4. Cumulative Impacts

4. CUMULATIVE IMPACTS

4-3 Cumulative contribution to Global Climate Change.

The proposed project would convert forests and grasslands to vineyards, a reservoir, corporation yard, and roads. According to the United States Environmental Protection Agency (USEPA, www.epa.gov) carbon sequestration rates vary by tree species, regional climate, topography, and management practices. In addition, soil carbon sequestration rates vary by soil type and cropping practice. In order to estimate the GHG effects of the project, CAL FIRE must analyze the difference between business as usual activities under current use for timber management and the effects of conversion of part of the site from forest to vineyard establishment plus change in management on rest of site from timber harvest to reserve.

~~The USEPA information states that reforestation of previously harvested lands results in sequestration of approximately 1.1 to 7.7 metric tons of carbon per acre annually.[i] Studies conducted at the Jackson State Forest in Mendocino County[ii] indicate that assuming the annual sequestration of approximately 2.0 metric tons of carbon per acre would be a reasonable expectation for the mixed coniferous forest located on the project site. Onsite vegetation is largely composed of second-growth forest; therefore, the reforestation sequestration rates currently apply. The USEPA information for grasslands indicates that carbon is sequestered at a rate of 0 to 1.9 tons per acre annually. Following conversion of the project site, cover cropping and "no till" agricultural practices would be implemented in the vineyard area. Conservation tillage has been shown to sequester approximately 0 to 1.1 metric tons of carbon per acre per year on croplands. As the project site would be practicing conservation "no till" agricultural practices, including cover crops, the vineyard areas should sequester carbon within or above the conservation tillage range. Furthermore, vines are woody vegetation that would also sequester carbon. As a result, both the forested areas and the vineyard areas of the project site would continue to absorb carbon from the atmosphere.~~

~~Carbon accumulation in forests and soils eventually reaches a saturation point, beyond which additional sequestration is no longer possible. This happens, for example, when trees reach maturity, or when the organic matter in soils builds up to saturation levels. Even after saturation, the trees or agricultural practices would need to be sustained to maintain the accumulated carbon and prevent subsequent losses of carbon back to the atmosphere.~~

Timber Harvest Operations

Out of a total of 324 acres, the proposed project includes the logging of an approximately 154~~171~~-acre timberland conversion area and develop~~ing~~ment of approximately 19 acres of grassland. The RPF for the project has performed detailed computations to estimate the total amount of greenhouse emissions that would result from all facets of the proposed on-site timber harvest operations. These computations were made by the RPF using CAL FIRE's recently released Greenhouse Emissions Calculator. The following section describes the methodology inherent in CAL FIRE's Greenhouse Gas Emissions Calculator (GHG Calculator) and the project-specific data entered into the Calculator by the RPF.

Greenhouse Gas Emissions Calculator Methodology

Standing Live Carbon

In order to determine the impact of the project on net sequestration of standing conifer and hardwood timber, an analysis of potential carbon sequestration under two scenarios was conducted. The first scenario involves carbon sequestration following a reasonable prediction of sustainable forest management on the project area ("No Project – Timber Resource Management Alternative"). The second analysis involves net carbon sequestration following implementation of the proposed conversion and creation of the reserve area.

The analysis was developed utilizing the CAL FIRE GHG Calculator which can be found at:

http://www.fire.ca.gov/resource_mgt/downloads/THP_GreenhouseGasEmissions_Calculator_061110.xls

Utilizing the CAL FIRE GHG Calculator, three sets of data were developed for the project area: 1) the conversion area, 2) the reserve area, and 3) No Project – Timber Resource Management Alternative (See Appendix R). The CAL FIRE GHG Calculator takes into account estimates of species percentage, current inventory, growth rates of hardwood and conifer timber, harvest volumes, emissions associated with harvest operations (chainsaws, tractors, loaders, log trucks etc.), emissions associated with milling of forest products, emissions required for site preparation (including removal of brush and stumps), and the amount of long-term sequestration stored in the wood products produced. The CAL FIRE GHG Calculator accounts for both above and below ground carbon in timber. The estimates provided in the CAL FIRE GHG Calculator of species percentage, current inventory and growth are based on professional judgment as no timber cruise has been conducted.

The analysis shows that for the 154 acres to be converted from timberland to vineyard, there will be a net loss of 24,223 Mg of CO_2e over the 100 year analysis period.[1] The 151 acres of forestland in the reserve area will sequester 95,796 Mg of CO_2e over the 100 year analysis period. It is unclear exactly when the amount of carbon stored in this reserve area would offset the CO_2e lost from the converted area, but it most likely occurs somewhere between years 40 to 50.

The "No Project – Timber Resource Management" analysis shows the amount of carbon sequestered in the 305 acres of forestland area (on the entire 324 acre property) if the conversion were not to occur and a periodic harvest be conducted as was the case in the past (i.e. business as usual). The calculations show that a sustainable harvest conducted every twenty years sequesters 52,388 Mg of CO_2e over the 100 year analysis period. Therefore, converting 154 acres of timberland while setting aside 151 acres of timberland in a reserve area, as is currently proposed, would result in an additional 19,185 Mg of CO_2e being sequestered over what would be sequestered if the current practice of a periodic harvest were to occur. Table 4-3 below shows these results in terms of Mg CO_2e and Mg C.

Table 4-3
Net Sequestration of No-Project, and Project Standing Live Carbon (> 8" DBH)

	Total Sequestration over 100 years Mg CO2e	Total Sequestration over 100 years Mg C	Annual per acre Sequestration over 100 years Mg C per Acre
151 acre Reserve Sequestration	95,796	26,126	1.730
154 acre Conversion Area Sequestration	-24,223	(6,606)	-0.429
Net Project Sequestration	71,573	19,520	
No Project – Timber Resource Management Sequestration (305 acres)	52,388	14,288	0.468
Net Difference	19,185	5,232	

[1] Metrics are as follows: Mg = one megagram or one metric ton, which is equivalent to about 2,204.6 pounds or 1.1 short tons. CO_2e is the equivalent weight of CO_2 per metric ton of carbon (C) expressed in metric tons. One metric ton of C is equivalent to approximately 3.67 metric tons of CO_2.

Other Carbon Pools

The CAL FIRE GHG Calculator addresses sequestration for standing live carbon in trees 8" DBH and larger. The analysis of sequestration and emissions must also address soil carbon, litter and duff, lying dead wood, standing dead wood, understory (brush or grass species), and non-merchantable standing live carbon (trees less than 8 inches DBH). With the exception of soil carbon, the other carbon pools are assumed to be on average static in the No Project – Timber Resource Management Alternative, thus there is no net sequestration or emission over time.

