APPENDIX U3

Evaluation of Greenhouse Gas Emissions Offset Availability within San Diego County

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Evaluation of Greenhouse Gas Emissions Offset Availability within San Diego County

WHITE PAPER

Greenhouse gas (GHG) emission offsets have emerged as a viable opportunity to mitigate GHG emissions impacts for projects subject to review under the California Environmental Quality Act (CEQA). The County of San Diego (County) Climate Action Plan allows for the use of carbon offsets in these instances, provided that carbon offset credits meet their specified requirements. This white paper evaluates the potential availability of offsets within the County of San Diego by comparing the potential supply of offsets that meet the County's Climate Action Plan requirements to the demand for offsets from current and future development in the County.

Summary

Carbon offset markets have been established as a way for organizations to meet their greenhouse gas (GHG) emission reduction goals through reductions created by GHG offset projects that occur outside their facilities. These offset projects reduce GHG emissions at the source or enhance GHG removals from the atmosphere above and beyond a "business as usual" baseline, and transfer title for those reductions to organizations seeking to meet compliance obligations. Consistent with recognized international best practices, emission reductions must be real, permanent, verifiable, and cannot be mandated by regulation in order to be registered and sold as carbon offsets. Offset programs register and issue GHG emission reduction credits to projects that satisfy the criteria specified in approved protocols, with each carbon credit representing one metric ton of carbon dioxide equivalent (MT CO_2e) emissions reduced.

Offsets used for California projects originate both within California as well as outside of California; however, the majority of the offsets come from out-of-state projects.

Offsets used for California projects have historically originated both within California as well as outside of California; however, the majority of the offsets come from out-of-state projects. As of November 28, 2018, the California Air Resources Board (CARB) has issued 116,821,777 emissions credits (or MT CO_2e) with 12,400,495 MT CO_2e (or approximately 11%) generated from projects located within California. CARB has issued 141,009,694 offsets for use as compliance instruments in the Cap-and-Trade Program from both early action and compliance offset projects. Of those 141,009,694 MT CO_2e of offsets, 27,343,361 MT CO_2e originated from projects located within California, representing approximately 19% of the total.

The San Diego County (County) Climate Action Plan requires that:

> Carbon offset credits must be purchased through any of the following: (i) a CARB-approved registry, such as the Climate Action Reserve, the American Carbon Registry, and the Verified Carbon Standard, (ii) any registry approved by CARB to act as a registry under the state's cap-and-trade program, (iii) through the CAPCOA GHG Rx and the San Diego County Air Pollution Control District (APCD), or (iv) if no registry is in existence as identified in options (i), (ii), or (iii), above, then any other reputable registry or entity that issues carbon offsets consistent with Cal. Health & Saf. Code section 38562(d)(1)), to the satisfaction of the Director of PDS.

In addition, per M-GHG-1 of the County's Supplement to the 2011 General Plan Update Program Environmental Impact Report GHG emissions analysis, the County will consider, to the satisfaction of the Director of Planning & Development Services (PDS), the following geographic priorities for GHG reduction features, and GHG reduction projects and programs: 1) project design features/on-site reduction measures; 2) off-site within the unincorporated areas of the County of San Diego; 3) off-site within the County of San Diego; 4) off-site within the State of California; 5) off-site within the United States; and 6) off-site internationally.

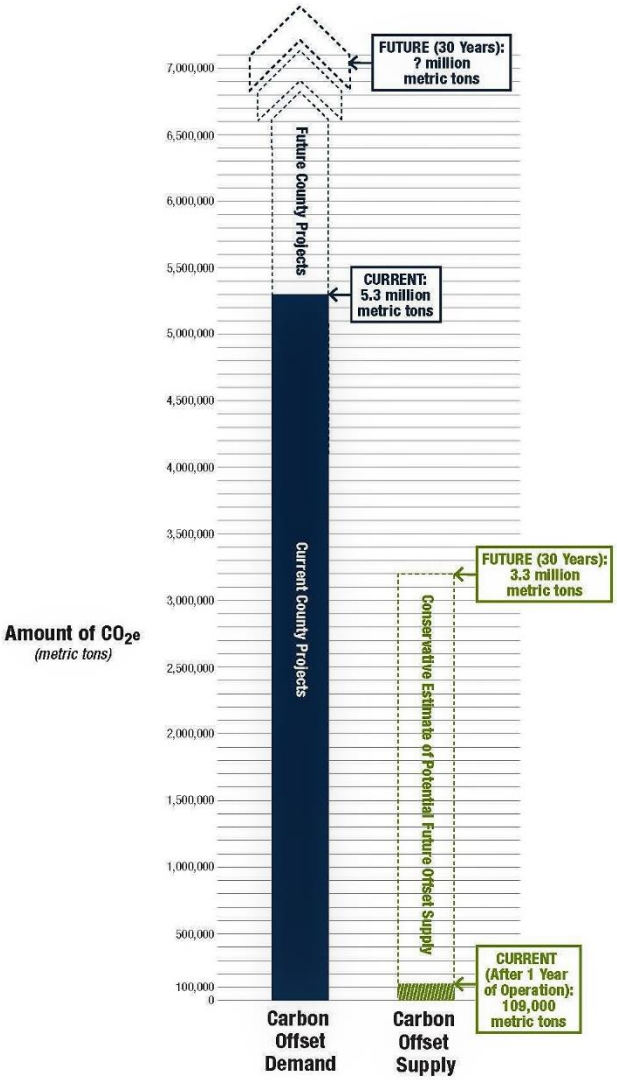
The three registries identified under item (i) of the Climate Action Plan requirement (i.e., the Climate Action Reserve, Verra (formerly the Verified Carbon Standard) and the American Carbon Registry) are the only entities currently approved by CARB to act as offset project registries under Compliance Offset Program component of the state's Cap-and-Trade Program (item ii) (CARB 2018a). Regarding items (i and ii), CARB has adopted and published Compliance Offset Protocols for the following six project types: U.S. Forest Projects, Urban Forest Projects, Livestock Projects, Ozone Depleting Substances Projects, Mine Methane Capture Projects, and Rice Cultivation Projects. However, not all of the project types are considered viable within the County, as some of the protocol sources are

not present or viable. At this time, within the County, the two viable project types where carbon offsets for California Environmental Quality Act (CEQA) mitigation could originate are CARB U.S. Forest or Livestock Projects.

Regarding item (iii), to date, only one offset project has registered under the CAPCOA GHG Rx registry, which was located within Placer County. Given the low adoption rate of this program throughout the state, the GHG Rx registry is not considered a viable option to generate GHG offsets within the County. In addition, currently, the San Diego County Air Pollution Control District has not established a program to supply GHG offsets for mitigation. Accordingly, this white paper evaluates the potential supply of carbon offsets within the County from CARB U.S. Forest or Livestock Projects.

CARB's U.S. Forest Projects Compliance Offset Protocol is used to generate CARB offsets for GHG removal enhancements associated with the sequestration of carbon achieved by increasing and/or conserving forest carbon stocks. Under the U.S. Forest protocol, the total sequestration potential of County forests was estimated to be approximately 103,387 MT CO_2e per year.

CARB's Livestock Projects Compliance Offset Protocol is used to generate CARB offsets for GHG removal enhancements associated with collection and destruction of methane generated by livestock waste through the installation of anaerobic digesters. Currently, there are only three commercial dairies in operation in the County at which an anaerobic digestion carbon offset project could occur. Based on conservative assumptions, the estimated annual emission reduction from the three dairies would total 5,511 MT CO_2e per year. As such, the total emission reduction potential from U.S. Forest or Livestock Projects in the County would be 108,898 MT CO_2e per year.



The current estimated GHG offset demand is greater than the potential estimated GHG offset supply, and offsets that originate outside of the County are necessary to meet the demand from County projects with offset commitments under CEQA.

