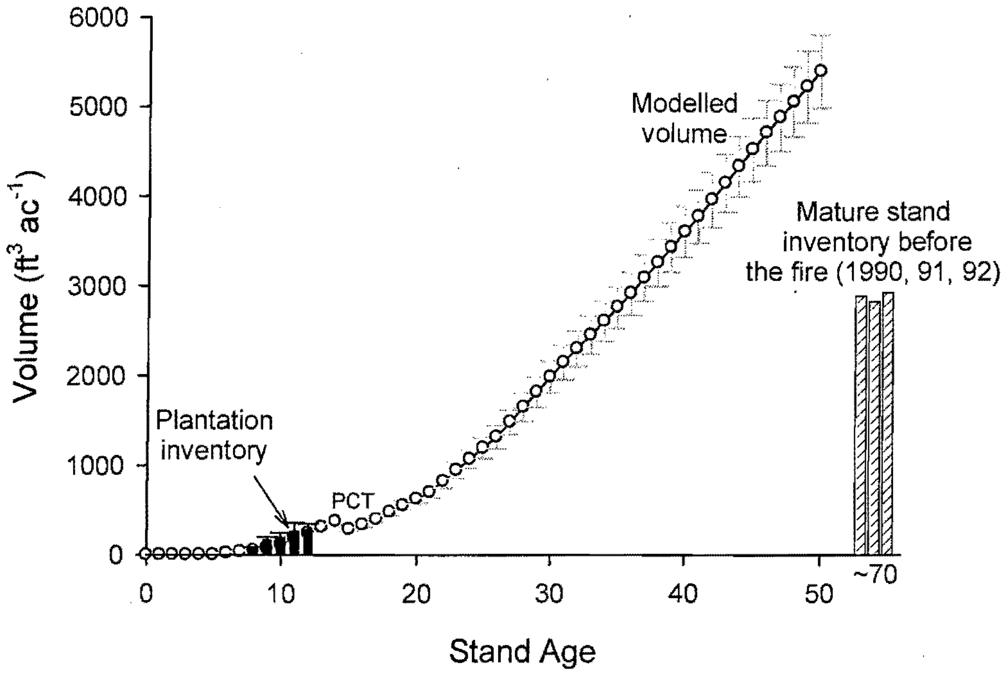

Fig. 3. Stand volume inventory for 1) the original natural-stands (bar only), at about 70-yr-old, in 1990, 1991, and 1992, prior to the Fountain Fire, 2) for some regenerated young plantations (bar+se) at age 8-12 after the fire, and 3) means (±se) of modeled volume (circle and line) based on the combinations of site quality and planted species with the Forest Projection Systems for up to 50 years. Pre-commercial thinning (PCT) has been assumed to be conducted at age 14.

Further, additional research by Battles (Battles et al., 2008) indicates:

> "...Simulated growth of a commercial pine plantation during a 50-yr management cycle (20 to 70 years-old) for 18 climate realizations predicted increase in yield both in terms of total tree volume and merchantable board feet. The increased growth was most directly tied to the consistent projections of warmer temperatures during the 21st century. Under the most extreme climate scenario, pine yield increased 28% above baseline by 2100. This result contradicts our previous work which reported decrease in pine yield by 2100 under similar climate predictions."

Based on past measurements in plantations and climate change modeling on the effects of a warming climate on forests there is some reason to be concerned. It is also recognized the modeling and anticipating future conditions is complex. However, it is the Department's conclusion that even-aged management regimes proposed by landowners has a reasonable expectation of providing management options for maximizing net biological productivity of the stands being managed and will benefit sequestration under a wide range of climate warming scenarios. No additional mitigations were determined to be necessary to avoid an adverse impact.

In summary for this Issue, the Department notes that SPIs management regime has selected a longer rotation age than would be required under the Forest Practice Rules. SPI has selected rotation ages that range from 70 to 80 years in length. The Forest Practice Rules require regeneration of the clearcut areas within 5 years with an equivalent of 300 seedlings per acre. SPI management practices emphasize the need for prompt regeneration and clearcut units are generally site prepped the season of or season immediately after the initial harvest. Planting is generally completed the season following site preparation. Site preparation piling of logging slash is usually followed by burning (all sites within an economic range of a biomass power plant are usually chipped and sent to biomass electrical generation facilities, rather than burned). Most sites are "ripped" prior to planting. Ripping is a process of deep tilling which is accomplished by pulling a steel ripper through the soil attached to a tractor. The objective of ripping is not to till the soil as would be the case in plowing, but to improve water storage capacity of the ripped area and provide better conditions for root growth and seedling establishment. – preliminary range research in Marin Co. show increased sequestration with ripping. The FPR requirements and SPI management practices provide for quick reestablishment of seedlings on the harvested sites and provide optimal conditions for early rapid growth and site occupancy necessary to minimize the period of time when emissions from soil related respiration and other processes dominates the GHG flux. Applications of these practices have been demonstrated to be successful on past THPs and it is anticipated that this will be the case for the Whitmore Grade THP as well. As such, the FPRs and measures contained in the regeneration plan included in the THP have been determined to constitute a reasonable set of mitigations to minimize the potential for emissions from the soil carbon pool through ensuring rapid conifer site occupancy and minimizing erosion. Increased respiration will be partially offset by the influx of additional carbon associated with logging slash and GHG impacts associated with increased respiration are likely to be minimal and short lived as trees will likely establish a shade canopy that will reduce respiration rates within 7 to 10 years.

Also, the Department has noted that the plan submitter is not proposing to intensively managed areas that were formally old growth. The management regime for the ownership is designed to restore higher levels of stocking (carbon storage) and improve growth rates (sequestration). The area covered by this plan is consistent with the silvicultural application proposed in the Option "a". This acreage has and will continue to be managed to produce wood products in a manner consistent with the Forest Practice Act.

It is the Department's conclusion, after reviewing and commenting on the pertinent literature and studies, that the proposed management regime with this plan as one of the implementing actions is consistent with the goal in the AB 32 scoping plan and will result in improvements in carbon sequestration rates. Significant adverse impacts from a climate and greenhouse gas accounting perspective are not anticipated.

3. Concern: **SPI recently publicized a white paper titled; Carbon Sequestration in Californian Forests Two Case Studies in Managed Watersheds. Because this research was funded ... by [SPI],CAL FIRE, like the U.S. Supreme Court, should decline to rely on it. (Exxon Shipping Co. v. Baker, 128 S. Ct. 2605, 2626 (U.S. 2008). Regardless, this paper has not been published in a peer-reviewed journal and is a highly biased and fatally flawed justification of SPI's forest management practices through selective presentation of data and analysis with regard to forest carbon stores and sequestration. The**

SPI paper concludes that the Intensive Scenario - in which existing forests are replaced by even aged monocultures, thereby converting them into forest plantations - results in an increase in sequestered carbon of 75 to 95 tons C/acre over 100 years compared to minimum compliance with Option C of the California Forest Practice Rules. (Option C of the CA Forest Practice Rules serves as the baseline for forest projects under the California Air Resources Board's forest protocols.) Two reviews of the SPI study conducted by experts on science, climate and logging found the study to lack credibility. One review was conducted by Dr. Olga Krankina, a professor and researcher of climate impacts at Oregon State University. Another was conducted by Peter Miller, a senior scientist with the National Resources Defense Council, a board member for the California Climate Action Registry, and a doctoral candidate in environmental planning at the University of California at Berkeley, whose research is on conservation planning in a changing climate. Our own review of the SPI paper also found many incorrect assumptions, flaws with the study methods, results and conclusions drawn from these results. Findings and conclusions from these reviews are outlined in the following sections. The SPI paper compares the total amount of carbon sequestered under four management scenarios for two different watersheds in the Sierra Nevada. These include Custodial Management (light to moderate selection harvests), Option C Selective Management (heavy thinning that reduces the stocking to minimum allowed level), Intensive Management (converting all remaining mixed conifer forests to Ponderosa Pine plantations with 80-year rotation age) and Regulated Management (hypothetical - even distribution of plantations by eight 10-year classes).

The first issue with these scenarios is that the regulated management option cannot be directly compared to the first three. The first three scenarios are generally comparable because they are initiated with the results of the current forest inventory (meaning they start from the same baseline). However, the regulated management scenario has an initial condition of a fully established normal or regulated forest. In other words, its starting point is actually achieved by 80 years of the Intensive Management Scenario. Krankina (2008) states; Therefore direct comparison of projected gains in carbon pools that involve Regulated management Scenario (e.g., p. 3; bottom paragraphs) is inappropriate. For example, in a comparison of the total carbon pool and the forest carbon pool across management scenarios, SPI reports results and makes the following conclusion based on these results Intensively managed and regulated forests show substantial increases in the forest carbon pool and total carbon pool yield when compared to the other more extensive Option C Selection and Custodial management approaches (James et al. 2007). This is an unfair comparison and conclusion given the different starting points of each scenario. This strongly and inappropriately biases the results in favor of Intensive and/or Regulated management. At the same time, the SPI paper fails to analyze important alternatives that would be critical for a meaningful assessment of the role of forest management practices (Krankina 2008). Krankina (2008) notes the absence of both the business- as- usual scenario that would show the long-term effects of current management and the no management scenario that would show the long-term effect of natural processes of carbon exchange. Krankina (2008) highlights the importance of the lack of consideration of the latter with the following; No management intervention scenario is not considered. Reduction of timber harvest in PNW National Forests resulted in dramatic increase in forest carbon stores (Alig et al. 2006). Figures in Appendix I suggest that allowing the existing mixed conifer forests attain age 160 years would result in forest carbon pool that is more than twice as high as the average forest carbon store in a regulated scenario for plantations. Miller (2008) also points out how SPI fails to include an alternative that prioritizes carbon sequestration and/or considers other environmental variables/impacts. Miller (2008) sums up the problem with omitting this management scenario in terms of carbon and wildlife impacts:

The SPI analysis fails to include a scenario with reduced harvest levels that allow a forest to sequester significantly increased amounts of carbon in forest biomass. Both watersheds evaluated in the SPI analysis are middle-aged forests that are near their maximum rates of growth and with reduced harvest levels could double or triple the volume of carbon sequestered as well as provide valuable wildlife habitat (p. 50). However, even the Custodial scenario is only designed to maintain current stocking levels(p. 20). A comparison of any of the SPI scenarios with a scenario designed to maximize forest carbon would demonstrate the climate benefits of a high-habitat value approach. Consideration of demand-side forest product programs like recycling and wood use efficiency could allow for reduced harvests (Miller 2008). Any conclusions the SPI paper draws from these inadequate comparisons are flawed and incomplete, and are not useful in estimating the relative capacity of the management scenarios to sequester carbon. The SPI paper estimated net changes in various carbon pools over 10 future decadal planning periods. SPI compared differences in carbon storage across components including live biomass, dead biomass, soil carbon, off site products, and off site land fills. In order to estimate live biomass, the authors tested three different statistical LBM models to determine tree biomass from forest stand characteristics. The SPI paper states; It was not possible to directly verify which of the above models (1 through 3) provide the most accurate biomass assessments for the watersheds in this study over the entire planning horizon (p. 25) (James et al 2007). Nonetheless, the SPI paper then ignored these limitations and provided a comparison of forest carbon over time using each of the models. This comparison resulted in SPI's assertion of significant differences among the LBM models particularly for the Intensive scenario (Miller 2008).However, SPI neglected to adopt a scientifically valid or reliable model or at least to provide a valid justification for their choice, and instead stated that they arbitrarily used Model 2 as a comparative basis (p.34).Despite differences in a comparison across management scenarios, SPI chose to report only the results of the arbitrarily-chosen Model 2 which produces the largest increase in sequestration from the Intensive scenario compared to the Option C scenario. Thus, SPI may have greatly overestimated the carbon sequestration benefit of their management scenarios by choosing to only focus on this model. In fact The net carbon benefit estimated using either of the other two models appears to be approximately 40% lower than the reported results. (p. 33) Model 2 also produces an estimate of decreased sequestration from the Option C scenario that is approximately 50% larger than either of the other two models (Miller 2008).

SPI recognizes the inadequacy of this approach. With specific regard to the lack of appropriate models, the SPI paper states; None are perfect and it would appear that live biomass estimation methods currently available in California are the most limiting in terms of precision when estimating total carbon stored in forest stands (p.26) ... It is also difficult to determine if existing biomass models were appropriate for use in California forests. Therefore, the study concluded the two main problems in providing an accurate forest carbon appraisal system in California that could be applied at the project level under the CCAR protocols were a) imprecise biomass modeling systems and b) shortcomings of publicly available forest growth models (p.41). Nonetheless, the SPI paper ignored these deficiencies, and did not modify their analysis to correctly represent this difficulty or lack of data. Instead they report and highlight the results that make it appear that intensive management will be the best for carbon sequestration. As a result, the conclusions and results are highly misleading in both their certainty and their substance. Krankina (2008) asserts; The approach adopted in the report includes several assumptions that bias the results in favor of intensive management. We highlight several of these below The SPI paper incorrectly assumes that dead biomass pools are in equilibrium when there is a change in forest management. Assuming that the amount of carbon stored in dead biomass (logs and snags or fallen trees) remains the same despite changes in forest management is incorrect. There is carbon stored in dead biomass (snags, logs, etc.) and when a forest is harvested, carbon is released from these pools. If the dead biomass is allowed to remain on the ground it will continue to accumulate carbon over time. In addition, logging removes trees that would have eventually died and fallen. Aggressive logging reduces the amount of trees that die and subsequently fall, thereby decreasing the amount of dead trees on the ground and the amount of carbon that is stored in these pools. Both studies cite this as a flaw: ... stasis is assumed for all dead biomass pools including snags and forest floor (which has to include logs even though they are not mentioned). As a result the SPI projections do not include losses or gains in dead biomass pools. In reality, logs and snags are created by tree mortality and are NOT in stasis (equilibrium) when there is a change in forest management. These are significant carbon pools and losses from these pools were shown to be a major source of carbon to the atmosphere as old-growth forests were harvested in the PNW (Harmon et at. 1990). As forest stands grow older, dead biomass pools increase unless timber harvest removes live trees. Aggressive management reduces tree mortality which is input into dead biomass carbon pools; the result is the extremely low level of dead biomass, especially coarse woody debris in intensively managed forests. There is a vast body of literature on the subject. Omission of the essential link between live and dead biomass pool is a major flaw of the report that likely biased the results in favor of intensive management scenario. (Krankina 2008). The SPI analysis assumes that soil carbon levels remain constant across management scenarios, despite the significant soil disturbance proposed under the Intensive scenario. In the Intensive scenario, forest soils would be mechanically ripped to three feet deep after existing stands were cleared, likely resulting in a significant loss of soil carbon. (p. 48)(Miller 2008). The SPI paper inappropriately overestimates the contribution of wood products to the carbon pool. The SPI report states that they used the following assumptions to account for carbon storage in the long-term wood product carbon pool: 25% of long-term wood products are assumed to go to landfills when they are taken out of service. Recent studies (Ximenes et al., 2005) indicate that the decomposition of wood products in landfills is insignificant so we assume wood carbon in landfills is permanently sequestered (p. 29) ..... Wood products are subsequently taken out of service at an annual rate of 1% of year (Winjnn et al. 1998). In fact, these are incorrect assumptions. Forest products that end up in landfills do slowly decompose and release carbon, thus they do not permanently sequester it as SPI suggests. The fact that the SPI study is based on this falsity has skewed their results to favor scenarios that include intensive logging. Both reviews of the SPI paper, as well as existing science, dispute these assertions and support the idea that SPI has overestimated the contribution of wood products to the carbon pool to favor intensive management. The assumption that forest products taken out of service and transferred to landfills retain carbon in perpetuity (p. 29; bottom) is clearly untrue. While the decomposition is slow in landfills it does occur and carbon is gradually released into the atmosphere. The no-decomposition assumption is yet another one that biases the results in favor of intensive management scenario. Finally, the assumption that wood products are taken out of service at an annual rate of 1% per year is also unrealistic. This would imply that 50% of long-term wood materials produced in 1930-ies are still in service today (Krankina 2008).

The analysis also assumes wood carbon in landfills is permanently sequestered, disregarding both the U.S. Department of Energy and the Environmental Protection Agency's methodology that includes decay rates for land filled wood. (p. 29) The use of a more realistic lifetime and decay rates would result in significantly reduced estimates of carbon storage in wood products and a smaller, if any, net climate benefit from increased wood product production in the Intensive scenario (Miller 2008). In the text of the report the authors identify two different possible options for tracking harvest residue (e.g. tree tops, branches, and foliage). The first option is to assume that this material contributes to maintaining forest floor biomass, which the study elsewhere assumes to remain constant at 11.5 tons C/acre. (p. 23) The second option is to assume that this material comprises an additional pool of sequestered carbon. Of course, this latter approach assumes that the forest floor carbon pool somehow remains constant without continued additions to compensate for decomposition. Nevertheless, having identified these two options, the study only reports results using the latter option. As a result, the study concludes that in the Intensive scenario, harvest residue comprises a large incremental pool of sequestered carbon, totaling approximately 20-40 tons C/acre of additional sequestration by the end of the timeframe. (p. 39) In contrast, the report concludes that harvest residue adds no more than 5 tons C/acre under either the custodial or option C scenarios (Miller 2008). The SPI paper fails to include any discussion of carbon flows from one carbon pool to another (i.e. forest floor, dead biomass, etc). As we have previously mentioned, these carbon pools do not remain constant with a change in management, but rather flows between them change. By failing to consider all components of an ecosystem and how carbon flows from one pool to another, as well as the feedback between pools, the SPI paper is not valid when applied to any ecosystem (personal communication Harmon 2008). There are many global studies that do actually consider carbon flows; overall they show that logging at short intervals has a negative impact on carbon sequestration opportunities. Throughout China and Europe and across the globe, there is overwhelming evidence that longer intervals between harvest results in the storage of more carbon. In Finland, Liski et al. (2001) and Pussinen et al. (2002) found that longer rotation lengths stored more C in forests than shorter ones. This was also true in a larch dominated boreal forest in China (Jiang et at. 2002), western Canadian boreal forests (Seely et al. 2002), forests in the United Kingdom (Dewar and Cannell 1992, Thomley and Cannell 2000), and tropical plantations (Schroeder 1992).

The SPI paper fails to adequately estimate greenhouse gas emissions from other sources. SPI does not correctly estimate greenhouse gas emissions from other sources. Miller (2008) states; GHG emissions from logging, transport, and landfills are ignored or assumed to be zero even though the Intensive management approach is likely to have significantly increased emissions in all of these categories compared to less intensive management approaches. (p.26-30) The SPI paper's numerous flaws and inadequacies all serve to subvert the fact that greenhouse gas emissions will increase with the intensive management approach. All of the above incorrect assumptions had a significant effect on the results that SPI chose to highlight and the conclusions that SPI chose to draw from them, thus calling their validity into question. For example, Krankina (2008) reports; The role of wood products and harvest residues is very important in supporting the conclusions of SPI Report they account for more than a half of all carbon gains projected for Intensive management scenario. Yet, the estimated increase in carbon pools associated with wood products and harvest residues is the function of assuming that these pools are at zero level at the start of the planning period and this assumption is clearly untrue. Similarly, assumptions regarding carbon pools over time led to skewed conclusions (Krankina 2008)Change in carbon pools over time as reported on Figure 12.2 indicates that among the 3 comparable scenarios (i.e., excluding the theoretical regulated scenario) the least intrusive custodial management results in greater forest carbon pools during the first 40 years of projection period for Upper San Antonio Creek watershed and during 60+ years in Canyon Creek watershed. When the total carbon pool is considered (including harvest residues and wood products; Figure 12.4) there is little difference among the three comparable scenarios during the first 40 years of projection period, but still custodial management results in slightly bigger carbon pools. Thus during the time period that is both policy-relevant and critical in terms of addressing climate change the custodial management gives better results than other management scenarios. This is a truly amazing result considering that the calculations were biased in favor of intensive management scenario as described above. Nevertheless the SPI Report concludes in summary on page 3 (bottom) that Intensively managed and regulated forests show substantial increases in the forest carbon pool and total carbon pool yield when compared to the other more extensive Option C Selection and Custodial management approaches. This is also the main message of the press release based on SPI Report. These conclusions of the SPI Report are supported by calculation results only for the last 3-4 decades of the 100-year projection period, but they are untrue for a significant (and the most policy-relevant) portion of the time-interval examined. Miller (2008) highlights a similar shortcoming in the interpretation and presentation of the results as related to the time frame of the study The SPI analysis only provides a comparison of the sequestered carbon at the end of the 100-year study timeframe. However, the relevant comparison for climate policy is the average amount of sequestered carbon over the life of the project. Because the transition to the Intensive management approach initially results in a decrease in total carbon sequestered, it shows a net decrease in carbon sequestration relative to custodial management for the first 40 years of the analysis. (p. 40) Even under the favorable assumptions of this analysis, Intensive management does not result in an increase in average sequestration relative to custodial management for over 50 years. Overall, the average differences between the scenarios are much smaller than the reported differences at the end of the timeframe. In conclusion, as detailed above the SPI paper contains substantial inconsistencies that call into question both the quantitative conclusions and the value of those conclusions for the development of climate policy (Miller 2008).Specifically, a review of the SPI paper shows that the overall conclusion drawn by SPI, that the Intensive Scenario is the best in terms of carbon sequestration, is inconsistent with the actual results of their calculations. In fact, their calculations show the opposite While the press release and the text of the report emphasize the advantages of intensive management scenario, the calculation results indicate that within the first 40-60 years of future projections the custodial management scenario leads to greater carbon storage than the intensive management scenario. Thus the conclusions of the report are not fully consistent with the results of calculations. This inconsistency is significant because the effects of carbon removal from the atmosphere are critical within the next decades and the time horizon of policy decisions tends to be even shorter (Krankina 2008). The fact is that even with SPI's biased calculations, the results show the advantage of less intensive management. This fact implies that if done differently, a revised analysis that incorporated correct assumptions and better methodology would show even different results. For example Inclusion of soil carbon losses and process emissions, adoption of a more realistic wood product lifetime, proper accounting of harvest residues, and use of either one of the other LBM models would result in a dramatic reduction in the estimated climate benefits of Intensive management (Miller 2008). Given these omissions, incorrect assumptions, and flaws in methodology, the SPI paper presents incorrect findings and conclusions and fails to provide useful policy guidance in reviewing or assessing the THP's impact on carbon stores and climate change. Consequently, CAL FIRE can not defer to the SPI paper instead of conducting an adequate analysis of the carbon impacts of logging/clear-cutting - because of the numerous errors and deficiencies of the SPI studies, to defer to them would violate CAL FIRE's duty under CEQA The cumulative impact analysis must be substantively meaningful. A cumulative impact analysis which understates information concerning the severity and significance of cumulative impacts impedes meaningful public discussion and skews the decision maker's perspective concerning the environmental consequences of the project, the necessity for mitigation measures, and the appropriateness of project approval. While technical perfection in a cumulative impact analysis is not required, courts have looked for adequacy, completeness, and a good faith effort at full disclosure. Joy Road Area Forest Watershed Assn. v. California Dept. of Forestry Fire Protection, 142 Cal. App. 4th at 667. Specifically, CAL FIRE can not rely on the conclusions of the SPI paper with regard to: 1) calculating and quantifying emissions associated with the THP, 2) the impacts of clear-cutting and/or the intensive management approach on greenhouse gas emissions and climate change, 3) the amount of carbon stored in wood products, 4) the estimation of the forest carbon pool, 5) information regarding dead biomass carbon pools and how they are affected by forest management, 6) carbon flows among carbon stores, or 7) greenhouse gas emissions from other sources.

RESPONSE: The Department has grouped together the numerous comments from the letter of concern because all of the concerns in this section deal with the unpublished paper from SPI titled: "Carbon Sequestration in Californian Forests: Two Case Studies in Managed Watersheds" which has been available on the SPI website for some time. According to updates in the THP submitted by SPI in response to public concerns about the paper, the study is currently undergoing peer review and will likely be published in the Society of American Forests monthly journal.

The Department understands its responsibility to not rely solely on the Sierra Pacific white paper. As evidenced by the many research citations in this Official Response and the list of references shown at the end of this Official Response, the Department consulted many sources in addition to the SPI white paper. However, it should be noted that many of the references and studies cited in the comments were done in either boreal forest situations which are quite different in climate and growing conditions from temperate forests; in Australia with evergreen hardwoods that are likely not similar to evergreen conifer forests; in Pacific Northwest old-growth "rain" forests, which have different protection issues from the Sierra forests that are prone to wildfire and insect protection problems; or in tropical situations where the soil holding capacity of rainfall is very different from the relatively deep soils of the Sierra forest districts. The Department finds it refreshing to have a study that was at least done in conditions that duplicate the forest type and harvesting regime of the THPs that are currently under consideration by CAL FIRE.