In order to determine the complete carbon sequestration picture, these other pools must be estimated. Based on the assumptions utilized with the CAL FIRE GHG Calculator, it is possible to determine the beginning live carbon stocks for the project area. The CAL FIRE GHG Calculator indicates that there is approximately 200 Mg of CO_2e (54.5 Mg C) per acre in the current standing stock of above and below ground conifer and hardwood timber. In order to estimate the relative percentage of carbon in each carbon pool, data from the FIA database for the 2009 California inventory was consulted[2]. The relative proportion of carbon for each carbon pool for private ownerships in the redwood forest type is shown in Table 4-4 below. This table shows that soil carbon, litter and understory carbon pools represent approximately 15%, 16% and 0.7% of all carbon pools, respectively.

Table 4-4
Carbon Pools for the Redwood Forest Type on Private Ownerships (FIA 2009)

	Soil	Litter	Standing Dead	Lying Dead	Understory[3]	Live Trees[4]	Total
Mg C per acre	22.04	23.97	6.42	10.27	1.05	82.91	146.66
% of Total Carbon	15%	16%	4%	7%	1%	57%	100%

Using the Redwood Forest Type percent carbon estimates from Table 4-4 with the CAL FIRE GHG Calculator estimate of 54.5 Mg/ac for above and below ground live carbon for live trees >8" DBH, Table 4-5 has been constructed to estimate the carbon content of all pools for the project area.

The project carbon stocks are less than those for the average of the redwood forest type derived (Table 4-4), but the assumption is made that the relative proportion of the carbon from the FIA data would be similar to that of the project area. However, since the project area is considerably less stocked and younger on average than the average stand estimated by the FIA data, we have assumed that the standing dead and lying dead pools are 30 to 40 percent of those predicted by

[2] http://fiatools.fs.fed.us/fido/index.html
[3] Above and below ground.
[4] Above and below ground 1" DBH and larger.

FIA, or 2 Mg C per acre (i.e., 0.3 * 6.42) and 4 Mg C per acre (0.4 * 10.27) respectively. The percentages of total carbon for the other pools were then adjusted slightly to account for these changes. Finally, a review of the FIA data indicates that approximately 6% of the total live tree carbon in the redwood forest type is found in trees < 8 inches DBH. Using the live tree carbon pool estimate from the CAL FIRE GHG Calculator of 54.5 Mg C per acre for trees >8" DBH, the total project live tree carbon pool is estimated at 57.98 Mg C per acre [54.5 ÷ 0.94(>8" DBH live tree carbon percentage)]. Live tree carbon <8" DBH is then estimated at 3.48 Mg C per acre (57.98 × 0.06). Based on these assumptions, the estimate of all carbon pools on the project area is shown in Table 4-5 below.

Table 4-5
Project Area Carbon Pool Estimates

	Soil	Litter	Standing Dead	Lying Dead	Understory	Live Trees <8" DBH	Live Trees >8" DBH	Total
Mg C per acre	15.41	16.76	2.00	4.00	0.69	3.48	54.50	96.84
% of Total Carbon	16%	17%	2%	4%	1%	4%	56%	100%

Note: The percentage of total carbon for each carbon pool shown in Table 4-5 differs slightly than the percentages for the average FIA data shown in Table 4-4 due to the lower estimate of standing and lying dead carbon on the project area as compared to the average FIA data.

Carbon Losses

The CAL FIRE GHG Calculator estimates losses from the live tree carbon pool >8" DBH, as well as approximately 2 Mg C of carbon losses from understory vegetation (understory and live tree <8" DBH pools from Table 4-5 above) removed as a part of site preparation. The CAL FIRE GHG Calculator thus already accounts for approximately 48% of the potential losses from the understory and live tree <8" carbon pools. The impacts on the other carbon pools due to conversion from forest to vineyard must now be estimated.

Soil Carbon Losses

The impacts of vegetation manipulation on soil carbon are complex, and are the least well understood component of the carbon cycle. The following discussion provides a conservative estimate of soil carbon impacts based upon the information obtained during the literature search.

Murty et. al.[5], 2002 indicates that soil carbon losses from forest conversion to cultivated land are around 20%. Soil carbon losses are rapid initially, but reach a new equilibrium within 5-10 years. Soil carbon in the soil occurs in two forms; mineral soil carbon, and forest floor soil carbon. Forest floor soil carbon storage is more susceptible to losses from the removal of vegetation, than is soil mineral carbon. Because deep ripping is not proposed as part of this project, impacts to

[5] Murty, D. et. al., "Does conversion of forest to agricultural land change soil carbon and nitrogen? A review of the literature," *Global Change Biol.*, 8: 105-123, 2002.

mineral carbon would be minimal.[6] These losses in soil carbon can be mitigated through the application of conversion methods and vineyard practices as described in the summary below. For this analysis, it is estimated that 25% of the soil carbon will be lost following conversion, which amounts to a slightly higher estimate of carbon loss than would be indicated by Murty et. al.

Losses from Other Pools

It is estimated that 100% of the carbon stored in litter will be removed on the portion of the site that is converted. The practice of placing cull logs and existing lying dead wood from the conversion area within the forest reserve during the conversion process is expected to decrease the potential for carbon losses from the standing dead and lying dead pools to 30%. The understory and small live carbon pools are estimated to be completely removed with the conversion. Because the CAL FIRE GHG Calculator already accounts for 48% of the potential losses from the understory and live tree < 8" DBH pools, these pools are only reduced by 52% in Table 4-6. Table 4-6 shows the estimated reduction in carbon for all of the pools based on the above assumptions.

[6] Deep ripping is practiced by using a ripper shank that penetrates 4-5 feet pulled by a D8 or larger tracklayer. This soil disturbing practice is not planned for the Fairfax Conversion project. It is important to note that deep ripping is not necessary for stump removal. Most stumps are small, and a typical, efficient method of removal is as follows:

- Cut the stem off 2-4 feet above the ground.
- Pull the stump and main roots using an excavator with thumb and gently shaking sideways while lifting.
- Minimum soil disturbance and maximum root removal occurs using this method.
- Larger stumps may require some digging around the base to free up the larger roots.

Shallow ripping is practiced using a smaller tractor and smaller set of ripper shanks that penetrate 18-24 inches into the ground. The tillage operation does not change the soil profile or bring material to the surface. It is used to break up any shallow hard pan to promote root penetration into the soil. In addition, rock removal will be negligible for the Fairfax Conversion project because the local Goldridge-variant sandy loam soils typically do not include rock in the profile.

