3.6 CLIMATE CHANGE

3.6.1 INTRODUCTION

This section covers the topic of global climate change associated with greenhouse gas (GHG) emissions, and describes existing conditions at and surrounding the project site. It summarizes relevant regulations and policies, and analyzes the Proposed Action and each alternative's potential impacts on global climate.

The Applicant has put forth a conceptual compensatory wetland mitigation plan that includes wetland restoration activities at three off-site mitigation properties. Since the mitigation plan is currently conceptual in nature, the specifics of grading activities associated with wetland restoration are not available. Therefore, temporary, short-term GHG emissions associated with wetland mitigation grading activities cannot be estimated. Furthermore, since no housing/commercial or other development would occur on any of the three mitigation properties, no long-term impacts with respect to GHG emissions would occur as a result of wetland restoration. Thus, the mitigation sites are not discussed further in this section.

Sources of information used in this analysis include:

- Amoruso Ranch Specific Plan (ARSP) EIR prepared by the City of Roseville (City of Roseville 2016a);
- City of Roseville General Plan 2035 (City of Roseville 2016b);
- 2015 Triennial Report (PCAPCD 2015);
- Traffic Study for the ARSP (Fehr & Peers 2016) (included in Appendix **3.14a**); and
- Traffic Study for the No Action, Proposed Action, and Alternatives 1 - 3 (Fehr & Peers 2018) (included in Appendix **3.14b**).

3.6.2 AFFECTED ENVIRONMENT

3.6.2.1 Background

Global climate change refers to any significant change in climate measurements, such as temperature, precipitation, or wind, lasting for an extended period (i.e., decades or longer) (USEPA 2010). Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- natural processes within the climate system (e.g., changes in ocean circulation, reduction in sunlight from the addition of GHGs and other gases to the atmosphere from volcanic eruptions); and
- human activities that change the atmosphere's composition (e.g., through burning fossil fuels) and the land surface (e.g., deforestation, reforestation, urbanization, desertification).

According to scientists, human activities have resulted in a change in global climate. The primary manifestation of global climate change has been a rise in the average global tropospheric temperature of 0.2 degree Celsius (°C) per decade, determined from meteorological measurements worldwide between 1990 and 2005.

The natural process through which heat is retained in the troposphere[1] is called the greenhouse effect. The greenhouse effect traps heat in the troposphere through a threefold process: (1) short-wave radiation in the form of visible light emitted by the Sun is absorbed by the Earth as heat; (2) long-wave radiation is re-emitted by the Earth; and (3) GHGs in the upper atmosphere absorb or trap the long-wave radiation and re-emit it back towards the Earth and into space. This third process is the focus of current climate change policy because increased quantities of GHGs in the earth's atmosphere result in more of the long-wave radiation being trapped in the atmosphere.

While water vapor and carbon dioxide (CO_2) are the most abundant GHGs, other trace GHGs have a greater ability to absorb and re-radiate long-wave radiation. To gauge the potency of GHGs, scientists have established a Global Warming Potential (GWP) for each GHG based on its ability to absorb and re-emit long-wave radiation over a specific period. The GWP of a gas is determined using CO_2 as the reference gas, which has a GWP of 1 over 100 years.[2] For example, a gas with a GWP of 10 is 10 times more potent than CO_2 over 100 years. The use of GWP allows GHG emissions to be reported using CO_2 as a baseline. The sum of each GHG multiplied by its associated GWP is referred to as "carbon dioxide equivalents" (CO_2e). This essentially means that 1 metric ton of a GHG with a GWP of 10 has the same climate change impacts as 10 metric tons of CO_2.

The impacts of climate change have been documented by the Office of Environmental Health Hazard Assessment (OEHHA), which includes the following changes that are already occurring (CARB 2017b):

- A recorded increase in annual average temperatures as well as increases in daily minimum and maximum temperatures.
- An increase in the occurrence of extreme events, including wildfire and heat waves.
- A reduction in spring runoff volumes, as a result of declining snowpack.
- A decrease in winter chill hours, necessary for the production of high-value fruit and nut crops.
- Changes in the timing and location of species sightings, including migration upslope of flora and fauna, and earlier appearance of Central Valley butterflies.

In addition to this, California's recent drought incited land subsidence, pest invasions that killed over 100 million trees, and water shortages. The total statewide economic cost of the 2014 drought was estimated at $2.2 billion, with a total loss of 17,100 jobs (Howitt, et al. 2014). An analysis of water usage between 1990 and 2012 showed that while California's energy policies have supported climate mitigation efforts, the performance of these policies have increased vulnerability to climate impacts (Fulton, et al. 2015).

