Berkeley College of Natural Resources
UNIVERSITY OF CALIFORNIA
DEPARTMENT OF ENVIRONMENTAL SCIENCE, POLICY & MANAGEMENT

November 14, 2018

Dear California Natural and Working Lands Climate Change Implementation Plan Team,

In the past two months, two separate powerpoints presented that are apparently designed to be used for the NWL inventory report and related strategy documents required by trailer bill SB 859. It is interesting that both of the reports present data developed from unexplained methods that are quite different from the positive carbon sequestration trends measured for California's forests that were documented in the state's Forest Carbon Plan (May 2018).

- Draft Natural and Working Lands Inventory – ARB's October 23, 2018 presentation and California NWL
- Climate Change Implementation Plan presentation of November 2, 2018

Both of these presentations seem to be tied to the Natural and Working Lands Implementation Plan that, interestingly, excludes Calfire even though the various estimates of carbon fluxes in both presentations are mainly about forests. It is also interesting that the implementation plan that is based on a totally different set of models and estimates of carbon fluxes in California's than what is in the May 2018 Forest Carbon Plan – where all of the groups promoting these new methods are signatories.

Since all the signatories of the ongoing NWL Implementation Plan signed on to the report that summarized the carbon flux situation as "When all forest pools are considered, California's forests are sequestering 34.4 MMT CO2e per year, and when land-use changes and non-CO2 emissions from wildfires are accounted for, the total net sequestration is 32.8 MMT CO2e per year… This estimate does not account for any carbon that may be transferred to other forest or wood product pools, nor does it quantify black carbon or other emissions that may have implications for global warming potential such as particulate matter emissions. It also does not include change associated with forest land conversions to other land-uses. (Forest Carbon Plan, May 2018, p 12)", it is extremely difficult for those outside the process to understand why consultants and state staff are creating new accounting and modeling systems that seem to contradict what is in the state's Forest Carbon Plan. In addition to being an expenditure of state funds that duplicates what has already been funded and published with state resources, there seem to be many arithmetic problems in the two NWL products.

At the end of the analysis, one fact should stand out for all parties. Wildfires are the #1 transformer of global carbon dynamics in California, and wildfires are roughly 3x more prevalent on federal lands with similar vegetation and zoning as private lands are (see Starrs et al. 2018). This year's fires have once again reinforced that pattern. Surely, reducing the large carbon emissions related to wildfires that seem to be much more prevalent on federal forest and shrublands can be agreed upon by all as the most immediate target to improve the overall carbon balance on California's forest lands. It would seem that the Forest Carbon Plan already laid out a useful inventory methodology and results, as well as strong evidence of 'best practices' that are far

higher than the statewide average practices. It would appear that some serious technical review will be needed in the coming months to avoid mixing good and bad methods and results.

**Technical issues in the October 23 2018 powerpoint presentation , " Draft Natural & Working Lands Inventory" California Air Resources Board.**

Slide 5. The stock difference method conceptually can work for above live ground vegetation if correctly calibrated, but it is unclear how the satellite based methodology will account for other carbon pools in the forest.

Slide 8 . It is unclear why CARB is trying to reanalyze all the carbon pools from the FIA databases that have already been summarized in the Forest Carbon Plan and in annual AB1504 reports delivered to the California Board of Forestry and Fire Protection. In those reports, all the pools are remeasured and accurate estimates of annual carbon sequestration are presented for all pools except litter. The figure below summarizes the net sequestration from in-forest carbon pools that follow IPCC definitions.