Most roots in the soil profile will be in the approximate upper foot of soil. A typical method of root removal is to use a brush rake mounted on a dozer blade to selectively bring roots to the surface. The brush rake penetration depth is generally 12 inches or less, depending on the size of the dozer. A combination of mechanical raking and hand picking will result in removal of most of the objectionable residual root mass.

Normal industry-standard agricultural practices include discing a field in preparation for planting, to create a seed bed free of competing weeds. A typical disc penetrates the first 6-8 inches of topsoil during that operation.

The one-time site preparation activity of shallow ripping modifies soil structure to 18-24 inches, only about 12-18 inches deeper than the final field preparation activity of discing. Once the vineyard is set up, there should be no further tillage or soil disturbing activity.

Table 4-6
Projected Reduction in Project Area Carbon Pools from Conversion in addition to GHG Carbon Calculator

	Soil	Litter	Standing Dead	Lying Dead	Understory	Live Trees <8" DBH	Total
% of Carbon Lost	25	100	30	30	52	52	
Mg C per acre Lost	3.85	16.76	0.60	1.20	0.36	1.81	24.58

Note: values calculated based on those contained in Table 4-5. For example, Soil carbon pool reduction = 15.41 Mg C per acre soil carbon x 0.25 (percent) loss = 3.85 Mg C per acre soil carbon lost.

The loss of 24.58 Mg C per acre on the conversion area equates to an annual loss of 0.246 Mg C per acre per year over the 100-year analysis period (24.58 Mg C per acre/100 years; see Table 4-7).

In addition to losses of soil carbon due to the conversion of forest to vineyard, the sequestration of carbon from forest soils in the 305 acres of forest in the business-as-usual scenario, and the 151-acre post conversion reserve area must be included. Based on the range of soil sequestration values presented in Heath et. al.[7] for various forest management activities, the current soil sequestration rate is set at 0.197 Mg C per acre per year which is the medium rate of soil sequestration for a harvest scenario which lengthens rotations (see Table 4-7). The reserve area is given a sequestration rate based on the high rate of sequestration due to lengthening rotations or 0.484 Mg C per acre per year (see Table 4-7).[8]

Vineyard Sequestration

Approximately ~~171~~116 acres of the 154-acre timberland conversion area would ~~then~~ be developed as a vineyard, including the cover cropped paths between the vines. ~~Implementation of the proposed project would likely reduce the carbon absorption of the project site (See Table 4-3).~~

In a study that modeled California's 15 largest agricultural counties and divided each county into three crop types (i.e., orchards vineyards, and annual crops), it is noted that in the past half century the amount of carbon released into the atmosphere through agricultural practices has decreased due to changing agricultural practices.[9] For example, improved crop varieties and industrial fertilizer have increased crop biomass and the amount of carbon returning to soils,

[7] Annual carbon sequestration rates for forest soils were obtained from The Potential of U.S. Forest Soils to Sequester Carbon and Mitigate the Greenhouse Effect, Chapter 23, The Potential of U.S. Forest Soils to Sequester Carbon, by Linda S. Heath, John M. Kimble, Richard A. Birdsey, and Rattan Lal, 2003.
[8] Table 23.3 in Heath et al. presents sequestration rates in kilograms per hectare per year (kg/ha/yr). To convert to Mg C per acre per year, the sequestration values from Table 23.2 are divided by 2.47 acres per hectare, and then divided by 1,000 kg per Mg.
[9] David A. Kroodsma and Christopher B. Field, "Carbon Sequestration in California Agriculture, 1980-2000," in *Ecological Applications*, 16(5), 2006, pp. 1975-1985.

thus increasing soil carbon stocks. Kroodsma and Field found that carbon sequestration varied significantly between crop types and perennial crops sequestered more carbon than annual crops, with vineyards sequestering 24 g $C/m^{-2}/yr^{-1}$.[10] Kroodsma and Field also note that soil carbon sequestration varied significantly between counties and soil carbon sequestration was highest in counties with a high percentage of rice and/or perennial crops, and lowest in counties with few perennial crops and a high percentage of silage crops.[11]

Using the woody material and soil carbon sequestration rates for California vineyards in Kroodsma and Field, the post-conversion annual sequestration rate for the proposed 116-acre vineyard on the Fairfax Conversion project site was estimated in Table 4-7 below. The 116-acre vineyard area has the potential to sequester carbon in woody material from the vines, as well as soil carbon.

It should be noted that an important factor when considering soil carbon dynamics is soil respiration. According to a recent UC Davis study entitled "Effects of Land Use on Soil Respiration: Conversion of Oak Woodlands to Vineyards," it is noted that soil CO_2 efflux, or "soil respiration," is one of the more important components of ecosystem C budgets.[12] Soil respiration consists of organic matter oxidation, root respiration, and rhizosphere respiration (i.e., microbial consumption of root exudates and contents of sloughed cells) (Hanson et al., 2001).

Grasslands

Nineteen (19) acres of grasslands are located in both the current land use and the proposed project. Thus, the project has no effect on current carbon and GHG emissions and sequestration for the grassland area.

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[10] Kroodsma and Field, 1980. Note this assumes 4 g $C/m^{-2}/yr^{-1}$ in woody material and 20 g $C/m^{-2}/yr^{-1}$ in soils.
[11] Kroodsma and Field, 1980.
[12] Eli A. Carlisle, Kerri L. Steenwerth, and David R. Smart, "Effects of Land Use on Soil Respiration: Conversion of Oak Woodlands to Vineyards," *Journal of Environmental Quality*, 35:1396–1404 (2006), 1396. The study consisted of three oak woodland and three vineyard sites with known land use histories in the Oakville Region of Napa Valley, California. The vineyard sites were formerly part of the adjacent oak woodlands before their conversion to vineyards. The vineyards were converted directly from oak woodlands 30 to 32 years ago. As noted in the Conclusion section of the study, the investigation has shown that the study oak woodland sites lose significantly more soil CO_2 than adjacent vineyards. Cultural practices such as tillage and vineyard preparation had large impacts on soil organic carbon (SOC) pools and SOC distribution through the soil profile. Soil [CO_2] and CO_2 values from this investigation have shown that the respiration sources in the soil profile change with season and depth, and that soil moisture content has a large influence on soil respiration values. The authors' estimates point to the clear need to develop a more acute understanding of the contribution of belowground production in perennial cropping systems, as well as in the perennial systems from which they were converted. While the results of the study by Carlisle et al are not directly applicable to the Fairfax Conversion project site given the site's lack of oak woodland forest type, it raises the important question which has heretofore been little studied – that is, whether or not soil respiration would be greater in mixed evergreen second growth forests, such as the Fairfax Conversion project site, as compared to an established vineyard.