According to the U.S. Forest Service National Insect and Disease Forest Risk Assessment, California is at risk of losing 12 percent of the total area of forests and woodlands in the State due to insects and disease, or over

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1 The troposphere is the bottom layer of the atmosphere, which varies in height from the Earth's surface from 6 to 7 miles.

2 All GWPs are given as 100-year GWP. Unless noted otherwise, all GWPs were obtained from the Intergovernmental Panel on Climate Change. *Climate Change 1995: The Science of Climate Change – Contribution of Working Group I to the Second Assessment Report of the IPCC*. Cambridge (UK): Cambridge University Press, 1996

5.7 million acres (U.S. Forest Service 2014). While future climate change is not modeled within the risk assessment, and current drought conditions are not accounted for in these estimates, the projected climate changes over a 15-year period (2013-2027) are expected to significantly increase the number of acres at risk, and will increase the risk from already highly destructive pests such as the mountain pine beetle. A recent aerial survey by the U.S. Forest Service identified more than 100 million dead trees in California (U.S. Department of Agriculture 2016).

The warming climate also causes sea level rise by warming the oceans which causes water to expand, and by melting land ice which transfers water to the ocean. Sea level rise is expected to magnify the adverse impact of any storm surge and high waves on the California coast. As temperatures warm and GHG concentrations increase more carbon dioxide dissolves in the ocean, making it more acidic. More acidic ocean water affects a wide variety of marine species, including species that people rely on for food (CARB 2017b).

While more intense dry periods are anticipated under warmer conditions, increased extreme wet conditions are also expected to increase due to more frequent warm, wet atmospheric river events and a higher proportion of precipitation falling as rain instead of snow. In recent years, atmospheric rivers have also been recognized as the cause of the large majority of major floods in rivers all along the U.S. West Coast and as the source of 30-50 percent of all precipitation in the same region (American Meteorological Society 2013). These extreme precipitation events, together with the rising snowline, often cause devastating floods in major river basins (e.g., California's Russian River). Looking ahead, the frequency and severity of atmospheric rivers on the U.S. West Coast will increase due to higher atmospheric water vapor that occurs with rising temperature, leading to more frequent flooding (Hagos, et al. 2016; Payne, et al. 2015).

As GHG emissions continue to accumulate and climate disruption grows, such destructive events will become more frequent. Several recent studies project increased precipitation within hurricanes over ocean regions (Easterling, et al. 2016; National Academies of Sciences, Engineering, and Medicine 2016). The primary physical mechanism for this increase is higher water vapor in the warmer atmosphere, which enhances moisture convergence in a storm for a given circulation strength. Since hurricanes are responsible for many of the most extreme precipitation events, such events are likely to become more extreme. Anthropogenic warming by the end of the 21st century will likely cause tropical cyclones globally to become more intense on average. This change implies an even larger percentage increase in the destructive potential per storm, assuming no changes in storm size (Sobel, et al. 2016; Kossin 2016). Thus, the historical record, which once set our expectations for the traditional range of weather and other natural events, is becoming an increasingly unreliable predictor of the conditions we will face in the future. Consequently, the best available science must drive effective climate policy (CARB 2017b).

California is committed to further supporting new research on ways to mitigate climate change and how to understand its ongoing and projected impacts. California's Fourth Climate Change Assessment and Indicators of Change Report will further update our understanding of the many impacts from climate change in a way that directly informs State agencies' efforts to safeguard the State's people, economy, and environment (California Natural Resources Agency 2018; OEHHA 2018).

Together, historical data, current conditions, and future projections provide a picture of California's changing climate, with two important messages:

- Change is already being experienced and documented across California, and some of the changes have been directly linked to changing climatic conditions.
- Even with the uncertainty in future climate conditions, every scenario estimates further change in future conditions.

California is taking steps to make the State more resilient to ongoing and projected climate impacts as laid out by the Safeguarding California Plan (California Natural Resources Agency 2018). The Safeguarding California Plan presents policy recommendations and provides a roadmap of all the actions and steps that state government is taking to adapt to the ongoing and inevitable effects of climate change. California's continuing efforts are vital steps toward minimizing the impact of GHG emissions and a three-pronged approach of reducing emissions, preparing for impacts, and conducting cutting-edge research can serve as a model for action (CARB 2017b).