The Department did not have involvement in the range of alternatives that SPI analyzed. However, based on the Department's review of the SPI research paper, the four alternatives appear to represent a reasonable array of alternatives. It is recognized that there are numerous alternatives that could have been analyzed. Likely a "no management" scenario was not analyzed because the ownership of SPI is largely in TPZ zoning, which legally anticipates that timber production and production of high quality timber products are desirable and that growth rates in California mixed conifer tend to slow when trees approach maturity. Slowing growth rates can adversely impact the rate of sequestration of carbon as from Jandl et al. (2007): "Old-growth forests have the highest C density, whereas younger stands have a larger C sink capacity." Also from Luyssaert et al. (2008): "There is some degree of age-related decline in NPP beyond 80 years of age and temperate and boreal forests both show a consistent pattern of declining NPP beyond an early maximum." While the Department appreciates that a business as usual alternative was not analyzed, the Department did not rely on the SPI analysis alone to respond to the concerns raised in this letter.

The Department concurs with the conclusions reached in the report and quoted above that biomass estimates for the carbon pools in California's forested landscape need refinement and policy decisions need to be made about acceptable mensurational approaches utilized to generate estimates of impacts of any particular forest management action on carbon pools and sequestration rates. The level of confidence in any mensurational approach needs to be robust enough to serve the need. In addition, accounting and modeling outputs have historically and generally been designed to estimate growth of bolewood of individual stems or growth in stands of trees. The Department agrees that the existing models need to be refined if they are to be expected to generate climate related metrics. As an example, from Pussinen et al. (2002): "There are many uncertainties in model based forecasting. Firstly, the climate scenario used might not be correct. For example, the precipitation might decrease during the growing season and decrease growth. Secondly, disturbances in the forest, such as insects, fire, wind damages and fungi might become more common. Thirdly, other tree species than pine might be more tolerant to changing environmental conditions." As Krumland demonstrates in the SPI paper, this can be done. However, as the comment writer reflects in this comment and in previous comments this is a complex process and while much is known about the metrics of some of the carbon pools, agreement on the best approach on how to incorporate these metrics and modeling will be dependent on the scale of the project, accuracy demanded of the outputs, and practicality of data capture. While there are clearly deficiencies, the SPI paper did not ignore the deficiencies. Rather these deficiencies were recognized, disclosed and the decisions on how the author elected to proceed in light of uncertainty, gaps in data, modeling, etc. were documented.

Based on other research (see previous responses) and similar analysis conducted by the Department on the effects of rotation age on sequestration and total carbon, the results and conclusions in the SPI report are not surprising given the scenarios that were analyzed.
The SPI report was designed in part to test the California Climate Action Registry (CCAR) protocols. Because these protocols assume a relative level of stasis related to dead biomass pools, it was appropriate for the SPI report to treat these carbon pools in a manner consistent with the CCAR protocols.

The Department concurs with the comment writer's conclusions regarding increasing dead biomass in older forest carbon pools and the reduction in the production of snags under intensive management. However, the Department also recognizes that decomposition of these dead trees and woody material is also an emission from these older stands that can lower the net sequestration rate for the stand. When leakage to account for replacement of wood products foregone from these stands as well as wildfire is factored into to a life cycle analysis, it is likely that these unmanaged stands may show a net emission at some point in the future. From a policy perspective this may be an appropriate decision based on other resource or societal considerations, but it should not be assumed that from a GHG perspective that a decision to forego management of a forest stand is the best choice from a global warming and greenhouse gas reduction perspective. As has been discussed in previous responses, life cycle analysis shows that forest management will likely be a better choice from a sequestration perspective.

From the perspective of the SPI report, it appears the soil carbon pool was held constant across the scenarios primarily to reflect how this particular pool is dealt with in the CCAR protocols.

The Department recognizes that the research does recognize that there is a loss of soil carbon attributable to forest management that persists 10 to 20 years before soil carbon returns to pre-harvest levels. It is also recognized that managed stands will likely never have the same carbon storage level as old growth or unmanaged stands. From Birdsey & Heath (1995), "After the initial 20% loss of soil carbon after harvest, it was assumed that soil carbon would return to pre-harvest levels by age 50 in the South and 55 elsewhere." and "A search of the literature indicated that a major forest disturbance, such as a clearcut harvest, can increase coarse litter and oxidation of soil organic matter. The balance of these two processes can result in a net loss of 20% of the initial carbon over a 10-15 year period following harvest, although a recent review suggested that the net effect may be less or even positive in many cases." Also from Heath & Smith (2000): "Much of the Carbon stored in soil is stable and does not change in response to land management such as logging." However, in evaluating the overall sequestration footprint of any particular management regime, it is necessary to analyze the impact across all carbon pools, evaluate sequestration rates for each carbon pool and factor in emissions associated with natural and anthropogenic emissions. Looking at solely the soil carbon pool is too narrow a perspective against which to evaluate the benefits or consequences of any particular management choice.

The approaches utilized in the SPI report are consistent with approaches used in other Life Cycle Analysis. Wood products in use and stored in landfills have been shown to have sequestration benefits. From Skog & Nicholson (2000); "If, when taken out of use, products are disposed of in a modern landfill, the literature indicates that they will stay there indefinitely with almost no decay. What may be more important for carbon sequestration or emissions is how much wastewood from discarded wood products or demolition is burned or how much is recycled." Also, from the EPA (2008) report "Inventory of US Greenhouse gas emissions and sinks: 1990-2006: "The net change in forest C is not equivalent to the net flux between forests and the atmosphere because timber harvests do not cause an immediate flux of C to the atmosphere. Instead, harvesting transfers C to a "product pool." Once in a product pool, the C is emitted over time as CO_2 when the wood products combusts or decays. The rate of emission varies considerably among different product pools. For example, if timber is harvested to produce energy, combustion releases C immediately. Although if such combustion replaces fossil fuel burning there may be significant atmospheric carbon benefit. Conversely, if timber is harvested and used as lumber in a house, it may be many decades or even centuries before the lumber decays and C is released to the atmosphere. If wood products are disposed of in SWDS, the C contained in the wood may be released many years or decades later, or may be stored almost permanently in the SWDS." (Where SWDS equals Solid Waste Disposal Sites.) The Department did review the SPI report and is familiar with the assumptions utilized by the author relative to treatment of various carbon pools and the modeling that was utilized to generate output and support conclusion reached by the author. However, since the Department did not solely rely on this report to analyze the impacts of their management regime on climate and sequestration, an exhaustive analysis of the underlying data and outputs was not undertaken. Nor was such an evaluation deemed to be necessary given the Department's conclusion that the SPI results were generally consistent with other published findings.

The SPI analysis was not intended to measure all carbon flow transfers from one carbon pool to another. It did intend to point out the importance of wood products in overall carbon sequestration accounting and did look at utilization, substitution of wood products, etc., as part of the comparison, although no direct estimate of substitution benefits was included. The fact that the paper does not consider all components of an ecosystem does not necessarily invalidate the conclusions of the paper as they relate to the hypotheses tested. However, it is not likely given other life cycle analyses that have been conducted (see also the Response to Concern #1 and #2) that the relative ranking of the various scenarios evaluated by SPI would change. It is recognized, however, that other scenarios are possible. However, the analysis is informative to the extent that it attempts to evaluate sequestration for California species. Furthermore, the results are consistent with what would be expected given the stands that were evaluated, harvesting regimes applied under each alternative, and primary stand productivity given the stocking. The results are also generally consistent with other studies and life cycle analyses.

The Department has not solely relied on the SPI report to evaluate the impacts of SPI's management regime as expressed in their Option "a". The Department has reviewed other research and literature and concluded that the proposed management regime will not have a significant adverse impact associated with diminished carbon sequestration potential. The SPI Option "a" proposes to build inventory and increase growth. The stands proposed for management are predominantly second growth stands that have had multiple silvicultural entries over the course of time. Based on the proposed 80 year rotation age to be implemented under the Option "a" and a review of the literature relative to sequestration and life cycle analysis, adverse climate impacts from the silvicultural regimes being applied under a series of THPs designed to implement the Option "a' are not anticipated (see also the Response to Concern #1 and #2).

In summary, the Department has not relied wholly on the conclusions of the SPI report. It was one of numerous sources including the Department's own analysis that led the Department to the conclusion that the SPI management regime will not have an adverse impact on climate and that to the extent that inventory and growth rates will increase between now and 2020 as well as into 2050, the proposed management regime is consistent with the objectives and will support the assurances for the Forest Sector reflected in the AB 32 Scoping Plan (see also the Response to Concern #1 and #2).

4. Concern: **It was stated that: the removal of a tree in the name of logging results in a direct release of carbon because the tree no longer removes carbon from the atmosphere and the removal of the tree results in a loss for future potential storage capacity from that tree. In addition to the loss of carbon from the logging of live biomass, there is also loss of carbon from removal of dead biomass as well as from the impacts to the soil- all of these impacts must be quantified in order to do an accurate assessment of the carbon implications of the timber harvest.**

In addition to these direct contributions to carbon emissions as an outcome of tree loss and soil impacts, the process of cutting down

trees, transporting them, making them into wood products, etc. likewise has significant contributions to carbon emissions and these too must be quantified in order to make an accurate assessment of the THP's carbon implications. Therefore, in any project, emissions that need to be accounted for include not only green carbon from killing living biomass and accelerating the rate of decomposition of dead biomass, but also grey carbon from burning fossil fuels for energy to do work (Mackey et al. 2008). As stated by Mackey et al. (2008)
When considering the carbon accounts associated with industrialized forests, it is necessary to include carbon emissions resulting from: a) forest management (for example, the construction and maintenance of roads, post-logging regeneration burns); b) harvesting (including use of machinery); c) transportation of logs, pulpwood and woodchips; and d) manufacturing.
A full evaluation of associated emissions, costs and energy is especially important for this project because in contrast with natural forests, industrialized forests contain a very small number of species and are not self-sustaining systems. They contain copies of genetic information that require a succession of energy inputs during their lifetime, from seedling propagation to harvest. Most of these energy inputs are sourced from fossil fuels and include site preparation (removal of existing vegetation), seed collection, growth trials to test the potential survival of species, seedling nursery inputs to grow seedlings for planting, planting of seedling trees, application of herbicides to suppress competition from weed species, measures to prevent animal species (vertebrates and invertebrates) from browsing on the seedlings, fertilizer application and continuing maintenance to suppress plant and animal pest species and fire (Mackey et al. 2008). As plantations are not self-sustaining systems, when the trees are harvested or die, energy inputs (again, sourced mostly from fossil fuels) are required to establish a new crop of trees. All of these fossil-fuel inputs, including those required for the manufacture of consumables such as fertilizer and pesticides, need to be taken into account, along with the biological processes, when assessing the carbon sequestration potential of tree plantations (and other agricultural crops). As plantations are eventually harvested, the fossil-fuel inputs, such as those required for road-making and upgrading, transport of the saw-logs for processing, the energy needs (and carbon dioxide emissions) for processing of timber or woodchips, and other industrial processes, should also be deducted from the gross pre-harvest carbon stock.

For the Whitmore Grade THP, there has been no effort to calculate, model, or estimate the amount of $C0_2$ and other GHG emissions from the project, including the emissions associated with [logging trucks, logging equipment, energy consumption, or the many other operations associated with logging.]OPR Technical Advisory (2008). Until that occurs, the THP cannot even begin to come into compliance with CEQA and FPA obligations. In addition, calculating and quantifying the emissions from a THP is not too speculative - in the analogous context of the National Environmental Policy Act (NEPA), the Ninth Circuit has already rejected the argument that global warming is too speculative to warrant NEPA analysis. Center for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1221 (9th Cir. 2008). Furthermore, the fact that a single methodology does not exist ... requires the [respondent] to do the necessary work to educate itself about the different methodologies that are available- it is incumbent on the THP to disclose all it can about its impacts and educate about methodologies that are available to inventory the emissions from the THP. Berkeley Keep Jets Over the Bay Comm. v. Board of Port Comm'rs (Berkeley Jets), 91 Cal. App. 4th 1344, 137(Cal. App. 1st Dist. 2001). In its recent white paper, CEQA Climate Change, Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (Jan. 2008), the California Air Pollution Control Officers Association (CAPCOA) has set forth methodologies for analyzing greenhouse gas pollution (CAPCOA 2008). The CAPCOA information should be helpful for addressing grey carbon - e.g., emissions from a) logging machinery, b) the transportation of logs and any other byproducts, c) the manufacturing of wood products, pesticides, and fertilizers, and d) the construction and maintenance of roads. Moreover, the OPR paper on CEQA And Climate Change discusses various models such as the EMF AC model (page 17), which can be used to calculate emission rates from all motor vehicles in California. The emission factors are combined with data on vehicle activity (miles traveled and average speeds) to assess emission impacts.

For green carbon quantification, the following studies, among others, provide useful guidance for addressing forest carbon pools (aboveground living biomass, belowground living biomass, dead biomass, and soils (mineral and organic horizons)}

Hamburg, S.P. 2000. Simple Rules For Measuring Changes In Ecosystem Carbon In Forestry-Offset Projects. Mitigation and Adaptation Strategies for Global Change 5:25-37

This paper lays out some general rules for measuring changes in ecosystem carbon:

1. Changes in carbon stocks of four compartments must be addressed aboveground living biomass, belowground living biomass, soil, and necromass.
2. Aboveground living biomass should be measured directly in all projects through the use of stand level inventories and either volume based yield tables and associated conversion factors, or allometric equations.
3. Belowground living biomass can be estimated through the use of root/shoot ratios or allometric equations, but conservative ratios need to be employed based on the specificity of data available.

4. Changes in soil carbon need to be measured in all projects except those where it is clear from the scientific literature that soil carbon is increasing or constant.
5. Soil needs to be measured to a depth of at least 1 m and organic and mineral soil horizons need to both be considered.
6. Soil samples need to be collected on a quantitative basis (bulk density and C concentration from the same samples) so that error estimates associated with the change in pool size can be calculated.
7. Changes in the necromass pool should be measured if there is evidence of a recent (what is recent varies with ecosystem type and decay rates, but in most systems would not exceed 10 years) disturbance (natural or anthropogenic).
8. If, following a disturbance, the decline in the aboveground living biomass is assumed to have been totally converted to carbon dioxide (thus requiring it be considered a negative stock change), then the necromass pool need not be measured.

Harmon, Mark E and B. Marks. 2002. Effects of silvicultural treatments on carbon stores in Douglas-fir - western hemlock forests in the Pacific Northwest, U.S.A.results from a simulation model. Canadian Journal of Forest Research 328633877.

This paper discusses STANDCARB, which is a model that can be used to determine long term outcomes from various forestry management regimes and practices. The object of STANDCARB is to simulate the accumulation of C over succession in mixed-species, mixed-aged forest stands.

In this article the model is parameterized for stands in the Pacific Northwest (but it can be parameterized for other ecosystems) and can be used to investigate the stand-level effects of various regeneration strategies, clear-cutting, effects of thinning, patch cutting, tree species replacement by design or by natural succession, slash burning, and wildfires. The model consists of 11 modules that allow for a simulation of certain parts, function and activities in the ecosystem, soil texture, climate, plant, dieout, neighbour, growth, mortality, decompose, harvest, burnkill, and site prep.

The model must be calibrated based on the ecosystem being simulated (in the instance of this study - the Pacific Northwest) and then the simulations are actually run. Harmon and Marks (2002) ran five simulations of eight forest management scenarios to test the effects of initial conditions, tree establishment rates, rotation length, tree utilization level, and slash burning on ecosystem and forest products C stores. There are eight different treatments that were simulated; agricultural row crop, old growth to plantation, agriculture to plantation, agriculture to old growth, low-severity burn, low-severity burn to protection, moderate-severity burn, moderate severity burn to protection. And in each treatment the results were examined relative to the increase or decrease of carbon stores. The predictions that are put forward all hinge on the calibration of the software and the inclusion of forest products. Calibration was done by using existing field data from reputable sources. Forest products were included to comply with the law of conservation of mass.

As in many C models, STANDCARB does not include the effects of nutrient cycling. It operates under the assumption that nutrient stores will not be influenced by the treatments enough to lead to major changes in site productivity. STANDCARB provides output on 10 live state variables, nine dead state variables, and three state variables related to the volume harvested. The state variables are saved as means and standard errors of the mean for each year.

STANDCARB is programmed in C++ and uses difference equations on an annual time step for all variables, except those used to estimate the effects of climate on tree establishment, growth, and decomposition. These climate-related variables are calculated on a monthly time step.

Spatially, STANDCARB is designed to simulate the dynamics of a number of cells within a stand. Each cell represents the area occupied by a single, mature tree (in these particular simulations an area of approximately 0.04 ha), although depending on age a cell can represent either a cohort of trees or a single tree. Within a cell, spatial arrangement of trees is not considered. This approach allows the model to have flexibility in terms of species mixtures and (or) tree ages, and allows the user to estimate the degree of spatial variation among cells within a simulation.

STANDCARB uses a number of levels of organization to estimate changes in C stores within a stand (see Fig. 1 on page 865 of Harmon and Marks 2002). A stand is composed of a number of cells, each which contains up to four layers of vegetation, six detritus pools, and a stable soil C pool. The four layers of vegetation that can occur in each cell are upper trees, lower trees, shrubs, and herbs. The two tree layers can have different species, whereas the shrub and herb layers are viewed as single species. Each cell can have any combination of layers except that lower trees can only occur when upper trees are present. Each of the layers can potentially have six live parts(i) foliage, (ii) fine roots, (iii) branches, (iv) sapwood, (v) heartwood, and (vi) coarse roots. In addition to these parts, bole, aboveground, belowground, and total live mass are derived from combinations of these parts. Each of the live parts of each layer contributes material to a corresponding detritus or dead pool. Thus, foliage adds material to the dead foliage, fine roots to dead fine, etc. Finally, all the detritus pools in a cell can potentially add material to a stable soil pool.

Harmon, Mark E., Ken Bible, Michael G. Ryan, David C. Shaw, H. Chen, Jeffrey Klopatek, and Xia Li. 2004. Production, Respiration, and Overall Carbon Balance in an Old-growth Pseudotsuga-Tsuga Forest Ecosystem. Ecosystems 7:498-512.

This paper provides useful guidance on the specifics of measuring the following forest components. The indented language is directly from the study itself and explains how each topic was measured/addressed

All trees larger than 5-cm DBH (diameter at breast height) were measured for diameter and height. Biomass of all live tree parts and volume for the bole were calculated using allometric equations (Gholz and others 1979; Means and others 1994). Species specific allometric equations were used when available, and substitutions for some minor species were used. Coarse-root allometric equations were used for roots larger than 5 mm in diameter. The mass of roots 2-5 mm in diameter from fine-root cores was added to the allometric equation estimates to calculate the total mass of coarse roots. Leaf mass was estimated using a sapwood area-based estimate using DBH-sapwood thickness and leaf area relationships developed for the H. 1. Andrews Experimental Forest in the central Cascades of Oregon (Gholz and others 1976; Waring and others 1982; Means and others 1999). Sapwood volume was estimated from equations developed by Harcombe and colleagues (1990) that predict the proportion of the total bole in sapwood from DBH.

20 soil cores of 5-cm diameter to a depth of 1 m were removed to estimate biomass of fine roots less than 2 mm in diameter. In each 1-ha quadrant of the crane plot, five cores were sampled at random distances along transects placed diagonally across the quadrant. Organic horizons were sorted by hand to remove live and dead fine roots. Mineral soil was subdivided into 20-cm depths and then washed using a root elutor to separate roots. Roots were sorted into size classes and live versus dead, oven dried at 55_ C, and weighed. Subsamples of root material were placed in an oven at 550_ C for 4h to determine ash-free dry weights. Means and standard errors were calculated using all 20 samples as a basis.

The aboveground biomass of understory shrubs and trees larger than 5-cm DBH was estimated by recording their diameter at the base within a 25 * 1-m belt transect at each location. The biomass of understory plants was calculated using allometric equations (Means and others 1994). In cases where equations for a species (particularly herbaceous ones) did not exist, equations from similar species were used.

Downed coarse woody detritus (larger than 1cm in diameter at the large end) was measured using the line-intercept method (Harmon and Sexton 1996). All standing dead trees larger than 10-cm DBH and more than 1 m tall (snags) were inventoried on the entire 12-ha set of plots by measuring the basal and top diameters and height as well as assigning them to decay classes. Volume was determined for each species and decay class of logs and snags, and these were converted to mass by multiplying by species and decay class specific density values (Harmon and Sexton 1996).

The mass of downed fine wood (less than 10 cm in diameter) was measured by harvesting all the wood in one hundred 1 * 1-m quadrats. Dead coarse roots were estimated assuming they equaled 18%-26% of snag and log mass. This range was calculated by assuming that belowground woody tissues were the equivalent of 15%-20% of the aboveground woody

biomass and then simulating the decomposition of the boles and roots at rates indicated by the field data for a 100-year period. The ratio for dead trees was then computed as the ratio of dead coarse roots and dead boles for this entire period. Suspended fine woody debris on snags was estimated using a similar set of calculations. In this case, dead attached branches were estimated to equal 100/0-13% of the snag mass. As branches fall off of snags, we assumed that they were only attached to decay class 1 and 2 snags. The decomposition of fine woody debris on the forest floor was measured by placing fresh branches of Douglas-fir and western hemlock on the forest floor and retrieving four branches of each species after 1, 2, and 3 years.
The store of C in the forest floor that is, excluding highly decomposed, buried coarse woody debris (CWD), but including partially and highly decomposed leaves, cones, and wood less than 1 cm in diameter was determined by two methods. The first used a 5-cm diameter, stainless steel corer that was driven into the soil. The core was then extracted, and decomposed wood was separated from the other material. The second method sampled forest floor at the locations of the 10 soil pits by using five similar-sized cores.
The estimates of C stores in mineral soil are from Remillard (1999). Soil texture, the faction of particles larger than 2 mm in diameter, bulk density, and C content were determined in 1soil pits that were at least 1 m deep. The latter three variables were determined for three depths(a) 0- 20 cm, (b) 20-40 cm, and (c) 40-100 cm. The fraction of particles larger than 2 mm in diameter was estimated for each sample depth. Soil C was calculated based on the C content of all fractions, the bulk density, fraction of coarse particles, and depth.

The information above demonstrates that measuring forest carbon emissions can be, and has been, done. Therefore, there is no reason that an inventory of the Whitmore Grade THP's carbon emissions can not be done. Without a complete inventory, the THP cannot adequately inform the public and decision-makers about its impacts. Similarly, without identifying, calculating and quantifying all the greenhouse gas emissions that will result from the project, there is simply no way that the THP can then adequately discuss alternatives, avoidance, and mitigation measures to reduce those impacts. See Joy Road Area Forest Watershed Assn. v. California Dept. of Forestry Fire Protection, 142 Cal. App. 4th at 667.

RESPONSE: The Department concurs that any life cycle analysis needs to account for the anthropogenic and natural emissions associated with any particular management strategy as well as the management related potential for enhancement of stand productivity. The work done to date by Dr. Elaine Oneil does factor in some of these anthropogenic sources as well as sequestration and growth in various carbon pools.

The Department recognizes that STANDCARB is a recognized model for estimating changes in carbon pools. The Department did not conclude, however, that utilization of this model to determine the potential impacts of implementation of the Whitmore Grade THP on global climate was necessary. The commenter in the concern above describes a technique from Harmon et al. (2004) for measuring carbon stores in an old-growth Douglas-fir/true fir stand in the Pacific Northwest. This technique involved measuring all trees larger than 5-cm dbh, taking 20 soil cores to a depth of 3', measuring understory plants and coarse and fine woody debris. The researchers used a stainless steel corer driven into the soil and soil pits to determine the store of partially and highly decomposed leaves, cones, and wood. Also soil was separated into areas of different soil particle sizes. While the comment above suggests that this method could be used on THPs to determine the carbon content of an area to be logged, the reality is that all the work done by researchers was done on an area that was only about ten acres in size. There is no suggestion in the report that this ten acre area was being selected to represent a larger sized area or that it was some sort of statistically valid sample to represent a larger area. Apparently, the ten acre area was selected only in order to compare the findings of carbon stores with the location of a canopy crane that was in the center of the plot and which was used for measuring carbon by the "eddy-flux" method. This leads to the question of whether such an intensive sampling method would be practical given a THP size of 300 acres to 2000 acres or larger. How many ten-acre areas would have to be intensively sampled within these larger THP sizes in order to achieve statistical validity? How much time and expense would be involved? Would it be necessary for small private timberland owners to pay for the expense on their properties? These kinds of decisions would have to be made into regulatory language by the BOF following public hearings where the merits and expenses of such a system would be discussed. At this point, there is no regulatory language in the Forest Practice Rules of the BOF that would require such a sampling scheme for measuring stand carbon. Interestingly enough, however, is that the ten-acre plot measuring yielded the finding that the old-growth stand "might be a small sink. These estimates contrast with the larger sink estimated at the same site using eddy-flux methods (Harmon et al., 2004)." Some of the reason for the discrepancy in various estimates that are typically used to measure C might be due to the amount of heartwood rot that is said to be present in an old-growth stand. The study found that: "We used literature values from forests in the region to set an upper limit (25%) of stem wood volume being attacked by heart rot (Harmon et al., 2004).", and: "For example, they noted that heart rot was present in the stand but did not include these respiration losses. As little as 10% of heart rot in stems of their forest could completely offset the gains in stem stores they estimated. These values of heart rot are within the range typical for old-growth Psuedotsuga forests." Apparently, from this study that included the impact of heart rot on the loss of C to the atmosphere, the old-growth forest may not be the sink that some other studies, where heart rot was ignored, have found. This is especially true given the earlier estimate in the paragraph above that heart rot in an old-growth forest could reach the upper limit of 25% of stem wood volume.