The following large land use development projects have been proposed or approved within the County between 2015 and 2018 and include a GHG offset commitment under CEQA: Fifth Avenue Landing Project & Port Master Plan Amendment, Harmony Grove Village South, Lake Jennings Market Place, Lilac Hills Ranch, National City Marine Terminal Tank Farm Paving and Street Closures Project & Port Master Plan Amendment, Newland Sierra, North River Farms, Otay Village 14 and Planning Areas 16 and 19, Otay 250 (Sunroad East Otay Mesa Business Park Specific Plan), Safari Highlands Ranch and Citywide Sphere of Influence Update, Tenth Avenue Marine Terminal Redevelopment Plan and Demolition and Initial Rail Component, The Villages – Escondido Country Club, Valiano, and Warner Ranch. These 15 projects propose development totaling 11,340 residential units and 2,134,561 square feet of non-residential land uses within approximately 6,572 acres. The estimated total GHG

emissions offsets needed from construction and operation (over 30 years) of these 15 development projects with offset commitments under CEQA is 5,283,685 MT CO_2e; however, this offset demand only represents a portion of demand within the County. Based on the San Diego Association of Governments (SANDAG) Regional Growth Forecasts, it is reasonable to assume additional growth within the County will occur over the next thirty years (SANDAG 2013), with some future development projects potentially requiring or voluntarily purchasing GHG offsets. Therefore, the offset demand identified above is considered low as it only represents proposed or recently approved projects in the County.

Based on the CEQA documents for the approved County projects, the project applicant is required to purchase and retire offsets prior to issuance of building permits to sufficiently offset the incremental amount of development (per their prescribed mitigation). The potential annual GHG offset supply within the County is conservatively estimated to total 108,898 MT CO_2e per year from County forests and existing dairy farms. Assuming that the forestry and livestock offset projects would continue to supply offsets for 30 years, and assuming the amount of offsets generated would be constant, the total offsets generated is estimated to be 3,266,940 MT CO_2e. As required by Division 25.5 of the Health and Safety Code (Assembly Bill 32), any reduction of GHG emissions used for compliance purposes must be real, permanent, quantifiable, verifiable, enforceable, and additional (Health and Safety Code Section 38562(d)(1) and (2)); therefore, it is unreasonable to anticipate that 30 years of offsets would be available when building permits for the approved County projects are issued as it would not meet the requirements to be real and verifiable. Even if, somehow, those 30 years of offsets were available at the time of building permit issuance for these projects, they would only total 3,266,940 MT CO_2e, which does not meet the current demand of 5,283,685 MT CO_2e. Lastly, the County's measure to develop a Local Direct Investment Program, which would result in the creation of carbon offsets starting in 2030, is estimated to result in offsets on the order of 50,100 and 198,800 MT CO_2e per year. However, there is a potential overlap of offset availability as estimated herein for County forests and existing dairy farms. In addition, the Local Direct Investment Program offsets are anticipated to be available starting in 2030, while the need for offsets from County projects with offset commitments is immediate.

Requiring the purchase of carbon offsets under geographic priorities 2 and 3 (off-site within the unincorporated areas of the County of San Diego and off-site within the County of San Diego, respectively) is determined to be infeasible at this time.

As such, and as indicated in the above graphic, the current estimated GHG offset demand is greater than the potential estimated GHG offset supply, and offsets that originate outside of the County are necessary to meet the demand from County projects with offset commitments under CEQA. In other words, requiring the purchase of carbon offsets under geographic priority 2 (off-site within the unincorporated areas of the County of San Diego) and geographic priority 3 (off-site within the County of San Diego) is determined to be infeasible at this time.

1 Introduction

The purpose of this white paper is to evaluate the availability of and demand for greenhouse gas (GHG) emissions offsets within San Diego County (County) (including the 18 incorporated cities and unincorporated communities within the County). For background, a brief discussion of GHGs and the global nature of climate change is provided in Section 2. A summary of the basics of GHG offsets is provided in Section 3, including regulatory requirements and offset programs, and an analysis of offset statistics is provided in Section 4. An evaluation of the potential supply of GHG offsets within the County and estimation of the potential demand for GHG offsets is provided in Section 5. A discussion of local GHG investment programs is provided in Sections 6 and 7. Finally, the conclusions are presented in Section 8 and references are cited in Section 9.

2 Climate Change and Greenhouse Gases

Climate change refers to any significant change in measures of climate, such as temperature, precipitation, or wind patterns, lasting for an extended period of time (decades or longer) (EPA 2017). The Earth's temperature depends on the balance between energy entering and leaving the planet's system. Many factors, both natural and human, can cause changes in Earth's energy balance, including changes in the greenhouse effect. The greenhouse effect is the trapping and build-up of heat in the atmosphere (troposphere) near the Earth's surface. Human activities that emit additional GHGs to the atmosphere increase the amount of infrared radiation that gets absorbed before escaping into space, thus enhancing the greenhouse effect and causing the Earth's surface temperature to rise.

A GHG is any gas that absorbs infrared radiation in the atmosphere. As defined in California Health and Safety Code Section 38505(g), GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) (see also State of California Environmental Quality Act (CEQA) Guidelines, Section 15364.5). There are many other GHGs (anthropogenic and non-anthropogenic), but those identified above are the most common GHGs.

GHGs and their attendant climate change ramifications are a global problem.

Unlike criteria air pollutants, where individual districts are characterized by varying levels of pollutant concentrations and source types, GHGs and their attendant climate change ramifications are a global problem (CAPCOA 2008). Climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it; the action of GHGs is global in nature, rather than local or regional (or even statewide or national) (CAPCOA 2008). Climate change has the characteristics of a collective action problem at the global scale because most GHGs accumulate over time and mix globally, and emissions by any agent (e.g., individual, community, company, country) affect other agents (IPCC 2014). While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions (CAPCOA 2008). As all GHG emissions generated throughout the Earth contribute to climate change, a reduction in GHG emissions on earth would offset the generation of GHG emissions and their contribution to climate change regardless of geographic location.

3 GHG Offsets Overview

3.1 Basics

Carbon offset markets are a way for organizations to meet their GHG emissions goals through reductions created by GHG offset projects that occur outside their facilities. These offset projects reduce GHG emissions at the source or enhance GHG removals from the atmosphere above and beyond a "business as usual" baseline, and transfer title for those reductions to organizations seeking to meet compliance obligations. For example, projects employing anaerobic digesters at dairy farms control methane emissions from manure management, and forestry projects result in increased sequestration of CO_2 from the atmosphere in forest carbon stocks. The resulting carbon offsets, which are quantified in metric tons of carbon dioxide equivalent (MT CO_2e), allow other organizations/projects to mitigate any GHG emissions that remain after implementation of internal reduction measures. As required by Division 25.5 of the Health and Safety Code (Assembly Bill 32 or AB 32), any reduction of GHG emissions used for compliance purposes must be real, permanent, quantifiable, verifiable, enforceable, and additional (Health and Safety Code Section 38562(d)(1) and (2)).

Any reduction of GHG emissions used for compliance purposes must be real, permanent, quantifiable, verifiable, enforceable, and additional.

Emission reduction projects utilize standardized protocols for the monitoring, quantification, and verification of carbon offsets. Protocols identify the project eligibility and reporting requirements as well as providing quantification methodologies to determine the number of GHG emissions reduced. Various programs and GHG offset registries—including the California Air Resources Board's (CARB) Compliance Offset Program—publish protocols that offset project developers use to quantify and report GHG emission reductions.

3.2 Regulatory Requirements and Double Counting

GHG emission reductions that occur as a result of legal mandates or regulatory requirements are not considered "additional" to the business-as-usual baseline, and are therefore not eligible to generate carbon offsets. For example, existing regulations in California require the collection and control of methane gas generated and emitted from landfills (CARB 2010). While destruction of methane in landfill gas reduces GHG emissions from solid waste disposal sites, the activity is no longer voluntary in California due to state regulations and therefore is not eligible to generate offsets. Any project type that would be legally mandated must be excluded from the potential supply of carbon offsetting activities as those reductions would occur regardless of any carbon offsetting program. As a result, available offset project protocols are limited to those reduction activities that are not already required by federal, state, or local law or regulation.