Greenhouse Gases

GHGs of most concern include the following compounds:

- Carbon Dioxide (CO_2). Anthropogenic CO_2 emissions are primarily generated by fossil fuel combustion from stationary and mobile sources. Over the past 200 years, the burning of fossil fuels such as coal and oil, deforestation, land-use changes, and other activities have caused the concentrations of heat-trapping GHGs to increase significantly in our atmosphere (USEPA 2018).[3] Carbon dioxide is also generated by natural sources such as cellular respiration, volcanic activity, decomposition of organisms, and forest fires. Carbon dioxide is the most widely emitted GHG and is the reference gas (GWP of 1) for determining the GWP of other GHGs.
- Methane (CH_4). Methane is emitted from biogenic sources (i.e., resulting from the activity of living organisms), incomplete combustion in forest fires, landfills, manure management, and leaks in natural gas pipelines. In the US, the top three sources of CH_4 are landfills, natural gas systems, and enteric fermentation (Bronstein, et al. 2012). Methane is the primary component of natural gas, which is used for space and water heating, steam production, and power generation. The GWP of CH_4 is 21.
- Nitrous Oxide (N_2O). Nitrous oxide is produced by natural and human-related sources. Primary human-related sources include agricultural soil management, animal manure management, sewage treatment, mobile and stationary combustion of fossil fuel, adipic acid production, and nitric acid production. The GWP of N_2O is 310.
- Hydrofluorocarbons (HFCs). HFCs typically are used as refrigerants in both stationary refrigeration and mobile air conditioning. The use of HFCs for cooling and foam blowing is growing particularly as the continued phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) gains momentum. The GWP of HFCs ranges from 140 for HFC-152a to 6,300 for HFC-236fa.
- Perfluorocarbons (PFCs). Perfluorocarbons are compounds consisting of carbon and fluorine. They are primarily created as a byproduct of aluminum production and semiconductor manufacturing. Perfluorocarbons are potent GHGs with a GWP several thousand times that of carbon dioxide, depending on the specific PFC. Another area of concern regarding PFCs is their long atmospheric

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3 US Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016. 2018.*

lifetime of up to 50,000 years (U.S. Department of Energy 2018). The global warming potentials (GWPs) of PFCs range from 5,700 to 11,900.

- Sulfur Hexafluoride (SF_6). Sulfur hexafluoride is a colorless, odorless, nontoxic, nonflammable gas. It is most commonly used as an electrical insulator in high voltage equipment that transmits and distributes electricity. Sulfur hexafluoride is the most potent GHG that has been evaluated by the Intergovernmental Panel on Climate Change with a GWP of 23,900.

Global Ambient CO2 Concentrations

To determine the global atmospheric variation of CO_2, CH_4, and N_2O from before the start of industrialization, air trapped by ice has been extracted from core samples taken from polar ice sheets. For the period from around 1750 to the present, global CO_2 concentrations increased from a pre-industrialization period concentration to 391 ppm in 2011, which represents an exceedance of 1750 levels by approximately 40 percent (IPCC 2013). Global CH_4 and N_2O concentrations show similar increases for the same period (see **Table 3.6-1, Comparison of Global Pre-Industrial and Current GHG Concentrations**).

Table 3.6-1
Comparison of Global Pre-Industrial and Current GHG Concentrations

Greenhouse Gas	Early Industrial Period Concentrations[1]	Natural Range for Last 650,000 Years[1]	2011 Concentrations[2]
Carbon Dioxide (CO_2)	280 ppm	180 to 300 ppm	391 ppm
Methane (CH_4)	715 ppb	320 to 790 ppb	1,803 ppb
Nitrous Oxide (N_2O)	270 ppb	NA	324 ppb

*Source: [1] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: The Physical Science Basis, Summary for Policymakers 2007. 2 IPCC,*Climate Change 2013 The Physical Science Basis. *2013.*
ppm=parts per million; ppb=parts per billion.

Contributions to Greenhouse Gas Emissions

Global

Worldwide anthropogenic GHG emissions for industrialized nations (referred to as Annex I) and developing nations (referred to as Non-Annex I) are tracked through the year 2014. The sum of the top five GHG producing nations (plus the European Union) totaled approximately 29,600 million metric tons of CO_2 equivalents ($MMTCO_2e$).[4,5] It should be noted that global emissions inventory data are not all from the same

4 World Resources Institute, "Climate Analysis Indicators Tool (CAIT)," https://www.climatewatchdata.org/ghg-emissions?breakBy=location&source=31&version=1

5 The CO_2 equivalent emissions commonly are expressed as "million metric tons of carbon dioxide equivalent ($MMTCO_2E$)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP, such that $MMTCO_2E$ = (million metric tons of a GHG) x (GWP of the GHG). For example, the GWP for methane is 21. This means that the emission of one million metric tons of methane is equivalent to the emission of 21 million metric tons of CO_2.

year and may vary depending on the source of the emissions inventory data.[6] The top five countries and the European Union accounted for approximately 55 percent of the total global GHG emissions according to the most recently available data (see **Table 3.6-2, Top Five GHG Producer Countries and the European Union [Annual]**). The GHG emissions in more recent years may differ from the inventories presented in **Table 3.6-2**; however, the data is representative of currently available global inventory data.