While the THP applicant did not use STANDCARB or another intensive sampling method to estimate the C impact of the plan, there was information added to the Whitmore Grade THP that estimates carbon stores in response to the request in the letter of concern. The raw details of this table appear here, but are better displayed in the THP on pages 111 et seq.:

Mechanized logging side for merchantable logs*****

OBT = 8.75 gallons of diesel/mbf to log and put on board truck (OBT)

Haul = 8.75 gallons of diesel/mbf to haul to a mill

2 trip per day (SPI average haul is more than 2 trips per day)

Chipping of tops and sub-merchantable material*****

OBV = 1.43 gallons of diesel/green ton to gather, chip and place on board a chip van (OBV)

Haul = 1.53 gallons of diesel/green ton to haul to a biomass plant or a mill with cogen

2 trip per day (SPI average biomass delivery is more than 2 trips per day)

Using the World Resources Institute Mobile Emissions Worksheet*****

Summary of CO_2 Emissions (in metric tonnes CO_2)*****

Logs/MBF

OBT = 8.75 ga. Diesel, fuel per unit is 0.140424, Emissions = 0.0909

Haul = 8.75 ga. Diesel, fuel per unit is 0.140424, Emissions = 0.0909

Chips/Green Ton

OBV = 1.43 ga. Diesel, fuel per unit is 0.140424, Emissions = 0.0149

Haul = 1.53 ga. Diesel, fuel per unit is 0.140424, Emissions = 0.0149

Biomass*****

Rule of thumb is 1 BDT of biomass roughly produces 1 MWH of electricity and 1 MWH of electricity produced by burning natural gas (fossil fuel) produces 1 metric ton of CO_2 therefore 1 BDT of biomass offsets 1 metric ton of CO_2 from fossil fuel. (TSS 2006 - consultants for Placer County Air Quality Control Board)

1 green US ton of chips / hog fuel

0.5 US ton dry weight (BDT)

2 green tons biomass equals 1 BDT and = 1 Metric ton CO_2 equivalent

0.06153 Metric tons of CO_2 to produce 2 green tons biomass (0.0308*2)

16.25 ratio of CO_2 equivalent produced per metric ton of CO_2 emitted in gathering, chipping and hauling.

SPI 2008 Scaled & Weighed Loads

13,632 Loads

59,670.6 MBF

366,507.11 Green Tons

Logs*****

6.14217 Ave. Green tons per MBF based upon the 13,632 weighed and scaled loads in 2008.

3.07109 Ave Dry tons per MBF (using a 50% average for moisture content)

2.07298 Ave Dry tons that after milling remains in softwood lumber (67.5%) based on mill efficiency for the US Southwest from 1605b table 1.4 (67.5%) (SPI efficiency is higher)

(Note: this 32.5% is not emitted but goes into both hog fuel and paper chips) Again a conservative estimate of our benefits.

0.97430 Ave Dry tons in softwood lumber after 100 years in use. Again at least 25% is permanently stored in landfills not emitted. based upon average in use lumber from the 1605b table 1.8 (47% is the average 100 year end use estimate)

0.48715 Ave Dry tons of Carbon in softwood lumber based upon the percent Carbon in wood being 50%

0.43498 converted Ave Dry tons above from English tons to metric tons. (Internationally CO_2 is always discussed in metric tons)

1.59492 converted tonnes of Carbon to tonnes of CO_2 equivalents per MBF in log form. (0.1819 metric tons emitted per MBF)

8.77 ratio of long term stored CO_2 in softwood lumber in end uses to the CO_2 emitted in logging and hauling

The conclusion is that, using the worst case scenario for net GHG emissions at the scale of each thousand board feet harvested, logging sequesters 8.77 tons of CO_2 in permanent off-site stored solid wood products for each ton of CO_2 emitted. Using a biomass cogeneration plant scenario, the situation would net 16.25 tons of CO_2 benefits from each ton of CO_2 emitted in the collection process. The Department notes that in the biomass estimate, the rule of thumb was using coal fired power plants, not the more likely California based example of lower CO_2 producing natural gas per MWH and this 16.25 multiplier would be reduced to approximately 8 fold.

5. Concern: It was stated that in order to comply with CEQA, CAL FIRE "must determine whether any of the possible significant environmental impacts of the project will, in fact, be significant." Protect the Historic Amador Waterways v. Amador Water Agency, 116 Cal. App. 4th

1099, 1109 (Cal. App. 3d Dist. 2004). Moreover, CEQA requires CAL FIRE to determine the significance of the THP's emissions with or without established significance thresholds -lack of established significance thresholds does not excuse CAL FIRE from its obligation under CEQA to determine the significance of a THP's impacts. As noted in the CAPCOA white paper on CEQA and Climate Change, "[t]he absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA." CAPCOA 2008 at 23. See also OPR Technical Advisory document, p. 4 ("Even in the absence of clearly defined thresholds [of significance] for GHG emissions, the law requires that such emissions from CEQA projects must be disclosed and mitigated to the extent feasible whenever the lead agency determines that the project contributes to a significant, cumulative climate change impact.")

Any determination of whether there is a fair argument that the THP may have a significant impact must also include the consideration of the California Global Warming Solutions Act of 2006 (AB 32), wherein the State of California recognized that "global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California" and required that existing levels of greenhouse gases be reduced to 1990 levels by 2020. Health & Safety Code §§ 38501(a), 38550. As recently pointed out in the OPR Technical Advisory document, p. 3, "AB 32 ... acknowledge[s] that [GHG] emissions cause significant adverse impacts to human health and the environment." Moreover, SB 97 "amends the CEQA statute to clearly establish that GHG emissions and the effects of GHG emissions are appropriate subjects for CEQA analysis." OPR Technical Advisory document, p. 3.

Because AB 32 establishes that existing greenhouse gas levels are unacceptable and must be substantially reduced within a fixed timeframe, any additional emissions that contribute to existing levels frustrate California's ability to meet its ambitious and critical emissions reduction mandate. Even ignoring emissions from smaller sources would be neglecting a major portion of the greenhouse gas inventory. In accordance with the scientific and factual data, and in order to account for the fact that any additional emissions are problematic, CAL FIRE should adopt a zero significance threshold for any Project's greenhouse gas emissions. The THP's contribution to emissions is especially serious when considered from a cumulative perspective. An impact is considered cumulatively significant where its "effects are individually limited but cumulatively considerable." See Friends of the Old Trees v. Dep't of Forestry & Fire Prot., 52 Cal. App. 4th 1383, 1394 (Cal. App. 1st Dist. 1997) ("[T]he Forest Practice Act and the Forestry Rules establish a statutory and regulatory framework that, construed together with CEQA, confers on the Department the obligation to see that cumulative impacts and alternatives to the project, as well as other specified environmental information, be taken into consideration in evaluating THP's."). As explained in Joy Road Area Forest & Watershed Assn. v. California Dept. of Forestry & Fire Protection, 142 Cal. App. 4th at 667:

[T]he substantive CEQA requirement of assessing cumulative environmental impact must be included in the evaluation of each THP by CDF. '[C]umulative damage [is] as a whole greater than the sum of its parts. . . . Furthermore, the cumulative impact analysis must be substantively meaningful. A cumulative impact analysis which understates information concerning the severity and significance of cumulative impacts impedes meaningful public discussion and skews the decision maker's perspective concerning the environmental consequences of the project, the necessity for mitigation measures, and the appropriateness of project approval. While technical perfection in a cumulative impact analysis is not required, courts have looked for adequacy, completeness, and a good faith effort at full disclosure.

Climate change is the classic example of a cumulative effects problem; emissions from numerous sources combine to create the most pressing environmental and societal problem of our time. Center for Biological Diversity v. NHTSA, 538 F.3d at 1218 ("the impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct."). While a particular project's greenhouse gas emissions represent a fraction of California's total emissions, courts have flatly rejected the notion that the incremental impact of a project is not cumulatively considerable because it is so small that it would make only a deminimis contribution to the problem as a whole. Communities for a Better Environment v. California Resources Agency, 103 Cal. App. 4th 98, 117 (Cal. App. 3d Dist. 2002); see also Kings County Farm Bureau v. City of Hanford, 221 Cal. App. 3d 692, 720 (Cal. App. 5th Dist. 1990) ("perhaps the best example of [a cumulative impact] is air pollution, where thousands of relatively small sources of pollution cause a serious environmental health problem"). As noted by former D.C. Circuit Judge Wald in a 1990 dissenting opinion, recently quoted with unanimous approval by the Ninth Circuit in Center for Biological Diversity v. NHTSA.: [W]e cannot afford to ignore even modest contributions to global warming. If global warming is the result of the cumulative contributions of myriad sources, any one modest in itself, is there not a danger of losing the forest by closing our eyes to the felling of the individual trees?

538 F.3d at 1217. Moreover, as stated in CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act Review, from the Governor's Office of Planning and Research: When

assessing whether a Project's effects on climate change are cumulatively considerable, even though its GHG contribution may be individually limited, the lead agency must consider the impact of the project when viewed in connection with the effects of past, current, and probable future projects. . .. Lead agencies should not dismiss a proposed project's direct and/or indirect climate change impacts without careful consideration, supported by substantial evidence. Documentation of available information and analysis should be provided for any project that may significantly contribute new GHG emissions, either individually or cumulatively, directly or indirectly (e.g., transportation impacts). Accordingly, because the THP's "felling of the .. , trees" will contribute to greenhouse gas emissions, CAL FIRE must unequivocally consider the THP's emissions to be a cumulatively significant impact. In sum, the contribution of THPs to carbon emissions is a serious and significant problem, and therefore it is important that THPs perform a thorough analysis of their cumulative contribution to carbon emissions and that CAL FIRE adequately address the issue. Many THPs are currently under consideration for approval, many THPs have recently been approved, and there are numerous past and future THPs - all of these must be considered together, and along with the effects of past, current, and probable future projects that are also contributing to global warming, in order to properly account for their cumulative impact to greenhouse gas emissions. Until that occurs, no THP will be in compliance with CEQA.

RESPONSE: The Department recognizes its responsibility under the Forest Practice Act (FPA) and CEQA to determine whether direct or cumulative environmental impacts will be significant and adverse. In the case of the management regime which is part of the Whitmore Grade THP, significant adverse impacts associated with the proposed application over the 100-year sustained-yield planning horizon are not anticipated. This conclusion is based on the information provided in the Option "a" that demonstrates increasing inventory and growth and research and modeling results reviewed by the Department. The Department has concluded that the impacts from implementation of this management regime will have a net benefit from a climate perspective. Recognizing that thresholds have not been established is not germane given that adverse impacts have not been identified.

With respect to SPI's Option "a", CAL FIRE has independently analyzed and reviewed the literature associated with climate change, analyzed and reviewed the information contained in the THP, and other pertinent information and has determined that the THP and the SPI Option "a" is in conformance with the rules of the BOF. Actual field measurements are made to obtain growth and yield information relative to the demonstration of MSP in the Option "a" plan associated with the current THP 4-08-24/AMA-1. The rules of the BOF found in 14 CCR 953.11(a) that pertain to a demonstration of MSP provide that the goal of MSP is to be demonstrated through: " (1) Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment; and, (2) Balancing growth and harvest over time, as explained in the THP for an ownership..." As the rules also state: "The projected inventory resulting from harvest over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon." As stated above and in the Response to Concern #1 and #2, the combination of projects on SPI ownerships will have a beneficial impact on climate based on execution of the management regime described in SPI's Option "a".

The Department recognizes that growth on California's forested landscapes remain below the potential productivity (FRAP 2003). Forest management through aggressive reforestation, enhancement of conifer site occupancy, genetic improvement, thinning, etc. can and will improve productivity on managed lands while balancing other resource values and providing positive benefit from a climate perspective. This positive benefit will come from increased inventory (i.e., carbon stock), increased growth (i.e., sequestration) and sequestration, storage in wood products and landfills, as well as substitution benefits attributable to forest management life cycle analyses. The Department also reviewed LTSY projections for the 2020 and 2050 periods for all larger landowners and it indicated that inventories are expected to increase. Given the LTSY projections for the larger landowners, the trend indicated in the FIA data relative to increases in growing stock volume and growth through 2050 is likely to continue.

As discussed in the Response to Concern #1 in this Official Response, the Department has cumulatively reviewed LTSY projections for the 2020 and 2050 periods for various landowners. The Option "a" documents which were evaluated cover approximately 3.2 million acres and show that inventory harvest is less than growth through 2020 and 2050 and that as a result inventory (carbon storage) and growth (sequestration) will improve significantly over current levels.

To determine direct and cumulative benefits of carbon storage in the forestlands of the State, the Department has worked with the Air Resources Control Board (ARB) to assist with development of the 1990 baseline for the Forest Sector and assisted ARB with workshops and liaison with the Board of Forestry and Fire Protection as part of the AB32 Scoping Plan development. The Scoping Plan was adopted in December of 2008 and establishes a year 2020 target for the Forest Sector of 5 million metric tons of carbon sequestration. Achievement of this target will require that the Sector maintain present estimated levels of net sequestration. Essentially this represents a no net loss strategy for the Forest Sector as a whole. Management regimes which maintain or increase inventory and growth will contribute to this objective. As we have discussed in previous responses, the Department has concluded that the estimates of inventory increase and growth for SPI's timberland are reasonable and that net sequestration over time will increase in support of the AB 32 targets. Adoption of a zero significance threshold in this case is not necessary given that the management regime will result in a net benefit from a climate standpoint.

The scoping plan adopted by the California Air Resources Board (CARB) included targets and goals for the management of private timberlands which are under the existing authority of the BOF and made recommendations for public timberlands in California as well. These measures include the maintenance of the current level of carbon sequestration through sustainable management practices including reducing the risk of catastrophic wildfire and avoiding land-use changes that reduce carbon storage. In addition to the negative impacts from the risk of wildfire and land-use change, the ruling pointed out the risk of insect attack on timberlands. The ruling also pointed out that; "The Board of Forestry and Fire Protection, working with the Natural Resources Agency, the Department of Forestry and Fire Protection and ARB would be tasked with developing a monitoring program, improving greenhouse gas inventories, and determining what actions are needed to meet the 2020 target for the Forest sector." This ruling was only adopted in October 2008, and as yet, the Board has not promulgated regulations affecting forest practices in this area. In the interim, however, CAL FIRE has examined the record of the history of logging in California to examine the changes that have occurred over time in order to determine if it is likely that the level of carbon sequestration in the forest sector can be maintained pursuant to the scoping plan target. For timber harvesting alone, the Board of Equalization, Timber Tax Division, keeps records of the volume of timber harvested in the state because they collect taxes on these amounts to be distributed to various counties. From the BOE; "The average annual volume of 1.96 million MBF in the period 1995-2005 was 53% of the 3.73 million MBF in the 1985-1994 annual average. Since the high in 1988, total volume declined an average of 2.18% per year from 4,688 MMBF to 1,730 MMBF in 2005. Much of this fall off is due to reduced harvest on public lands, which is readily seen below in the statistics from the Board of Equalization.

VOLUME FIGURES – ALL TIMBER

	TOTAL MMBF	GOV VOLUME	GVT PCT	PRIVATE VOLUME
Year				
1978	4,491	1,725	38.4%	2,766
1979	3,991	1,723	43.2%	2,268
1980	3,164	1,228	38.8%	1,936
1981	2,672	950	35.6%	1,722
1982	2,318	818	35.3%	1,500
1983	3,358	1,468	43.7%	1,890
1984	3,456	3,546	40.8%	2,100
1985	3,818	1,613	42.2%	2,205
1986	4,265	1,869	43.8%	2,396
1987	4,500	1,860	41.3%	2,640
1988	4,670	2.048	43.9%	2,622
1989	4,424	1,791	40.5%	2,633
1990	4,021	1,326	33.0%	2,695
1991	3,195	1,142	35,7%	2,053
1992	2,973	841	2,83%	2,132
1993	2,871	608	21.2%	2,263
1994	2,316	344	14.9%	1,972
1995	2,306	375	16.3%	1,931
1996	2,273	288	12.7%	1,985
1997	2,400	357	14.9%	2.043
1998	2,091	254	12.1%	1,837
1999	2,144	241	11.2%	1,903
2000	1,966	265	13.5%	1,701
2001	1,603	128	8.9%	1,475
2002	1,690	169	10.0%	1,521
2003	1,663	155	9.2%	1,508
2004	1,706	113	6.6%	1,593
2005	1,725	230	13.3%	1,495
2006	1,631	200	12.3%	1,431
2007	1,626	187	11.5%	1.440

TOTAL	85,417	25,762		59,656
AVG.	2,847	859	25.7%	1,989

(http://frap.cdf.ca.gov/projects/BOE/BOETimberTax.html).

At this time, given the state of the economy and the reduction in demand for lumber with the collapse of home building as one of the main outlets for forest products, CAL FIRE would predict a continuation in the downward trend on private timberland forest production as noted in the table above. Additionally, with the political situation in California and in the federal government as well, CAL FIRE would also predict that federal lands would also not be likely to recover to pre-1990 levels in the State, and might even be more likely to continue to decline in production of forest products. With these figures and predictions in mind, the Department finds that it should be cumulatively feasible to achieve, and possibly even exceed, the baseline1990 levels suggested by the CARB rules pursuant to AB32 when considering just the element of volume production from California timberlands.

In summary, the Department has considered the cumulative impact of these THPs as the implementation instruments of the SPI's overall management regime as discussed in the Option "a" and determined that the overall impacts of these THPs is beneficial from a climate perspective. (see above paragraphs and other responses).

6. Concern: It was stated that: **THE THP MUST ANALYZE AND ADOPT ALL FEASIBLE MITIGATION MEASURES AND ALTERNATIVES TO REDUCE ITS CARBON IMPACT.**

The failure to recognize the cumulatively significant impacts from the THP directly leads to the failure to consider feasible mitigation measures and alternatives to reduce the cumulatively significant impact. CEQA requires that agencies "mitigate or avoid the significant effects on the environment of projects that it carries out or approves whenever it is feasible to do so." Pub. Res. Code § 21002.1(b); see also 14 CCR 15252 ("The document used as a substitute for an EIR or negative declaration in a certified program shall include at least the following items: (1) A description of the proposed activity, and (2) Either: (A) Alternatives to the activity and mitigation measures to avoid or reduce any significant or potentially significant effects that the project might have on the environment .... ")

A rigorous analysis of reasonable alternatives to the project must be analyzed to comply with this strict mandate. "Without meaningful analysis of alternatives in the EIR, neither courts nor the public can fulfill their proper roles in the CEQA process." Laurel Heights

Improvement Ass 'n v. Regents of University of California, 47 Cal.3d 376, 404 (Cal. 1988). Moreover, "[a] potential alternative should not be excluded from consideration merely because it would impede to some degree the attainment of the project objectives, or would be more costly." Save Round Valley Alliance v. County of Inyo, 157 Cal. App. 4th 1437, 1456-57 (Cal. App. 4th Dist. 2007) (quotations omitted). An analysis of alternatives should also quantify the estimated greenhouse gas emissions resulting from each proposed alternative. Here, potential alternatives include different silvicultural techniques (i.e., non even-aged management), and/or reduced cutting. All of these alternatives, and any others, must be considered as they would "avoid or reduce" the cumulatively significant effect of the THP.

In addition to thoroughly evaluating project alternatives, "the [THP] must propose and describe mitigation measures that will minimize the significant environmental effects that the EIR has identified." Napa Citizens for Honest Gov 't v. Napa County Bd. of Supervisors, 91 Cal. App at 342, 360 (Cal. App. 1st Dist. 2001). Mitigation of a project's significant impacts is one of the "most important" functions of CEQA. Sierra Club v. Gilroy City Council, 222 Cal.App.3d 30, 41 (Cal. App. 6th Dist. 1990). Therefore, it is the "policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures which will avoid or substantially lessen the significant environmental effects of such projects." Pub. Res. Code § 21002. Importantly, mitigation measures must be "fully enforceable through permit conditions, agreements, or other measures" so "that feasible mitigation measures will actually be implemented as a condition of development." Federation of Hillside & Canyon Ass'ns v. City of Los Angeles, 83 Cal.App.4th 1252, 1261 (Cal. App. 2d Dist. 2000). After all measures have been implemented to reduce emissions in the first instance, remaining emissions that cannot be eliminated may be mitigated through offsets. Care should be taken to ensure that offsets purchased are real (additional), permanent, and verified, and all aspects of the offsets should be discussed in the THP. Mitigation options for dealing with emissions from logging operations (e.g., machinery use, transportation emissions, processing of timber or woodchips, pesticides, road construction and maintenance, etc.) are available and include, but are not limited to:

- upgrade to higher efficiency equipment
- reduce harvest levels to leave more trees and more soil intact
- reduce discing, soil disturbance during and after harvest

- **afforest/reforest enough additional acreage to offset the emissions**
- **purchase offsets**

RESPONSE: The Department has determined that effects of the proposed management regime from an overall climate perspective will not create direct or cumulative significant adverse environmental impacts. (See the Response to Concerns 1 – 5, and 7 in this Official Response.) In accordance with 14 CCR Sec. 896, 14 CCR Sec. 897, 14 CCR Sec. 898.1 and the definition of "significant" from 14 CCR Sec. 895.1, further plan mitigations are not required when the project does not create significant adverse environmental impacts In particular, 14 CCR Sec. 897(a) states: RPFs who prepare plans shall consider the range of feasible silvicultural system, operating methods and procedures provided in these rules in seeking to avoid or substantially lessen significant adverse effects on the environment from timber harvesting." (emphasis added)

The Department has further found, in consideration of the projected future growth and inventory data from numerous Option "a" documents within the state as a whole, including the Option "a" from SPI in the Southern Forest District, and as reported elsewhere in this Official Response that: "The Department recognizes that growth on California's forested landscapes remain below the potential productivity (FRAP 2003). Forest management through aggressive reforestation, enhancement of conifer site occupancy, genetic improvement, thinning, etc. can and will improve productivity on managed lands while balancing other resource values and providing positive benefit from a climate perspective. This positive benefit will come from increased inventory (i.e., carbon stock), increased growth (i.e., sequestration) and sequestration, storage in wood products and landfills, as well as substitution benefits attributable to forest management life cycle analyses." The measures included in the site preparation and regeneration plan will partially mitigate the carbon loss that will occur during reforestation of the replanted sites. The impacts of the site preparation activities and reforestation on carbon pools will also be addressed by prompt reforestation and selection of an 80 year rotation age and improved growth rates associated with managed stands.

No additional mitigation was determined to be needed for emission standards for the diesel engines as regulations associated with diesel engines has recently been addressed by the Air Resources Control Board and diesel engines will have to meet these standards as the regulations take full effect and will additionally have to meet any future standards set for them. In addition, even-aged management, and clearcutting in particular, tends to minimize the fossil fuel energy needed to produce an equivalent volume of harvest by providing a more compact area, especially for yarding activities, than would be used in an uneven-aged system and from an energy consumption perspective represents the best option for energy use efficiency. Based on this Air Board action and harvesting based energy efficiencies attributable to the silvicultural method, the Department has concluded that no additional mitigation is needed for diesel equipment. The THP also provided an analysis of these direct emissions from the worst case harvest scenario and determined them to sequester 8 times the CO_2 equivalent to CO_2 emitted.

7. Concern: **It was stated that climate change poses enormous risks to California. Scientific literature on the impact of greenhouse gas**

emissions on California is well developed. The California Climate Change Center ("CCCC") has evaluated the present and future impacts of climate change to California and the project area in research sponsored by the California Energy Commission and the California Environmental Protection Agency (Cayan et al. 2007). The severity of the impacts facing California is directly tied to atmospheric concentrations of greenhouse gases (Cayan et al. 2007; Hayhoe et al. 2004). According to the CCCC, aggressive action to cut greenhouse gas emissions today can limit impacts, such as loss of the Sierra snow pack to 30%, while a business as-usual approach could result in as much as a 90% loss of the snowpack by the end of the century. As aptly noted in a report commissioned by the California EPA:

Because most global warming emissions remain in the atmosphere for decades or centuries, the choices we make today will greatly influence the climate our children and grandchildren inherit. The quality of life they experience will depend on if and how rapidly California and the rest of the world reduce greenhouse gas emissions (Cayan et al. 2007). Some of the types of impacts to California and estimated ranges of severity - in large part dependent on the extent to which emissions are reduced - are summarized as follows:

• A 30 to 90 percent reduction of the Sierra snowpack during the next 100 years, including earlier melting and runoff.

• An increase in water temperatures at least commensurate with the increase in air temperatures.

• A 6 to 30 inch rise in sea level, before increased melt rates from the dynamical properties of ice-sheet melting are taken into account.

• An increase in the intensity of storms, the amount of precipitation and the proportion of precipitation as rain versus snow.

• Profound impacts to ecosystem and species, including changes in the timing of life events, shifts in range, and community abundance shifts. Depending on the timing and interaction of these impacts, they can be catastrophic.

• A 200 to 400 percent increase in the number of heat wave days in major urban centers.

• An increase in the number of days meteorologically conducive to ozone (03) formation.