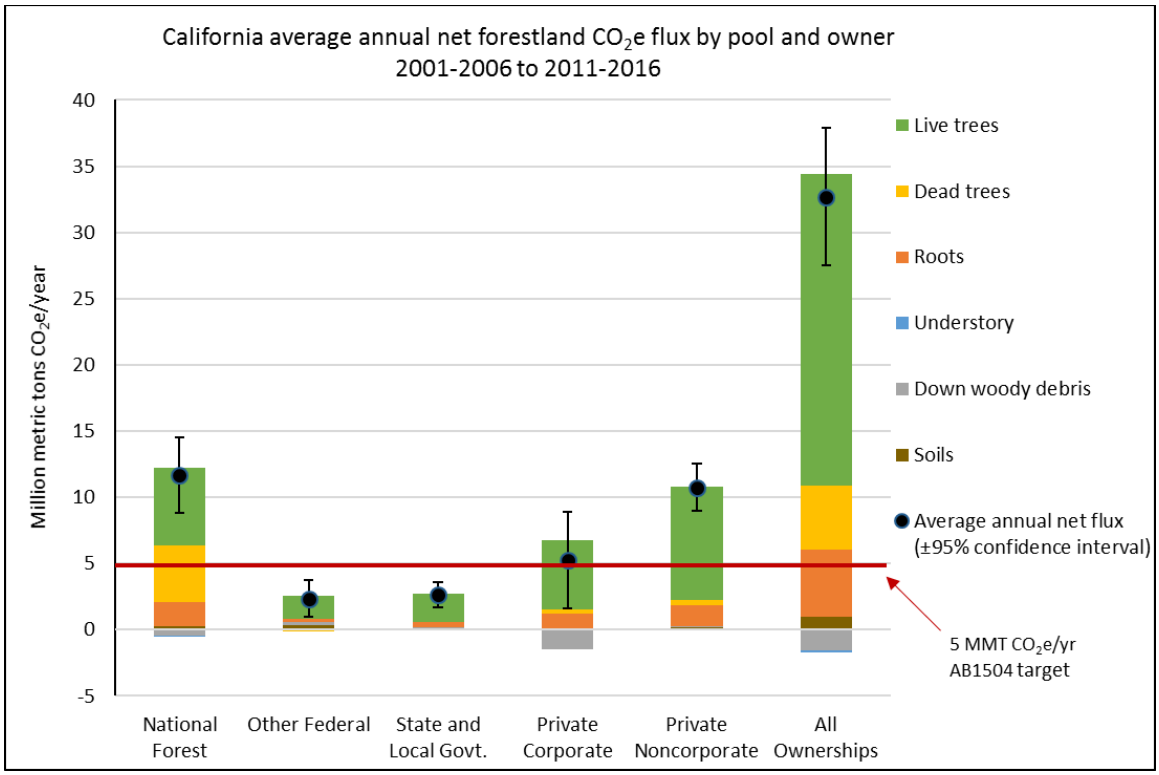


**Figure 4.2.** California average annual net forestland carbon flux by pool and ownership, 2001-2006 to 2011-2016 (MMT CO2e/yr). Estimates exclude emissions from land-use changes (1.5 MMT CO2e/yr) and non-CO2 greenhouse gases (0.5 MMT CO2e/yr). Roots includes belowground live and dead tree roots. Understory includes aboveground and belowground understory vegetation. Error bars represent the 95% confidence interval of estimated net flux. Figure derived from Table 4.3/Appendix 2, Table B1. (AB1504 report, 2018 Update to the BOF. This is the same data cited in the May 2018 Forest Carbon Plan, and is updated annually).

Slide 8 – Forest Land Carbon Pools - Above ground liv biomass 846 Tg, Litter 924 Tg

- The figures shows a phenomenally high litter estimate – that is greater than all the above ground biomass. This estimate is far higher than the national and regional plot based estimates published by Domke et al. in 2016. It would have been useful if CARB staff had explicitly described how their consultants developed these estimates. I must say, for a layer that is rarely thicker than 1 foot, it is sure an impressively large estimate. If the NWL estimates are to be believed, this litter layer must produce an astounding amount of smoke when it burns. It is unclear how the future emissions from litter in sites hit by wildfire are accounted for in this system.
- It is also not clear how the remote sensing method used to estimate change in the landfire live tree height categories can give estimates for the other five carbon pools initially estimated – main roots, understory, dead standing, dead down, and litter.

Slides 10, 11, and 12 provide huge numbers for carbon losses of forests becoming grasslands. This is a surprisingly large number as the AB 1504 report annual looses of forests to grasslands of only 9,269 acres (standard error 2,928 acres), for a total forest land area of around 30 million acres. The purported loss of carbon when forests are converted to grasslands would benefit from some maps of where the consultants think this is happening.