Table 3.6-2
Top Five GHG Producer Countries and the European Union (Annual)

Emitting Countries	2014 GHG Emissions ($MMTCO_2e$)
China	12,000
United States	6,300
European Union (EU), 27 Member States	3,600
India	3,200
Indonesia	2,500
Russia	2,000

Source: World Resources Institute, "Climate Analysis Indicators Tool (CAIT)," https://www.climatewatchdata.org/ghg-emissions?breakBy=location&source=31&version=1. 2018

United States

As noted in **Table 3.6-2**, the U.S. was the number two producer of global GHG emissions in 2010. The primary GHG emitted by human activities in the U.S. was CO_2, representing approximately 82 percent of total GHG emissions. Carbon dioxide from fossil fuel combustion, the largest source of GHG emissions, accounted for approximately 76 percent of US GHG emissions (USEPA 2016).[7]

State of California

The California Air Resources Board (CARB) compiles GHG inventories for the State of California. Based on the 2017 GHG inventory data (i.e., the latest year for which data are available), California emitted 440 $MMTCO_2e$, including emissions resulting from imported electrical power in 2015 (CARB 2017a). Based on the GHG inventories compiled by the World Resources Institute, California's total statewide GHG emissions

6 The global emissions are the sum of Annex I and non-Annex I countries, without counting Land-Use, Land-Use Change and Forestry (LULUCF). For countries without 2005 data, the United Nations Framework Convention on Climate Change (UNFCCC) data for the most recent year were used. United Nations Framework Convention on Climate Change, "Annex I Parties – GHG total without LULUCF," http://unfccc.int/ghg_emissions_data/ghg_data_from_unfccc/time_series_annex_i/ items/3841.php and "Flexible GHG Data Queries" with selections for total GHG emissions excluding LULUCF/LUCF, all years, and non-Annex I countries, http://unfccc.int/di/FlexibleQueries/Event.do?event= showProjection. n.d.

7 The troposphere is the bottom layer of the atmosphere, which varies in height from the Earth's surface from 6 to 7 miles.

rank second in the U.S. (Texas is number one with 874 $MMTCO_2e$) with 455 $MMTCO_2e$ emitted in 2017 (World Resources Institute 2017).

The primary contributors to GHG emissions in California are transportation, electric power production from both in-state and out-of-state sources, industry, agriculture and forestry, and other sources, which include commercial and residential activities. **Table 3.6-3, GHG Emissions in California**, provides a summary of GHG emissions reported in California in 2000 and 2015 by categories defined by the IPCC.

Table 3.6-3
GHG Emissions in California (2000 and 2015)

Source Category	2000 ($MMTCO_2e$)	Percent of Total	2015 ($MMTCO_2e$)	Percent of Total
ENERGY	**408.9**	**87.52%**	**367.6**	**83.48%**
Energy Industries	401.83	86.01%	132.93	30.19%
Manufacturing Industries & Construction	22.75	4.87%	19.98	4.54%
Transport	175.29	37.52%	163.64	37.16%
Other Sectors (Residential/Commercial/Institutional)	44.67	9.56%	40.33	9.16%
Solid Fuels	0.04	0.01%	0.01	0.00%
Fugitive Emissions from Oil & Natural Gas	5.78	1.24%	7.51	1.71%
Fugitive Emissions from Geothermal Energy Production	1.13	0.24%	1.15	0.26%
Pollution Control Devices	0.11	0.02%	0.00	0.00%
INDUSTRIAL PROCESSES & PRODUCT USE	**19.6**	**4.20%**	**32.5**	**7.38%**
Mineral Industry	5.60	1.20%	5.23	1.19%
Chemical Industry	0.06	0.01%	0.03	0.01%
Non-Energy Products from Fuels & Solvent Use	2.46	0.53%	1.90	0.43%
Electronics Industry	0.52	0.11%	0.26	0.06%
Substitutes for Ozone Depleting Substances	6.10	1.31%	18.37	4.17%
Other Product Manufacture and Use	1.52	0.33%	1.39	0.32%
Other	3.31	0.71%	5.26	1.19%
AGRICULTURE, FORESTRY, & OTHER LAND USE	**29.4**	**6.29%**	**31.7**	**7.20%**
Livestock	19.62	4.20%	23.25	5.28%
Aggregate Sources & Non-CO_2 Sources on Land	9.76	2.09%	8.42	1.91%
WASTE	**9.3**	**1.99%**	**10.6**	**2.41%**
Solid Waste Disposal and Biological Treatment	7.22	1.55%	8.40	1.91%
Biological Treatment of Solid Waste	0.13	0.03%	0.33	0.07%
Wastewater Treatment & Discharge	1.93	0.41%	1.90	0.43%
EMISSIONS SUMMARY				
Gross California Emissions	467.19		440.36	