Summary of above Pre- and Post-Project Sequestration Analysis

Table 4-7 shows the average annual sequestration for the current use, and the project over a 100-year analysis period. Losses of carbon resulting from removal of standing live biomass and cultivation of soil are shown as annualized emissions. The net result of this comparison shows that the project does not result in a net loss of carbon sequestration over the 100-year analysis period.

~~Table 4-3~~ ~~Onsite Carbon Sequestration Estimates~~					
~~Current Use~~	~~Acreage (ac.)~~	~~Carbon Sequestration Rates (metric tons per acre per year)~~	~~Low Estimate (metric tons of carbon)~~	~~California Estimate (metric tons of carbon)~~	~~High Estimate (metric tons of carbon)~~
~~Pre-Conversion~~					
~~Forest (Reforestation rates)~~	~~305~~	~~1.1 to 7.7 (2.0 for California Estimate)~~	~~335.5~~	~~610~~	~~2,348.5~~
~~Grassland~~	~~19~~	~~0* to 1.9 (0.02 for California Estimate)~~	~~0~~	~~0.4~~	~~36.1~~
~~**Pre-Conversion Totals**~~	~~**324**~~		~~**335.5**~~	~~**610.4**~~	~~**2,384.6**~~
~~Post-Conversion~~					
~~Vineyard (Conservation tillage)~~	~~159~~	~~0* to 1.1 (Mid-range of 0.55 assumed for California Estimate)~~	~~0~~	~~87.5~~	~~174.9~~
~~Preserved Forest (Reforestation rates)~~	~~134~~	~~1.1 to 7.7 (2.0 for California Estimate)~~	~~147.4~~	~~268~~	~~1,031.8~~
~~Roads, ponds, etc.~~	~~31~~	~~0~~	~~0~~	~~0~~	~~0~~
~~**Post-Conversion Totals**~~	~~**324**~~		~~**147.4**~~	~~**355.5**~~	~~**1,206.7**~~
~~**Net Change (decrease in carbon absorption)**~~			~~**-188.1**~~	~~**-254.9**~~	~~**-1,177.9**~~

~~*Assumes that the soil is saturated with carbon.~~

~~*Sources:*~~
~~*Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture; 2005. Accessed on www.epa.gov June 2007.*~~
~~*Winrock International. Measuring and Monitoring Plans for Baseline Development and Estimation of Carbon Benefits for Change in Forest Management in Two Regions, March 2004. Accessed at http://www.energy.ca.gov/reports/CEC-500-2004-070/CEC-500-2004-070F.PDF on March 27, 2008.*~~
~~*Applied Geosolutions, LLC and Complex Systems Research Center, University of New Hampshire. Assessing Impacts of Rangeland Management and Reforestation of Rangelands on Greenhouse Gas Emissions: A Pilot Study for Shasta County, February 2007. Accessed at http://www.energy.ca.gov/2006publications/CEC-500-2006-108/CEC-500-2006-108.PDF on March 27,2008.*~~

Table 4-7
Onsite Average Annual Net Carbon Sequestration Estimates over 100-year Analysis Period

Current Use	Acreage (ac.)	Carbon Sequestration Rates (metric tons per acre per year)	Estimate (metric tons of carbon)
Pre-Conversion			
Forest	-	-	-
Standing live biomass	305	0.468[1]	142.88
Forest soils	305	0.197[2]	60.09
-		**Pre-Conversion Totals**	**202.97**
Post Conversion (Vineyard Operation)			
Reserved Forest (Streamside corridor and reserves)	-	-	-
Standing live biomass	151	1.730[1]	261.23
Forest soils	151	0.484[2]	73.08
Conversion (116 ac. vineyard, 38 ac. roads, ponds, etc.)	-	-	-
Standing live biomass	154	-0.429[1]	-66.07
All other pools	154	-0.246[3]	-37.85
Vineyard	-	-	-
Woody material	116	0.016[4]	1.86
Vineyard soils	116	0.081[4]	9.40
-		**Post Conversion Totals**	**241.77**
Net Change (increase in carbon absorption)			39.11 metric tons of carbon (144 metric tons of CO_2)

Notes:
[1] See Table 4-3 above.
[2] Annual carbon sequestration rates for forest soils were obtained from *The Potential of U.S. Forest Soils to Sequester Carbon and Mitigate the Greenhouse Effect*, Chapter 23, "The Potential of U.S. Forest Soils to Sequester Carbon," by Linda S. Heath, John M. Kimble, Richard A. Birdsey, and Rattan Lal, 2003.
[3] See Table 4-6 above.
[4] Annual carbon sequestration for vineyard woody material and soils was obtained from David Kroodsma and Christopher Field, "Carbon Sequestration in California Agriculture 1980-2000," *Ecological Applications* Vol 16, 1975-1985.

The vast majority of carbon loss would occur during the initial harvest and site preparation operations. However, as demonstrated above in Table 4-7, long-term sequestration to offset the initial spike in carbon release would occur throughout the planning period. In addition, the initial short term release of carbon would be partially addressed through the various methods/vineyard practices included in the project description (see Chapter 3 of the DEIR for more detailed information), such as:

- Utilizing chipped slash on-site will lessen the short term impact of carbon removals from the conversion area as the slash will not be burned.

- Supplementing large woody debris stocks on the reserve through to placement of cull logs and existing large downed logs from the conversion area
- Minimizing ripping (as noted above, deep ripping is not proposed)
- Planting/restoration of riparian vegetation

  As part of the implementation of the Timber Harvest Plan (THP), the applicant will implement a California native riparian planting plan to enhance the Patchett Creek riparian corridor, act as a filter for stormwater runoff from the proposed vineyards, and benefit biological resources along Patchett Creek.

  The objective of the riparian planting plan is to create a continuous riparian canopy along Patchett Creek. Species to be planted were selected based upon the species that now characterize the upper reaches of Patchett Creek on the project site. Species to be planted include interior live oak (Quercus wislizenii) and California bay (Umbellularia californica). Riparian planting will occur in gaps in the riparian canopy along Patchett Creek setbacks.

- Improved vineyard practices
- Use of vineyard cover crops

  As discussed above, the project involves the implementation of cover crops~~ and no-till practices~~. ~~Furthermore, grape vines are a woody plant that would absorb carbon. At this time a numerical model foranalyzing the carbon sequestration of vineyards is not available. However, the carbon sequestration rates for the vineyard area are likely to be on the higher side of the estimates shown in Table 4-3 because carbon sequestration in woody plants such as vines would be higher than in grasses~~. More specifically, as indicated in the Erosion Control and Mitigation Plan prepared for the proposed project, hillside vineyard rows and field avenues and perimeter roads (19 acres total) will include temporary and permanent cover crops. These permanent cover crops will be native species planted prior to October 15th.