• A 55 percent increase in the expected risk of wildfires (Cayan et al. 2007).

Given that California's temperatures are expected to rise "dramatically" over the course of this century (Cayan 2007), affecting snowpack and precipitation levels, and because California's ecosystems depend upon relatively constant precipitation levels, and water resources are already under strain (Cayan 2007), California will face significant impacts. For instance, there will likely be shifts in the range of California's tree species. Parmesan (2006) notes that "upward movement of treelines has been observed in Siberia (Moiseev & Shiyatov 2003) and in the Canadian Rocky Mountains, where temperatures have risen by 1.5° C (Luckman & Kavanagh 2000)." And Breshears et al. (2008) states; Warming temperatures associated with anthropogenic increases in greenhouse gases have led ecologists to predict that vegetation gradients will "march" up the hill as climate envelopes shift with elevation, at a lag that scales with species' generation times. [T]he finding of Kelly and Goulden is particularly significant in that (i) it documents synchronous change among dominant species across an entire vegetation gradient; (ii) the change occurred relatively rapidly, rather than with a major lag as previously postulated; and (iii) the magnitude of elevation change corresponds directly to expectations associated with co-occurring temperature change.

In other words, range shifts are not just speculation as to what might happen down the road. The above articles show that such shifts are happening now. Range shifts will very likely have significant impacts here in California; indeed, specifically in regard to California, Loarie et al. (2008) "project that up to 66% [of California endemic flora] will experience >80% reductions in range size within a century." Loarie et al. (2008) also note that "the foothills of the northern Sierra Nevada are extremely vulnerable to species loss." Consequently, timber harvest plans must address these imminent changes.

Seedling failure and tree mortality will also be a result of warming. Van Mantgem et al. (2007), when researching the "apparent climatically induced increase of tree mortality rates" in the Sierra Nevada of California, "found that mortality rate, but not recruitment rate, increased significantly over the 22 years of measurement (1983-2004)." "Though [the researchers] detected no change in recruitment rates during [their] study," they noted "it is possible that recruitment and mortality are responding with differing lags or response strengths to climatic changes (Brubaker 1986; Lloyd 1997). Tree seedling dynamics are strongly influenced by climate (van Mantgem et al. 2006; Iba'n-ez et al. 2007)." (Van Mantgem et al. 2007).

Moreover, as explained in Battles et al (2008), plantation forests will likely be especially hard hit by global warming:

> Stem volume growth declined under all four climate projections [examined in the study]. Declines were typically most severe for the pine plantations and least severe under single tree selection (Tables 2,3, and 4). By the end of the century (i.e., 2071-2100), the severity of the declines, as measured by stem volume increment, ranged from a minimum of 5% relative to baseline (single tree selection, PCM B1) to a maximum of 25% (pine plantation, GFDL A2).
>
> The intensity and extent of the moisture deficit that develops during the summer are considered to be limiting factors in the growth and viability of Sierran conifers (Royce and Barbour 2001a). Higher summer temperatures in a Mediterranean climate (absent any changes in precipitation) could induce greater tree water stress through higher evapotranspiration rates and/or faster depletion of moisture in the soil profile. These changes would hasten the onset of drought stress that occurs in the late summer and early fall before the winter rains return. The result would be a shorter growing season due to lack of moisture, which is already recognized as a primary growth constraint on most commercial timber sites in Sierran forests (Royce and Barbour 2001 b). Despite cultivating a species that is most tolerant of summer temperature (ponderosa pine, Figs. 2 and 4), plantations showed the biggest relative loss of stem volume increment and a comparable absolute loss of timber production. Monodominant stands (i.e., forests where one tree species constitutes more than 50% of the stand) are at most risk. A spatially mixed forest limits the spread of both pathogens and insects.

These factors will impact the planned THP, as well as exacerbate its own environmental impacts. Thus, when analyzing the project, the THP must take into account global warming. To ignore the impact of global warming on timber harvesting and the resources impacted by the THP would significantly understate THP impacts. See, e.g., Laurel Heights Improvement Ass'n v. Regents of Univ. of Cal., 47 Cal.3d at 392 (EIR is intended "to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action.").

RESPONSE: Cayan et al. (2007) has information which show the fact that there is no agreement among models about the actual extent of the future temperatures and that, because of this, it would be difficult at this time to design a management scheme to cope with an unknown future condition, as is stated: "During the next few decades, the three scenarios project average temperature increases to rise between 1 and 2.3° F: however, the projected temperature increases begin to diverge at mid-century so that, by the end of the century, the temperature increases projected in the higher emissions scenario are approximately twice as high as those projected in the lower emissions scenario. Cayan et al. (2007), also states with respect to the temperature impacts that: "Some climate models indicate that warming would be greater in summer than in winter...." If this is true, there would be relatively less of an effect on the winter snowpack than may be reported elsewhere. Cayan et al. (2007) also states the future unknown conditions with respect to precipitation: "On average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century. The Mediterranean seasonal precipitation pattern is expected to continue with most precipitation falling during winter from North Pacific storms. One of the three climate models projects slightly wetter winters, and another projects slightly drier winters with a 10 to 20 percent decrease in total annual precipitation." Hayhoe et al. (2004) also finds that there is not only uncertainty with respect to the modeled precipitation for California, but that a great amount of the impact could be centered on regions of the state that are outside of the location of the current THP and others submitted in the Southern Forest District by the Plan Submitter: "Precipitation shows a tendency toward slight decreases in the second half of the century with no obvious interscenario differences in magnitude or frequency. Three of four simulations project winter decreases of -15% to -35%, with reductions concentrated in the Central Valley and along the north Pacific Coast. Only PCM B1 projects slight increases (~7%) by the end of the century. These results differ from previous projections showing precipitation increases of 75-200% by 2100, but they are consistent with recent PCM-based midrange projections." And also from Hayhoe et al. (2004) demonstrating the extreme variability of California precipitation from decade to decade, even in the absence of any global climate change: "Because interdecadal variability often dominates precipitation over California, projected changes in climate and impacts associated with the direct effects of temperatures should be considered more robust than those determined by interactions between temperature and precipitation or precipitation alone." Historically, the forests of California have developed in consort with this variability in precipitation.

With respect to a prediction of wildfire increase of up to 55% as stated in Concern #7, Cayan et al. (2007) further refines this statement by indicating that the effect could as well be more tilted to grasslands or chaparral instead of conifer lands by saying: "Because wildfire risk is determined by a combination of factors including precipitation, winds, temperature, and landscape and vegetation conditions, future risks will not be uniform throughout the state. In many regions, wildfire activity will depend critically on future precipitation patterns. For example, if precipitation increases as temperatures rise, wildfires in the grasslands and chaparral ecosystems of southern California are expected to increase by approximately 30 percent toward the end of the century because more winter rain will stimulate the growth of more plant "fuel" available to burn in the fall. In contrast, a hotter, drier climate could promote up to 90 percent more northern California fires by the end of the century by drying out and increasing the flammability of forest vegetation." As a firefighting and land management agency with a long history in California, CAL FIRE would further refine these comments by saying that we would agree that future risks will not be uniform throughout the state's wildland because there would be differences based on the type of land management that is being practiced on the different land holdings. Where there is good management (spacing of trees, avoidance of ladder fuels, removal and treatment of insect or disease infected trees in a timely manner, good access for firefighting equipment), which is the expectation in this THP, the risk of wildfire should logically be less than where the forest management is non-existent or lacking.

Quotes from Parmesan (2006), Moiseev & Shiyatov (2003) and Luckman & Kavanagh (2000) were findings from boreal forest conditions, which are likely to react different from either tropical or temperate forests. (Pregitzer and Euskirchen (2004) as discussed in the Response to Concern #2) The quote from Breshears et al. (2008), which was done in California in the temperate forest situation is totally incomplete as reported in Concern #7. The actual finding from the study is that: "Kelly and Goulden document rapid changes in a vegetation gradient - spanning >2000 m in elevation along the Santa Rosa Mountains in southern California – that occurred over a 30-year interval during which regional climate warmed. Over this period the central tendencies of the distribution of dominant plant species along the elevation gradient shifted synchronously upslope, in contrast to expectations based on population dynamics and paleoecological studies that vegetation responses should lag behind changes in climate. The range limits of each dominant species, however, remained unchanged. Consequently, in contrast to expectations of a "march" up the hill, the vegetation gradient essentially synchronously "leaned" upslope – the distribution shifted upslope within the existing range." (emphasis added) (Breshears et al. 2008)

With respect to the study "Changes in biotic interactions and climate determine recruitment of Jeffrey pine along an elevation gradient" (Gworek, et al. 2006), which was also done in the California temperate forest area, there was also the finding that: "If climatic conditions along the eastern Sierra Nevada continue to become hotter and drier, the distribution of Jeffrey pine is predicted to shift upslope. Clearly, neither seed availability nor the dispersal of seeds is likely to limit future population growth anywhere along or above the current species elevation range. Instead, changing climate is likely to improve conditions for successful seedling emergence at and above the species' upper elevation range, and increased mortality of adult trees without replacement is likely to cause upslope retraction of the lower margin of the species range. Both of these processes are likely to occur slowly (i.e., over periods of decades or even centuries.) Also from the report (Gworek, et al. 2006), it is interesting to see how trees are able to adapt to climate conditions, as follows: "Seeds at low elevation were significantly larger, which could indicate local adaptation to more arid conditions at low elevation where larger seeds might increase the probability of seedling establishment." (Dunlop and Barnett, 1983; Westoby et al., 1992; Bonfil, 1998; Vander Wall et al., 2006).

One study "Climate Change and the Future of California's Endemic Flora" (Loarie, et al. 2008), evaluates eight different future climate conditions on California flora, showing just how uncertain it is to try to adjust forest growth rates when the future is unknown. ("We assess 8 different potential scenarios for the future of the California flora in the face of climate change. These are the combinations of three pairs of possibilities.") This report shows that there could be more diversity among California flora, or not: "Under the highest level of climate change examined here...we project peak diversity to drop as low as 247 species per km. In contrast, under relatively low amounts of climate change ... diversity increases across extensive areas, particularly the northern coasts." (Loarie, et al. 2008) This report also shows that the condition of the geography in California are peculiar and the response of vegetation to climate change is possibly atypical, as follows: "As one might expect, species tend to move to higher elevations and often northward. Interestingly, these trends result in divergent projections for elements of the flora. Given California's geography, movement to higher elevations often means taking a *southward* path." (Loarie, et al. 2008) This same report also states that the ability of vegetation to respond to changing conditions cannot be overlooked, as follows: "On the other hand, resilience of established plants and seed banks, differing population responses at range margins, and adaptive evolutionary responses might mitigate the influence of climate change." (Loarie, et al. 2008)

It is recognized that California will get warmer but the level of warming is not known. At the global scale there is scientific consensus that the climate is changing and will change in response to increased concentration of greenhouse gases in the atmosphere. The research on how this warming climate will impact forests is underway with a number of researchers testing vegetation responses under a series of warming scenarios. Kahrl and Roland-Holst (2008) in summarizing the impacts of climate change on agriculture, forestry and fishing state:

> "Climate change will mean significant changes for agriculture, forestry and fisheries in California. In lower warming scenarios, some of these changes will be beneficial for agriculture and forestry, although there is some debate about the net impact. Both higher and likely lower warming scenarios, even if they cause no net economic impacts will lead to gradual but substantial change in the composition and location of agricultural, forest and fish production… Forestry will experience high yields, but also higher fire risk and drought vulnerability…."

Lenihan, Bachelet, Drapek and Neilson (Lenihan, et al. 2006) evaluated through modeling the impacts on vegetation cover for various vegetation classes. Their conclusions based on the modeling were as follows:

> "Significant declines in the extent of Alpine/Subalpine Forest were simulated under all three scenarios, especially under the warmest GFDL-A2 scenario. At high elevation sites the model responded to longer and warmer growing seasons, which favored the replacement of Alpine/Subalpine Forest by other vegetation types.
>
> The simulated extent of forest land in the state (i.e., the combined extent of Evergreen Conifer Forest and Mixed Evergreen Forest) increased relative to the historical extent by 0.5% under the PCM-A2 scenario. Forest cover declined by) 0.6% and 0.9% under the GFDL-B1 and GFDL-A2 scenarios, respectively.
>
> Evergreen Conifer Forest declined under all scenarios, but the largest declines were simulated under the warmer and drier GFDL scenarios. Much of the simulated loss of this type was due to replacement by Mixed Evergreen Forest with increases in temperature, but reductions in effective moisture and increases in fire also resulted in losses to Evergreen Conifer Forest to Woodland, Shrub land, and Grassland."

Lenihan's et al. conclusion regarding net primary productivity of simulated ecosystems stated:

> "…ecosystem net primary productivity (NPP showed considerable interannual and interdecadal variability, especially over the first half of the 21st century when NPP was frequently greater than normal…even under the drier GFDL scenarios. From about mid-century on, there was a general increasing trend in NPP under the relatively cool and wet PCM-A2 scenario, and a general decreasing trend under the warmest and driest GFDL_A2 scenario (Figure 5a)…
>
> …Net biological production (NBP) is the balance between carbon gained by the ecosystem via net primary productivity, and carbon lost from the ecosystem via

decomposition and consumption by fire....The simulated trends in cumulative NBP under the warmer and drier GFDL scenarios (Figure 5b) showed a steady decrease over the course of the future period,...These losses represent a decline in total carbon stocks of 1.3%(B1) and 2.2%(A2), respectively (Table 2)..."

Forest Management as means of controlling stocking, reducing fire risk, matching tree species to anticipated changes in conditions, responding to insect infestations, etc. can and will be utilized to maintain NPP in managed stands.

The study (Van Mantgem et al., 2007) is incompletely represented in the Concern #7 as this study is from old-growth unmanaged forests in national parks ("Twenty-one permanent study plots ranging in size from 0.9 to 2.5 ha were established between 1982 and 1996 in old-growth stands within the coniferous forest zones of Sequoia and Yosemite national parks, Sierra Nevada, California.") Increases in mortality in an unmanaged stand can hardly be compared to private industrial timberland where tree spacing and competition is controlled and, in the case of this THP, planted trees are expected to be genetically improved. The study also reports: "The apparent increase in mortality rate in response to increasing water deficit so far has been gradual and subtle, and is concentrated in small trees. The concentration of mortality in small trees has meant that stand densities have decreased without a detectable decrease in stand biomass.... Climatic conditions so far have remained below thresholds that might lead to large-scale forest die-back." (Van Mantgem et al., 2007) As a forest management agency with decades of experience, CAL FIRE finds that it is hardly surprising that high levels of stocking in an unmanaged forest will lead to mortality among the weakest members of the stand that are growing in the understory without full access to sunlight and which cannot compete for moisture with trees that would likely have a more developed root structure, especially when drought stress comes along as it does periodically in California. Forest insects are especially adapted to take full advantage of these weaker trees in unmanaged stands where bark thickness is not a barrier to their entry and where pitch abundance is low given drought stresses so that the trees are unable to "pitch out" boring insects.

The plan submitter has provided a review of the "CCC Study" in the THP. As discussed, the findings in this report have already been modified based on more data and has changed the claimed decrease in future growth from 31% in ponderosa pine plantations to 25%. The THP goes on to report more recent calculations from Battles now published that shows 9 to 28% increase in future plantation growth as the study findings and calculations evolve (see below). The 25% decrease claimed in the amended "CCC Study" was based on the worst-case-scenario of continued unabated increases in atmospheric CO_2 from emissions. This scenario would presume that no one in any country was going to do anything to abate the GHG emissions from various sources in spite of various treaties and legislation and efforts that are currently underway in California and elsewhere. However, the study also identified the impacts of another scenario of potentials for increases in CO_2 that was less than "worst-case" (i.e., the A2 scenario) and found that by the end of the century, the severity of the declines, as measured by stem volume increment was around 5% for ponderosa pine plantations when using the PCM climate data projections. (Table 4, Revised Battles Study 2008). These differing yield projections represent a wide range of outcomes, leading to the question of which future CO_2 emissions scenario should a landowner be required to use. CAL FIRE finds that this is perhaps a policy issue for the BOF at a future time when perhaps regulations are under consideration in a public forum with expert testimony and that any requirements to "downsize" growth projections for California forests would have to apply equally to all industrial and perhaps even non-industrial timberland owners in the State and not just to apply unequally to a single timberland owner as a matter of equal enforcement and fair business practices. In fact, CAL FIRE notes in the study Climate Change 2007 (Bernstein et al. 2007) use of six different future emission scenarios. This report models using a B1 scenario of a best estimate temperature change in the last decade of this century of .6 degrees C, another at 1.8 degrees C, another at 2.4 degrees C, another at 2.8 degrees C, another at 3.4 degrees C and yet another at 4.0 degrees C. While these different outcomes were not modeled in the Battles Study for Blodgett Forest, it would be presumed that each would lead to different outcomes of growth based on the wide divergence of findings that were evident in the two scenarios that were used in Battles.

Additionally, a memo was received to the official record for THP 4-08-05/CAL-1, which is hereby referenced for the current plan that is the subject of this Official Response, from Timothy Robards, CAL FIRE Division Chief – Forest Biometrician and one of the authors of the quoted Battles et al. 2006 report. The following is a copy of the text of that memo:

> "This memo addresses references made in public comment by Mr. John H. Curran on THP 4-08-05/CAL-1 (Squiqqly) to forest productivity research conducted by myself and colleagues (Battles et al. 2008; Battles et al. 2006). My objective here is to provide updated information on subsequent research on this subject that is specific to the forest types of the Sierra Nevada ecoregion. The background of my involvement in this scientific inquiry is as a Ph.D. candidate at U.C. Berkeley conducting research for my dissertation. I am also employed by CAL FIRE, but that is independent from my work at U.C. Berkeley.
>
> The modeling that was conducted for the Battles et al. publications used the only existing methodology at the time for California, for incorporating climatic effects into a forest growth projection system. It was based on an analysis that used existing "climate dumb" growth models (Wensel and Robards 1989) and calibrated the projections using climate data. The growth data used for the calibrations was based on the stem analysis dataset of the Northern California Forest Yield Cooperative. Given the relatively short time-horizon of that project, that was the best available approach.
>
> Recognizing the need for accurate projections of forest growth under variable climate, I have assembled the best available data and constructed new tree diameter and height growth models for the following six species: ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), incense-cedar (*Calocedrus decurrens*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*) and red fir (*Abies magnifica*) (Robards 2009). The tree growth data included the stem analysis data of the previous analysis and three other data sets were used, providing tens of thousands of observations covering 40 years. These models have been incorporated in the USDA Forest Service's Forest Vegetation Simulator, Westside Sierra variant (FVS-WESSIN). The models were evaluated on independent tree growth data and found to be unbiased. Projections of mature stands and 20-year old plantations were made for an east-west

transect in the mid-Sierra Nevada. These projections used downscaled climate projections of global circulation models (GCMs) developed at the Scripps Institute (Cayan et al. 2006). Ponderosa pine, Douglas-fir, mixed conifer and red fir stands were projected to 2099. The mean annual increment (MAI) of total cubic volume was compared for the first and second halves of the twenty-first century to the last half of the twentieth century. MAI productivity increased in all cases. The range of increase was up to 12% for ponderosa pine and 15% for mixed conifer plantations.

In my opinion, these models and simulations provide the most accurate evaluation of forest productivity in a changing climate currently available for managed forests in the Sierra Nevada Ecoregion. The new information that is referenced here is in process of preparation for publication in peer-reviewed scientific journals. I can provide the MS PowerPoint presentation from the referenced seminar as well as additional explanations to any of the interested parties."

With the Battles study itself, one would have to accept that the conditions, both temperature and precipitation, were similar on the Blodgett forest site as compared to the plan submitters ownerships as described in their Southern Forest District Option "a" or in the THP itself to adopt the findings in the Battles study as being representative. While the original Battles study is for ponderosa pine at about 3600' elevation, much of the SPI ownership is at higher elevations than this, although some of their lands are immediately adjacent to Blodgett Forest. THP 4-08-24/AMA-1 is located at a similar elevation to Blodgett although located at a slightly more southerly longitude. The Battles study itself contains the following caution regarding comparisons between the study area and other areas of the Sierra Nevada forestland: "Care must be taken in generalizing from data obtained from Blodgett Forest and in extrapolating to other parts of the Sierra. All silvicultural methods used at Blodgett may be applied throughout the Sierra. However, the results, particularly of growth, must be extrapolated to other areas with caution because Blodgett Forest is located on high site quality land capable of producing at least 165 ft^3/ac/yr; on relatively flat ground (no cable yarding required), has relatively small compartments (less than 90 acres, and has a high degree of technical competence and supervision of silvicultural activities. In the Sierra Nevada, approximately 7% of private forest industry lands (196,000 ac) and 3% of public lands (222,000 ac) are of similar site quality. Consequently, results from Blodgett Forest are directly applicable to perhaps 420,000 acres in the Sierra." With respect to THP 4-08-24/AMA-1 itself, while it could possibly fit within the compatible area, the ground itself is certainly not as level as the Blodgett site as evidenced by the need to use cable yarding on a portion of the area. This was one of the cautions from the Battles study against making data extrapolations.

While the concern #7 above cites fears of potential changes in precipitation due to climate, the actual Battles study on page 9 states, "Increased summer temperature was the primary driver of these changes. For this specific site, there was no trend in winter precipitation for any of climate scenarios (Figures 1 and 2.)" Indeed, both weather service projections used for future trends in precipitation as shown on the graphs showed no consistency and were "all-over-the-map", so to speak. In fact, the graphs showing future trends of precipitation from Figures 1 and 2 demonstrated a pattern of future precipitation that was very similar to the actual precipitation rates shown on the graph for the period of 1950 to present. Also the report states that the location of the projected data from the weather services was in an area that was both "warmer and drier" than the conditions observed at Blodgett Forest. While this location near the intersection of Mosquito Road and Stope Road in El Dorado County is warmer in the summer and in the winter than Blodgett Forest and has less rainfall, it is not certain that this would make a significant difference in the outcomes of a model that utilizes projected climate data from that location. But this is another factor that makes it increasingly difficult to extrapolate the Battles study data as a guide to making assumptions about growth reductions, especially when considering the widely spaced ownerships held by the plan submitter in the Option "a" document that range from El Dorado County in the north to Tuolumne County in the south and that also have a wide range of elevations within these counties.

In general, growth and yield for plantations, particularly plantations of ponderosa pine, has received considerable attention and research (Oliver and Powers, 1978, Oliver 1972, Oliver 1979). SPI has modeled yield for their established plantations and LTSY calculations are based on consistency of silvicultural application and the accuracy of the growth projections for these regenerated stands.

Zhang et al.(2008) evaluated and modeled future stem volume in plantations established during the reforestation of the 1992 Fountain Fire which is located in eastern Shasta County. Their findings indicate:

> "...by the age of 36 years, the young plantations will carry as much stem volume as the prefire stands at about the age of 70 years (Figure 3), indicating that a fully stocked plantation with understory vegetation controlled grows much more bole wood than a natural stand does on the same lands...."

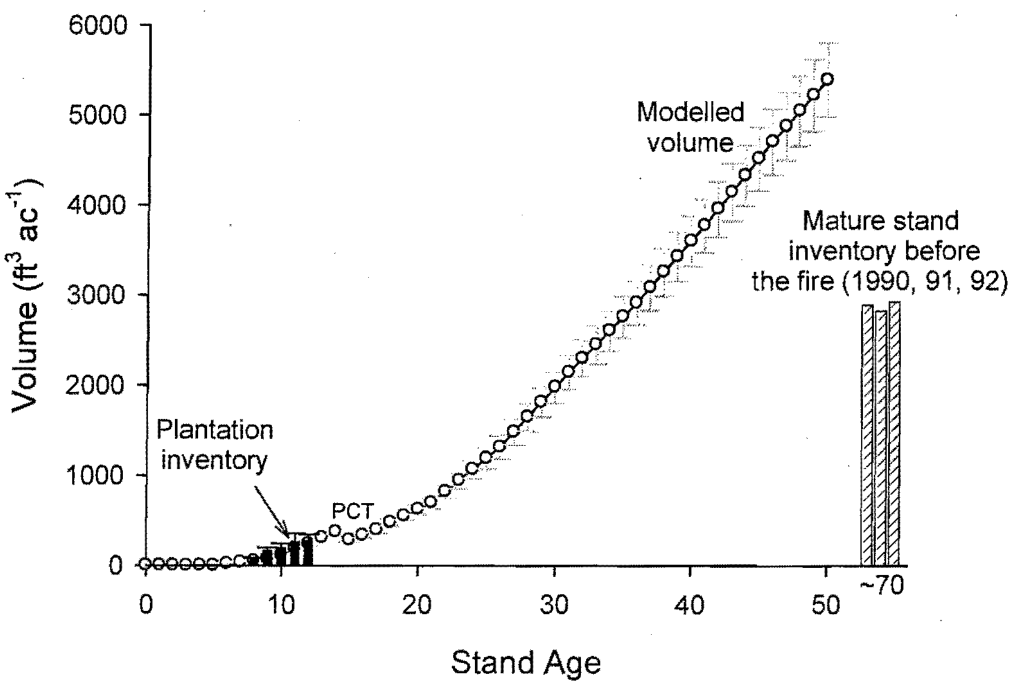

Fig. 3. Stand volume inventory for 1) the original natural-stands (bar only), at about 70-

yr-old, in 1990, 1991, and 1992, prior to the Fountain Fire, 2) for some regenerated young plantations (bar+se) at age 8-12 after the fire, and 3) means (±se) of modeled volume (circle and line) based on the combinations of site quality and planted species with the Forest Projection Systems for up to 50 years. Pre-commercial thinning (PCT) has been assumed to be conducted at age 14.