GHG emission reductions must also be unique and not double counted when applied for the purposes of offsetting. In the context of a cap-and-trade regulation, such as California's under Assembly Bill 32, this means that any offsets must originate from sectors of the economy that are outside of the cap and not subject to emissions limits. This requirement ensures that activities receiving offsets create voluntary reductions beyond what is mandated by the cap-and-trade regulation and do not occur at facilities already subject to emissions limits.

Fuel (e.g., natural gas, gasoline, and diesel) suppliers and electricity providers are currently subject to the reporting and compliance requirements of CARB's Cap-and-Trade regulation, meaning they must report emissions associated

with the consumption of energy products they supply to the California market and surrender compliance instruments to CARB for these emissions. Accordingly, project activities that reduce energy consumption, such as energy efficiency measures or replacement of inefficient boilers and engines, are already accounted for within the cap because they will be represented in lower reported emissions (and corresponding compliance obligations) for energy suppliers. As such, any project activities that create these types of reductions are not eligible to generate offsets within California because this would represent double counting of the reduction. In practical terms, this means any carbon offset protocols that account for the reduction of electricity consumption or displacement of fossil fuels should be ruled out from consideration for the purposes of GHG mitigation under CEQA.

3.3 Offset Programs and Available Offset Methodologies

Offset programs register and issue GHG emission reduction credits to projects that satisfy the criteria specified in approved protocols. The San Diego County's Climate Action Plan requires that:

> Carbon offset credits must be purchased through any of the following: (i) a CARB-approved registry, such as the Climate Action Reserve, the American Carbon Registry, and the Verified Carbon Standard, (ii) any registry approved by CARB to act as a registry under the state's cap-and-trade program, (iii) through the CAPCOA GHG Rx and the San Diego County Air Pollution Control District (APCD), or (iv) if no registry is in existence as identified in options (i), (ii), or (iii), above, then any other reputable registry or entity that issues carbon offsets consistent with Cal. Health & Saf. Code section 38562(d)(1)), to the satisfaction of the Director of PDS.

In addition, per M-GHG-1 of the County's Supplement to the 2011 General Plan Update Program Environmental Impact Report GHG emissions EIR analysis, the County will consider, to the satisfaction of the Director of Planning & Development Services (PDS), the following geographic priorities for GHG reduction features, and GHG reduction projects and programs: 1) project design features/on-site reduction measures; 2) off-site within the unincorporated areas of the County of San Diego; 3) off-site within the County of San Diego; 4) off-site within the State of California; 5) off-site within the United States; and 6) off-site internationally (County of San Diego 2018a).

Per the Climate Action Plan, the potential supply of carbon offsets in the County is limited to emission reduction projects eligible under the previously referenced GHG offset programs and registries. The San Diego County APCD currently operates an Emission Reduction Credit program; however, the scope of air pollutants covered does not include GHG emissions (SDAPCD 2018). To date throughout California, only one offset project located in Placer County has registered under the CAPCOA GHG Rx registry identified in previously outlined item (iii) and retired a total of 788 MT CO_2e (CAPCOA 2018). Given the lack of a current program operated by the local APCD and the overall low adoption rate of this program throughout the state, the GHG Rx registry is not considered a viable option to generate carbon offsets within the County. The San Joaquin Valley APCD operates an Emission Reduction Credit program, the scope of which does include some types of GHG emissions (SJVAPCD 2018); however, the program is not linked to the CAPCOA GHG Rx Registry and does not utilize GHG accounting protocols approved for GHG Rx. Accordingly, no air district programs are deemed available to supply carbon offsets for GHG mitigation within the County.

The remaining three registries previously identified under item (i) and item (ii) (i.e., the Climate Action Reserve, Verra, and the American Carbon Registry) are the only entities currently approved by CARB to act as offset project registries under Compliance Offset Program component of the state's Cap-and-Trade Program (CARB 2018a). Eligible projects located in the United States or its territories register their GHG emission reductions with one of these three registries to receive emission reduction credits that can be sold to obligated parties for use as compliance instruments under the Cap-and-Trade Program.

Currently, CARB has adopted and published Compliance Offset Protocols for the following project types (CARB 2018b):

- U.S. Forest Projects
- Urban Forest Projects
- Livestock Projects
- Ozone Depleting Substances Projects
- Mine Methane Capture Projects
- Rice Cultivation Projects

Relative to the six project types identified above, further associated details include the following:

- No active or abandoned coal or trona mines exist in the County; therefore, the Mine Methane Capture protocol is excluded from further consideration.
- No hazardous waste combustors or comparable facilities that are capable of destroying Ozone Depleting Substances exist in the County; therefore, the Ozone Depleting Substances protocol is excluded from further consideration.
- The County of San Diego 2014 Greenhouse Gas Emissions Inventory identified that there were no emissions from rice cultivation in the County. Therefore, no opportunity exists in the County to implement an offset project under the Rice Cultivation Protocol (County of San Diego 2014).
- Despite the availability of CARB's Urban Forest Projects Compliance Offset Protocol since 2011, no Urban Forest Projects have generated offsets under this protocol to date (CARB 2018b). In addition, no Early Action Offsets generated from projects applying the Climate Action Reserve's Urban Forestry protocol, which was first published in August 2008 (CARB 2018b). This means Urban Forestry offset protocols have been available to the California market for over a decade, but not a single Urban Forestry offset project—in state or out—has been developed. Contrasted with the nearly 100 million offsets issued to date for reforestation, avoided conversion, and Improved Forest Management (IFM) projects, empirical evidence dictates that any offsets originating in the forest sector would be developed under the U.S. Forest Projects Compliance Offset Protocol and not the Urban Forests Projects Compliance Offset Protocol. Accordingly, Urban Forest Projects are not considered a viable option for the County and are not considered further herein.

Accordingly, at this time, potential carbon offsets for CEQA mitigation within the County must originate from the CARB U.S. Forest or Livestock Projects.

Of the six CARB-adopted Compliance Offset Protocols, only two project types are feasible for County offset projects: U.S. Forest and Livestock projects.

The Climate Action Reserve, Verra, and the American Carbon Registry all publish emission reduction protocols for carbon offset projects beyond the six protocol types approved, as previously described (e.g. landfill gas destruction and energy efficiency). Project developers can generate carbon offsets using these registry-specific methodologies; however, only the six protocols and project types listed above have been approved by CARB to generate compliance offsets for the state's Cap-and-Trade Program. Thus, any offsets generated using other voluntary GHG reduction protocols published by the Climate Action Reserve, Verra, or the American Carbon Registry are not considered "CARB-approved" because they were not registered with these programs using carbon offset protocols approved by CARB, and therefore should not be considered viable offset options for CEQA mitigation.

4 Analysis of GHG Offset Statistics

As of November 28, 2018, CARB has issued a total of 116,821,777 credits (or MT CO_2e), to projects utilizing one of the compliance offset protocols listed above (CARB 2018c). To date, no offsets have been generated by Urban Forest or Rice Cultivation projects. Of the total, 12,400,495 MT CO_2e (or approximately 11%) have been generated from projects located inside of California.

Only 19% of the offsets generated under the state's Cap-and-Trade Program have originated from projects located within the State of California.