The above analysis shows that the proposed project sequesters more carbon over the 100-year analysis period than the No Project – Timber Resource Management Alternative. This is due to the inclusion of the 151-acre forest reserve. As the redwood forest type has the potential to sequester carbon over long periods of time, the forest reserve creates the potential for significant carbon sequestration. Redwood forests in the North Coast of California have the capability of sustaining volume growth and in turn sequestration of carbon until stand ages of 80 to 100 years. Recent research indicates that redwood forests can continue to sequester significant amounts of carbon well past stand ages of 100 years. This analysis conservatively excludes increases in the standing dead and lying dead pools on

the 151-acre reserve over the 100-year analysis period. Although excluded from this analysis, increases in the standing dead and lying dead pools within the reserve would serve to increase the net sequestration of the project over time.

Vineyard Vehicle and Equipment Emissions

~~Logging and tilling would result in emissions of GHG through the use of tractors, logging trucks, and chainsaws. In addition, tilling and deep ripping of the soils would release carbon currently stored in the soil.~~ Following establishment of the project, vineyard operations would require the use of tractors and automobiles both for harvesting and transportation of workers.

Vehicles

The following is a general estimate of the yearly carbon dioxide creation of the proposed project based on the average employee vehicle miles traveled per day. The employee estimates are based on six months of peak harvest season trips, and six months of off-season trips. As noted in the *Transportation and Circulation* Chapter of the DEIR, Chapter 3.9, employee trips constitute home-to-work trips, lunch trips, errands, and other business trips. Ten percent of the employees are expected to carpool from home to work, while 50 percent are anticipated to carpool for lunch. Errands and other business would be expected to generate 0.2 trips per employee. To be conservative in the traffic analysis, TJKM assumed a high percentage of car ownership among seasonal workers. Based upon an average occupancy of three employees per car for carpooling, average employee traffic is estimated at 128 trips per day. ~~Estimates are not attempted for the use of tractors, power equipment, or large trucks. However, the numbers contained in Table 4-4 are still considered to be a conservative estimate of the proposed project's vehicle carbon dioxide production as the longest potential harvest season was presumed, and seven day work weeks were used on a year round basis.~~

As also noted in the *Transportation and Circulation* Chapter of the DEIR, Chapter 3.9, grapes are usually delivered in double gondola trucks carrying 22 tons of grapes each, or on flatbed trucks carrying 11 tons of grapes each. In order to estimate the number of trucks required to deliver grapes, a truck composition of 80 percent gondola trucks and 20 percent flatbed trucks was used. These assumptions are based on TJKM's familiarity and experience in studying similar vineyard projects in the area. On the average, each truck hauling grapes would carry 19.8 tons of fruit.

Using the TJKM formula, a 137-acre vineyard could yield up to 617 tons of grapes annually. This would require about 31 (= 617/19.8) trucks to haul the grapes during the harvest season. At an average harvest rate of 30 tons per day, approximately 21 maximum working days would be needed to harvest all 617 tons of grapes. The total number of weekday truck trips for the harvest season is approximately the total number of trucks divided by the number of weekdays for

the harvest, multiplied by two trips (one inbound and one outbound) per truck. The result of this equation is an average of two truck trips per day required during the harvest season. This analysis assumes a maximum of three truck trips per day during the harvest season.

As shown in Table 4-~~4~~9, the vehicle emissions generated by the proposed project would annually generate approximately ~~231~~296.8 metric tons of carbon dioxide. ~~The figure does not account for tractor emissions, small engine emissions (e.g., weedeaters), or the initial emissions associated with logging and conversion of the site.~~

During the construction phase of the vineyard the vehicle emissions would total approximately 19.7 metric tons of CO_2 (See Table 4-8(A)).

Equipment

Table 4-8(B) includes a comprehensive list of the types of motorized equipment that are anticipated to be utilized during vineyard preparation and subsequent operation and maintenance.

Reservoir Installation

Sod and topsoil would be salvaged and stockpiled in a designated work area. Grading work would be conducted by a licensed contractor hired by the owner and under the direction of the Geotechnical Engineer of record. The Geotechnical Engineer would monitor excavations and backfill and evaluate the engineering properties of the soil by compaction testing and other means deemed appropriate by the Geotechnical Engineer. The Civil Engineer responsible for the earthwork plan would provide grade staking and dimensional controls either in person or by direction of the contractor or a licensed surveyor. Earthwork would progress by excavation of embankment support keyways inspected and approved by the Geotechnical Engineer. Subdrain installation within the keyways is expected for control of any incidental shallow groundwater under the impoundment, with drainage by gravity flow to rock armored outlets. The keyway would be filled and the embankment created using compacted lifts of engineered fill under direction of the Geotechnical Engineer. Trenching and installation of concrete encased drain lines and overflow pipe would occur within the earthwork area at the appropriate locations and times. Fill material would be excavated from within the impoundment area. Earthwork cut and fill volumes are balanced, such that import or export of soil or bulk materials is not anticipated.

Table 4-8 A
Vineyard Development: Vehicle CO2 Generation

Vineyard Site Preparation (one-time occurrence)

Season	Employees	Total Weekly Round Trips	Total Round Trips for Duration of Phase	Average Miles per Round Trip	Total Miles Traveled During Phase	Total Gallons[1]	Total CO2 (pounds)[2]
Reservoir Installation (4 weeks)	8 [3]	11 [3]	44	50	2200	108.4	2102.5
Vineyard Development							
4 weeks for initial grading and excavation	2	5 [4]	20	50	1000	49.3	955.7
1 week for smoothing of soil surface	2	5 [4]	5	50	250	12.3	238.9
5 weeks for vineyard trellis installation	21 [5]	35 [6]	179 [7]	50	8950	440.9	8553.2
10 weeks for vineyard irrigation installation	21 [5]	35 [6]	350 [7]	50	17500	862.1	16724.1
6 weeks for planting of vineyard	31	52	312	50	15600	768.5	14908.4
						Pounds of CO2	**43482.8**
						Metric Tons of CO2 ~~Per Year~~ [8]	**19.7**

[1] Overall average fuel economy for passenger vehicles of 20.3 mpg utilized (weighted by vehicle miles traveled [VMT] for passenger cars and light trucks). Per "*Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle* ," US EPA, accessed online February 15, 2011 at http://www.epa.gov/oms/climate/420f05004.htm.

[2] 19.40 pounds of CO2 per gallon of fuel per "*Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle* ," US EPA, accessed online February 15, 2011 at http://www.epa.gov/oms/climate/420f05004.htm.