Further, additional research by Battles (Battles et al., 2009) indicates:

> ...Simulated growth of a commercial pine plantation during a 50-year management cycle (20 to 70 years old) for 18 climate realizations predicted increases in yield as measured in total tree volume. The increased growth was most directly tied to the consistent projections of warmer temperatures during the twenty-first century. Under the different climate scenarios, pine yield increased from 9 percent to 28 percent above baseline by 2100. **This result contradicts our previous work, which reported decreases in pine yield by 2100 under similar climate projections.** (emphasis added)

Based on past measurements in plantations and climate change modeling, it is also recognized that modeling and prediction of future conditions is complex. However, it is the Department's conclusion that even-aged management regimes proposed by landowners have a reasonable expectation of providing management options for maximizing net biological productivity of the stands being managed and will benefit sequestration under a wide range of climate warming scenarios. No additional mitigations were determined to be necessary to avoid an adverse impact.

Finally, as noted in the Battles (2008) study, there is no credit given in the model to the possible beneficial effects of CO_2 fertilization on plantation growth or tree growth in general. In Battles (2008), there is a statement that; "The magnitude and persistence of any changes in forest productivity related to changes in CO_2 concentrations are crucial to projections of tree growth and yield. Biogeochemistry-based simulation models (e.g., CENTURY) predict increases in plant productivity under increasing atmospheric CO_2 (transpiration decreases thus improving water use efficiency). Lenihan et al. (2003, 2006) include this CO_2 fertilization-effect in their state-wide analysis of climate change effects on California vegetation. However growth chamber studies of plant physiological response to increased CO_2 routinely report photosynthetic acclimation implying that any increases in productivity will be short-lived (Long et al. 2004). Results from the free air CO_2 enrichment experiments parallel some of the findings from enclosure studies (Long et al. 2004) but a recent meta-analysis of FACE experiments support the contention that tree productivity does respond to CO_2 enrichment (Ainsworth and Long 2005)." Also in the report, "It remains an unresolved question whether the observed increases in tree production under enriched CO_2 translates into sustained increases in stem growth (Norby et al. 2005)." As noted by Shugart et al. (2003) in their national assessment of climate change impacts on forest resources, the direction and magnitude of any carbon fertilization effect will be an important determinant of timber productivity under a CO_2 enriched climate. (Shugart et al., 2003, Forests and global change: Potential impacts on US forest resources. (Pew Center for Climate Change.) It is also interesting to note that Battles 2008 also cites an example of a study where gross productivity gains ranging from 5 to 19% were measured at year three on one species of tree grown in enriched CO_2

environment. If such an example of CO_2 enrichment were projected for pine plantations, it would almost entirely eliminate the growth reductions from increased CO_2 that ranged from 5 to 25% in the CCC Study. However, it is apparent from the literature that not enough work has been done in the area of CO_2 enrichment to make this leap of logic until more studies are done and more information is available.

Regarding the use of models that largely ignore the effects of CO_2 enrichment, from Shugart et al. (2003); "There remains considerable uncertainty in projecting the impacts of climate change on forest yield. How useful are the estimates of future forest yields based on process or biogeochemical models such as BIOME-BGC, TEM, and CENTURY? These models simulate, four different scenarios of global warming, the expected changes in net primary production (NPP) or forest carbon uptake. But can these outputs be used as good proxies for changes in yield?" and "The use of NPP as a proxy for forestry yield is a provisional step necessitated by the absence of good yield models. At present, however, the task of predicting future forest yields in response to climate change or rising CO_2 still must overcome substantial problems. Resolving these uncertainties will require, in addition to the diverse array of new research efforts identified above, progress on a set of experiments and models dedicated specifically to the NPP versus yield issue." (Shugart et al., 2003). The take-away message here is that models are imperfect predictors and are not as desirable as actual yield measurements. This is a point that CAL FIRE has made numerous times in this Official Response.

The more important take home message is that the commenter relied on a scientific work that has been replaced by the same author that now shows increased yield rather than decreased yield as a result of the expected changes in climate.

8. Concern: There was a request for the 2007 study by SPI stating that it, "was compiling results from an in-house plantation diversity study."

Response: The RPF removed this reference from the THP. The study has not been published and can not be used by CAL FIRE for evaluation. The THP does reference the following publication (THP, p.136):

DiTomaso, Joseph M., et al. 1997. Post-fire herbicide sprays enhance native plant diversity. California Agriculture 51(1):6-11

CAL FIRE used this publication in evaluating the THP. This publication's summary states:

> Following catastrophic fire, broad-spectrum herbicides such as hexazinone are often used to control shrubs and forbs that compete with planted conifers. This practice encourages rapid growth and reduces and reduces mortality of conifers. Although the initial effect is to reduce native plant species richness, recovery is rapid and plant diversity exceeds that in untreated areas within 8 years of application. Success of native forb and grass species in herbicide-treated areas appears to be due to early suppression of otherwise dominant shrubs.

CAL FIRE concludes there is no reason to wait for the publication of the referenced in-house biodiversity study.

9. Concern: It was stated that the following comments primarily address a recent submission from SPI regarding the impacts of clear-cut logging on greenhouse gas ("GHG") emissions. However, from the outset, it should be emphasized, as recently put by the Attorney General's Office, that "the plain intent of the Legislature in enacting the [Forest Practice Act] was to require the Board to view the forests of the state as a complete working ecosystem, and not only as a producer of high quality timber, but also as forestlands valuable in their own right as a public resource." Advice Regarding Board of Forestry's Regulatory Authority to Provide for the Restoration of Resources at 4 (emphasis added). "[T]he protection of California's watersheds and soils has been an important goal of the FP A since its enactment in 1973," id. at 5, and "the explicit language of the FPA requires that the Board balance timber production and protection and restoration of forest resources. However, the FPA does not require that this balance be affirmatively struck in favor of timber production.... [B]oth CEQA and CESA assure that forest resources ... be protected during timber operations and thus balance the Board's authority to weigh too heavily in favor of timber production." Id. at 8 "The requirements of CEQA, CESA, and the functional equivalent certification of the THP review process all require that the Board consider and mitigate for adverse environmental impacts when making its decisions." Id. at 9. As the lead agency, it is CAL FIRE's duty to ensure that all THPs conform with applicable law. With regard to GHG emissions analysis under CEQA, the Attorney General's Office has recently stated that:

Lead agencies should make a good-faith effort, based on available information, to calculate, model, or estimate the amount of CO_2 and other GHG emissions from a project, including the emissions associated with vehicular traffic, energy consumption, water usage and construction activities. The question for the lead agency is whether the GHG emissions from the project . . . are considerable when viewed in connection with the GHG emissions from past projects, other current projects, and probable future projects. Unlike more localized, ambient air pollutants which dissipate or break down over a relatively short period of time (hours, days or weeks), GHGs accumulate in the atmosphere, persisting for decades and in some cases millennia. The overwhelming scientific consensus is that in order to avoid disruptive and potentially catastrophic climate change, then it's not enough simply to stabilize our annual GHG emissions. The science tells us that we must immediately and substantially reduce these emissions. The decisions that we make today do matter. Putting off the problem will only increase the costs of any solution. Moreover, delay may put a solution out of reach at any price. The experts tell us that the later we put off taking real action to reduce our GHG emissions, the less likely we will be able to stabilize atmospheric concentrations at a level that will avoid dangerous climate change?

[Agencies should] evaluate at least one alternative that would ensure that the [agency] contributes to a lower-carbon future. See Climate Change, the California Environmental Quality Act, and General Plan Updates: Straightforward Answers to Some Frequently Asked Questions California Attorney General's Office [Rev. 3/06/09] (emphasis added). The California Resources Agency has also addressed the issue of GHG emissions and has pointed out that the following must be considered when assessing GHG emissions associated with logging: Type of Forest Management (Clear Cutting or other types of logging management). Age of forest at issue, tree type. Store of Carbon in Bio Mass, Soils, and Old Growth. Rate new growth sequesters carbon. Changes to system overall. Reduction of carbon stores v. rate of carbon uptake. Increases and Decreases in Carbon to Environmental Setting. Cumulative Impacts. Fair Argument: A lead agency must require an EIR (or its equivalent- THP) where it is presented with substantial evidence supporting a fair argument that significant environmental impacts may result from a project, even though there is also substantial evidence in the record to the contrary. (Application of Thresholds to facts). See Powerpoint Presentation of Resource Agency (presented at February, 2009, Board of Forestry meeting). The above statements from the Attorney General and Resources Agency make clear that business-as-usual is no longer an option. Agencies must now give careful attention to the greenhouse gas emissions associated with the projects they approve and must actually calculate, model, or estimate all of the emissions associated with a particular project. Here, that means accurately calculating the emissions associated with the clear-cutting of this particular THP, including calculating the emissions associated with a) severe soil disturbance, b) loss of understory, c) site preparation/prevention of development of understory (e.g., herbicide use), d) burning or decay of leftover slash material, and e) emissions associated with the actual cutting, movement and development of wood products (i.e., gray emissions). It also means fully acknowledging what is lost (i.e., are we losing any large old trees, and even if not, approximately how many trees of each age class and type of tree being lost must be determined and assessed), and what is foregone (i.e., addressing the fact that SPI even-aged management will never allow the stands to develop the large carbon stores associated with forest stands dominated by large, old trees, or even reach an age that has the highest rate of carbon sequestration). In short, generalized claims about how forests can be carbon sinks does not constitute an adequate analysis because it does not account for what is occurring in this instance - this THP proposes the complete loss of 172 acres of mostly native mixed-species multi-story forest with high biodiversity value via clear-cutting and conversion to single-species plantation with greatly reduced environmental functions. The generalized calculations that SPI provides do not address this THP, and obfuscate the issue, and hence, fail to provide the necessary substantive information about the emissions associated with this particular THP. It is also important to note that GHG emissions are now more than ever understood to be at a tipping point. This means timing is of utmost importance in the sense that sequestration in the far off future is irrelevant if emissions in the short term have pushed us over the brink. In other words, emissions occurring in the short term can not be explained away by pointing to sequestration that may occur in the distant future. Indeed, the best available scientific evidence now indicates that a warming of 2°C is not "safe" and would not prevent dangerous interference with the climate system. In order to avoid dangerous anthropogenic interference (DAI) with the climate system, sound climate analysis must minimize the risk of severe and irreversible outcomes. Stabilizing greenhouse gas emissions at 350 ppm CO_2eq, would reduce the mean probability of overshooting a 2°C temperature rise to 7 percent. A 350 ppm CO_2eq stabilization level is also consistent with that proposed by leading climatologists, who have concluded that in order "to preserve a planet for future generations similar to that in which civilization developed and to which life on Earth is adapted ... CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm." 7 While current CO_2 levels exceed 350 ppm, a pathway toward 350 ppm is possible though the rapid phase-out of coal emissions, improved agricultural and forestry practices, and possible future capture of CO_2 from biomass power plants. Id. In short, time is of the essence when addressing GHG emissions, and therefore, timing must be properly considered and accounted for when determining and addressing the emissions associated with a THP - for instance, significant emissions in the short term cannot be discounted by pointing to uncertain future sequestration. The THP is considered the functional equivalent of an environmental impact report ("EIR") that would normally be prepared under CEQA. However, while THPs are subject to the Forest Practice Act, they are also subject to the California Environmental Quality Act ("CEQA") which mandates that environmental impacts, including cumulative impacts, be considered and analyzed, and significant impacts then avoided and/or mitigated. See Sierra Club v. State Bd. of Forestry (1994) 7 Cal. 4th 1215, 1228 ("in approving timber harvesting plans, the [agency] must conform not only to the detailed and exhaustive provisions of the [Forest Practice] Act, but also to those provisions of CEQA from which it has not been specifically exempted"). CEQA demands, among many other things, that enough information be provided regarding a project to allow informed decision-making. The statement submitted by SPI regarding greenhouse gas emissions associated with its clear-cut logging practices falls well short of that standard and is therefore deficient from an informational standpoint. As stated by the Supreme Court in Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova (2007) 40 Cal. 4th 412, 449-50 (emphasis added): The preparation and circulation of an EIR is more than a set of technical hurdles for agencies and developers to overcome. The EIR's function is to ensure that government officials who decide to build or approve a project do so with a full understanding of the environmental consequences, and, equally important, that the public is assured those consequences have been taken into account. See also East Peninsula Ed. Council, Inc. v. Palos Verdes Peninsula Unified School Dist. (1989) 210 Cal.App.3d 155, 174 ("Where failure to comply with the law results in a subversion of the purposes of CEQA by omitting information from the environmental review process, the err is prejudicial"); Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal. 3d 376, 402 ("CEQA's fundamental goal of fostering informed decision making"). One major problem is that the current THP fails to describe the approximate number of trees of each species by age class and diameter. Without that information, it is not possible to perform an accurate accounting of the carbon emissions because tree species, age, and diameter are necessary to conduct an accurate accounting. Only with that information (and more, as described in the Center's first comment letter) can CAL FIRE and the public accurately estimate the carbon emissions that would be associated with the clear-cutting of all of these trees. Larger, older trees are a major carbon store, and can have high rates of carbon uptake. Thus, until we have enough information to accurately assess the amount of carbon that would be cut, the THP fails as an informational document. CAL FIRE is aware that "disclosure of potential significant adverse impacts pertaining to large old trees is required, even in those situations involving a single tree or small stand of trees less than 20 acres in size (i.e. does not meet the minimum stand acreage for Late Succession Forest Stands per 14 CCR § 895.1).,,8 The situation here demands an accounting of large, old trees, even if they are in groups smaller than the 20 acre minimum stand size associated with Late Succession Forest Stands. Large, old trees, as explained extensively in the Center's initial comment letter, represent a major carbon store and their loss is of great significance. In other words, while the "description of the environmental setting shall be no longer than is necessary to an understanding of the significant effects of the proposed project and its alternatives," 14 CCR 15125, here, knowledge of the approximate number of large, old trees that would be cut is absolutely necessary in order to determine the effects of the clear-cut. Therefore, SPI's failure to provide enough information to assess how many large old trees will be cut, as well as its failure to provide information about how many early to mid-aged trees will be cut, is prejudical to informed decision-making. See San Joaquin Raptor/Wildlife Rescue Ctr. v. County of Stanislaus (1994) 27 Cal. App. 4th 713, 723 ("Knowledge of the regional setting is critical to the assessment of environmental impacts. Special emphasis should be placed on environmental resources that are rare or unique to that region and would be affected by the project."); Cadiz Land Co. v. Rail Cycle (2000) 83 Cal. App. 4th 74, 94 (finding environmental setting description inadequate because "an estimate of the volume of groundwater in the aquifer is critical to a well informed determination of whether the risk of groundwater contamination is worth taking .... Because the EIR must be certified or rejected by public officials, it is a document of accountability. If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees."); 14 CCR 897 ("The information in [THPs] shall also be sufficiently clear and detailed to permit adequate and effective review by responsible agencies and input by the public to assure that; significant adverse individual and cumulative impacts are avoided or reduced to insignificance.") Another major informational deficiency of the THP is its failure to disclose the impacts of the clear-cutting on greenhouse gas emissions associated with the release of soil carbon stores. Belowground carbon stores may equal aboveground live tree biomass, and can have similar impacts on greenhouse gas emissions. Clear-cutting causes a pulse of carbon to be released from forest soils because it generates large, instant input of material into the soil carbon pool. This input includes tree biomass in the form of roots and stumps (combined these represent 20-25 % of live forest biomass), and slash (including tree branches, tops, small trees, parts of bark and other logging debris, which together represent 15-20% of live forest biomass). This added material decomposes over time and generates a substantial pulse of carbon release lasting for many years. In addition, the removal of the forest canopy by clear-cutting exposes the soil to direct sunlight, which tends to increase soil respiration; soil preparation (such as discing) for tree planting also increases soil respiration; and soil erosion associated with clear-cutting and soil preparation can cause significant losses of soil carbon. All of these factors are significant and potentially substantial additions to the greenhouse gas emissions, and therefore are impacts of the project, and can be estimated using available survey techniques and indices. Furthermore, there is an informational deficiency in SPI's statement in terms of the accounting. What is absolutely certain are the carbon emissions in the short term associated with the clearrcutting. However, the long-term sequestration that SPI points to in an attempt to compensate for the emissions is significantly less certain. Consequently, it is crucial that SPI disclose all emissions from all pools and sources, including foregone pools (e.g., the future sequestration by the current forest that would have occurred but for the clear-cut), in order to accurately and adequately explain the circumstances of this THP's impacts on carbon emissions and sequestration. So far, SPI continues to ignore the fact that: a) the significant impacts that will occur in the short term cannot be dismissed based on uncertain future mitigation (especially when, as here, that future mitigation will likely not make up for the carbon lost due to clearrcutting), and b) all pools and sources of emissions must be accounted for including the emissions associated with i) decay, ii) soil, understory, litter, and duff impacts, iii) cutting, site preparation, transportation, and manufacturing emissions, and iv) foregone carbon sequestration. There is simply no escaping the need for immediate GHG reductions and all SPI offers is uncertain mitigation in the far off future for significant impacts that will occur in the short term. It takes decades for a replanted forest to make up for all the carbon lost to a clear-cut, and even after many decades, there may still be a net loss of carbon (due to the lack of information from SPI, this cannot be fully determined). The below graph (from Olga Krankina, Assistant Professor, Forest Science, Oregon State University) illustrates the problem well, and while the graph uses an old-growth forest as the starting point, the problem can still occur when starting from the point that this THP starts from, namely, a mostly native mixed-species multi-story forest which will be completely destroyed via clear-cutting and converted to a plantation.

Response: CAL FIRE would refrain from making legal conclusions with respect to those items of the Concern #9 that are the purview of the court to decide on matters relating to the adequacy of the review and analysis that was done by the Department in conjunction with this particular THP project. CAL FIRE would like to point out, however, that it has made every effort to analyze all pertinent literature on the subject of GHG in relation to the current project to determine if there was any potential for significant adverse cumulative or direct impacts as a result of this project or this project acting in combination with similar projects. As witness, CAL FIRE points to the volume of information in the file for this THP, including the THP itself, the PHI, the mitigations requested by the Interagency Review Team and this Official Response. (see also the Response to Concern 1 through 7 in this Official Response.) Not stopping at the current THP, CAL FIRE has analyzed the possible GHG effects of all major timberland owners in the State via their published yield by decade and has examined the projected increases future standing inventories of conifers that will be sequestering increasing amounts of carbon for the remainder of a century in order to address any possible significant adverse environmental cumulative impacts. CAL FIRE pleads that it has made the "good faith effort" as commanded in the publication "Climate Change, the California Environmental Quality Act, and General Plan Updates: Straightforward Answers to Some Frequently Asked Questions, California Attorney General's Office (Rev. 3/06/09). CAL FIRE also opines that it has more than adequately addressed the spirit and content of the guidance that was given to the BOF in the powerpoint presentation that was presented at the February 2009 Board meeting. This Resource Agency presentation was given to the BOF to communicate to that body the rulemaking process being undertaken by the OPR in addressing the matter of how projects will be evaluated and reviewed pursuant to CEQA and to communicate the responsibilities of the Board and the Department. While the Department has used every authority it could muster to evaluate the project for the production of GHG and has required a willing and concerned THP applicant to also address this matter even in the absence of actual specific BOF rule language. Ultimately the BOF is the body that has the responsibility for promulgating regulatory language regarding THP content and analysis that the Department would then be responsible for enforcing once new regulations relating to GHG were adopted by the BOF via a publicly conducted hearing process.

Likewise, with respect to the mention in Concern #9 of the January 2009 opinion letter from the office of the Attorney General of the State of California dated January 5, 2009, the opinion was sought by the BOF and was not a product of the Department (as witnessed by the title of the document: Confidential-Privileged Attorney-Client Communication and Work Product, from the office of the Attorney General and addressed to the Board of Forestry and Fire Protection). As the BOF is the agent that will eventually have the opportunity to promulgate regulations that are consistent with the findings of the January 2009 letter, the Department at this time has only a limited role in the findings as the Department is charged with enforcing the rules of the BOF after rules are adopted and not before. The opinion itself was sought by the BOF in consideration of whether there was regulatory support for the concept of requiring restoration of forest values in the case of so-called "Threatened or Impaired" watersheds. The BOF had previously gone very slowly into the area of requiring forest landowners to make expensive improvements to existing conditions in the watershed, and instead had focused on requiring conditions to not decline any further. It is still not clear how widespread they will choose to apply the findings of the January 2009 letter and whether or not they would apply outside the "Threatened and Impaired" watershed category or even if they will apply them to this category at all. These decisions will be made in a public rulemaking process with ample opportunity for stakeholders and the public to comment. When that process is complete and rules are promulgated and adopted, the Department will be then charged with the duty to enforce the resulting rules on the appropriate THP projects. Meanwhile, the Department understands it's obligations under the existing rules of the BOF and the other applicable regulations to weigh the twin goals of protection of forest resources and production of forest products during the review of this and other THP projects. Already and for a very long time, the majority of the time that CAL FIRE spends on review of THP projects revolves around the protection of forest resources, including but not limited to, water quality and watershed protection, protection of rare, threatened and endangered populations of plant and animal species, protection of non-listed biological resources, avoidance of erosion and sediment production and loss of road surface materials, long-term maintenance of roads, protection of archaeological and historical resources, issues related to air quality, noise, and traffic and the aesthetics of the project as viewed by substantial numbers of the public. In fact, the Department and its employees feel like they spend precious little time indeed on matters relating to the actual production of forest products.

CAL FIRE as lead agency has itself concluded that the content of the THP conforms to the rules of the BOF with respect to the information provided on so-called "large trees" and/or the information in general about tree sizes and ages. The rules of the BOF in 14 CCR Sec. 1034 fully discuss the information requirements of a THP, as follows: The plan shall serve two functions: to provide information the Director needs to determine whether the proposed timber operation conforms to the rules of the Board; and to provide information and direction to timber operators so that they comply with the rules of the Board. For the plan to serve these functions, it shall, as a minimum, contain the following information:

(a) Name, address, and telephone number of the timber owner(s).

(b) Name, address and telephone number of the timberland owner(s).

(c) Name, address telephone number, and license number of the timber operator(s).

(d) Name, address, and telephone number of a person to be contacted on the operation who will be responsible for the conduct of the timber operation. If unknown at the time of plan submission, it shall be provided prior to the start of timber operations.

(e) Name, address, and telephone number of the plan submitter. If the submitter is not a person indicated in (a), (b), or (c) above, an explanation of his/her authority to submit the plan shall be provided.

(f) Name, address, telephone number, and registration number of RPF who prepared the plan. The plan required for timberland conversion does not have to be prepared by an RPF, *[ref. PRC 4622]*.

(g) A description of the plan area within which timber operations are to be conducted. The description shall include the following:

(1) U.S. Geological Survey (USGS) Quadrangle name(s) and date(s),
(2) township, range, and section number(s),
(3) county name(s),
(4) CALWATER 2.2 planning watershed number(s), and
(5) approximate acreage.

(h) The forest district and subdistrict (if any) in which the timber operation is located.

(i) Whether a timberland conversion certificate is in effect, its date of expiration, and its identification number.

(j) Whether a plan is on file with the Department for any part of the plan area for which a Report of Satisfactory Stocking has not been issued by the Department (show plan number).

(k) Expected dates of commencement/completion of timber operations.

(l) The types of forest products to be harvested and if management of broadleaf or optional species is being proposed.

(m) Identity of the regeneration methods, intermediate treatments, special harvesting methods, alternative prescriptions, and any information specified by the district rules. Also for THPs that do not reference an approved Sustained Yield Plan, or do not demonstrate achievement of MSP pursuant to 913.11(c), the following applies:

(1) The plan shall provide a description of the stand before and after harvesting including: volume, growth projection, stocking, and species composition.

(2) The Director may require such additional information as necessary and feasible to demonstrate how maximum sustained production of high quality timber products will be achieved for an ownership within a THP. **(n)** Type of yarding (logging) systems and equipment to be used. Yarding systems will be placed in one or more of the following groups:

(1) Animal
(2) Tractor, skidder, forwarder
(3) Cable
(A) Ground-lead
(B) High-lead
(C) Skyline
(4) Balloon, helicopter
(5) Other, as explained in the plan

(o) Explanation and location of new roads wider than single lane with turnouts.

(p) Whether the RPF has informed the timber owner, timberland owner and timber operator of their responsibilities for compliance with the stocking requirements of the Act and rules, and for maintenance of erosion control structures.

(q) Whether the RPF will be supplying the timber operator with a copy of the approved THP.

(r) How the requirements of 14 CCR 1032.7(f) are to be met.

(s) If an archaeological survey has been made on the area to be harvested.

(t) If there are any recorded archaeological or historical sites in the area to be harvested, and how the sites are to be protected if they exist.