CARB has also issued compliance credits from Early Action Offset Projects throughout the United States for GHG emission reductions that occurred prior to 2015. Early action projects are those that originally registered emission reductions using eligible project protocols published by the Climate Action Reserve, Verra, and the American Carbon Registry prior to their transitioning to CARB's Compliance Offset Program. CARB approved for use as early action offset protocols eight different methodologies previously published by the Climate Action Reserve, Verra, and the American Carbon Registry, applicable to the six project types above. In 2015, existing projects previously registered under these protocols were allowed to transition to CARB's compliance program and convert historical emission reductions banked in the early action program (i.e., Climate Action Reserve, Verra, or American Carbon Registry) to compliance credits through a third party desk review process. A total of 24,187,917 Early Action offsets were issued to Early Action Offset Projects during the desk review window. Due to the disproportionate share (greater than 25%) of these offsets coming from three forestry projects in Northern California, approximately 62% of the total early action credits recognized by CARB come from projects within California.

Taken together, CARB has issued a total of 141,009,694 offsets for use as compliance instruments in the Cap-and-Trade Program between both early action and compliance offset projects. Of the 141,009,694 MT CO_2e of offsets generated to date, 27,343,361 MT CO_2e (only 19% of the total) have originated from projects located within the State of California.

5 Evaluation of GHG Offset Availability

This section evaluates the potential future supply and existing demand for carbon offsets within the County.

5.1 Supply

As previously described in Section 3.3, available offset project protocols that satisfy the criteria of the County's Climate Action Plan are limited to CARB's U.S. Forest Project and Livestock Project protocols; therefore, they are considered viable carbon offset options for CEQA mitigation actions. The potential offset supply for each project type for projects located in the County is discussed as follows.

5.1.1 Forestry Projects

A review of the CARB-approved registries identified only one forestry project previously developed in the County. The Cuyamaca Rancho State Park Reforestation Project (CAR505) was a project under the Climate Action Reserve's

voluntary offset program, which was listed in 2009. A verification for CAR505 was performed in 2012 for project activities from 2007 to 2011, but no reductions were claimed at that time, referencing a deferral until performance of the second verification. To date, no additional verifications have occurred and no offsets have been issued by the Climate Action Reserve to the project.

CARB's U.S. Forest Projects Compliance Offset Protocol (Forest Protocol) is used to generate CARB offsets for GHG removal enhancements associated with the sequestration of carbon achieved by increasing and/or conserving forest carbon stocks (CARB 2015). The Forest Protocol identifies project eligibility, monitoring, quantification, reporting and verification requirements. The current version of the Forest Protocol was adopted by CARB on June 25, 2015.

The Forest Protocol identifies three types of eligible activities:

- Reforestation, or restoration of tree cover on land that currently has no, or minimal, tree cover.
- IFM, where management activities increase carbon stocks on forested land relative to baseline levels of carbon stocks.
- Avoided Conversion, where conversion of privately owned forestland to a non-forest land use is prevented by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership.

Rates of carbon sequestration by forests can vary dramatically within tree species, soil types, and geographic areas, depending on age, temperature, humidity, and water and nutrient availability. To quantify GHG removal enhancements, or the amount of carbon dioxide sequestered by the project forests, the Forest Protocol requires field inventory measurements, and in some cases, computer modeling. For potential forestry projects where such actual field data are not available, our emission removals estimates rely on the sequestration rate of 0.79 MT CO_2e per acre per year identified by the California Forest Carbon Plan (Forest Climate Action Team 2018). This sequestration rate is reasonable and conservative as it represents the average sequestration rate for all California forests based on U.S. Forest Service Forest Inventory and Analysis Program data from 2006 through 2015.

The total carbon sequestration potential of all of the County's forested land, which is identified as 130,870 acres based on U.S. Geographic Survey (USGS) Land Cover data (USGS 2011), is estimated to be approximately 103,387 MT CO_2e per year. However, this total includes sequestration in incorporated areas of the County, so it overstates the overall potential and, therefore, is conservative. Further, some of this potential sequestration is "business as usual" and would not fall under eligible activities credited by CARB's protocol as additional. The following approaches were performed to identify potentially creditable sequestration in the County.

To identify potential areas for reforestation, GIS analysis was performed using USGS Land Cover data (USGS 2011) and California Department of Forestry and Fire Protection's (CAL FIRE's) Fire Perimeters data set (CAL FIRE 2018). The USGS land cover data includes 21 land cover classes, including forest classes of Deciduous Forest, Evergreen Forest, and Mixed Forest. CAL FIRE's Fire Perimeter data identifies wildfire perimeters dating back to 1878. The analysis identified locations where the Fire Perimeters data indicated wildfires had occurred from 1996 through the data publication date on land, which the USGS data identifies as one of the above forest types. These areas potentially meet the Forest Protocol's eligibility requirement of "significant disturbance" for reforestation projects. The analysis identified 70,578 acres of County forests subject to potential "significant disturbance" as described, with a reforestation sequestration potential of 55,757 MT CO_2e per year based on the assumed sequestration rate of 0.79 MT CO_2e per acre per year.

To identify potential areas for avoided conversion projects, GIS analysis was performed using USGS Land Cover data (USGS 2011), San Diego Association of Government (SANDAG) Current and Planned Land Use data (SANDAG

2014, 2017a), and SANDAG's Public Land Ownership data (SANDAG 2017b). The USGS land cover data includes 21 land cover classes, including forest classes of Deciduous Forest, Evergreen Forest, and Mixed Forest. SANDAG's Current and Planned Land Use data, reflecting actual land use in 2017 and planned land use in 2050, includes over 100 land use classes, including undeveloped land classes of Open Space Park or Preserve; Park – Active, Undevelopable Natural Area, and Vacant and Undeveloped Land. SANDAG's Public Land Ownership data includes 19 types of local, state, and federal public land ownership. An initial analysis compared differences between the Current and Planned Land Use data to identify areas converted from one of the undeveloped classes above to an alternative developed use. Subsequent analysis identified locations where these "converted areas" intersect with land the USGS Land Cover data identified as one of the above forest types. A final analysis applied the Public Land Ownership data to limit these potentially converted areas of forested land to only those areas held under private ownership, reflecting the Forest Protocol's requirement that avoided conversion projects must transfer private land to protection under public ownership. The analysis identified 23,782 acres of County forests as potential "converted areas" of forested land under private ownership as described, with an avoided conversion sequestration potential of 18,788 MT CO_2e per year based on the assumed sequestration rate of 0.79 MT CO_2e per acre per year.

IFM projects are defined by the implementation of management activities (e.g., increasing rotation ages and thinning diseased trees) on existing forests in order to increase carbon stocks on the managed lands beyond baseline levels defined by the Forest Protocol. Detailed data identifying management methods and existing versus projected carbon stocks are not publicly available as needed to estimate both possible project locations as well as sequestration potential since only the additional carbon stock beyond the baseline are creditable.

However, since the Forest Protocol specifies IFM projects cannot occur on federal lands, GIS analysis was performed to identify forested areas not under federal ownership, as a very conservative estimate of IFM project potential. The analysis was performed using USGS Land Cover data (USGS 2011) and SANDAG's Public Land Ownership data (SANDAG 2017b). The USGS land cover data includes 21 land cover classes, including Deciduous Forest, Evergreen Forest, and Mixed Forest. SANDAG's Public Land Ownership data identifies federal land ownership, including Military Reservations, Indian Reservations, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service and Other Federal land. By excluding any federal land from the USGS Land Cover data identified as one of the above forest types, the analysis identified 60,246 acres of County forests not under federal ownership as described, with an IFM sequestration potential of 47,595 MT CO_2e per year based on the assumed sequestration rate of 0.79 MT CO_2e per acre per year.

It should be noted that all projects under the Forest Protocol (CARB 2015) are subject to several additional eligibility requirements that are difficult to determine from publicly available data, including meeting natural forest management criteria for native species composition; distribution of age classes; and structural elements of standing and lying dead wood, which could further reduce the potential area for sequestration projects.

In summary, the total sequestration potential of County forests was estimated to be approximately 103,387 MT CO_2e per year. However, if only forest lands that are eligible to generate offsets are included, which is still a very conservative measure, the forestry sequestration potential is less than this total when the overlap between different types of eligible forestry activities is considered.