Slide 10 – Forests add 11 mmtc but loses 3.67 mmtc to grasslands over 2 years 2010-2012
Slide 11 - Forests add 5 mmtc but loses 6 mmtc to grasslands over 2 years 2012-2014
Slide 12 – Forest add 3.63 mmtc but lose 15.87 to grasslands 2012-2014 ( for both live and dead pools – even though it is not clear how satellite based stock differences in live trees are used to generate dead wood estimates, since dead wood many not give a measurable signal different than rocks or dirt in the satellite imagery based geospatial data.

Slide 14 – The annual estimate of 34, 718 hectares (48,175 acres) of private sector forest management actions over the 2012-2014 period appears to have been estimated from satellites, but does not compare that well with ~150,000 acres/year estimate from the agency that actually regulates and tracks these same activities on state regulated lands. The 150,000 acres of forest treatment on private lands is published in FRAP's 'California's Forest and Rangelands: 2017 Assessment' that is available on line at www.fire.ca.gov.

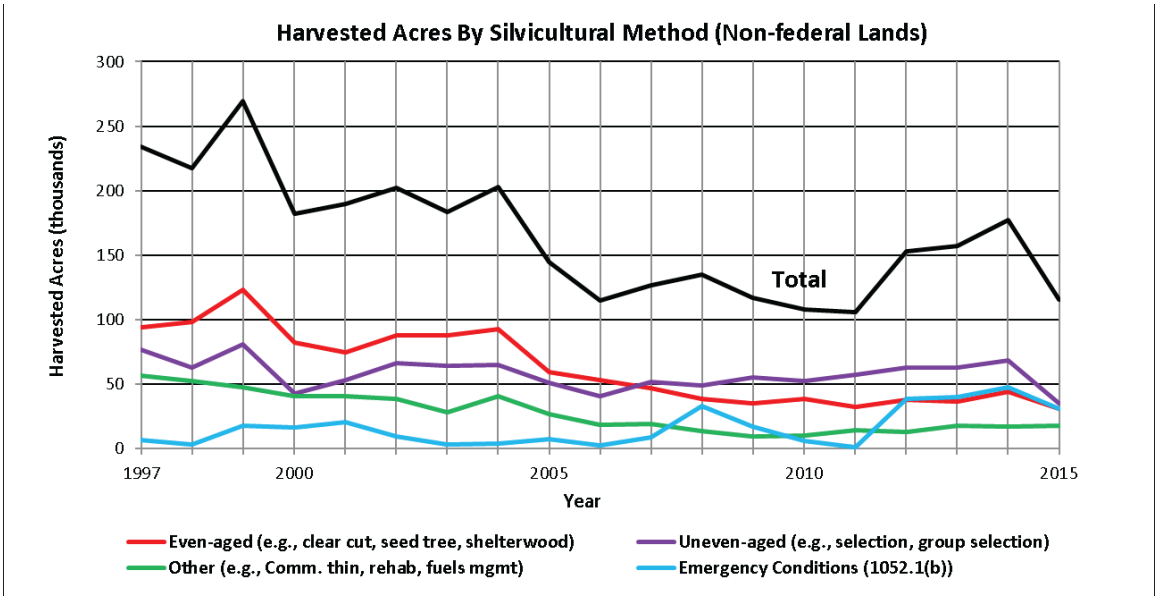

Figure 1.7: Harvest Acres by Silvicultural Method (Non-federal Lands).
Data Source: Forest Practice System (FPS), CAL FIRE, 1997–2015.
(FRAP 2017 Assessment . Chapter 1: Sustainable Working Forests)

Slide 29 – estimates that forest soils lose 7 mmtc to conversion to croplands, and 7 mmtc to conversion to other lands, but mysteriously the earlier identified forest conversion to grasslands losses are nil. The AB 1504 report has published estimates of net change from forests to cropland and developed land of 3,891 acres/yr and 11,004 acres/yr respectively. It is not clear how the consultants or CARB staff got such large estimate of soild carbon stock change. It may be due to the use of two separate teams of consultants, but since there are no references to who did what, or where it is published, one can only wonder.

Slide 34 – mysteriously provides slightly different forest stocks estimates from those earlier. Here they assert that above ground biomass is 2/3 dead trees (1496 Tg) and 1/3 live trees (892 Tg) ( a Tg is equal to a million metric tons – but ARB must have two different sets of consultants). As noted earlier, this phenomenally high estimate of 'dead' carbon is out of line with any other published estimates for California forests.