(u) Where the timber owner or timberland owner has not signed the plan, indication that written notice of such plan has been given to either or both of these persons, as required by 14 CCR 1032.7(b).

(v) Whether there are any adverse insect, disease, or pest problems in the plan area and what mitigating measures, if any, will be used to improve the health and productivity of the stand.

(w) Information on the presence and protection of known habitat or individuals of any listed species and information on the presence and protection of non-listed species which may be significantly impacted by the timber operation.

(x) On titled USGS (if available) or equivalent topographic maps of a scale not less than 2" to the mile, the information in subsections (1-4), (8), (9), and (11-13) shall be clearly shown. Additional maps, which may be topographic or planimetric, may be used to provide the information required in the other subsections or show specific details, to improve map clarity. The appurtenant roads referenced in subsection (4) may be shown on a map which may be planimetric with a scale as small as one-half inch equals one mile. Color coding shall not be used. A legend shall be included indicating the meaning of the symbols used. See the district rules for the appropriate minimum mapping acreages.

(1) Boundaries of logging area (shall be shown on quadrangle map or its equivalent).

(2) Boundaries of regeneration methods, intermediate treatments, special harvesting methods, and alternative prescriptions that are to be applied.

(3) Boundaries of yarding (logging) systems, if more than one system is to be used.

(4) Location of public roads and those private roads to be used for timber operations within the plan area, and private roads appurtenant to the timber operations where such roads are under the ownership or control of the timber owner, timberland owner, timber operator, or submitter of the plan, and classification of all proposed and existing logging roads as permanent, seasonal, or temporary roads.

(5) Probable location of proposed and existing landings in the watercourse and lake protection zone, and landings outside the zone that are greater than 1/4 acre in size or whose construction involves substantial excavation.

(6) Road failures on existing roads to be reconstructed.

(7) Location of all watercourse crossings of classified watercourses except temporary crossings of Class III watercourses without flowing water during timber operations at that crossing.

(8) Location of erosion hazard rating areas, if more than one rating exists.

(9) Location of all watercourses with Class I, II, III, or IV waters.

(10) Location of known unstable areas or slides.

(11) Location of understocked areas prior to timber operations, and other areas not normally bearing timber to at least a 20-acre minimum, or as specified in the district rules.

(12) Location of boundaries of timber-site classes needed for determination of stocking standards to be applied, down to at least a 20-acre minimum or as specified in the district rules.

(13) Location of main ridge tops on the logging area suitable for fire suppression efforts that will require the felling of snags.

(14) Location of Coastal Commission Special Treatment Areas or any special treatment area.

(15) Location for which heavy equipment use is proposed on unstable areas, or on areas for which tractor use is proposed beyond the limitations of the standard forest practice rules.

(16) Location of any in lieu use of heavy equipment and location of roads other than crossings in the WLPZ, marshes, wet meadows, and other wet areas.

(17) Location of any new or reconstructed road segment(s) that exceed an average 15% grade for over 200 feet.

(y) Any additional information that is submitted on separate pages shall be clearly marked "plan addendum" and shall bear the date on which it was prepared.

(z) Explanation and justification for, and specific measures to be used for tractor operations on unstable areas, on slopes over 65%, and on areas where slopes average over 50% and the EHR is high or extreme.

(aa) Explanation and justification for tractor operations in areas designated for cable yarding.

(bb) Winter period operating plan where appropriate.
(cc) Explanation and justification for use of watercourse, marshes, wet meadows, and other wet areas as landings, roads, or skid trails.
(dd) Explanation and justification of any in-lieu practices for watercourse and lake protection.
(ee) Explanation of alternatives to standard rules for harvesting and erosion control.
(ff) Explanation and justification for landings that exceed the maximum size specified in the rules.
(gg) Any other information required by the rules or the Act to be included in the plan. The district rules provide for exceptions and alternatives to standard requirements that require inclusion of information in the THP.
(hh) Where roads, watercourse crossings, and associated landings in the logging area will be abandoned, the methods for abandonment shall be described.
(ii) On a map complying with subsection 1034(x), the locations and classifications of roads, watercourse crossings, and landings to be abandoned shall be shown.
(jj) A general description of physical conditions at the plan site, including general soils and topography information, vegetation and stand conditions, and watershed and stream conditions.

Within these regulations quoted above, there is not a requirement for detailed stand and volume information, and in fact, detailed information about stand inventory is considered by the Board to be a "trade secret", as shown in the following quote from the rules relating to a Sustained Yield Plan: "A discussion of the accuracy of the inventory data for the management unit and/or ownership. Inventory data, models and growth and harvest projections utilized for harvest scheduling projections shall be available for confidential audits by reviewing agencies along with the basis for such data, including but not limited to the cruise design and sample plot data and statistical validity of such estimates." Part of the purpose of a Pre-Harvest Inspection is to allow CAL FIRE and the responsible agencies the ability to observe stand conditions and to ascertain information that is not required to be displayed in the THP itself. For an Option "a", which for SPI is the document attached by reference to this particular THP, confidential trade secret information regarding detailed inventory data for the ownership in the Southern Forest District is allowed by the BOF to be submitted to CAL FIRE, but is kept separate from the publicly viewed portion of the Option "a".

Finally, CAL FIRE finds that other matters in the Concern #9 have previously been discussed in this Official Response. (see especially the Response to Concern #1 & #2)

10. Concern: **It was stated that he SPI statement fails to address the potentially great differences in GHG emissions from clear-cutting compared to less intensive harvest scenarios. Because the THP still does not address the impacts of clear-cutting, the THP's conclusions about carbon emissions are not meaningful and cannot substitute for the required cumulative impact analysis. Joy Road Area Forest & Watershed Assn. v. California Dept. of Forestry & Fire Protection (2006) 142 Cal. App. 4th 656, 676 ("[T]he cumulative impact analysis must be substantively meaningful. A cumulative impact analysis which understates information concerning the severity and significance of cumulative impacts impedes meaningful public discussion and skews the decisionmaker's perspective concerning the environmental consequences**

of the project, the necessity for mitigation measures, and the appropriateness of project approval."); Communities for a Better Environment v. California Resources Agency (2002) 103 Cal. App. 4th 98, 117 ("The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.") In addition, SPI relies extremely heavily on reference to the SPI paper (James, C., et al.) to dismiss concerns over the impacts of greenhouse gas emissions from their even-age management scenario. However, the SPI statement fails to address the issues raised by the Center with regard to the serious inadequacies of that paper. In particular, the SPI statement fails to address that: a) the James et al's conclusions are based on a comparison of incomparable management scenarios, and fail to include critical comparisons of alternatives; b) James et al's estimate of the carbon pool is incomplete, not scientifically valid, and not justified; and c) James et al used incorrect assumptions and statistics that biased the results in favor of intensive management.

Response: CAL FIRE makes the assurance that there was no "skewing" of the decisionmaker's ability to make an informed decision about the potential impacts of an even-age regeneration system vs. any other type of silviculture with respect to the issue of GHG emissions, as evidenced by the thorough discussion of these matters in this Official Response. All pertinent information was reviewed in arriving at a decision on this THP. The THP contains a thorough discussion of the background information that went into a decision to use the particular silvicultural system that was designed for the project on pages 50 to 57. SPI's Option "a" completed a full CEQA review, was approved by CAL FIRE, and contains the proof of long-term sustained yield and maximum sustained productivity as required by the Forest Practice Act and rules of the BOF. As discussed in the Response to Issues #1 through #8 above, there is no anticipation of significant environmental impacts from the project relating to the production of GHG, and therefore, no need to further mitigate the plan or look for alternative feasible silvicultural methods.

With respect to clearcutting, comments have been made to the ARB that clearcutting removes carbon from the forest and that replacement forest plantations do not sequester carbon at a rate equal to the stored carbon in the trees that are removed. However, the statement is general in that the fate of the removed trees in the form of forest products must be considered as well as the rate of growth of the forest stand in comparison to the rate of growth of the replacement plantation. The letter to the ARB states: "In the Forest Protocols wood products are treated as an optional carbon store. I believe this is completely appropriate for several reasons. While it is true that some of the carbon harvested from a forest is stored for a period of time it is not the case that this material is stored forever. Similar to other forest-related pools, it is the balance of inputs versus outputs that determines whether the wood products pool is increasing or decreasing. (M.E Harmon, 2007)." The plan itself notes that the existing stand is not growing at full potential. One benefit from removal of this particular type of forest stand is to replace it with faster growing, genetically improved trees. As stated in the comments to the ARB, "There is a grain of truth to the assertion that forests at a relatively young age do have the potential to take up more carbon than older forests. But it is also true that forests younger than this optimum age also take up less carbon. (M.E Harmon, 2007)." As stated in the study "Two Decades of Carbon Flux from Forests of the Pacific Northwest" regarding the ability of plantation trees to sequester carbon, "Although forest succession processes in the region are beginning to be understood, the mechanisms are complex and interactive. Under the natural regeneration regime that was common before the 1970's, closed-canopy conifer forests were expected to emerge approximately 30-40 years after harvest. The now-common intensive forest planting regime, which involves immediate planting of improved genetic stock and timely hardwood and brush control, has narrowed the estimated time to closed-canopy conifer condition to as little as 20 years. Thus, barring regeneration failure, most forests currently in an early-successional condition due to harvest activity are expected to return to closed-canopy conifer condition within the next two decades. (Cohen et .al., 1996)"

The question of whether or not clearcutting of an individual acre will have an adverse impact is best answered through a Life Cycle Analysis approach. The Department recognizes that Life Cycle Analyses utilizing even-aged silvicultural systems have not been done for California species. In the absence of California specific LCAs, the Department reviewed LCA results for conifer species managed under short rotation even-age harvesting regimes (Birdsey and Lewis 2002, Oneil et al 2007). In both cases the rotations evaluated were generally shorter than those which will be utilized by California timberland owners. In both cases the trends in carbon accumulation over one or a series of rotations show increasing sequestration. The Oneil data trends when the impact of substitution is factored in showed high levels of accumulated carbon and avoided emissions. Although wood product substitution does not permanently eliminate carbon from the atmosphere it can and does offset the use of more GHG-intensive fuels.

When leakage to account for replacement of wood products foregone from these stands as well as wildfire are factored into to a life cycle analysis, it is likely that unmanaged stands may show a net emission at some point in the future. From a policy perspective this may be an appropriate decision based on other resource or societal considerations, but it should not be assumed that from a GHG perspective that a decision to forego management of a forest stand is the best choice from a global warming and greenhouse gas reduction perspective.

Quoted from the report "A Carbon Budget for Forests of the Conterminous United States" is the following regarding the fate of carbon releases after harvesting; "Immediately after harvesting, woody debris is the largest pool. After one or two decades, woody debris has declined and the tree carbon pool has surpassed it. (Turner et. al., 1995)." While there was a concern stated in the above that removal of the trees themselves during harvesting comprised a large loss of stored carbon, the report "A Carbon Budget for Forests of the Conterminous United States" shows that, "Half of the total timberland carbon is in the mineral soil. Tree carbon, which includes coarse roots, is the next largest component at 33%, followed by woody debris (10%), forest floor (6%), and understory (1%), (Turner et. al., 1995)." However, looking at these percentages, the coarse root carbon is not removed from the site during harvest, the soil carbon is not entirely depleted during logging or reforestation, woody debris are often burned or left on site and incorporated into the soil, and the tree bole itself is turned into a product that continues to sequester carbon until it decomposes over time. There is a statement that "The carbon uptake associated with net annual growth is 331 Tg, however, much of that is balanced by harvest-related mortality (266 Tg) and decomposition of woody debris. The forest land base at the national level is accumulating 79 Tg/yr, with the largest carbon gain in the Northeast region. (Turner et. al., 1995)." Our forests continue to sequester large amounts of carbon, and in some cases, the private forestlands are doing a better job of sequestering that the public forests: "In the Pacific Northwest (West), where the age-class distribution on public lands was taken into consideration, private lands accounted for 65% of the net uptake but only 45% of the total timberland area. That difference is due to the greater productivity of the younger stands, which characterize private lands in this region. Sessions (1991) reported that 40% of the total area of public timberland in Oregon was greater than 150 years of age, while the comparable value for Douglas-fir stands on forest industry lands was about 5% [trees greater than 150 years of age] (Turner et. al., 1995)."

Comparisons of long rotation or no harvest scenarios to shorter rotations need to be done in light of leakage, wood products substitution benefits, low carbon fuel benefits associated with woody biomass, etc. All of these factors would need to be analyzed through a life cycle analysis comparison of the various management scenarios. These types of life cycle analyses have not been completed although it can reasonably infer that a relatively broad range of management scenarios can support high levels of sequestration. The Department's analyses of rotation length (Robards, 2008) while not exhaustive did indicate that a 50 to 80-year rotation length will capture a high proportion of the sequestration production capacity of a given site depending on site productivity. Decisions to require longer rotations need to balance the GHG implications with other resource values. For California privately owned timberlands production of wood products is recognized as one of the uses that will occur on these landscapes. (see also the Response to Concern #1 and #2 in this Official Response.

CAL FIRE has not relied heavily on the report from James, C et al. or given it any higher consideration than any of the myriad of other publications that were reviewed in preparation for a decision on this THP. The report, however, is interesting from the perspective that it is one of only a handful of studies that was actually done under California conditions. CAL FIRE understands that the publication will be undergoing peer review prior to publication in a professional journal. Perhaps as the publication undergoes the peer review process, the disparaging comments related in the second letter of concern from CBD will be either resolved, exposed or dismissed. Until that time, CAL FIRE notes that SPI's discussion in the THP did not seem to heavily rely on the paper either and notes that some 77 references were cited as studies that were reviewed during the formation of the SPI discussion on GHG found on pages 111.1 et seq. to 114.

11. Concern: **It was stated that SPI makes some unfounded conclusions with regard to climate change impacts on the forest ecosystem and vegetation growth rates. SPI attempts to dismiss the problem that their analysis ignores the impacts of climate change by first attempting to limit the discussion of the impacts of climate change to changes in growth rates, and second, by limiting the discussion of growth rates to changes in precipitation. SPI relies entirely on findings from a new model in Battles et al (2009), which projects an**

increase in pine yield over baseline by 2100. However, when reporting this findings, California Climate Action Team (2009)9 was careful to point out that these preliminary results come from a newly developed model that focuses on growth in a commercial pine plantation and are limited to a 50-year period, the results contradict earlier published results by Battles (2008) that projected a 25% reduction in growth rate, and that further evaluations are needed to better estimate the reliability of the new model. Climate Action Team (2009), page 1.13. Perhaps most significantly, Battles (2009) does not appear to differentiate between rain and snowfall in winter precipitation, and effects of declining snowpack. This is a potentially critical point, as Battles (2008) stated that, "The intensity and extent of the moisture deficit that develops during the summer are considered to be limiting factors in the growth and viability of Sierran conifers (Royce and Barbour 2001a). Higher summer temperatures in a Mediterranean climate (absent any changes in precipitation) could induce greater tree water stress through higher evapotranspiration rates and/or faster depletion of moisture in the soil profile. These changes would hasten the onset of drought stress that occurs in the late summer and early fall before the winter rains return. The result would be a shorter growing season due to lack of moisture, which is already recognized as a primary growth constraint on most commercial timber sites in Sierran forests (Royce and Barbour 2001b)." In addition, Climate Action Team (2009) cites Shaw et al. (2008) who found that "the impact of climate change on carbon sequestration depends in part on whether the future will be warmer and wetter ... or hotter and drier." One model projected "an increase in aboveground carbon for both the lower (B 1) and higher (A2) emissions scenarios above the baseline scenario (Figure 10). In contrast, the hotter, drier model (GFDL) projects much lower carbon stocks than the baseline scenario, with a marked drop around 2080 in the A2 emissions scenario. The climate future generated by CCSM3 results in an even sharper decline in carbon stocks over the 21st century, with the largest loss expected under the A2 scenario. By 2070 to 2099, carbon stocks could increase by 9 percent in the warmer, wetter future, or drop by 26 percent in the hotter, drier scenario." Climate Action Team (2009), page 1.15. SPI claims that "While some models indicate less snow and more rain, that still does not impact the forest vegetation's ability to continue to grow because the forest depends on water that is stored in the soil. . .It does not necessarily affect forest vitality because no runoff occurs until the soil has been recharged." This is not an accurate depiction of the scientific understanding of the climate change projections for California. The Intergovernmental Panel on Climate Change Fourth Assessment Report (2007)10 includes a compilation of more than 20 climate models, and projects an average annual temperature increase of2.5 to 3.5 C in California, with increases greater in the Sierra Nevada. Annual precipitation is projected to change only 0-5%, but summer precipitation is projected to decrease by as much as 15% while winter precipitation is expected to fall increasingly as rain, with decreasing snowpack. Hayhoe (2004) provides downscaled projections for California, projecting increases in winter temperatures of2-4 C in winter and 5510 C in summer in the Sierra Nevada. California Climate Change Center (2006) states that "if heat-trapping emissions continue unabated, more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring snowpack by as much as 70 to 90 percent." Again, this is a potentially critical point; as Battles (2008) stated that, "The intensity and extent of the moisture deficit that develops during the summer are considered to be limiting factors in the growth and viability of Sierran conifers (Royce and Barbour 2001a). Higher summer temperatures in a Mediterranean climate (absent any changes in precipitation) could induce greater tree water stress through higher evapotranspiration rates and/or faster depletion of moisture in the soil profile. These changes would hasten the onset of drought stress that occurs in the late summer and early fall before the winter rains return. The result would be a shorter growing season due to lack of moisture, which is already recognized as a primary growth constraint on most commercial timber sites in Sierran forests (Royce and Barbour 200 1 b)." SPI narrowly and incorrectly cites USCCSP (2008) as saying that forest growth rates will increase. "Although SPI did not assume any increased growth in our Option A modeling, with the available water we will likely see increased growth in young forests on fertile soils ... " SPI statement. However, this statement in USCCSP (2008) derives from IPCC (Field et al., 2007)12 which stated that "vegetation growing season has increased by an average of 2 days per decade since 1950 in Canada and the conterminous United States, with most of the increase resulting from earlier spring warming (Bonsal et al., 2001; Easterling 2002; Bonsal and Prowse, 2003; Feng and Hu, 2004). While this allows a greater period of growth and, thus, potential to increase productivity, earlier warming can also contribute to dryer conditions and increased potential for disturbance, both of which may act to offset the increases ... Easterling et al. (2007) cited research projecting short-term productivity increases in California forests, in the area available for productive softwood growth, through 2020 with reductions in the long run (up to 2100) (Mendelsohn, 2003) ... At lower elevations, however, growth was negatively correlated with summer temperature, suggesting water limitations. (Peterson and Peterson, 2001; Peterson et al., 2002 in Field et al., 2007)." (emphasis added)

Response: With respect to the changing findings from the Battles study cited in Concern #11 as reported in California Climate Action Team (2009), CAL FIRE has already discussed the uncertainty of the various projections for future climate conditions in California and elsewhere, especially in the Response to Concern #7 above. The California Climate Action Team (2009) admits using a newly developed model, showing that models themselves are evolving as are the presumptions that go into the models regarding the state of future climate in California. One of the summary statements in California Climate Action Team (2009) on page 1.34 is as follows: "The work summarized in this chapter constitutes ongoing research that will continue for the foreseeable future. It is clear, however, that the science on climate change, impacts, and adaptation needs for California is progressing in important ways. Major advances since the 2006 project have been made, including: Downscaling of global climate model outputs to produce greater resolution and thus more realistic climate change projections for the state; Understanding of the climate and terrestrial influences on global sea level rise and thus improve projections for the 21st century; Collection and analysis of data to better understand the state's regional and local exposure to changing climate risks such as floods or extreme heat; Understanding the impacts of climate change on crop yields for important commodities of California's agriculture; Providing more detailed insights into the complex challenges and clots involved in meeting future energy needs." It would appear from this statement and others already cited in this Official Response that this is an evolving situation with respect to the assumptions that can be made about future climate conditions.

Regarding statements in Concern #11 about decreases in summer rainfall, one wonders in a Mediterranean climate as we have in California, what that implies for future conditions given that we have so very little rainfall in the summer in the first place. Findings from the Weather and Climate Newsletter dated May 6, 2009 found at http://cdec.water.ca.gov/cgi-progs/products/WNewsletter.pdf show that the amount of rainfall normally falling in the northern Sierra is as follows:

October 6%
November 13%
December 17%
January 18%
February 16%
March 14%
April 8%
May 4%
June 2%
July less than 1%
August less than 1%
September less than 1%

Therefore, what exactly do the predictions of a 15% decrease in summer rainfall from the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007) mean for California's forests? This is practically tantamount to calculating that 15% of nothing is still nothing! A small decrease in summer rainfall, which is already not very significant given the overall rainfall occurring during a typical year, is likely not be very significant based on these predictions and applying them to the normal rainfall by month and season. If one assumes a 50" annual rainfall, which is the case for the example given above in the http://cdec.water.ca.gov website example, the three month normal summer rainfall would be 1.50 inches. Therefore the 15% decrease only comes to .225" of precipitation, or about a half a percent of the annual total precipitation. Given that California forests have evolved in a Mediterranean climate which typically has little normal summer rainfall, and in some years no summer rainfall, it seems likely that trees evolving in this situation would be adapted to handle a ½% shortfall in summer rain, especially where the future conditions do not show a dearth of rainfall for this area. While the Concern #11 above cites a decrease in precipitation as being a factor in modeled tree growth declines in Battles, the actual study on page 9 states, "Increased summer temperature was the primary driver of these changes. For this specific site, there was no trend in winter precipitation for any of climate scenarios (Figures 1 and 2.)" Indeed, both weather service projections used for future trends in precipitation as shown on the graphs showed no consistency and were "all-over-the-map", so to speak. In fact, the graphs showing future trends of precipitation from Figures 1 and 2 demonstrated a pattern of future precipitation that was very similar to the actual precipitation rates shown on the graph for the period of 1950 to present. Also the report states that the location of the projected data from the weather services was in an area that was both "warmer and drier" than the conditions observed at Blodgett Forest, which was studied in the Battles example. The projected-data-location near the intersection of Mosquito Road and Stope Road in El Dorado County and is warmer in the summer and in the winter than Blodgett Forest and has less rainfall, so it is not certain that this would make a significant difference in the outcomes of a model that utilizes projected climate data from that location. (see also the Response to Concern #7 above.)

As charged in Concern #11, the discussion by SPI in the THP does not seem to "entirely" rely on Battles (2009) any more than it "heavily relied" on the James, C et al. report as was alleged in Concern #10. Again, there are some 77 references cited by SPI in the GHG discussion in the THP. The new Battles (2009) findings, however, do show an increase in growth given the expected future conditions in California including temperature and rainfall expectations. (CAL FIRE has already quoted a memo received to the official record for THP 4-08-05/CAL-1 from Timothy Robards, CAL FIRE Division Chief – Forest Biometrician and one of the authors of the quoted Battles et al. 2006 in the Response to Concern #7). But there are other examples of studies that demonstrated likely growth increases, as is expanded in the next paragraph.

The research paper (Hayhoe, 2004) compliments the previous comments made by CAL FIRE regarding the uncertainty of future conditions and all the various modeled future conditions that are being used. (see also the Response to Concern #2 above) Hayhoe attempts to show the future conditions in California by displaying the results of both the highest and lowest IPCC emissions pathways for climate change and then displays the results of these using two different climate models. The report admits that the highest CO_2 limit was arrived at with the premise that there would be no worldwide effort to reduce GHG. Hayhoe then breaks the modeled future into two eras, one being the first part of the 21st century and the other being the second part. Hayhoe also displays maps of California that show with shading the expected climate impacts on various portions of the state when comparing 1961-1990 with 2070-2099 for both summer temperatures and winter temperatures for each of the models and for each of the future climate scenarios. From Table 1 in the report, summer temperatures range from a modest 1.2 C° to an extreme of 8.3 C°, while winter temperatures vary from an modest increase of 1.3 C° to a moderate increase of 4.0

C°.. Summer precipitation either increased a few millimeters, or decreased quite a few millimeters, while winter precipitation also either increased modestly or decreased markedly.