Finally, a forestry sequestration offset project is subject to a variety of transaction costs. These costs include, but are not limited to, initial development of the forest inventory, baseline calculations, and reporting; ongoing monitoring and reporting; and the initial and periodic project verification as well as annual desk reviews. Though transaction costs will vary based on activity type, size, location and other factors, the Climate Action Reserve's Forest Project Feasibility Tool identifies average development costs of $50,000, ongoing project maintenance costs of $12,000 per year, and annual verification/desk review expenses of $35,000 for CARB forest offset projects (CAR 2017).

5.1.2 Livestock Projects

CARB's Livestock Projects Compliance Offset Protocol (Livestock Protocol) is used to generate CARB offsets for GHG removal enhancements associated with collection and destruction of methane generated by livestock waste through the installation of anaerobic digesters (CARB 2014). The Livestock Protocol identifies project eligibility, monitoring, quantification, reporting and verification requirements. The current version of the Livestock Protocol was adopted by CARB on November 14, 2014.

A review of existing projects registered under the Livestock Protocol revealed that no projects currently exist in the County. Furthermore, out of the 77 total Livestock projects actively supplying offsets to the state's Cap-and-Trade Program, less than 10% (8 projects) are located in California (CAR 2018; American Carbon Registry 2018; Verra 2018). Due to the lack of existing projects in the County, a review was conducted to identify candidate facilities that could feasibly install manure digester technology to develop an offset project within the County. Currently, there are only three commercial dairies in operation in the County at which an anaerobic digestion carbon offset project could occur (SDRWQCB 2008):

- Frank J. Konyn Dairy
- T.D. Dairy
- Van Ommering Dairy

It should be noted that the Van Ommering Dairy installed an anaerobic digester in 2004, but was taken offline in 2009 because of maintenance issues that made it uneconomical to operate (CEC 2015; EPA 2018).

For the purposes of quantifying potential offsets from each of these three dairies, the quantification methodology set forth by the CARB Livestock Protocol was applied. The inputs required to quantify the amount of methane emissions avoided, expressed in MT CO_2e, include, but are not limited to: monthly average temperature, monthly herd inventories for each livestock category, the dairy's historical manure management practices, type of digester technology implemented, monthly volumetric flow of biogas generated by the digester, and average methane concentration of the biogas. Without the availability of specific data for the dairies identified above, conservative assumptions were made based on publicly available information sourced from the US EPA's AgSTAR database for estimated monthly biogas flow, dairy permit data from the California Regional Water Quality Control Board – San Diego Region for herd population data, and typical operating conditions for manure digesters for monthly methane concentration, digester technology, and manure management practices. Based on this information, emission reductions were calculated using the Climate Action Reserve's COP Livestock Calculation Tool, Beta Version 2014i – October 2016 (CAR 2016). Each dairy is estimated to generate the following annual offsets as shown in Table 1, and detailed worksheets are provided in Attachment A.

Table 1: Livestock Emission Reductions

Project	Acres	Estimated Annual Emission Reductions (MT CO_2e per year)	Estimated Annual Emission Reductions (MT CO_2e per acre per year)
Frank J. Konyn Dairy	39.31	2,065	52.53
T.D. Dairy	19.65	2,005	102.04
Van Ommering Dairy	19.26	1,441	74.82
Total	**78.22**	**5,511**	**70.46**

Source: ArcGIS.
See Attachment A for detailed emission calculations for each dairy.

As shown in Table 1, the estimated annual emission reduction from the three dairies would total 5,511 MT CO_2e per year. Estimated annual emission reductions are based on conservative assumptions, one of which is historical manure management practices. The calculations assume manure is being managed in an open lagoon where animal waste is collected in alleys and flush lanes as liquid slurry and stored in open air ponds. However, it should be noted that lagoon manure management is not common practice in arid climates, such as the County. As identified in the Climate Action Reserve's Livestock Project Reporting Protocol, typical manure management practice in Southern California is dry lot management, with animals kept in dirt corrals where manure is allowed to dry until it is periodically removed (CAR 2008). Dry lot manure management is an aerobic process which results in significantly less methane generation when compared to anaerobic open lagoon manure management and which generates approximately 39.5 times more methane. Therefore, applying a dry lot manure management scenario in the baseline calculations for potential projects in the County would yield significantly lower emission reductions—and potentially negative emission reduction after accounting for emissions caused by project implementation—relative to those estimates identified in the table above for the far more conservative scenario that assumes all waste was stored in an anaerobic lagoon prior to installation of the digester.

One could argue that the dairy industry could grow in the County and increase the potential supply of carbon offsets available from livestock operations beyond the 5,511 MT CO_2e projected in Table 1 above. However, it is unrealistic to presume that commercial dairy operations will even expand beyond the three existing farms. Three of the six dairies covered under the Regional Water Quality Control Board's order for dairies are no longer in operation (SDRWQCB 2008). Further, livestock and poultry contributed only 1% to the value of the County's total agricultural output in 2017, making it a marginal player in the larger sector (County of San Diego 2017a). As such, it is not reasonable to expect the potential supply of offsets from manure digesters in the County to grow due to new dairy construction.

Though unlikely to occur, to assess the potential contribution of new dairies to the County's supply of offsets, a metric for potential offsets per acre of dairy farm land was computed based on the three existing farms in the County. The acreage for the milking operations, animal housing, and manure storage was estimated for each farm using ArcGIS, as shown in Table 1. It should be noted that the acreage estimates determined for each farm do not include supporting crop land that is required for the operation of a dairy. This means the metric calculated is overstated—and therefore conservative—relative to its true value when ancillary acreage is accounted for.

Dividing the total projected emission reductions in Table 1 (5,511 MT CO_2e per year) by the total acres of the three dairies presented in Table 2 (approximately 78 acres), expansion of the dairy industry in the County would result in approximately 70 offsets generated per acre of available dairy land. However, developing a manure digester project requires significant time and financial resources. It takes two to three years at a minimum to complete design, permitting, construction, and commissioning of an anaerobic digester at a dairy farm. The U.S. EPA's AgSTAR resource identifies that typical capital costs can range anywhere from $750,000 to $2 million per digester in addition to ongoing operational and maintenance costs (EPA 2012). Capital expenditures associated with a digester project are the most significant hurdle barrier to project implementation, and makes realizing the credits identified in the table above impractical due to the size of the farms. While livestock projects are an option for CEQA mitigation, the low potential for offset generation and high capital costs place practical limits on the viability of new digester projects in the County.

5.2 Demand

To estimate the demand of GHG offsets within the County, recent large development projects were identified (Section 5.2.1) and development projections from the SANDAG regional growth forecast were considered (Section 5.2.2).

5.2.1 Current Large Development Projects

The following large land use development projects have been proposed or approved within the County between 2015 and 2018: Fifth Avenue Landing Project & Port Master Plan Amendment (proposed), Harmony Grove Village South (approved July 2018), Lake Jennings Market Place (approved January 2018), Lilac Hills Ranch (proposed), National City Marine Terminal Tank Farm Paving and Street Closures Project & Port Master Plan Amendment (approved August 2016), Newland Sierra (approved September 2018), North River Farms (proposed), Otay Village 14 and Planning Areas 16 and 19 (proposed), Otay 250 (Sunroad East Otay Mesa Business Park Specific Plan) (Approved July 2018), Safari Highlands Ranch and Citywide Sphere of Influence (SOI) Update (proposed), Tenth Avenue Marine Terminal Redevelopment Plan and Demolition and Initial Rail Component (approved December 2016),The Villages – Escondido Country Club (Approved November 15, 2017), Valiano (Approved July 2018), and Warner Ranch (proposed). Per the CEQA documentation for the aforementioned projects, all projects include a GHG offset commitment.

For context, Table 2 presents a development summary of the identified projects within the County, including estimated total site acreage, number of residential units, and square footage of non-residential land uses.