Source:
[1] *California Air Resources Board, "California Greenhouse Gas 2000-2015 Inventory by IPCC Category - Summary," https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_ipcc_sum_2000-15.pdf. 2017.*

California's GHG emissions have followed a declining trend since 2007. In 2015, emissions from routine emitting activities statewide were 1.5 $MMTCO_2e$ lower than 2014 levels, representing an overall decrease of 10 percent since peak levels in 2004 (CARB 2017a).

3.6.3 SIGNIFICANCE THRESHOLDS AND ANALYSIS METHODOLOGY

3.6.3.1 Significance Thresholds

NEPA does not specify significance thresholds that may be used to evaluate the effects of a proposed action on global climate. The appropriate approach to evaluating a project's impact on global climate under NEPA is still under development. In February 2010, the Council on Environmental Quality (CEQ), the entity responsible for ensuring Federal agencies meet their obligations under NEPA, released draft NEPA guidance on the consideration of the effects of GHG emissions and climate change in NEPA documents. This guidance was revised in 2014, and finalized in August of 2016.

The CEQ draft NEPA guidance had stated:

> *CEQ proposes to advise Federal agencies to consider, in scoping their NEPA analysis, whether analysis of the direct and indirect GHG emissions from their proposed actions may provide meaningful information to decision makers and the public. Specifically, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public.*

The guidance further noted that:

> *CEQ does not proposes this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs.*

The guidance recommended 25,000 metric tons CO_2 equivalent ($MTCO_2e$) of direct emissions[8] as a presumptive threshold for analysis and disclosure within NEPA documents. The guidance suggested that if a proposed action would result in direct emissions below this threshold, the emissions would not be relevant to and would not need to be discussed within a NEPA analysis.

The guidance further noted:

> *When a proposed federal action meets an applicable threshold for quantification and reporting, CEQ proposes that the agency should also consider mitigation measures and reasonable alternatives to reduce action related GHG emissions.*

The CEQ guidance also noted that land management techniques, including land use changes (such as those involved in the Proposed Action) lack any established federal protocol for assessing the effect of their GHG emissions at a landscape scale. In these instances, the guidance suggests that the federal agency should use

8 The CEQ guidance does not define direct emissions. However, in industry-standard GHG reporting protocols, direct emissions are defined to include all sources that are within the organizational control of the property/facility owner, and often comprise sources such as on-site stationary sources, fleet, and fugitive and process emissions.

NEPA's provisions for inter-agency consultation with available expertise to identify and follow the best available protocols for evaluating comparable activities.

In April 2017, the CEQ issued a withdrawal of its final guidance for federal agencies on how to consider GHG emissions and the effects of climate change in NEPA reviews, and therefore the Corps may approach the evaluation of the Proposed Action's GHG impacts using a methodology that it finds appropriate.

In the absence of federal guidance, the Corps examined State of California and local guidance and protocols related to the effects of GHG emissions to select the approach to analyzing the Proposed Action's effect related to GHG emissions and the threshold of significance to use to evaluate the effect.

At the state level, CARB has not yet put forth significance thresholds for use to evaluate projects in California. However, CARB has commenced the implementation of a mandatory GHG reporting program that requires large industrial GHG emitters to report their GHG emissions. Large stationary combustion facilities that emit greater than or equal to 25,000 $MTCO_2e$ per year are subject to the reporting requirements. While the CARB's reporting program and the CEQ's draft NEPA guidance do not provide significance thresholds, the 25,000 $MTCO_2e$ reporting threshold can be seen as a dividing line for major GHG emitters.

At the local level, the PCAPCD has set forth thresholds of significance for determining the significance of the effect of a project's GHG emissions. The PCAPCD significance thresholds are presented in **Tables 3.6-4** and **3.6-5**.

Table 3.6-4
PCAPCD GHG Significance Thresholds for Construction and Stationary Source Operational Emissions

All Construction Project-Level	Stationary Source Operational Project-Level
10,000 $MTCO_2e$/year	

Source: PCAPCD CEQA Air Quality Handbook, 2017.