Concern #11 sites an example where SPI allegedly incorrectly cited the USCCP (2008) study by saying that growth rates will increase and that this statement derived from an IPCC (Field et al., 2007) study showing the growing season has increased by an average of 2 days per decade since 1950. However, CAL FIRE finds that this is not the only study that has shown a potential growth impact, including the aforementioned Battles (2009) just reported above. CAL FIRE has previously reported on studies that showed the potential growth effect of CO_2 fertilization and the growth effect of an earlier break in tree growth dormancy that occurs in a normal winter period, especially at elevation. In the interest of brevity, these examples will not be repeated here. (see instead the Response to Concern #7)

12. Concern: It was stated that SPI claims that reductions in carbon stored in duff and litter components are "short lived as the planted trees soon begin to augment this pool." SPI statement. For this assertion, SPI cites Baldocchi (2008), that states, "[i]n general, there is a large respiratory pulse from the ecosystem within a few years after disturbance. Many sites become carbon neutral within a decade, plus/minus a few years through natural and managed stand reestablishment - former plant colonies sprout from roots, pioneer species invade and establish seedlings/saplings, or managers plant new seedlings." Baldocchi (2008), p. 13. However, this use of Baldocchi (2008) inappropriately conflates the difference between short-term carbon flux and long-term carbon balance. SPI is confusing the point at which a site begins to sequester more carbon than it emits in a given year, with the point at which the forest cumulatively sequesters (stores) as much carbon or more than was released due to the disturbance. In fact, the timeframe noted in Baldocchi (2008) refers only to the point at which the annual carbon flux at the site turns negative (sequestering carbon), not the time necessary to overcome the negative carbon effects of the clear-cutting. In addition, SPI characterizes the Baldocchi (2008) study as "relating disturbance (both logging and fire) to age since disturbance; found on most sites that net carbon exchange from the atmosphere became negative .. .in 10 years or less." SPI statement. However, SPI fails to note that these findings include post-burn sites which Baldocchi (2008) identifies as likely to more quickly become carbon neutral than post-harvest sites. "There are some differences in the carbon-flux trajectory among sites that have been burnt and logged (Amiro et al. 2006). Burnt sites tend to produce a smaller, post-disturbance respiratory pulse than do logged sites. This is because burnt sites have many aerial snags that take several years to rot at the base, fall and come in contact with the wetter soil to begin respiration (Amiro et al. 2006). They may also experience a rapid recovery in photosynthesis, as do boreal forests when aspen stems shoot out from below ground roots. Logged sites, in contrast, have much residue on the surface and organic matter in the soil that readily decomposes (Law et al. 2003; Clark et al. 2004; Amiro et al. 2006)." Baldocchi (2008), p. 14. Furthermore, Amiro et al (2006) included only one harvested site, and found that site to be a significant net carbon source 8 years after harvest.13 In short, it appears that SPI's statement that "many sites become carbon neutral within a decade" relies entirely on data from post-bum sites, and ignores conflicting data from post-harvest sites. The SPI statement also fails to acknowledge that regardless of what happens in ten years, clearcutting is causing significant emissions, and hence, is a significant source of emissions as soon as the cut takes places. There is no question that the clear-cutting will lead to immediate carbon emissions, from all pools and from gray emissions, and it can take many years, if ever, for the forest to return to being a net sink of carbon emissions as opposed to a net source. Ryu et al. (2008)14 found that mechanical thinning increased soil respiration in a mixed-conifer Sierran forest. This is potentially substantial, considering that, according to Ryu et al. (2008): Carbon storage in belowground biomass is twice that of atmospheric carbon (C), and soil respiration (terrestrial RS: 136 _ 55 pg C yr_1), a major C pathway from the ecosystem to the atmosphere, is more than ten times that of C02 release through fossil fuel combustion (Raich and Schlesinger, 1992; Raich and Potter, 1995; Janssens et al., 2001; Lal, 2008). More specifically, forest soils contain about 45% of all belowground C, an amount equal to atmospheric C (Dixon et al., 1994; Johnston et al., 2004; Litton et al., 2003), and RS accounts for 67-76% of total forest ecosystem respiration (Janssens et al., 2001; Raich and Potter, 1995). The Center's initial comments raised the issue that clear-cutting reduces the carbon stored in forest soils and floors. The only comment in the SPI statement responsive to this point is the claim that unpublished research "indicates that there have been net gains in soil carbon irrespective of roots in the 15 years since the initial sampling [after clear-cut] ... Thus it is appropriate to assume that there is no significant emission from the belowground carbon pool, and in fact SPI management is likely increasing this carbon pool" SPI statement. However, the McFarlane study was not provided with the SPI statement, and therefore, because the public cannot assess it independently, this study cannot be relied upon. More importantly, the McFarlane study does not appear to directly address the issue of soil carbon loss due to disturbance· from clear-cutting. Clear-cutting potentially reduces carbon soil more significantly and for longer periods than selective harvest or other management scenarios because clearcutting exposes a greater proportion of the soil surface to direct sunlight, and soil treatment following clear-cutting on many SPI projects includes discing the soil several inches deep, leading to greater respiration rates and loss of subsurface carbon. Jandl et al

(2007) "reviewed the experimental evidence for long-term carbon (C) sequestration in soils as consequence of specific forest management strategies" and found that In the years following harvesting and replanting, soil C losses may exceed C gains in the aboveground biomass. The long-term balance depends on the extent of soil disturbance. In a comparative study, harvesting turned forests into a C source because soil respiration was stimulated, or reduced to a lesser extent, than photosynthesis (Kowalski et al., 2004). A scheme of C dynamics after harvest shows the almost immediate C loss that is followed by a slow recovery of the C pool. Measurement of net ecosystem C exchange showed that for at least 14 years after logging, regenerating forests remained net sources of C02 owing to increased rates of soil respiration (Olsson et al., 1996; Schulze et al., 1999; Yanai et al., 2003). Reductions in soil C stocks over 20 years following clear cuts can range between 5 and 20 t C/ha and are therefore significant compared to the gain of C in biomass of the maturing forest (Pennock and van Kessel, 1997). Continuous-cover forestry, including selective harvesting, resembles thinning with respect to its effect on the soil C pool, and is considered a possible measure to reduce soil C losses compared with clear-cut harvesting (ECCP-Working group on forest sinks, 2003). At the landscape level, longer rotation lengths with more old forests lead to higher C pools than short rotations with only young plantations. What is beyond dispute is that the formation of a stable soil C pool requires time. Avoiding soil disturbances is important for the formation of stable organomineral complexes which in turn are crucial elements in the process of C soil sequestration. Furthermore, Janisch and Harmon (2002), similarly addressed the impact of release of carbon from coarse woody debris (CWD) from harvest actions, and reported durations of several decades to return to cumulative sequestration in harvested old-growth. "Because CWD is ultimately oxidized unless it enters some form of permanent storage, stands should be treated as C02 sources at least until regenerating live tree mass balances the C02 debt generated by clearcutting. This point is critical because if the C fixation rate exceeds the C loss rate, stands with absolute C02 debts relative to pre-harvest C storage will register as C02 sinks during 'instantaneous' or short-term monitoring of NEP. When NEP accounting includes decomposition of all CWD, the source-to-sink transition changes to 27-57 years (Scenario 2), 38-165 years (Scenario 3) and 105-200+ years (Scenario 4) (based on mean live tree growth versus range of CWD)."

Response: Regarding the Baldocchi (2008) study, which is claimed in Concern #12 to be the basis for SPIs finding that many sites will change from a carbon emitter to a carbon sequester in ten years or so, the study reportedly averages burned areas with clearcut-logged areas. According to the study, burned areas are less of an emitter than clearcut-logged areas because snags are left on-site. CAL FIRE finds that this conclusion is not very realistic on California's private industrial timberlands because most responsible private landowners are going to make some effort to harvest the merchantable standing snags as a way of gaining some financial benefit from what would otherwise be a total loss. Pointing to this conclusion is language in the rules of the BOF that allow treatment of burned (or diseased and insect killed trees) to be logged using an expedited procedure that bypasses the normal submission and public review of a THP (i.e., EIR). This process is explained in 14 CCR Sec.1052 (et seq.) as follows: **Emergency Notice---**

(a) Before cutting or removing timber on an emergency basis, an RPF on behalf of a timber owner or operator shall submit a Notice of Emergency Timber Operations to the Director, on form RM-67 (9/99), or form RM-65 (1052.4)(1/1/08) for a Fuel Hazard Reduction emergency, as prescribed by the Director. The notice shall include, but not be limited to, the following:
(1) Names and addresses of all timberland owner(s), timber owner(s), and timber operator(s) for the area on which timber will be cut or removed.
(2) A description of the specific conditions that constitute the emergency, its cause, extent and reason for immediate commencement of timber operations.
(3) Legal description of the area from which timber will be cut or removed.
(4) A titled USGS (if available) or equivalent topographic map(s) of scale not less than 2" to the mile, or larger scale, showing the area from which timber will be cut or removed, the legal description, roads and Class I, II, III and IV watercourses, and yarding systems if more than one will be used.
(5) Yarding system to be used.
(6) The expected dates of commencement and completion of timber operations.
(7) A declaration by the RPF, made under penalty of perjury, that a bona fide emergency exists which requires emergency timber operations.
(8) A declaration by the timber owner, made under penalty of perjury, that any applicable timber yield taxes will be paid pursuant to Section 38115 of the Revenue and Taxation Code.
(9) Name, address, license number, and signature of the RPF who prepares the notice and submits it to the Director on behalf of the timber owner or operator.
(10) For Emergency Notices covering three acres or more in size, the RPF shall include a Confidential Archaeological Letter with the Emergency Notice submitted to the Director. The Confidential Archaeological Letter shall include all information required by 14 CCR §929.1 [949.1, 969.1](c)(2), (7), (8), (9), (10) and (11), including site records, if required pursuant to 14 CCR §929.1 [949.1, 969.1](g) and 929.5. The Director shall also submit a complete copy of the Confidential Archaeological Letter and two copies of any required archaeological or historical site records, to the appropriate Information Center of the California Historical Resource Information System within 30 days from the date of Emergency Notice submittal to the Director. Prior to submitting the emergency notice to the Director the RPF shall send a copy of the emergency notice to Native Americans as defined in 14 CCR §895.1.
(A) For projects filing an emergency notice for fuel hazard reduction under 14 CCR § 1052.4, archaeology requirements shall be conducted by a person possessing current certification pursuant to 14 CCR § 929.4 [949.4, 969.4].
(b) Timber operations pursuant to an emergency notice shall comply with the rules and regulations of the Board. A person conducting timber operations under an Emergency Notice shall comply with all operational provisions of the Forest Practice Act and District Forest Practice Rules applicable to "Timber Harvest Plan", "THP", and "plan".
(c) In-lieu practices for watercourse and lake protection zones as specified under Article 6 of the rules, exceptions to rules, and alternative practices are not allowed unless necessary to protect public health and safety.

(d) Timber operations pursuant to an Emergency Notice may not commence for five working days or 15 days for a fuel hazard emergency per 14 CCR §§ 1052.1(e) and 1052.4, from the date of the Director's receipt of the Emergency Notice unless such waiting period is waived by the Director. The Director shall determine whether the emergency notice is complete. If it is found to be complete the Director shall send a copy of a notice of acceptance to the timberland owner. If the Emergency Notice is not complete it shall be returned to the submitter. If the Director does not act within five working days, 15 days for a fuel hazard emergency per 14 CCR §§ 1052.1(e) and 1052.4, of receipt of the Emergency Notice, timber operations may commence.
(e) Timber operations shall not continue beyond 120 days after the Emergency Notice is accepted by the Director unless a plan is submitted to the Director and found to be in conformance with the rules and regulations of the Board, except for burning operations to treat fuels in accordance with § 1052.4(d)(6) which shall be completed by April 1 of the year following fuel creation.

1052.1 Emergency Conditions

The following are conditions that constitute an emergency pursuant to 14 CCR 895.1:
(a) Trees that are dead or dying as a result of insects, disease, parasites, or animal damage.
(b) Trees that are fallen, damaged, dead or dying as a result of wind, snow, freezing weather, fire, flood, landslide or earthquake.
(c) Trees that are dead or dying as a result of air or water pollution.
(d) Cutting or removing trees required for emergency construction or repair of roads.
(e) Where high, very high or extreme fuel hazard conditions, the combination of combustible fuel quantity, type, condition, configuration and terrain positioning, pose a significant fire threat on private timberlands. Cutting and removal of hazardous fuels, including trees, shrubs and other woody material, is needed to eliminate the vertical and horizontal continuity of understory fuels, and surface fuels, and/or crown fuels, for the purpose of reducing the rate of fire spread, fire duration and intensity, and fuel ignitability.
The following are conditions that constitute a financial emergency as defined in 14 CCR 895.1:
Potential financial loss of timber previously inoperable or unmerchantable due to one or more of the following factors: access, location, condition, or timber volume that has unexpectedly become feasible to harvest provided that the harvest opportunity will not be economically feasible for more than 120 days and provided that such operations meet the conditions specified in 1038(b)(1)-(10) and meet minimum stocking requirements at the completion of timber operations.

1052.2 Emergency Substantiated by RPF

The RPF preparing the Notice of Emergency Timber Operations shall describe the nature of the emergency and the need for immediate cutting in sufficient detail so that the reason for the emergency is clear. Where tree killing insects have killed and are likely to kill trees within one year on timberland an emergency is presumed to exist. Trees will be considered likely to die when they are determined, by an RPF, to be high risk by either:
(a) Risk classification systems including Smith et al., 1981; *The California Pine Risk-Rating System: Its Development, Use, and Relationship to Other Systems; In Hazard-Rating Systems in Forest Insect Pest Management*, Hedden et al, eds. USDA Forest Service General Technical Report WO - 27, pp. 53-69; Ferrell. 1989; *Ten-Year Risk-Rating Systems for California Red Fir and White Fir: Development and Use*; USDA Forest Service General Technical Report PSW-115, 12p.; or similar risk-rating systems recognized by the profession; or
(b) Where evidence of a current beetle attack exists (i.e., existence of boring dust, woodpecker feeding, or recent top kill) and these trees are within 100 feet of multiple tree kills. Such trees shall be marked by an RPF or the supervised designee before felling.

1052.3 Emergency Notice For Insect Damaged Timberlands

Emergency timber operations, under the presumed emergency standard of 14 CCR 1052.2, may be commenced provided an RPF is responsible for an on-site inspection, and tree marking when required by subsection (a):
(a) The emergency notice used with this section is to be used only for the harvesting of dead trees and those dying because of insect attack. Trees with green crowns that are to be harvested must be under insect attack which is likely to lead to mortality within one year, and shall be stump marked or otherwise designated by an RPF prior to cutting.
(b) A 60-day extension of an existing emergency notice may be submitted by a RPF where expanded or subsequent insect attack is occurring and it is explained and justified why the timber operation could not be completed during the first 60-

day period. *[NOTE: Section 1052.3(b) was made invalid by changes operative 1-1-98, Register 97, Number 48, to Section 1052.]*

1052.4 Emergency Notice for Fuel Hazard Reduction

The RPF preparing the Notice of Emergency Timber Operations for Fuel Hazard Reduction shall describe the nature of the emergency and the need for immediate cutting in sufficient detail so that the reason for the emergency is clear. Emergency timber operations, under the presumed emergency standard of 14 CCR § 1052.1, may be commenced and conducted when in conformance with the following:

(a) RPF develops and documents the vegetative treatments necessary to meet the goals of 14 CCR 1052.1(e), and ensures post harvest conditions are in accordance with all subsections in 14 CCR § 1052.4. Such documentation shall include the following:

(1) A description of the preharvest stand structure and statement of the postharvest stand stocking levels.

(2) A description of the criteria to designate trees to be harvested or the trees to be retained.

(3) All trees that are harvested or all trees that are retained shall be marked or sample marked by or under the supervision of a Registered Professional Forester before felling operations begin. When trees are sample marked, the designation prescription for unmarked areas shall be in writing and the sample mark area shall include at least 10% of the harvest area to a maximum of 20 acres per stand type which is representative of the range of conditions present in the area.

(4) Post harvest compliance shall be determined by the combination of physical measurements and observations. Post harvest compliance shall be met on at least 80 percent of the project area as calculated excluding WLPZs and other wildlife protection requirements developed in accordance with 14 CCR § 1052.4 (e).

(b) The conditions of subsection 14 CCR § 1038(b)(1) through (10) are applied or, for operations in the Lake Tahoe Basin, (f)(1) through (14) are applied.

(c) Geographic area: operations are permitted:

(1) Within ¼ mile from approved and legally permitted structures that comply with the California Building Code (legal structure). Such legal structures shall be within or adjacent to a community listed in the "California Fire Alliance list of Communities at Risk" (copyright date 2003 on file in the official rulemaking file and incorporated by reference) and have densities greater than 1 structure per 20 acres.

(2) Within 500 feet of a legal structures outside the area defined in 14 CCR § 1052.4(c)(1);

(3) Within 500 feet of either side of a public or federal road;

(4) Within 500 feet on either side of a private road providing access to legal structures;

(5) Within 500 feet on either side of a mainline haul road necessary for fire suppression or evacuation as identified in a fire prevention plan or with the written concurrence of a public fire agency and as accepted by the Director.

(6) Within 500 feet on either side of ridges suitable for fire suppression as identified in a fire prevention plan or with the written concurrence of a public fire agency and as accepted by the Director.

(7) Within 500 feet of infrastructure facilities such as transmission lines or towers or water conduits.

(d) Vegetation Treatments: Tree removal shall target understory trees. The residual stand shall consist primarily of healthy and vigorous dominant and codominant trees from the preharvest stand. Standards listed shall be met by retaining the largest diameter trees in the preharvest project area.

(1) The quadratic mean diameter of trees greater than 8 inches dbh in the preharvest project area shall be increased in the post harvest stand.

(2) Only trees less than 24 inches outside bark stump diameter may be removed except under the following condition. If the goal of fuel reduction cannot be achieved by removing trees less than 24 inches outside bark stump diameter, trees less than 30 inches outside bark stump diameter may be removed if that removal is necessary to meet the fuel objectives stated in 14 CCR § 1052.1(e).

(3) **(A)** Minimum post treatment canopy closure of dominant and codominant trees shall be 40 percent for east side pine forest types; 50 percent for coastal redwood and Douglas–fir forest types in or adjacent to communities and legal structures referenced in subsection 1052.4(c)(1) and (2); 60 percent for coastal redwood and Douglas–fir forest types outside of communities and legal structures referenced in subsection 1052.4(c)(1) and (2); and 50 percent for mixed conifer and all other forest types.

(B) Post treatment stand shall contain no more than 200 trees per acre over 3 inches in dbh.

(4) Stocking shall meet commercial thinning requirement of 14 CCR § 913.3 [933.3, 953.3] immediately upon completion of operations.
(A) In the High Use Subdistrict of the Southern Forest District where preharvest tree stocking does not meet commercial thinning requirement of 14 CCR § 953.3, the basal area minimum stocking standards for Selection Unevenaged Management in 14 CCR § 953.2 (a)(2)(A)1., 2., and 3., shall be met following harvesting.
(B) In areas where preharvest tree stocking does not meet commercial thinning requirement of 14 CCR § 913.3 [933.3, 953.3], and as necessary to establish or maintain an unevenaged stand structure, minimum stocking standards for Selection Unevenaged Management in 14 CCR § 913.2[933.2, 953.2] (a)(2)(A)1., 2., 3. and 4., shall be met following harvesting.
(5) (A) This subsection applies to geographic areas listed in 14 CCR § 1052.4 (c) (2) and (6), and to areas within 500 feet of structures in 14 CCR § 1052.4(c)(1). Surface and ladder fuels in the harvest area, including logging slash and debris, brush, small trees, and deadwood, that could promote the spread of wildfire shall be treated to achieve standards for vertical spacing between fuels, horizontal spacing between fuels, maximum depth of dead ground surface fuels, and reduction of standing dead fuels, as follows:
1. Ladder and surface fuels, excluding residual stand dominant and codominant trees, shall be spaced to achieve vertical clearance distance of eight feet or three times the height of the post harvest fuels, whichever is the greater distance, measured from the base of the live crown of the post harvest dominant and codominant trees to the top of the surface <u>or ladder</u> fuels<u>, whichever is taller</u>. **2.** Ladder fuels, excluding residual stand dominant and codominant trees, shall be spaced to achieve horizontal clearance distance of two to six times the height of the post harvest fuels measured from the outside branch edges of the fuels. On ground slopes of zero percent to 20 percent horizontal clearance distance shall be two times the height of post harvest fuels; on ground slopes of greater than 20 percent to 40 percent horizontal clearance distance shall be four times the height of post harvest fuels; on ground slopes of greater than 40 percent horizontal clearance distance shall be six times the height of post harvest fuels.
3. Dead surface fuel depth shall be less than 9 inches.
4. Standing dead or dying trees and brush shall generally be removed. Such material, along with live vegetation associated with the dead vegetation, may be retained for wildlife habitat when isolated from other vegetation.
(B) This subsection applies to geographic areas listed in 14 CCR § 1052.4 (c)(3), (4), (5), and (7) and to areas between 500 feet to 1320 feet of structures in 14 CCR § 1052.4(c)(1). **1.** Dead fuels<u>, excluding dead branches on trees retained stocking,</u> shall be treated to achieve a minimum clearance distance of 8 feet measured from the base of the live crown of the post harvest dominant and codominant trees to the top of the dead fuels.
2. All logging slash created by the timber operations shall be treated to achieve a maximum post harvest depth of 9 inches above the ground.
<u>(C) The requirements of this subsection shall not supersede requirements of PRC § 4291.</u>
(6) Fuel treatments shall include chipping, removal or other methods necessary to achieve the fuel hazard reduction standards in this section, and shall be accomplished within 120 days from the start of operations, except for burning operations, which shall be accomplished by April 1 of the year following surface fuel creation.
(e) As part of the preharvest project design, the RPF shall evaluate and incorporate habitat requirements for fish, wildlife and plant species in accordance with 14 CCR §§ 898.2, 916.9 [936.9,956.9] and 919. Such evaluations shall include use of the California Natural Diversity Database (as referenced by the California Department of Fish and Game, http://www.dfg.ca.gov/whdab/html/cnddb.html) and local knowledge of the planning watershed. Consultation with California Department of Fish and Game personnel is recommended. Examples of habitat requirements to be incorporated into the project include retention of large woody debris and snags congruent with emergency condition goals, and vegetative screening for wildlife cover and visual aesthetics.
(f) Operations conducted concurrently in the same geographic area (ref. 14 CCR § 1052,4(c)) pursuant to 14 CCR § 1038(b) shall not remove diseased trees in excess of the diameter limit required under 14 CCR § 1052.4(d)(2).

The quote from Concern #12 about the study (Amiro et al., 2006) finding that a harvested site was still a significant emitter of C at eight years after harvest was unfortunately done in a boreal forest site. CAL FIRE has already pointed out the fact that research considers there to be three different scenarios with respect to responses from disturbances to production of GHG, and these are boreal, tropical and temperate. The boreal condition has a much shorter growth season than California, different and not-as-developed soils, often permafrost and soaked upper soil layers in the summer season, etc. However, one of the conclusions of this study is that: "These data indicate that there is still a broad gap in our knowledge of carbon fluxes to forest stands between about 10 and 50 years of age." One would suspect that this statement is related to information gaps in boreal forests, but still it shows the lack of information that is still available to decision makers on the subject of GHG production or sequestration in this relatively new field.

CAL FIRE finds comments in Concern #12 about the carbon release from soils in clearcutting vs. other harvest methods to be of interest. These statements seem to imply that clearcut would open more soil surfaces to atmospheric release of C and to disturbance than other methods. However, this would possibly be the situation only if the area of timber operations were of equal size. And, if the areas were of equal size, the resulting amount of harvested volume and production of forest products would not be equal when comparing a clearcut with other harvest methods, just using simple mathematics and logic. Therefore, in order to produce the same economic benefit and make the volume of forest products that would be available for purchase by the public, the area treated by uneven-age or alternative methods would have to be much larger. (The purpose of harvest as described in the THP is to fill a supply and demand need. The plan is not proposing to cut down trees just to get rid of them!) With a larger area needed to fill the same supply and demand, there would therefore be an increase in road surface area needed to get around the larger area, increasing areas of bare mineral soil skid trails needed to yard the trees to a landing, and increases in the distances that logging equipment with fossil fuel engines would have to travel. Likewise, there would still have to be forest openings created in order to insure available space and water, soil, minerals, organics and sunlight resources for future seedlings to become established where they would then be available to sequester atmospheric CO_2. Potentially, these openings could remain "open" for a longer period of time than they would in clearcutting as the Forest Practice Rules do not actually require any restocking surveys for silviculture such as Selection. The only thing required is that there is the right amount of basal area retained and that a stocking survey (or more commonly, a wavier of stocking survey) be submitted within six months from the completion of timber operations. This six months requirement is most likely going to occur long before the emergence of any germinated seeds or resulting seedlings. Therefore, there is absolutely no assurance in the rules that there will be any seedlings to occupy the forest openings created by uneven-aged logging so that these disturbances could persist as emitters for quite a while. (see stocking rules in 14 CCR Sec. 1071). To the contrary, use of even-age methods requires a stocking survey to be submitted within five years from completion of the timber operation and, at that time, 300 pt. ct. of seedlings must be present that are two years of age, are "live and healthy", have at least 1/3 of its length in live crown, and be of a commercial species from a local seed source (as defined in PRC 4528(b) - "Countable tree"). Where even-aged regeneration harvest is used, these "countable tree" requirements will come from newly and promptly planted seedlings that are required by regulation to quickly occupy the openings created by logging.

The report by Ryu et al. (2008) studied a California situation to determine the fate of soil respiration with overstory thinning, understory thinning and no thinning and duplicated with the three thinning regimes with broadcast burning or no burning. The study is largely a "snapshot" in time (one month) and does not track the fate of C over time. Not too surprisingly, where the litter depth is high, a relatively high amount of C was lost to burning, especially with overstory thinning, although in absolute numbers, the loss was in terms of plus or minus 1% or so for the different treatments. A conclusion of the study was that: "Further study is needed to better understand the potential effects of different forest management practices on soil respiration and on changes in the biomass and activity of root and soil microorganism. Understanding the interaction between soil respiration and management can help us accomplish sustainable carbon management in forest ecosystems, as soil respiration is a major component of ecosystem respiration." The application of this study to the current THP is not known as the THP does not propose either overstory or understory thinning and there will likely not be extensive areas of broadcast burning for site preparation.