[3] Employee total for Reservoir Installation comprised of the following: 2 employees max per day (assume carpool) to operate equipment; an additional 4-6 personnel (i.e., 4-6 individual vehicle trips) per week for periodic visits by engineer, consulting se

[4] One trip based on assumption that 2 employees required to operate equipment during phase would carpool each day.

[5] Number of employees includes 20 person crew and 1 supervisor.

[6] Consistent with Traffc Study prepared for the Fairfax Conversion DEIR carpool assumption is 3 persons per vehicle. Therefore, for a crew of 21, total trips per day is approximately 7. This equates to 35 round trips per week.

[7] Methodology = 35 weekly trips x 5 week phase = 175 total round trips + 4 additional round trips for miscellaneous equipment delivery and inspection.

[8] ~~Carbon generation was determined as follows (Miles per season * 366 grams per mile / 1000 grams per kilogram / 1000 kilograms per metric ton). For carbon dioxide generation - Proposed Methodology to Model Carbon Dioxide Emissions and Estimate Fuel Economy, Accessed on www.arb.ca.gov June 2007~~. Total pounds of CO2 divided by 2,205 since there are 2,205 pounds in 1 metric ton.

Table 4-8 B
Vineyard Development: Equipment CO2 Generation

Reservoir Installation		
Equipment Type	**Number of Pieces of Equipment**	**Total Duration of Use (weeks at 30 hours per week)**
Bulldozer sized D4	1	2
Bulldozer sized D8	1	2
Excavator	1	4
Earthmoving scraper of 20-30 cubic yard capacity or off-road trucks if soil is too wet	2	4
Water truck	1	4
Self-propelled compactor	2	4
4WD or crawler ag tractor with disc	1	3
Backhoe	1	4
Concrete Truck	1	1
Vineyard Development		
Equipment Type	**Number of Pieces of Equipment**	**Total Duration of Use (weeks at 40 hours per week)**
Crawler tractor (D-8 or smaller)	1	5
Water truck	1	5
Trencher (irrigation system installation)	1	10
Backhoe (drainage system installation)	3	16
Labor force ATVs, trailers	4	16
Labor force gas powered hand tools - chain saw, trench compactor, generator, string trimmers, etc.	3	16
Dump truck - rock riprap, drain rock	2	3
Bobcat or loader - rock management, supplies distribution	1	10
Post-pounding tractor (vineyard trellis and irrigation system installation)	2	8
75-hp tractor (planting of grapevines)	2	2
Metric Tons of CO_2 Per Year (includes reservoir installation and vineyard development)[1]		**1153.12**

[1] Tons of CO_2 per year for each phase of vineyard development construction calculated using the URBEMIS 9.2.4 emissions modeling program, and converted to metric tons.

Table 4-9
Vineyard Operation: Vehicle and Equipment CO2 Generation

Vehicle Emissions: Vineyard Harvest Season
(Note: Harvest will not occur for first 3 years of project's operation due to vineyard establishment)

Employee Trips

Season	Employees	Total Daily Trips	Average Miles per Round Trip	Total Miles Per Day	Total Miles Traveled	Total Gallons[1]	Total CO2 (pounds)[2]
Harvest (183 days)	72 seasonal + 6 full-time	128 (i.e., 64 round trips)	~~25~~ 50 miles	3200	585600	28847.3	559637.4
~~Off Season (182 days)~~	~~6~~	~~10 (.077 x 128)~~	~~25 miles~~				
						Metric Tons of CO2 Per Year [3]	**253.8**

Gondola Trucks

Season	Employees	Total Weekly Round Trips	Total Round Trips for Duration of Phase	Average Miles per Round Trip	Total Miles Traveled During Phase	Total Gallons[1]	Total CO2 (pounds)[2]
Grape Delivery (6-7 days)	N/A	10 [4]	12	200 [5]	2400	118.2	2293.6
						Metric Tons of CO2 Per Year [3]	**1.0**

Equipment Emissions: Annual Operation and Maintenance

Equipment Type	Number of Pieces of Equipment	Total Duration of Use (annual in hours)
75 hp farm tractor	2	250
Harvest rental tractors (35hp)	2	250
Sump Pump Motor	1	250
ATV	2	250
	Metric Tons of CO_2 Per Year[6]	**41.97**
Total Vineyard Operation Vehicle and Equipment Emissions (Metric Tons of CO_2/Yr)		**296.77**

[1] Overall average fuel economy for passenger vehicles of 20.3 mpg utilized (weighted by vehicle miles traveled [VMT] for passenger cars and light trucks). Per "*Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle* ," US EPA, accessed online February 15, 2011 at http://www.epa.gov/oms/climate/420f05004.htm.

[2] 19.40 pounds of CO2 per gallon of fuel per "*Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle* ," US EPA, accessed online February 15, 2011 at http://www.epa.gov/oms/climate/420f05004.htm.

[3] Total pounds of CO2 divided by 2,205 since there are 2,205 pounds in 1 metric ton.

[4] 10 trips based on assumption that 2 grape delivery trips would occur per day = 10 per week.

[5] Based upon Artesa Winery being located approximately 100 miles from the project site.

[6] Tons of carbon per year for equipment calculated using the URBEMIS 9.2.4 emissions modeling program, and converted to metric tons.

Sources: For employees and traffic trips - *Traffic Impact Study for Artesa Vineyards Project* , 2004.

Vineyard Development

As discussed in the *Project Description* Chapter of the DEIR, Chapter 2, the applicant proposes to perform all land clearing and development activities during spring, summer, and fall months. Following subsurface preparation, organic material (e.g., roots with a one-inch or larger diameter) would be gathered by hand or mechanical means, and would be either piled and chipped or removed from the site. The soil surface would then be smoothed and/or re-contoured using tractor equipment. This operation would involve "floating" the soil with a blade to create relatively smooth fields suitable for planting. According to the applicant, the vineyard layout is designed to minimize the need for grading. Smoothing would take approximately one week and would require a crew of one to two people and the use of a crawler tractor (D-6 or smaller). A farm tractor would then disc the soil in preparation for planting. Field terrace, row, and avenue locations would be laid out following discing.

The vineyard trellises and irrigation system would be installed concurrently using post-pounding tractors, trenchers, and/or backhoes. The post-pounding tractor would place the vineyard trellis posts, and a trencher or backhoe would be used to install the irrigation pipeline trenches. These trenches would be roughly one foot wide and two feet deep, and would be backfilled after installation of the irrigation pipelines.

The rootstock chosen for planting of the vines would be drought-tolerant and provide deep rooting patterns. Planting would require a crew and a 60-hp tractor. Vineyard blocks would be pre-irrigated using the installed drip irrigation system; then holes would be dug to accommodate roots, the vines would be placed, and soil around the roots would be compacted to support the vines.