Slide 35 – claims 'forests and other natural lands' lost 150 TgC (or MMTC) from 2001-2010 , but have stabilized since then. But the stabilization can be calculated away by using the total 2001-2014 period, allowing a calculation of an overall decline of -0.24% over 2001-2014. As noted earlier, this estimate of an annual loss of carbon from forests is at loggerheads with the estimates in the Forest Carbon Plan – of which CARB and the others in the NWL Implementation Plan group were signatories. The updated AB 1504 report to the Board of Forestry and Fire Protection stated "Approximately 10% of the stored carbon is found aboveground in dead wood pools (205 ± 6.4 MMT C, Table 4.12, figure 4.9). "(AB1504 update 2018). This is very different than the 63% of above ground carbon in dead wood presented in this ARB powerpoint.

The overall impression is that the new methods proposed by ARB to create a new NWL emission inventory are out of sync with previously published estimates in state documents where ARB was a signatory. This is a bit confusing.

**Technical issues in the November 2, 2018 powerpoint presentation , " California Natural & Working Lands Climate Change Implementation Plan" California Air Resources Board.**

On November 2, 2018, the consortium who backed the October 23, 2018 NWL inventory had another presentation at a public workshop based on different consultants who used the USDA'S COMET model for agricultural lands and a proprietary CALAND model for forest carbon fluxes. While the presentation asserts that the 'forests ' component is based on the Forest Carbon Plan and Executive Order B-52-18, the slides present yet another carbon flux modeling approach that seems to have nothing in common with the data used in the Forest Carbon Plan. As with the October 23 presentation, slide 13 presents the same disturbance data that was shown to count only 1/3 of the private forest disturbance acreage tracked by FRAP and Calfire.

Slide 18 summarizes some modeled outputs, with cartoon arrows rather than numbers that are described later.

Slide 48 shows that the Alternative A results are based on annual actions over the next 12 years of 100,000 acres of 'forest thinning, prescribed burn, and understory treatment and 50,000 acres of 'less intensive forest management'.

Slides 58 – 60 present the model results in a confusing cumulative numbers rather than simpler annual numbers. However, it appears the preferred plan is modeled to generate ~ 4 mmt CO2/yr of sequestration from the 150,000 acres of treatments, but ~7 mmt CO2/yr of additional emissions from those same treatments. The very confusing cumulative results stretching out to 2100 on slide 60 could have been recast to show that the proposed package of treatments would generate an additional emission of ~ 3 mmt co2/yr for the next 12 years – to apparently be financed with 'cap and trade' dollars from GHG polluters. It is extremely hard to understand how to justify the use 'cap and trade' dollars for projects that would generate additional emissions. It is especially confusing since the forest carbon sequestration data used in the Forest Carbon Plan clearly show that some forest landowners in California are currently using 'best practices that 1) initially capture more carbon dioxide from the air (higher gross tree growth per acre rates) and 2) lose considerably less carbon from in live trees that ends up in dead trees that slowly release nearly all the carbon dioxide back into the atmosphere. The patterns are well summarized in figure 4.4 from the AB 1504 reports.