Table 2: San Diego County Development Projects Summary

Project	Jurisdiction	Site Acreage	Residential Units	Non-Residential Square Footage
Fifth Avenue Landing Project & Port Master Plan Amendment	Port of San Diego	18	0	796,000
Harmony Grove Village South	County of San Diego	111	453	5,000
Lake Jennings Market Place	County of San Diego	13	0	76,100
Lilac Hills Ranch	County of San Diego	608	1,746	130,000
National City Marine Terminal Tank Farm Paving and Street Closures Project & Port Master Plan Amendment	Port of San Diego	65	0	0
Newland Sierra	County of San Diego	1,985	2,135	81,000
North River Farms	Oceanside	177	656	94,000
Otay Village 14 and Planning Areas 16 and 19	County of San Diego	1,284	1,119	10,000
Otay 250	County of San Diego	253	3,158	843,000
Safari Highlands Ranch and Citywide SOI Update	Escondido	1,098	550	14,350
Solana 101	Solana Beach	2	25	63,211
Tenth Avenue Marine Terminal Redevelopment Plan	Port of San Diego	96	0	0

Table 2: San Diego County Development Projects Summary

Project	Jurisdiction	Site Acreage	Residential Units	Non-Residential Square Footage
and Demolition and Initial Rail Component				
The Villages – Escondido Country Club	Escondido	109	392	21,900
Valiano	County of San Diego	239	326	0
Warner Ranch	County of San Diego	514	780	0
	Total	*6,572*	*11,340*	*2,134,561*

Sources: City of Escondido 2017a, 2017b. City of Oceanside 2018. City of Solana Beach 2018. County of San Diego 2016, 2017b, 2018b, 2018c, 2018d, 2018e, 2018f, 2018g. Port of San Diego 2016a, 2016b, 2017.
Notes: Projects noted in **bold** are approved.

Table 3 presents estimated construction and operational GHG emissions from each project based on the project's Environmental Impact Report GHG emissions analysis. Consistent with the County's current approach to evaluating potential GHG emissions impacts, the assumed lifetime of each project was estimated to be 30 years; therefore, for purposes of calculating the total operational GHG emissions offsets needed, the estimated annual operational GHG emissions were multiplied by 30. Accordingly, the total estimated GHG emissions offsets needed from each project, as presented in Table 3, is the total estimated construction GHG emissions plus the total operational GHG emissions over 30 years.

Table 3: Estimated Greenhouse Gas Emissions Offsets Needed from Large Development Projects within San Diego County

Project	Estimated Total Construction GHG Emissions (MT CO_2e)	Estimated Annual Operational GHG Emissions (MT CO_2e)	Estimated Total Operational GHG Emissions[a] (MT CO_2e)	Total GHG Emissions Offsets Needed from Construction and Operation (MT CO_2e)
Fifth Avenue Landing Project & Port Master Plan Amendment	12,435	16,999	522,406	522,406[a]
Harmony Grove Village South	4,411	5,222	156,660	161,071[a]
Lake Jennings Market Place	2,708	2,396	71,830	74,588[a]
Lilac Hills Ranch	18,239	23,561	706,830	725,069[a]
National City Marine Terminal Tank Farm Paving and Street Closures Project & Port Master Plan Amendment	6,159	1,090	38,844	38,844[a]
Newland Sierra	93,323	43,498	1,304,940	1,398,263[a]
North River Farms	4,951	10,288	313,591	313,591[a]

Table 3: Estimated Greenhouse Gas Emissions Offsets Needed from Large Development Projects within San Diego County

Project	Estimated Total Construction GHG Emissions (MT CO_2e)	Estimated Annual Operational GHG Emissions (MT CO_2e)	Estimated Total Operational GHG Emissions[a] (MT CO_2e)	Total GHG Emissions Offsets Needed from Construction and Operation (MT CO_2e)
Otay Village 14 and Planning Areas 16 and 19	22,760	16,159	484,770	507,530[a]
Otay 250	27,060	31,884	956,520	983,580[a]
Safari Highlands Ranch and Citywide SOI Update	19,620	12,033	380,610	223,250[b]
Solana 101	707	2,016	61,187	19,530[b]
Tenth Avenue Marine Terminal Redevelopment Plan and Demolition and Initial Rail Component	752	40,150	1,204,500	34,044[b]
The Villages – Escondido Country Club	7,873	5,673	178,063	50,472[b]
Valiano	6,123	4,493	134,790	140,913[a]
Warner Ranch	18,144	2,413	72,390	90,534[a]
Total				*5,283,685*

Sources: City of Escondido 2017a, 2017b. City of Oceanside 2018. City of Solana Beach 2018. County of San Diego 2016, 2017b, 2018b, 2018c, 2018d, 2018e, 2018f, 2018g. Port of San Diego 2016a, 2016b, 2017.
Notes: Projects noted in **bold** are approved.
[a] Assumes a 30-year lifetime.
[b] The project has committed to offset all project emissions to net zero.
[c] The project has committed to offset project emissions to the applicable CEQA significance threshold.

As shown in Table 3, the estimated total GHG emissions offsets needed from these 15 projects with offset commitments under CEQA is 5,283,685 MT CO_2e.

It has been shown in recent decisions by the County that when offsets are used to mitigate project impacts, the purchase and retirement of the offsets is required to be fulfilled prior to the County issuing building permits for the project. Therefore, a project's entire offset obligation (construction and operation) must be settled prior to the project beginning operation.

Another large project called Otay Village 13 (Otay Ranch Preserve and Resort) is currently proposed within the County. Otay Village 13 proposes development of 1,938 residential units, 20,000 square feet of neighborhood commercial uses, and a 17.4-acre hotel within 1,869 acres (County of San Diego 2015). The Draft Environmental Impact Report for Otay Village 13, which was released in 2015 for public review, estimates project-generated construction GHG emissions to total 29,310 MT CO_2e and annual operational GHG emissions to total 33,715 MT

CO_2e per year (County of San Diego 2015). While not included in the estimated offset demand, this project represents an increase in approximately 20% of total GHG emissions from recent large projects within the County.[1]

5.2.2 Future Growth

The GHG emissions and anticipated offsets needed presented in Section 5.2.1 represent a portion of GHG offset demand within the County. It is reasonable to assume additional growth within the County will occur over the next 30 years, with some development projects potentially requiring or voluntarily purchasing GHG offsets.

SANDAG has produced growth forecasts of population, housing, employment, income, and land use in the San Diego region since 1971. These forecasts help SANDAG and local jurisdictions plan appropriate facilities, services, and development practices over the long term. To provide a snapshot of growth anticipated within the County area, Table 4 presents SANDAG 2020 and 2050 estimates and the calculated change (numeric and percent) for four growth indicators: population, housing units, jobs, and developed acres.

Table 4: SANDAG 2050 Regional Growth Forecast

Growth Subject	2020	2050	Numeric Change (2020–2050)	Percent Change (2020–2050)
Total Population	3,143,429	4,068,759	925,330	29%
Total Housing Units	1,165,818	1,491,935	326,117	28%
Jobs	1,450,913	1,911,405	460,492	32%
Developed Acres	846,884	1,052,334	205,449	24%

Source: SANDAG 2013.
Notes: Based on Series 13 model.

As presented in Table 4, between 2020 and 2050, growth is anticipated in population, housing units, jobs, and developed acres.

After accounting for the residential units associated with the 15 identified projects with offset commitments, there would still be an additional 314,777 residential units projected to be built in the County between 2020 and 2050.

As shown in Table 2 (Section 5.2.1), the total residential units from the 15 projects with offset commitments are 11,340 units. Between 2020 and 2050, a growth of 326,117 residential units is projected, which is 314,777 additional units than proposed by the 15 projects with offset commitments.