The significance thresholds listed above take into consideration thresholds adopted by other air districts, projects reviewed by the PCAPCD over the last 13 years, applicable statewide regulatory requirements, and the special geographic features in Placer County (PCAPCD 2017). These thresholds are used in this EIS to evaluate the effects of the GHG emissions associated with the Proposed Action and alternatives on global climate.

For the purposes of this analysis, the Proposed Action or an alternative would result in a significant effect on the environment if:

- Construction GHG emissions would exceed 10,000 $MTCO_2e$/year.
- Operational GHG emissions exceed 4.5 MT CO_2e/capita, or a total of 10,000 $MTCO_2e$/year.

Table 3.6-5
PCAPCD GHG Significance Thresholds for Land Development Operational Emissions

Bright-Line Threshold			
10,000 $MTCO_2e$/year			
Efficiency Matrix			
Residential		Non-Residential	
Urban	Rural	Urban	Rural
$MTCO_2e$/year		$MTCO_2e$/year	
4.5	5.5	26.5	27.3
De Minimis Level			
1,100 $MTCO_2e$/year			

Source: PCAPCD CEQA Air Quality Handbook, 2017.

3.6.3.2 Analysis Methodology

The analysis presented below is based primarily on the Final Environmental Impact Report (EIR) prepared by Analytical Environmental Services for the ARSP. The Corps independently reviewed this study, and found it to be accurate in its analytical approach and results. The methodology used in the ARSP EIR is summarized below.

The study used the CalEEMod version 2013.2 to estimate the construction-related CO_2 emissions for the Proposed Action. Construction activities associated with the Proposed Action would occur over a number of years, with construction of the project being developed in phases. However, the exact timing and duration of these phases is not currently known as they will be determined by market conditions and other factors that are unpredictable over the course of development. The construction period over which the buildout of the Proposed Action is assumed, for purposes of the analysis, to occur is from the year 2017 to 2034.[9] In addition, because CO_2 emissions have a long residence period in the atmosphere, and effects from GHGs are typically understood as taking place over a long period of time, the total construction emissions from the Proposed Action (and alternatives) are more relevant to a discussion of effects from GHGs than emissions in any specific year. Specific assumptions about construction equipment and scheduling are provided in the technical study, included in **Appendix 3.3**.

9 Although the greenhouse gas analysis in this EIS for the Proposed Action is based on project construction beginning in 2017, if a DA permit is issued in 2018, construction would likely begin in 2019. Emissions estimates based on a construction start in 2017 are conservative and provide a higher estimate of likely emissions than the emissions that would occur if construction of the first phase begins in 2019 or later. This is because with improvements in equipment emissions control and fuel efficiency and quality, emission rates for construction equipment and vehicles continue to improve. As a result, actual construction emissions for the first phase will likely be lower than the numbers reported in this EIS.

Mobile GHG emissions during operation were estimated using CalEEMod and trip generation rates provided by a traffic study performed by Fehr & Peers (Fehr & Peers 2015). Emissions from area sources were also estimated using default CalEEMod values. These emissions are primarily associated with combustion of natural gas and operation of landscape maintenance equipment.

The technical study also estimated emissions from indirect sources, including electricity use, water use, solid waste disposal, and wastewater treatment. Residential electricity use was estimated based on the utilities data for the project. Commercial electricity use was estimated using California Energy Commission (CEC) rates for square foot of commercial space. Both, water use and wastewater treatment, produce GHG emissions due to energy consumption during treatment and transport. Electricity use for both was based on reports to the CEC. Further details on methodology are available in the technical study, included in **Appendix 3.3**.

As noted earlier, GHG reporting protocols define direct emissions as those emitted by sources that are within the organizational control of the property/facility owner. The GHG emissions that would be produced following the occupancy of the Proposed Action would not be under the organizational control of the Corps or the Applicant. Therefore, none of the emissions produced by the Proposed Action would be defined as direct emissions. However, for purposes of analysis, all GHG emissions generated by the homes and other land uses built on the site, such as area sources and mobile sources, are categorized as direct emissions. All other emissions such as those from generation of electricity, solid waste, etc., are categorized as indirect emissions.

3.6.4 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Impact GHG-1 GHG Emissions due to Construction

No Action Alt. Construction of the No Action alternative would result in one-time emissions of GHGs. The primary GHGs generated during construction are CO_2, CH_4, and N_2O. These emissions are the result of fuel combustion in construction equipment and motor vehicles. The other GHGs such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are typically associated with specific industrial sources and processes and would not be emitted during construction of the No Action alternative.

