL plan to address nitrous oxide emissions and improved soil organic matter and related carbon sequestration.
- Include the full suite of Healthy Soils program practices in the list of agricultural management practices as described in the Appendix.

3. Goal Setting: Ambitious Target Needed

The current greenhouse gas emissions reduction target of 15-20 MMTCO2e by 2030 from the natural and working lands sector is surprisingly low. The literature supports a much more ambitious target. For example:

- Sophisticated modeling done by Dr. Johan Six and others from UC Davis showed that combinations of conservation tillage, reducing synthetic fertilizer and adopting cover crops had a GHG mitigation potential of about -0.5-1.25 Mt CO_2-eq $acre^{-1}$ yr^{-1}. Scaling this up to 25% of irrigated croplands (~2.5 million acres) would nearly match or exceed the current GHG emissions target in croplands alone.
- Even when considering a very limited set of agricultural management practices, a recent PNAS paper by Dr. Richard Cameron and his colleagues at The Nature Conservancy[2] found that natural and working lands management strategies could reduce greenhouse gas emissions by 147 MMTCO2e by 2030.
- Past state estimates (2008 Economic and Technical Advancement Committee) of the GHG mitigation potential for agriculture were much higher (17 MMT CO_2e yr^{-1}).

We suggest that the state consider embracing a target that reflects this work and others.

Recommendation:

- Revise upward the GHG target for NWL considering these and others studies.

Thank you for your consideration of this important issues. Please feel free to be in touch with us with any questions you may have.

Sincerely,

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[2] Dr. Cameron et al. Oct. 5, 2017. Ecosystem management and land conservation can substantially contribute to California's climate mitigation goals. PNAS. http://www.pnas.org/content/114/48/12833

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Additional literature for consideration:

1. Bowles, T.M., A.D. Hollander, K.L. Steenwerth, and L.E. Jackson. 2015. Tightly-coupled plant-soil nitrogen cycling: Comparison of organic farms across an agricultural landscape. *PLoS ONE* 10(6): e0131888. doi:10.1371/journal.pone.0131888 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131888

2. Cameron et al. Oct. 5, 2017. Ecosystem management and land conservation can substantially contribute to California's climate mitigation goals. PNAS. http://www.pnas.org/content/114/48/12833

3. De Gryze, S., A. Wolf, S.R. Kaffka, J. Mitchell, D.E. Rolston, S.R. Temple, J. Lee, and J. Six. 2010. Simulating greenhouse gas budgets of four California cropping systems under conventional and alternative management. Ecological Applications 20(7), 1805–1819.

4. Williams, J.N., A.D. Hollander, A. Toby O'Geen, L.A. Thrupp, R. Hanifin, K.L. Steenwerth, and L.E. Jackson. 2011. Assessment of carbon in woody plants and soil across a vineyard-woodland landscape. *Carbon Balance and Management* 6-11. http://www.cbmjournal.com/content/6/1/11

5. Suddick, E.C., K.M. Scow, W.R. Horwath, L.E. Jackson, D. R. Smart, J.P. Mitchell, and J. Six. 2010. The potential for California agricultural crop soils to reduce greenhouse gas emissions: a holistic evaluation. Donald L. Sparks, editor. *Advances in Agronomy* 107:123-162. http://ucanr.edu/repository/?get=93560

6. Ryan Byrnes, Valerie Eviner, Ermias Kebreab, William R. Horwath, Louise Jackson, Bryan M. Jenkins, Stephen Kaffka, Amber Kerr, Josette Lewis, Frank M. Mitloehner, Jeffrey P. Mitchell, Kate M. Scow, Kerri L. Steenwerth, Stephen Wheeler. September 2017. Review of research to inform California's climate scoping plan: Agriculture and working lands. California Agriculture. Vol. 71. No. 3. http://calag.ucanr.edu/archive/?article=ca.2017a0031

7. Elizabeth Verhoeven, Engil Pereira, Charlotte Decock, Gina Garland, Taryn Kennedy, Emma Suddick, William Horwath, Johan Six. September 2017. N2O emissions from California farmlands: A review. California Agriculture. Vol. 71. No. 3. http://calag.ucanr.edu/archive/?article=ca.2017a0026

8. Kennedy, Taryn & C. Suddick, Emma & Six, J. 2011. Reduced nitrous oxide emissions and increased yields in California tomato cropping systems under drip irrigation and fertigation. Agriculture, Ecosystems & Environment. 170. 16–27. 10.1016/j.agee.2013.02.002.

9. Tomich, T.P., S.B. Brodt, R.A. Dahlgren, K.M. Scow (eds). 2016. The California Nitrogen Assessment: Challenges and Solutions for People, Agriculture, and the Environment. University of California Press.