The California Department of Housing and Community Development issues a Regional Housing Need Determination for SANDAG and other association of governments. In assessing SANDAG's regional housing need, the Department of Housing and Community Development and SANDAG staff completed an extensive consultation process from October 2016 through June 2018 covering the Department of Housing and Community Development methodology, data sources, and timeline for both the Department's Regional Housing Need Determination and SANDAG's Regional Housing Need Allocation (RHNA). The Final Regional Housing Need Determination issued in July 2018 identified a minimum regional housing need of 171,685 total units among four income categories for SANDAG to distribute among its local governments for the period of June 30, 2020 through April 15, 2029 (California Department of Housing and Community Development 2018).

[1] Assuming a 30-year lifetime for Otay Village 13, estimated total construction GHG emissions (29,310 MT CO_2e) plus operational emissions over 30 years (1,011,450 MT CO_2e) would equal 1,040,760 MT CO_2e (and would increase the "demand" for offsets by 20%).

6 County Local Direct Investment Program

The County identified within its Climate Action Plan GHG Reduction Measure T-4.1 (Establish a Local Direct Investment Program) to close the 2030 GHG emissions reductions target gap (County of San Diego 2018h). Implementation of GHG Reduction Measure T-4.1 would result in a variety of direct investment in local projects that would offset carbon emissions within the unincorporated County by 2030. The Local Direct Investment Program would create offsets within the County through registering of projects through a CARB-approved GHG registry and through protocols approved by CARB (County of San Diego 2018a).

In support of the Climate Action Plan, a preliminary assessment of the Local Direct Investment Program was prepared to evaluate the feasibility of potential offsets generated within the County (Ramboll Environ 2017). This study evaluated all available protocols within the CARB approved registries and eliminated those that would not meet the geographic scope of the County, whether the GHG sources exist within the County, and whether the protocols were already accounted for within other Climate Action Plan measures (Ramboll Environ 2017). It should be noted that because the study looked at both CARB-approved Cap-and-Trade protocols and voluntary offset protocols within the CARB-approved registries, some of the protocols do not meet the definition of additional as they may be required by State or other regulation, such as landfill methane collection and combustion, which is currently a CARB regulation (CARB 2010). Therefore, it is likely that the estimates provided in the study are overestimated and not likely. Regardless, the study estimated that by 2030 the County could offset between 50,100 and 198,800 MT CO_2e per year under the Local Direct Investment Program. To conservatively estimate the projected emissions from the Local Direct Investment Program, it was assumed the full 198,800 MT CO_2e would be available by 2030 for County use. It should be noted that there is overlap between the emissions estimated in Section 5.1 and that within the Ramboll study; therefore, the combined potential GHG offset supply is likely overstated but included herein for discussion purposes.

7 Other Local Direct Investment Programs

Within each jurisdiction, the adopted climate action plans and their associated environmental CEQA documents provide the guidelines to meet the adopted GHG reduction targets, consistent with State goals. Each of these climate action plans was reviewed to determine (1) whether the jurisdiction acknowledges the use of GHG offsets as a viable tool to reduce GHG emissions, and (2) whether that jurisdiction has developed any guidance or GHG offset mechanism to adhere to. Of the 18 incorporated cities within the County, 10 have formally adopted climate action plans. Of those 10 cities, only 3 addressed offsets. Of those 3 cities that addressed GHG offsets, none developed a local direct GHG investment program in which projects can offset their GHG emissions. Two of those cities acknowledge the use of offsets within their climate action plan inventories and one city proposes using GHG offsets to meet its GHG reduction goals. None of the 18 cities and 10 climate action plans address offsets within the context of approved protocols or registries. Therefore, no direct investment or other local GHG offset program exists within the incorporated cities of the County.

8 Conclusions

The potential total offset demand from 15 recent County projects with offset commitments under CEQA is estimated to be 5,283,685 MT CO_2e. Based on the CEQA documents for the approved County projects, the project applicants are required to purchase and retire offsets prior to issuance of building permits to sufficiently offset the incremental amount of development (per their prescribed mitigation).

As discussed in Sections 3 and 5.1, while the County's Climate Action Plan allows for offsets to be purchased through various programs, not all protocols and projects are available or feasible. The two types of projects considered viable for the County are U.S. Forest or Livestock projects. The potential annual GHG offset supply within the County is estimated to total 108,898 MT CO_2e per year from County forests and existing dairy farms. Assuming that the forestry and livestock offset projects would continue to supply offsets for 30 years, and assuming the amount of offsets generated would be constant, the total offsets generated is estimated to be 3,266,940 MT CO_2e. As required by Division 25.5 of the Health and Safety Code (Assembly Bill 32), any reduction of GHG emissions used for compliance purposes must be real, permanent, quantifiable, verifiable, enforceable, and additional (Health and Safety Code Section 38562(d)(1) and (2)); therefore, it is unreasonable to anticipate that 30 years of offsets would be available when building permits for the approved County projects are issued, as they would not meet the requirements to be real and verifiable. The County's Local Direct Investment Program offsets are anticipated to be available starting in 2030, while the need for offsets from County projects with offset commitments is immediate. As the current estimated GHG offset demand is greater than the potential estimated GHG offset supply, offsets that originate outside of the County are necessary to meet the demand from County projects with offset commitments under CEQA. In other words, requiring the purchase of carbon offsets under geographic priority 2 (off-site within the unincorporated areas of the County of San Diego) and geographic priority 3 (off-site within the County of San Diego) is determined to be infeasible at this time.

As the current estimated GHG offset demand is greater than the current estimated GHG offset supply, offsets that originate outside of the County are necessary to meet the demand from current County projects with offset commitments under CEQA.

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Attachment A

Supporting Documentation and Worksheets

Attachment A

Forestry Calculation Details

The following tables present the carbon sequestration calculations for all of San Diego County, followed by the potential carbon offset estimates for reforestation, avoided conversion, and improved forest management projects implemented on available land in the County.

A-1 San Diego County Total Sequestration Potential

U.S. Geological Survey, NLCD 2011

Land Cover	Acres		
Open Water	24,270.46		
Developed, Open Space	183,013.20		
Developed, Low Intensity	117,670.40		
Developed, Medium Intensity	162,721.77		
Developed High Intensity	43,559.19		
Barren Land (Rock/Sand/Clay)	325,930.40		
Shrub/Scrub	1,342,809.89		
Grassland/Herbaceous	310,908.91		
Pasture/Hay	6,181.47		
Cultivated Crops	46,736.43		
Woody Wetlands	17,532.39		
Emergent Herbaceous Wetlands	14,743.15	MT CO2e/acre/year*	MT CO2e/year
Deciduous Forest	232.77	0.79	183.89
Evergreen Forest	78,874.48	0.79	62,310.84
Mixed Forest	51,762.63	0.79	40,892.48
Total:	2,726,947.54		
Subtotal: Forested	130,869.88		103,387.20

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

A-2 San Diego County Reforestation Sequestration Potential

	U.S. Geological Survey, NLCD 2011	Subset by CalFire, Fire Perimeters ("fire17_1"), 2018-04-13		
Land Cover	Acres	Acres		
Open Water	24,270.46	3,138.73		
Developed, Open Space	183,013.20	41,437.48		
Developed, Low Intensity	117,670.40	11,229.36		
Developed, Medium Intensity	162,721.77	4,324.19		
Developed High Intensity	43,559.19	522.10		
Barren Land (Rock/Sand/Clay)	325,930.40	2,429.05		
Shrub/Scrub	1,342,809.89	620,914.70		
Grassland/Herbaceous	310,908.91	102,149.96		
Pasture/Hay	6,181.47	1,391.79		
Cultivated Crops	46,736.43	8,456.80		
Woody Wetlands	17,532.39	5,627.58		
Emergent Herbaceous Wetlands	14,743.15	3,752.49	MT CO2e/acre/year*	MT CO2e/year
Deciduous Forest	232.77	76.80	0.79	60.67
Evergreen Forest	78,874.48	42,710.76	0.79	33,741.50
Mixed Forest	51,762.63	27,790.67	0.79	21,954.63
Total:	2,726,947.54	875,952.46		
Subtotal: Forested	130,869.88	70,578.22		55,756.80