As illustrated in Table 4-8(B), the one-time vineyard development phase will generate an estimated 1,153.12 metric tons of CO_2 from equipment emissions. Therefore, the total amount of CO_2 emissions generated during the vineyard development phase is approximately 1,173 metric tons (1,153.12 Mt CO_2 for equipment and 19.7 Mt CO_2 for employee vehicles).

Vineyard Operation and Maintenance

This section pertains to the types of mechanical motorized equipment that is expected to be utilized during vineyard operation and maintenance activities, which excludes vehicle trips associated with harvest employees and grape delivery trucks; these vehicle emissions are addressed above in Table 4-9.

Vineyard Vehicle and Equipment Emissions Summary

As illustrated in Table 4-9 above, the annual CO_2 emissions in metric tons per year associated with vineyard operations, which will occur starting three years after the vineyard is planted, are 296.8 metric tons of CO_2.

In addition, while the "one-time" emission of CO_2 during the vineyard development phase will be approximately 1,173 metric tons of CO_2 (See Tables 4-8(A) and (B)), annualized over the 100-year analysis period, this amount would be equal to approximately 11.7 metric tons of CO_2 per year. In order to obtain a comprehensive picture of the project's total annual CO_2 emissions, the 11.7 metric tons per year must be combined with the projected annual operational emissions of 296.8 metric tons of CO_2. Therefore, the combined total amount of CO_2 generated annually by the project, assuming that the construction phase emissions are annualized over the 100-year analysis period, would equal approximately 308.5 metric tons of CO_2. Given the results of Table 4-7, that is, the determination that the project will sequester approximately 144 metric tons of CO_2 per year, the net amount of CO_2 expected to be generated by the project on an annual basis is 164.5 metric tons of CO_2.

Comparison of Project Climate Change Analysis to other Alternatives

Offsite Alternative

As discussed in Chapter 6, *Alternatives Analysis*, of the DEIR, the Offsite Alternative would differ from the proposed project only in the location of the conversion area. In trying to satisfy most of the important site criteria (soils, elevations, slopes, and solar aspects), the offsite location would likely be located in the area surrounding Annapolis, or south of the town along Annapolis Road.

The Fairfax Conversion project site has a set of natural features around which 151 forested acres are being set aside. These natural features include existing stream channels and unique plant and wetland habitats. Without the identification of a specific offsite alternative location, it is not possible to determine whether similar characteristics exist on other available sites in the Annapolis region that may be similarly conducive for set aside purposes. In addition, the Fairfax Conversion project site currently contains approximately 19 acres of grassland habitat that would be developed as part of the vineyard. Other available offsite locations in the vicinity meeting most of the important site criteria may be entirely forested, which would result in more timbered acres being converted as compared to the proposed project. Overall, the findings of the greenhouse gas emissions analysis for the proposed project – that the vineyard would ultimately sequester more carbon on an annual basis as compared to managing the site for periodic timber harvest – would be expected to also apply to the Offsite Alternative, unless a sufficient timber reserve area cannot be feasibly incorporated into the overall vineyard design.

Reduced Acreage Alternative

As discussed in Chapter 6, *Alternatives Analysis*, of the DEIR, the Reduced Acreage Alternative would strategically reduce project acreages in three areas to reduce impacts to adjoining properties and on-site biological resources. While the proposed project would establish reserves for biological and cultural resources, the Reduced Acreage Alternative would expand the reserves around the resources by eliminating certain vineyard units; thereby maintaining these sites in their natural state. The Reduced Acreage Alternative would reduce the overall vineyard area by 33.2 acres (24.6 percent) by eliminating Unit Areas 1(a-d), 3, and 4.

The reduction in vineyard acreage would result in the greater retention of forested acres on the project site. Incorporating a larger timber reserve in the Reduced Acreage Alternative is significant given the substantial sequestration potential identified for the reserve area in the project analysis included above (See Table 4-7). Given the larger reserve, the Reduced Acreage Alternative would be anticipated to sequester more carbon per acre annually than the proposed project. In addition, decreasing the extent of timber harvest would correspondingly reduce the initial, short-term release of carbon, which for the proposed project, is projected to be 26.58 Mg C per acre on the conversion area (See Table 4-6 above). However, it is important to remember that, for the project analysis, once the 151-acre forest reserve standing live biomass and forest soils, as well as the vineyard woody vines and soils, are taken into consideration relative to their ability to continue to sequester carbon, the project would ultimately result in an increase in carbon sequestration over existing conditions of 39.11 metric tons of carbon per year. Overall, however, the Reduced Acreage Alternative is anticipated to have fewer impacts to global climate change as compared to the proposed project.

Summary

As directed by SB97, the California Natural Resources Agency adopted Amendments to the CEQA Guidelines for greenhouse gas emissions on December 30, 2009. On February 16, 2010, the Office of Administrative Law approved the Amendments, and filed them with the Secretary of State for inclusion in the California Code of Regulations. The Amendments became effective on March 18, 2010. CEQA Guidelines section 15064.4, states that, in determining the significance of greenhouse gas emissions, a "lead agency shall have the discretion to determine whether to use a quantitative approach or to "rely on a qualitative analysis or performance based standards." Given the challenges associated with determining a reasonable and proper quantitative significance criterion for GHG emissions when one does not yet fully exist, CAL FIRE has exercised proper discretion (and acted in accordance with the CEQA Guidelines on GHG emissions) in utilizing a qualitative significance criterion for the current project.

Notwithstanding the lack of a governing GHG emissions threshold, as explained above, CAL FIRE, using the best available information available and acting in accordance with CEQA, has established the above-referenced qualitative threshold ("an action that would block implementation of an ARB established regulation to reduce GHG emissions") to assess project GHG emissions. (See CEQA Guidelines, § 15064.7(a) ["[a] threshold of significance is an identifiable quantitative, *qualitative* or performance level of a particular environmental effect…"] (italics added).)

Furthermore, OPR's Technical Advisory entitled, *CEQA and Climate Change Addressing Climate Change Through California Environmental Quality Act (CEQA) Review* acknowledges that no statewide thresholds have been established, and states that "[a]s with any environmental impact, lead agencies must determine what constitutes a significant impact….individual lead agencies may undertake a project-by-project analysis, consistent with available guidance and current CEQA practice." Lead agency discretion to select a proper significance threshold for assessing GHG emissions is also specifically allowed under the amended CEQA Guidelines for assessing GHG emissions that were issued by the California Natural Resources Agency.