GHG emissions that would be emitted during the construction of the No Action alternative were not estimated using a model. However, because construction emissions are roughly proportional to the land area to be graded as well as the total building space to be constructed, construction emissions for the No Action alternative (as well as all other alternatives) were calculated by multiplying the emissions estimated for the Proposed Action with the ratio of the proposed development under the Proposed Action and the proposed development under the No Action alternative. The total construction emissions for the No Action alternative are shown in **Table 3.6-6, Estimated Yearly Construction GHG Emissions**. As the table shows, the GHG emissions from the construction of the No Action alternative would be less than the threshold set forth by the PCAPCD or 25,000 $MTCO_2e$/year of GHG emissions in the former CEQ guidance. Furthermore, as discussed in **Section 3.3, Air Quality,** it is highly likely that the City would impose **Mitigation Measure AQ-1** on the No Action alternative. That mitigation measure includes a number of measures that would not only reduce emissions of criteria pollutants, but would also further reduce GHG emissions during construction of the No Action alternative. Based on the significance criteria and reasons listed above, **no direct** or **indirect** effects associated with GHG emissions, as a result of construction, under the No Action alternative were identified.

Table 3.6-6
Estimated Yearly Construction GHG Emissions

Alternative	Maximum Yearly Emissions (Metric Tons CO_2e Per Year)
No Action	2,241
Proposed Action	3,853
Alternative 1	3,567
Alternative 2	3,834
Alternative 3	3,791
PCAPCD Significance Threshold	**10,000**

Source: Impact Sciences, Inc. 2018
*Emissions calculations are provided in **Appendix 3.3**.*

Proposed Action

As shown in **Table 3.6-6** above, GHG emissions associated with the construction of the Proposed Action would not exceed PCAPCD thresholds. Based on the former CEQ guidance which listed a threshold of 25,000 metric tons per year of GHG emissions as an indication of a major source of GHG emissions, the annual construction emissions associated with the Proposed Action would not exceed this presumptive threshold. Furthermore, as discussed in **Section 3.3, Air Quality, Mitigation Measure AQ-1** has been imposed on the Proposed Action by the City, which includes a number of measures that would not only reduce criteria pollutant emissions but would also further reduce GHG emissions during construction. Therefore, **no direct** effects associated with GHG emissions as a result of construction under the Proposed Action were identified**.** Furthermore, n**o indirect** effects associated with construction GHG emissions under the Proposed Action were identified.

Alts. 1, 2, 3

As noted above, construction emissions for Alternatives 1, 2, and 3 were estimated by using a ratio of the proposed development under an alternative to the proposed development under the Proposed Action. Maximum yearly emissions anticipated to result from the construction of each alternative are shown in **Table 3.6-6**. As the table shows, GHG emissions associated with the construction of Alternatives 1, 2, or 3 would not exceed PCAPCD thresholds. Furthermore, as discussed in **Section 3.3, Air Quality,** it is highly likely that the City would impose **Mitigation Measure AQ-1** on Alternatives, 1, 2, or 3**,** which includes a number of measures that would not only reduce criteria pollutant emissions but would also further reduce GHG emissions during construction. Therefore, **no direct** effects from GHG emissions as a result of construction under Alternatives 1, 2, or 3, were identified**.** Furthermore, **no indirect** effects were identified.

Impact GHG-2 GHG Emissions due to Operation/Occupancy

No Action Alt. Upon occupancy, the No Action alternative would generate GHG emissions - primarily CO_2, CH_4, and N_2O - from a number of sources that include area sources (natural gas consumption), motor vehicles, indirect sources (electricity consumption, water, and wastewater), and potential stationary sources (such as boilers or emergency generators).

GHG emissions that would be emitted during the occupancy and operations of the No Action alternative were not estimated using a model. However, because GHG emissions from both area and mobile sources are proportional to the scale of development, specifically the number of residential units to be constructed and the total amount of commercial or other space that would be built on the site, emissions from the No Action alternative were estimated based on the ratio of the number of residential units and acreage of commercial or other development proposed under the No Action alternative to the number of residential units and acreage of commercial and other development under the Proposed Action. As the project site is primarily grassland with no significant sources of carbon sequestration at the present time, reduction in carbon sequestration as a result of the No Action alternative was assumed to be negligible, and no adjustments were made to the estimated operational emissions to account for changes in carbon sequestration.

The results are shown in **Table 3.6-7, Estimated Operational GHG Emissions.** The No Action alternative's operational emissions of 29,675 $MTCO_2e$ would exceed the presumptive threshold of 25,000 $MTCO_2e$, as well as the PCAPCD bright-line threshold of 10,000 $MTCO_2e$ per year.