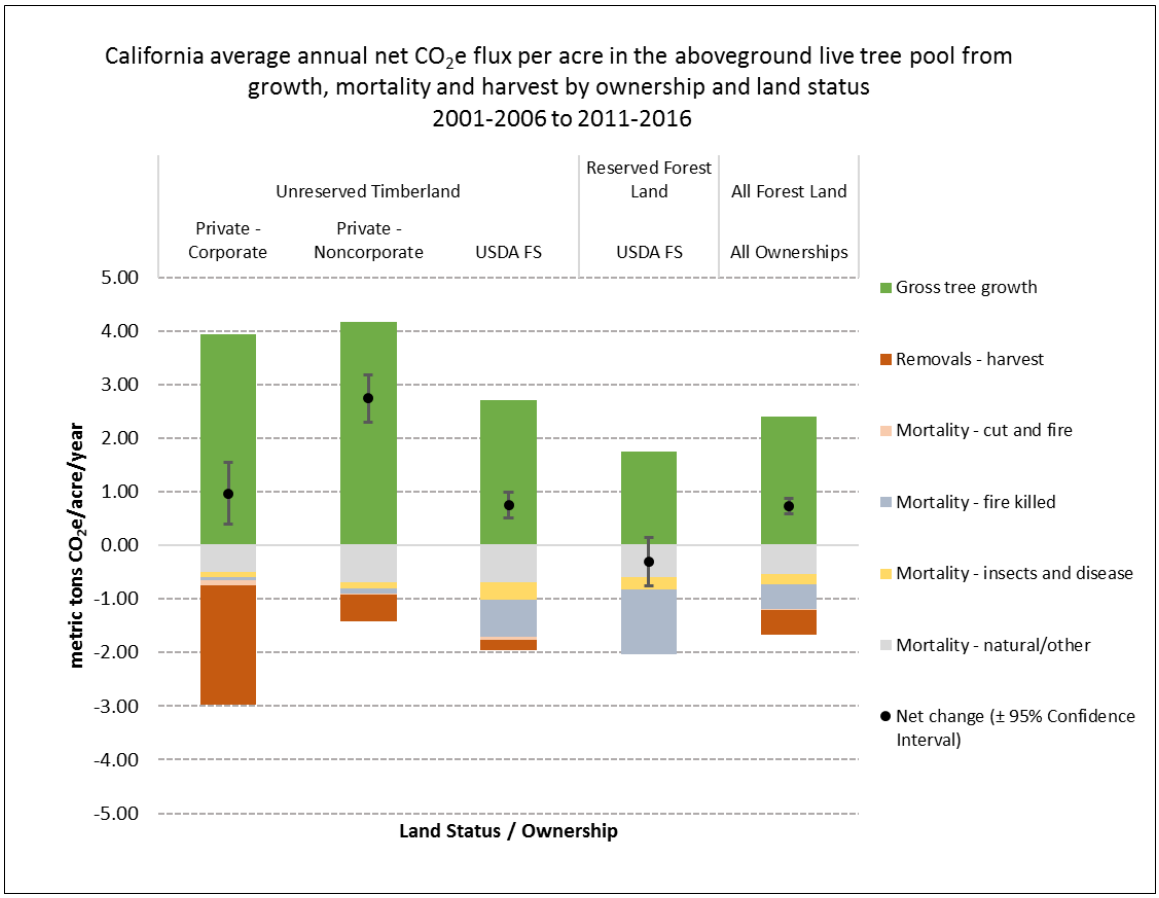


Figure 4.4. Average annual net CO2e flux per acre in aboveground live tree carbon pool from growth, mortality and harvest by ownership and land status of California's forests (MT CO2e/acre/year), 2001-2005 to 2011-2015. The "all ownerships" category includes all other state

and federal agencies managing fewer overall acres of forest land in California. The error bars represent the 95% confidence interval of net change. Figure derived from Appendix 2, Table B12.

To add to the confusion of suggesting that the NWL Implementation Plan subsidize activities that generate net new emissions, the presentation concludes with mathematically confusing combinations of cumulative CALAND outputs with annual COMET outputs.

Overall, it is clear that the NWL team has some interesting results from their consultants, but they do not match up very well with published results in peer reviewed journals or with state publications such as the Forest Carbon Plan (May 2018) that most of the agencies were signatories to. It does seem that the final NWL plan may require another external review to clarify where the new numbers come from and whether the NWL is really going to promote spending cap and trade dollars on projects that, in their own best case scenario, generate additional emissions. A simpler alternative could be to look at the results in the AB 1504 reports and the Forest Carbon Plan as a roadmap identifying which current best practices should be extended.

Sincerely,

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Literature cited

Domke, G.M., Perry, C.H., Walters, B.F., Woodall, C.W., Russell, M.B. and Smith, J.E. 2016 Estimating litter carbon stocks on forest land in the United States. *Science of The Total Environment*, **557–558**, 469-478.

Starrs, C.F., Butsic, V., Stephens, C. and Stewart, W. 2018 The impact of land ownership, firefighting, and reserve status on fire probability in California. *Environmental Research Letters*.