In formulating a threshold to measure the project's GHG emissions, CAL FIRE recognizes that climate change is a global issue. The solution to global climate change is complex, requires consideration of many factors, and collaboration and cooperation on a large scale. Given the lack of a governing quantitative project-specific significance criterion for GHG emissions, CAL FIRE has properly chosen to use a qualitative significance threshold for the project.

As demonstrated in detail above, converting 154 acres of timberland while preserving 151 acres of timberland as is currently proposed would result in an additional 19,185 Mg of CO_2e being sequestered over what would be sequestered if the current practice of a periodic harvest were to occur over the 100-year analysis period. If we were to account for carbon losses from soils carbon and other pools in Table 4-6 as well, the proposed conversion is estimated to result in a loss of 24.58 Mg C per acre on the conversion area, which equates to an annual loss of 0.246 Mg C per acre per year over the 100-year analysis period (24.58 Mg C per acre/100 years; see Table 4-7). Yet, as shown in Table 4-7, once the 151-acre forest reserve standing live biomass and forest soils, as well as the vineyard woody vines and soils, are taken into consideration relative to their ability to continue to sequester carbon, the project would ultimately result in an increase in carbon sequestration over existing conditions of 39.11 metric tons of carbon per year. Finally, the analysis evaluates the total amount of CO_2 generated during all phases of vineyard development, which would generate a one-time emission of approximately 1,173 (1153.12 metric tons of CO_2 from equipment during vineyard development + 19.7 metric tons of CO_2 from vehicles during vineyard development) metric tons, or 11.7 metric tons of CO_2 on an annual basis if the construction emissions were to be annualized over the 100-year study period. This

amount, in combination with the annual amount of CO_2 generated during vineyard harvest operations of 296.8 metric tons per year of CO_2 (See Table 4-9) would equal 308.5 metric tons of CO_2. As discussed above, because the project will sequester approximately 144 metric tons of CO_2 per year, the net amount of CO_2 expected to be generated by the project on an annual basis is 164.5 metric tons of CO_2, which is considered less than significant ~~Currently, the project site serves as a carbon sink for emissions generated elsewhere. Following conversion the project site would continue to sequester carbon; however, the sequestration rate would be reduced as a result of the decreased tree cover. The combination of the reduction in sequestration and the vehicle carbon generation indicates that implementation of the proposed project would result in a scenario that falls in between the sequestration of 975.7 metric tons under the High Estimate (231 metric tons [operational emissions] – 1,206.7 metric tons [sequestration]) and a net increase in carbon of 83.6 metric tons under the Low Estimate (231 metric tons [operational emissions] – 147.4 metric tons [sequestration]) of carbon dioxide equivalents per year. Use of the California Estimate on carbon sequestration indicates that implementation of the proposed project would result in the sequestration of 124.5 metric tons of carbon dioxide equivalents (231 metric tons [emissions] – 355.5 metric tons [sequestration]). Therefore, except for the low carbon sequestration estimate, the project site would continue to sequester more carbon dioxide than vineyard activities would emit. Under the worst-case scenario the project would result in net emissions of 83.6 metric tons of carbon dioxide equivalents.~~ In comparison, California emits approximately in the context of the 492 million metric tons per year of carbon dioxide equivalents emitted in California.

~~It is also important to note that certain aspects of the project's design, as well as operational activities, would help to minimize the generation of greenhouse gases. For example, wildfires are a large source of carbon emissions and the conversion of timberland adjacent to rural residential communities, such as the proposed project, would reduce the potential for fires started in the community spreading into the nearby forests, which could result in catastrophic wildfires. To further reduce the project's potential to result in wildfires, and reduce emissions, the project would chip woody wastes from logging and vineyard trimming instead of burning, and utilize solar powered electric water pumps instead of diesel powered water pumps.~~ As is clear from the above analysis, the majority of project CO_2 emissions would be attributable to the combustion of fossil fuels in motor vehicles; however, the State has been working to adopt regulations that would reduce carbon dioxide emissions from fuel combustion state-wide. For example, the California Air Resources Board adopted the Low Carbon Fuel Standard (LCFS), which went into effect in January 2010, and among other things, promotes the use of alternative forms of fuel.[13] ~~Furthermore, t~~The proposed

[13] The LCFS regulation is expected to reduce greenhouse gas (GHG) emissions of the transportation sector in California by about 16 million metric tons in 2020. These reductions account for almost 10 percent of the total GHG emission reductions needed to achieve the State's mandate of reducing GHG emissions to 1990 levels by 2020 (cf. http://www.arb.ca.gov/regact/2011/lcfs11/lcfsnotice.pdf; accessed February 17, 2011).

project would be subject to the LCFS and any additional regulations established by the ARB in response to the direction provided by AB 32. Over time the project's greenhouse gas emissions would be reduced through the implementation of the low-carbon fuel standard, as well as increased vehicle fuel efficiency.

~~In addition, as stated in the traffic report, at least ten percent of project workers are expected to carpool to the project site.~~ It is also very important to consider the current function of the project site as a carbon sink. The project site currently provides a service to the community as regards the sequestration of carbon. Implementation of the proposed project would reduce the magnitude of the service provided; however, based upon the above analysis, the project will continue to sequester carbon at a greater rate that the proposed project would generate carbon emissions.

Currently, thresholds of significance for GHGs have not been identified by either the ARB, or the NSCAPCD. Early actions proposed by the ARB[14] are not strictly applicable to the proposed project, and the proposed project would be subject to any applicable State regulations as they are developed. Furthermore, in the context of statewide, nationwide, or global emissions, and considering the carbon sequestration that would continue to occur once the vineyards are planted, the proposed project's incremental contribution to this cumulative impact would not be cumulatively considerable. Therefore, the proposed project would have a ***less-than-significant*** impact on climate change.

Mitigation Measure(s)
None required.

~~Endnotes~~

~~[i] *Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture*; 2005. Accessed on www.epa.gov June 2007.~~
~~[ii] Winrock International. Measuring and Monitoring Plans for Baseline Development and Estimation of Carbon Benefits for Change in Forest Management in Two Regions, March 2004. Accessed at http://www.energy.ca.gov/reports/CEC-500-2004-070/CEC-500-2004-070F.PDF on March 27, 2008.~~
~~[9] Applied Geosolutions, LLC and Complex Systems Research Center, University of New Hampshire. Assessing Impacts of Rangeland Management and Reforestation of Rangelands on Greenhouse Gas Emissions: A Pilot Study for Shasta County, February 2007. Accessed at http://www.energy.ca.gov/2006publications/CEC-500-2006-108/CEC-500-2006-108.PDF on March 27,2008.~~

[14] California Air Resources Board. Proposed Early Actions to Mitigate Climate Change in California, April 20, 2007.