The estimated energy emissions in **Table 3.6-7** do not account for reductions that will result from future regulatory changes in California pursuant to AB 32. The estimate of these emissions is not discounted to reflect the alternative-energy mandate of SB 107, which requires electric utilities to provide at least 20 percent of its electricity supply from renewable sources by 2010 and 30 percent by 2020. Because Roseville Electric is still procuring enough renewable energy to meet this goal, the estimated rate of GHG emissions from electricity is expected to decrease between now and 2020. In addition, SB 1368 requires more stringent emissions performance standards for new power plants, both in-state and out-of-state, that will supply electricity to California consumers. Thus, implementation of SB 1368 would also reduce GHG emissions associated with electricity consumption.

Further reductions are also expected from other regulatory measures that would be developed under the mandate of AB 32. In general, the Scoping Plan focuses on achieving the state's GHG reduction goals with regulations that improve the efficiency of motor vehicles and the production (and consumption) of electricity. Thus, even with the implementation of no project-specific mitigation, the rate of GHG emissions from development on the project site are projected to decrease in subsequent years as the regulatory environment progresses under AB 32, SB 32, and other state laws and regulations.

Table 3.6-7
Estimated Operational GHG Emissions

Alternative	Mobile Sources	Area Sources	Energy Sources	Water Sources	Waste Sources	Total Emissions
No Action	18,742	446	7,440	733	2,314	29,675
Proposed Action	32,213	766	12,788	1,260	3,978	51,006
Alternative 1	29,828	710	11,841	1,167	3,683	47,229
Alternative 2	32,057	763	12,726	1,254	3,958	50,758
Alternative 3	31,698	754	12,583	1,240	3,914	50,189
Significance Threshold	--	--	--	--	--	**10,000**

Source: Impact Sciences, 2018.
Emissions calculations are provided in **Appendix 3.3**.

The operational emissions shown in **Table 3.6-7** also do not include any GHG reductions or other efficiency or sustainability measures and would therefore be considered conservative. Nonetheless, given the magnitude of these emissions, the No Action alternative's **indirect** effect on global climate would be **significant**. **No direct** effects to climate change under the No Action alternative were identified.

As discussed in **Section 3.3, Air Quality,** it is highly likely that the City would impose **Mitigation Measure AQ-2a** on the No Action alternative**.** That mitigation measure would establish on-site mitigation by incorporating design features within the project to reduce GHG emissions, including but not limited to "green" building features such solar panels, energy efficient heating and cooling, exceeding Title 24 standards, bike lanes, and bus shelters. However, because the GHG emissions would be considerable, this mitigation measure would not reduce the effect.

Proposed Action

Table 3.6-7 shows a summary of the total estimated GHG emissions from operation of the Proposed Action. The Proposed Action's operational emissions of 51,006 $MTCO_2e$ per year would exceed the PCAPCD threshold of 10,000 $MTCO_2e$ per year, or the presumptive threshold of 25,000 $MTCO_2e$ per year. Given the magnitude of these emissions, the **indirect** effect of the Proposed Action on global climate would be **significant**. **No direct** effects to climate change under the Proposed Action were identified.

As discussed in **Section 3.3, Air Quality,** the City has imposed **Mitigation Measure AQ-2a,** which would reduce the GHG emissions from the occupancy and operation of the Proposed Action. However, because the GHG emissions would be considerable, this mitigation measure would not reduce the effect.

Alts. 1,2,3 Alternatives 1, 2, and 3 vary in the amount of residential, public, commercial, and other buildings that would be constructed. Similar to the methodology used to estimate the operational emissions for the No Action alternative, emissions from the occupancy and operation of the three alternatives were estimated by modifying the emission rates calculated for the Proposed Action according to the number of residential units and acreage of commercial or other buildings proposed under each alternative. The results are shown in **Table 3.6-7**, above.

As the table shows, Alternatives 1, 2, and 3 would result in GHG emissions that would be substantially over the thresholds put forth by the PCAPCD and presumptive threshold in the former CEQ guidance as indicative of a major GHG emitting source. Given the magnitude of these emissions, the **indirect** effect of the alternatives on global climate would be **significant**. **No direct** effects on climate change, after mitigation under Alternatives 1, 2, or 3 were identified.

As discussed in **Section 3.3, Air Quality,** it is highly likely that the City would impose **Mitigation Measure AQ-2a** on the alternatives. However, because the GHG emissions would be considerable, this mitigation measure would not reduce the effect.

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