The study (Concilio et al., 2006) was done over a longer "snapshot" in time (3 years). However, this study was done in a thinning in an old-growth type in the Sierra and it is not known if the results are applicable to the stand found in the THP, which is a second or third growth that is not growing at a desired rate. One thing that the study noted was there was great variety in the results from year to year on the same site probably due to changes in yearly precipitation. ("Within our sampling period there was as much as 37% variation ($p = 0.0005$) between years in the undisturbed patches, which appeared to be driven by changes in precipitation.") Again, the application of this study to the current THP is not known as the THP does not propose thinning, although one of the findings of the study is that more intense disturbance results in more soil respiration as compared to less disturbances in relative terms. In absolute numbers, however, the differences appear to be small as displayed in the graphs in Fig. 3.

The paper (Jandl et al, 2006) is more of a search of existing research than any actual study on a particular area. The paper shows examples of studies that have found more loss of C with higher levels of harvest disturbance, as well as contrary findings. One of the quotes from the paper is that: "A review of harvesting techniques suggested that the effect on soil C is rather small, on average, and depends on the harvesting type (Johnson and Curtis, 2001). Whole-tree harvesting caused a small decrease in A-horizon C stocks, whereas conventional harvesting, leaving the harvesting residues on the soil, resulted in a small increase. Although soil C changes were noted after harvesting, they diminished over time without a lasting effect. In general, different harvesting methods had a far greater effect on ecosystem C due to its effect on the biomass of the regenerating stand, and a weaker effect on soil C (Johnson and Curtis, 2001; Johnson et al., 2002). "Also of interest with respect to fire-prone forest types was the quote: "Recommendations for forest management need to consider the regional disturbance regime. Fire has always played an integral role in the structure and function of forest ecosystems, especially in seasonally dry forests (Fisher and Binkley, 2002). The policy of fire suppression can delay but cannot prevent wildfires over the long term. It leads to an apparent net C accumulation that in fact increases the risk of large C release during catastrophic fires." Regarding the C effect of intensive site preparation, such as is proposed in the current THP, the paper states: "Intensive site preparation methods might result in increased nutrient losses and decreased long-term productivity (Lundmark, 1988). **In most of the reviewed studies biomass production was favored by site**

preparation and this effect may balance or even outweigh the loss of soil C in total ecosystem response." (emphasis added) Finally, quoted from the report: "Even though single old-growth forests can have impressive rates of C sequestration, we are skeptical with respect to the role of elongation of the rotation period of forests. Forests beyond a certain age are susceptible to disturbances. The aboveground productivity declines with age (Ryan et al., 2004). Openings in the canopy are closed more slowly than in younger stands and old stands are therefore more vulnerable to windthrow. Limits in the expectable life span of forests are evident from records of long-term experimental plots. Only a few of these studies can be continued over decades, where as most stands disintegrate when they reach maturity (Johann, 2000). Recommendations for the elongation of the rotation period need to be based on experimental evidence obtained from a representative set of stands. **These trials still await implementation.**" (emphasis added)

CAL FIRE has reviewed the literature on the subject of soil C loss and notes the findings from these studies are often done off-site or represent a brief period of time. There does not seem to be anything in these studies that would significantly conflict with findings made by the THP applicant that are specific to a particular THP situation. (see also the Responses to Concern #1 through #7 above)

13. Concern: It was stated that SPI inappropriately refers to the California Climate Action Registry (CCAR) as justification for SPI's estimates of carbon sequestration. "The 100-year permanency period is the same as that used by the California Climate Action Registry for its analysis of a permanent carbon offset." SPI statement. However, this is a mischaracterization of the CCAR protocols currently under revision. Contrary to SPI's assertion, the current CCAR revision has deliberately and specifically excluded wood products discarded in landfills, both because the estimates of carbon permanency in landfills is highly uncertain and disputed, and because attributing carbon offsets to carbon discarded in landfills creates perverse disincentives to diverting wood waste to much more responsible and carbon effective end uses. Furthermore, a recent literature review (The Wilderness Society 2009) found that approximately 18% of original live tree volume is actually incorporated into long-lived wood products. The remaining 82% waste would potentially result in emissions, as well as any portion of the wood products that are subsequently converted to emissions. In addition, SPI claims that "using [harvested] biomass to generate electricity and steam nets 16.25 tons of CO_2 benefits for each ton of CO_2 emitted in the collection process." However, this relies on an extremely optimistic set of assumptions, not disclosed by SPI. More importantly, this reduction in emissions occurs if (and only if) there is an assured reduction in the use of electricity and steam generated by fossil fuels, not identified in the THP. Lastly, the THP includes no actual plans for biomass or co-generation facilities.

Response: Whether the CCAR report discounts the permanency of carbon sources stored in landfills or not, there are certainly many references that would offer the opinion that landfills can afford long-term storage of carbon sources. (see also the research citations in the Response to Concern #2) Actually, statements from the quoted Wilderness Society 2009 report also support that finding as follows: "Field tests near Sydney, Australia, confirm that solid wood may last for a significant time in landfills (Ximenes et al., 2008). Researchers estimated carbon losses based on the proportion of lignin in excavated wood that was buried for 19, 29, and 46 years. Wood buried for shorter periods appeared to decompose very little, while an estimated 17%-18% of initial wood carbon had been released from the 46-year sample." This seems like a pretty good storage rate, especially given that it is likely that a 46-year old landfill would not be as technologically advanced as a modern landfill. As reported earlier in this Official Response with respect to landfill construction as related to storage, the report by Skog and Nicholson (2000) pointed out: "If, when taken out of use, products are disposed of in a modern landfill, the literature indicates that they will stay there indefinitely with almost no decay." And "Wood and paper sent to landfills (or dumps prior to 1986) includes residue from solid wood mills (in very limited amounts), construction and demolition waste, and discarded paper, paperboard, and solid wood products. These same materials are sometimes burned with or without energy. Prior to 1972, most materials were placed in dumps....". In most cases, modern laws require the use of landfills for disposal of these material when prior to these laws, materials were exposed to the elements in dumps. (see other references to landfill storage rates in the Response to Concern #2 above).

Another "criticism" in the Concern #13 is that co-generation of electricity from wood waste is not actually planned for in the THP and yet it is claimed as a CO_2 benefit by the analysis in the THP from the plan submitter. With respect to this, one could argue that there is no requirement in 14 CCR Sec. 1034 co-gen production as an item in the THP. However, also available to the public are reports on this subject on the plan submitter website at http://www.spi-ind.com/html/operations_cogen.cfm. The information there states the following: "Sierra Pacific Industries turns "wood waste" into energy for California homes and businesses through eight state-of-the-art cogeneration plants. Together, these facilities produce over 150 megawatts of electrical power. That is enough power for 150,000 homes. Bark, sawdust, and other low-grade byproducts of the manufacturing process were burned or sent to landfills in the past. Today, SPI turns these materials into fuel for on-site cogeneration facilities. Wood waste from the forest is also utilized in the cogeneration process. Un-merchantable wood (small trees & branches) is selectively removed and processed to improve the remaining stand of timber in areas where trees are too dense and pose a fire danger. Clean renewable energy production and environmental stewardship go hand in hand. Some of the power produced is used to operate the mill where it is generated. Excess electricity is sold to local public utilities and to energy service providers, helping to reduce the nation's dependence on fossil fuels. Biomass power produces a number of societal and environmental benefits in addition to its displacement of fossil-fueled electricity generation, which is a benefit common to all renewable generation technologies. In brief, the biomass power industry provides an environmentally responsible means of disposal of about 25 million tons of woody wastes annually, turning waste materials into valuable electricity. It prevents the open burning of a substantial amount of these tons, mostly agricultural and forest residues, with the attendant massive amounts of air pollution. It provides an alternative to landfill disposal of a substantial portion of these tons, with its attendant consumption of landfill volume and resulting generation of landfill gasses."

Also available at the SPI website is a report titled "FOREST BIOMASS REMOVAL ON NATIONAL FOREST LANDS; A progress Report, November 17, 2008, prepared by: Placer County Chief Executive Office, Auburn, CA. and TSS Consultants, Rancho Cordova, CA" This project was done on 1,585 acres of USFS property near the SPI facility in Foresthill, CA and was done on 45 year old ponderosa pine plantations in need of thinning. The project shows the advantages of using modern methods of co-generation to both produce electricity from otherwise unmerchantable slash while at the same time minimizing the output of CO_2 through the use of technology. The study compared the pollution derived from open pile burning as compared to the co-generation facility. For PM10 production, about 106,000 lbs. would be produced from open pile burning as compared to 3,000 lbs from co-generation, or a reduction of 97.2%. For NOx production, open pile burning would generate more than 28,000 lbs. compared to 8.6 lbs for co-generation, or a reduction of 60.9%. For CO production, the comparison was 1,063,000 lbs compared to 523 lbs for co-generation, or a reduction of 98.4%. Finally, for non-methane organic hydrocarbons, the comparison was 106,000 lbs. compared to 53 lbs for co-generation, or a reduction of 99.7%. Conclusions of the study are that: "An overall reduction of 2,205 tons of GHG is achieved from the biomass-to-energy operations. Based on an assumption that an average passenger vehicle emits 5.75 tons ofCO_2e per vehicle per year, this overall reduction is equivalent to removing approximately 380 vehicles off the road. The project team is in the process of developing a formal biomass waste-to-energy GHG protocol for official issuance of GHG offset credits from these types of projects. The protocol will be based on the data gathering and calculations presented from this forest biomass waster recovery and utilization program." As discussed above, while this study or the above comments relating to the eight co-generation plants operated by SPI were not part of the THP, the information was readily available to the public via the internet website.

Finally it is important to note that the THP also states that regardless of collection and burning of wood waste to produce biomass electricity, the potential emissions from such residues left in the woods is completely offset by the fact that the SPI property is a net sink on an annual basis as demonstrated by their Option A. So if such activity were to take place the only outcome would be an even greater atmospheric carbon benefit than is going to occur by implementing this plan.

14. Concern: It was stated that SPI fails to address the fact that carbon sequestration would be greater if stands were not harvested, and that much sequestration is foregone as a result of clear-cutting. SPI asserts that its "forests are managed second- and third-growth forests and not old growth so we do not analyze converting an old-growth forest to a managed forest..." SPI statement. However, the question is not whether the carbon loss from this THP is equivalent to the harvest of an old-growth forest, but whether the stand would sequester more carbon if it were not harvested. For instance, as discussed in Hudiburg et al (2009): Decrease in NPP with age was not general across ecoregions, with no marked decline in old stands (200 years old) in some ecoregions. In the absence of stand-replacing disturbance, total landscape carbon stocks could theoretically increase from 3.2 + 0.34 Pg C to 5.9 + 1.34 Pg C (a 46% increase) if forests were managed for maximum carbon storage. Trends in NPP with age vary among ecoregions, which suggests caution in generalizing that NPP declines in late succession. Contrary to commonly accepted patterns of biomass stabilization or decline, biomass was still increasing in stands over 300 years old in the Coast Range, the Sierra Nevada and the West Cascades, and in stands over 600 years old in the Klamath Mountains. If forests were managed for maximum carbon sequestration total carbon stocks could theoretically double in the Coast Range, West Cascades, Sierra Nevada, and East Cascades and triple in the Klamath Mountains (Fig. 8). The SPI statement also declares that "[s]ome would assert that SPI could store even more carbon by not harvesting or harvesting by different silvicultural methods ... While, it may appear based on superficial analysis, that more wood could be stored by simply letting the forest continue to grow, that dangerous conclusion ignores the grave risks of wildfire and disease potential that such dense stocking creates." SPI statement. This statement incorrectly implies that the clear-cut harvest in this project significantly reduces the landscape-scale factors that affect wildfire and disease potential and that no harvest scenarios other than clear-cutting would achieve reductions in these risks. More importantly, this statement is unresponsive to the point that clear-cutting has significantly greater greenhouse gas impacts than other harvest scenarios, harvest scenarios that themselves can reduce risk from fire, etc. Mitchell et al. (2009), a study of the effects of various fire and mechanical thinning treatments on ponderosa pine and mixed-conifer forests of the Northwest, found that although fuel reduction treatments can be effective in reducing fire severity, "fuel removal almost always reduces C [sequestered carbon] storage more than the additional C that a stand is able to store when made more resistant to wildfire ... Fuel reduction treatments that involve a removal of overstory biomass are, perhaps unsurprisingly, the most inefficient methods of reducing wildfire-related C losses because they remove large amounts of C for only a marginal reduction in expected fire severity. (emphasis added)" In addition, Concilio et al. (2006)19 found that 2 years after thinning, soil carbon release had significantly increased, and suggested that thinning may contribute more to elevated C02 emissions than prescribed fire." The SPI statement cites Hurteau and North (2009) as purported evidence that harvesting sequesters more carbon than developing old-growth. "A recent publication addressing this question and clearly coming down on the side of active management suggests that management to produce large well-spaced pine forests (similar to SPI's management strategy) is the best overall carbon solution." SPI statement. However, this is a gross mischaracterization of that study. The applicable quote from Hurteau and North (2009) is: "Although the concept of restoring forests in the western US to some pre-settlement target may not be feasible as the climate changes, reducing fire severity and increasing and stabilizing tree-based C storage may be achieved with fuel treatments that promote low-density, large pine-dominated stand structures." It is completely inappropriate for SPI to compare a clear-cut and plantation system with the fuel treatments proposed in Hurteau and North (2009), which focused on fuels reduction and understory thinning with large-tree retention. Furthermore, it is critical to note that the Hurteau and North (2009) study is explicitly based on a comparison of carbon stores in response to a hypothetical, uniform, modeled fire. That is, Hurteau and North (2009) model which forest structures store the most carbon after a modeled fire, not "the best overall carbon solution" as SPI mischaracterizes it. Lastly, it is important to note that the Hurteau and North (2009) study does not include soil carbon stores, and models only a simulated uniform fire.

Response: The THP analyzes the "no project" alternative and states the reasons why this option is not beneficial in terms of fire control and reduced stand vigor with increasing mortality. The project as proposed is consistent with the Timberland Productivity Act, the Forest Practice Act and Forest Practice Rules, the acreage proposed for harvest by large landowners under individual Timber Harvesting Plans is generally zoned for timber production, and the timber operations comply with the provisions of the Forest Practice Act, California Environmental Quality Act, California Endangered Species Act, Timberland Productivity Act and other applicable statutes.

In addition, because the landowner owns more than 50,000 acres of timberland, the Forest Practice regulations require demonstration of Maximum Sustained Productivity (MSP) for their ownership which discloses for their desired management regime the inventory, growth and harvest for the ownership. This requires modeling to develop a Long Term Sustained Yield (LTSY) for the ownership. The LTSY estimates the inventory at the end of a 100 year planning period and predicts growth on that inventory. THPs submitted for the ownership are expected to be consistent with the management regime which supported the modeling for the LTSY calculation. The applicant has an approved Option "a" plan which denotes the type of silviculture that is expected to be practiced in order for the timberland to meet the objective of long-term sustained yield. The definition of MSP in the rules of the BOF includes the following "guarantee" for timberland owners who have an approved Option "a" plan: "...MSP will be achieved by: (1) Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values..." (14 CCR Sec. 953.11(a)) A "no project" alternative would not produce a yield of timber products specified by the landowner and the plan accounts for the "other forest values" mentioned in the regulations.

The project meets the legislative intent of PRC. 4512 including PRC 4512(c) as follows: "The Legislature thus declares that it is the policy of this state to encourage prudent and responsible forest resource management calculated to serve the public's need for timber and other forest products, while giving consideration to the public's need for watershed protection, fisheries and wildlife, and recreational opportunities alike in this and future generations. A "no project" alternative would not serve the public's need for timber and other forest products and the plan gives consideration to public resources as specified in the law.

With respect to the study (Hudiburg et al., 2009) mentioned in Concern #13, the quotation provided by the author of the concern contains an incomplete thought with respect to net primary productivity (NPP). Adding the remainder of the thought changes the thrust of the findings. In the paragraph below, CAL FIRE has added the excluded thought in bold and underlined font, as follows:

"Decrease in NPP with age was not general across ecoregions, with no marked decline in old stands (200 years old) in some ecoregions. In the absence of stand-replacing disturbance, total landscape carbon stocks could theoretically increase from 3.2 + 0.34 Pg C to 5.9 + 1.34 Pg C (a 46% increase) if forests were managed for maximum carbon storage. **<u>Although the theoretical limit is probably unattainable, given the timber-based economy and fire regimes in some ecoregions, there is still potential to significantly increase the land-based carbon storage by increasing rotation age and reducing harvest rates."</u>** No doubt the Sierra Nevada region is one of those fire prone ecoregions specified in the quote as can be interpreted from reading the study. The adoption of the Option "a" plan for SPI has increased rotation age for these stands as previously uneven-aged entries were being made on a level of once or twice a decade. Regarding the reduction of harvest rates from the quote above, CAL FIRE has previously documented a substantial reduction in statewide harvest levels from what was typical in 1990 and prior years. (see the Response to Concern #1 above). Also from Hudiburg et al.(2009): " Our results indicate that Oregon and California forests are at 54% of theoretical maximum levels (3.2 plus/minus 0.34 Pg C vs. 5.9 plus/minus 1.34 Pg C) given the absence of stand replacing disturbance. These theoretical levels are calculated using the mean trend of the data and account for variation in site quality, climate, and partial disturbance (i.e., thinning, insect outbreaks, and non-catastrophic fire). An increase of 15% may be possible in just 50 years. **However, these levels (if reached) may be unstable in high-frequency fire regions**." (emphasis added). CAL FIRE points out that, not only do the even-age units offer the ability to clean-up past accumulations of slash and debris that have resulted from decades of uneven-age harvest entries and fire suppression, which is required as part of the project to prepare the area for replanting, but the resulting plantations of twenty acres in size or less offer areas of less resistance to fire-fighting activities such as building fire lines. Additionally, SPI has actively engaged in the construction of fuelbreaks using the BOF Fuelbreak/Defensible space method from 14 CCR Sec. 953.4(c). An example of a THP that has used the Fuelbreak/Defensible Space method is the current THP 4-08-024/AMA-1 which contains 290 acres of this type of protection for forestlands and communities. There are numerous other examples from the files of CAL FIRE of situations where SPI has used this method to protect California's wildlands and thus hopefully aid in the ability of these timberlands to achieve increases in C storage. While Hudiburg et al.(2009) purports to show that there are continuous increases for live biomass over time up to a maximum stand age, the graphs in Fig. 2 and information in Table 2 really show that, for the Sierra Nevada at least, the actual gains in live biomass drop off considerably around or just before age 100. The increases are pretty flat after that time, and as shown in Table 2, almost all of the increases are shown to drop off after the "mature" stand age which is defined as somewhere between 80 and 200 years. For NPP, Fig. 4 shows likewise that nearly all of the NPP is achieved just before age 80 and Fig. 5 shows steadily increasing mortality in these Sierra Nevada stands. For private industrial timberland, this mortality is encouraged by the rules of the BOF to be captured and removed from the stand using incentives such as Emergency Notices and Exemptions. This capture also helps to sanitize the stand and keep diseases and insects from spreading to healthy trees as well as removing potential fuel for wildfire.

The discussion in Concern #13 speaks of a study by Mitchell et al. (2009), but again, this study was done in the Pacific Northwest which does in some cases have a very different fire regime than does the Sierra Nevada. This is especially true of stands in the report for the west Cascades and Coast Range ecosystem, but the report also looked at east Cascade ponderosa pine stands. There is perhaps some potential for these east-side stands to mimic some of the conditions found in the Sierra Nevada, such as a long summer growing season with little or no precipitation and a flammable brushy understory. For these eastside stands, instead of supporting the quote from Concern #13 ("Fuel reduction treatments that involve a removal of overstory biomass are, perhaps unsurprisingly, the most inefficient methods of reducing wildfire-related C losses because they remove large amounts of C for only a marginal reduction in expected fire severity."), the report found that "**With the possible exception of some xeric ecosystems in the east Cascades**, our work suggests that fuel reduction treatments should be forgone if forest ecosystems are to provide maximal amelioration of atmospheric CO_2...".

Comments about Hurteau and North(2009) from Concern #13) attempt to indicate that the "plantation management" of SPI is not going to produce the type of "low-density, large pine-dominated stands" described in the report as being the best kind of stands for reducing wildfire severity. However, the Option "a" for SPI lands in the Southern Forest District proposes to produce that kind of stand. From the THP itself: "The most profound effect of our management is an increase in the average tree diameter over time. Today, for example, the average diameter of a harvested tree on SPI lands in the Sierra Nevada is 22" at breast height. In 100 years, using our planned silviculture, the average tree at harvest will be 32" to 34" dbh. ...Data contained in SPI's Option "a" for each Forest District demonstrate that volume for all diameter classes greater than 18" dbh increases each decade for the projected next 100 years." While reported on a decade by decade increase, it should be recognized that this projected increase in total inventory and stored carbon actually occurs annually, so SPI at an ownership wide basis is net increasing its total carbon storage annually. The Option "a" containing demonstrations of these increases was approved by CAL FIRE and is made an attachment to the THP by reference. Also, the Hurteau and North (2009) paper quotes the following: 'Thinning trees from small size classes had little impact on tree-based C storage, but did raise the average height from the ground to the base of the live crown, a key factor in reducing fire intensity (Agee and Skinner 2005)." For the SPI ownership, thinning and spacing of plantation trees over time to control spacing is also part of the management regime.

SUMMARY AND CONCLUSIONS

The Department recognizes its responsibility under the Forest Practice Act (FPA) and CEQA to determine whether environmental impacts will be significant and adverse. In the case of the management regime which is part of the THP, significant adverse impacts associated with the proposed application over the 100-year sustained-yield planning horizon are not anticipated. Furthermore, based on the information provided in the Option "a" relative to increasing inventory and growth and research and modeling results reviewed by the Department, the Department has concluded that the impacts from implementation of this management regime will have a net benefit from a climate perspective.

CAL FIRE has considered that owners of large tracts of timberland (50,000 acres or more), including SPI, are required to have a management plan (an "option 'a' plan" or a Sustained Yield Plan) as per the Rules, code section 14 CCR 913.11[933.11, 953.11]. Growth and harvest must be balanced over time. The growth and yield calculations have been reviewed by the Department. These growth and yield plans demonstrate that for the majority of the land ownerships of 50,000 acres or greater that there will be an increase in standing volume and growth on these ownerships as a whole over time. Therefore the total amount of carbon stored in the forest trees over time will increase through the management regimes proposed under these plans. Each harvest leads to long term sequestration of carbon with the manufacture of wood products, primarily lumber. The Rules provide protection for soils, water and other resource values that also minimize the potential for loss of carbon storage elsewhere in the ecosystem (outside of the trees themselves). Protection measures for watercourses, sensitive wildlife species (fish and birds such as the spotted owl in particular) add to carbon storage through reduced harvest levels on portions of the managed landscapes.

CAL FIRE has considered that, if the stands were left unmanaged they would return to the "old growth" state and in that state would be sequestering more carbon. In isolation this argument may have some validity. However, timber management is not a closed system. Timber is harvested to meet a demand. In California the demand for wood products results in 5 to 7 billion board feet of lumber imports into the state each year. The impact of taking industrial timberlands out of production in California simply shifts the harvest to another state or country. Assuming a similar carbon balance for the stands where the imported products are grown and manufactured this would add additional use of fossil fuel for the transportation of the wood products into the state.

CAL FIRE has reviewed the potential impacts from the harvest and reviewed concerns from the public and finds that there will be no expected significant adverse environmental impacts from timber harvesting as described in the Official Response above. Mitigation measures contained in the plan and in the Forest Practice Rules adequately address potential significant adverse environmental effects.

CAL FIRE has considered all pertinent evidence and has determined that no significant adverse cumulative impacts will result from implementing this THP. Pertinent evidence includes, but is not limited to the assessment done by the plan submitter in the watershed and biological assessment area and the knowledge that CAL FIRE has regarding activities that have occurred in the assessment area and surrounding areas where activities could potentially combine to create a significant cumulative impact. This determination is based on the framework provided by the FPA, CCRs, and additional mitigation measures specific to this THP.

CAL FIRE has supplemented the information contained in this THP in conformance with Title 14 CCR Sec. 898, by considering and making known the data and reports which may have been submitted from other agencies that reviewed the plan; by considering pertinent information from other timber harvesting documents including THPs, emergency notices, exemption notices, management plans, etc. and including project review documents from other non- CAL FIRE state, local and federal agencies where appropriate; by considering information from aerial photos and GIS databases and by considering information from the CAL FIRE maintained timber harvesting database; by technical knowledge of unit foresters who have reviewed numerous other timber harvesting operations; by reviewing technical publications and participating in research gathering efforts and participating in training related to the effects of timber harvesting on forest values; by considering and making available to the RPF who prepares THPs, information submitted by the public.

CAL FIRE further finds that all pertinent issues and substantial questions raised by the public and submitted in writing are addressed in this Official Response. Copies of this response are mailed to those who submitted comments in writing.