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

A-3 San Diego County Avoided Conversion Potential

U.S. Geological Survey, NLCD 2011

Land Cover	Acres
Open Water	24,270.46
Developed, Open Space	183,013.20
Developed, Low Intensity	117,670.40
Developed, Medium Intensity	162,721.77
Developed High Intensity	43,559.19
Barren Land (Rock/Sand/Clay)	325,930.40
Shrub/Scrub	1,342,809.89
Grassland/Herbaceous	310,908.91
Pasture/Hay	6,181.47
Cultivated Crops	46,736.43
Woody Wetlands	17,532.39
Emergent Herbaceous Wetlands	14,743.15
Deciduous Forest	232.77
Evergreen Forest	78,874.48
Mixed Forest	51,762.63
Total:	2,726,947.54
Subtotal: Forested	130,869.88

Forested Areas Total	130,870	
Forested Areas within Conversion Areas Total	50,750	Determined using SANDAG LANDUSE_CURRENT** and LANDUSE_PLANNED***
Forested Areas within Conversion Areas on Federal Land	24,160	Determined using SANDAG LAND_OWNERSHIP_SG****
Forested Areas Within Conversion Areas on Public Lands	2,808	Determined using SANDAG LAND_OWNERSHIP_SG****
Forested Areas Within Conversion Areas on Private Lands	23,782	

MT CO2e/acre /year*	MT CO2e/year
0.79	18,788.17

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

**San Diego Association of Government (SANDAG), Current Land Use ("LANDUSE_CURRENT"), 2017-03-06

***San Diego Association of Government (SANDAG), Planned Land Use ("LANDUSE_PLANNED"), 2014-10-02

****San Diego Association of Government (SANDAG), Public Land Ownership ("LAND_OWNERSHIP_SG"), 2017-10-10

A-4 San Diego County Improved Forest Management Potential

U.S. Geological Survey, NLCD 2011

Land Cover	Acres
Open Water	24,270.46
Developed, Open Space	183,013.20
Developed, Low Intensity	117,670.40
Developed, Medium Intensity	162,721.77
Developed High Intensity	43,559.19
Barren Land (Rock/Sand/Clay)	325,930.40
Shrub/Scrub	1,342,809.89
Grassland/Herbaceous	310,908.91
Pasture/Hay	6,181.47
Cultivated Crops	46,736.43
Woody Wetlands	17,532.39
Emergent Herbaceous Wetlands	14,743.15
Deciduous Forest	232.77
Evergreen Forest	78,874.48
Mixed Forest	51,762.63
Total:	2,726,947.54
Subtotal: Forested	130,869.88

Forested Areas Total	130,870	
Forested Areas on Federal Land	70,624	Determined using SANDAG LAND_OWNERSHIP_SG**
Forested Areas on all Private and Other Public Land	60,246	

MT CO2e/acre/ year*	MT CO2e/year
0.79	47,594.58

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

* Forest Climate Action Team. 2018. California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate. Sacramento, CA. 178p

**San Diego Association of Government (SANDAG), Public Land Ownership ("LAND_OWNERSHIP_SG"), 2017-10-10

Livestock Project Calculation Details

The following table summarizes the inputs used to estimate potential GHG reductions from the installation of anaerobic digesters at the three dairy farms in San Diego currently in operation. The table provides the inputs values for each dairy for each parameter, as well as the data source referenced.

Calculation Input Parameter	Parameter Description	Unit of Measure	T.D. Dairy	Van Ommering Dairy	Konyn Dairy	Data Source Reference
L	Type of livestock categories on the farm	Livestock category	Milking Cows	Milking Cows	Milking Cows	Conservatively assumed all animals are milking cows
PL	Average number of animals for each livestock category	Population (# head)	675	485	695	California Regional Water Quality Control Board – San Diego Region; Waste Discharge Requirements Order No. R9-2008-0130
MassL	Average live weight by livestock category	kg	680	680	680	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.1.
B0,L	Maximum methane producing capacity for manure by livestock category	(m3 CH4/kgVS)	0.24	0.24	0.24	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.2.
VSL	Daily volatile solid production	(kg/day/1000 kg mass)	11.41	11.41	11.41	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.4.
T2	Average monthly temperature at location	°C	25.91 (Annual Average)	25.91 (Annual Average)	25.91 (Annual Average)	WeatherUnderground.com

Calculation Input Parameter	Parameter Description	Unit of Measure	T.D. Dairy	Van Ommering Dairy	Konyn Dairy	Data Source Reference
	of the operation					Station: Ramona, CA SanDiego County
BCE	Biogas capture efficiency of the anaerobic digester, accounts for gas leaks.	%	95	95	95	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.3.
BDE	Methane destruction efficiency of destruction device(s)	%	93.6	93.6	93.6	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.6.
C_{CH4}	Methane concentration of biogas	%	50	50	50	American Biogas Council
F	Monthly volume of biogas from digester to destruction devices	scf/month	902,464	648,437	929,203	US EPA's AgSTAR database
MCF_{ep}	Methane conversion factor for BCS effluent pond	%	65	65	65	CARB Compliance Offset Protocol Livestock Projects, Adopted November 14, 2014; Table A.5.
$MSL_{,BCS}$	Fraction of manure from each livestock category managed in the BCS	%	100	100	100	Conservatively assumed all manure will be managed in the digester in the project scenario

Calculation Input Parameter	Parameter Description	Unit of Measure	T.D. Dairy	Van Ommering Dairy	Konyn Dairy	Data Source Reference
MSL	Fraction of manure from each livestock category managed in the baseline waste handling system 'S	%	100	100	100	Conservatively assumed all manure is currently managed in an open lagoon in the baseline scenario

The following calculation summaries present the emission reduction calculation summaries for the offset quantities identified in Table 1.

Emission Calculations for the Frank J. Konyn Dairy

Worksheet II: Emissions Summary

Legend:

Green	Automatically drawn from the other worksheets
Blue	Automatic calculations
Rose	Final Calculation Results

Offset Project Registry Project ID	**Konyn Dairy**
Reporting Period	**01/01/2017 - 12/31/2017**

II.A. Total Modeled Baseline Emissions

II.A.i. Total Modeled Baseline Methane Emissions by Livestock Category (L)

Livestock Category (L)	Total $BE_{CH4,L,y}$ (MT)	Total $BE_{CH4,L,y}$ (CO2e)
Dairy cows (on feed)	244.88	5,143
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.ii. Total Modeled Baseline Methane Emissions by Storage/Treatment Component (S)

Storage Component (S)	Total $BE_{CH4,S,y}$ (MT)	Total $BE_{CH4,S,y}$ (CO2e)
Uncovered anaerobic lagoon	244.88	5,143
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.iii. Total Modeled Baseline Methane Emissions [Equation 5.2]

BE_{CH4} (MT) =	244.88	tonnes CH_4 $year^{-1}$
BE_{CH4} (CO_2e) =	5,142.57	tonnes CO_2e $year^{-1}$

II.A.iv. Total Baseline Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00	tonnes CO_2 $year^{-1}$

II.B. Total Project Emissions

II.B.i. Project Methane Emissions from the BCS

CH_4(BCS) (MT) =	12.25	tonnes CH_4 $year^{-1}$
CH_4(BCS) (CO_2e)	257.29	tonnes CO_2e $year^{-1}$

IIB.ii. Methane Emissions from Venting Events

$CH_{4,vent,i}$ (MT)	0.00	tonnes CH_4 $year^{-1}$
$CH_{4,vent,i}$ (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.iii. Project Methane Emissions from the BCS Effluent Pond

CH_4(EP) (MT) =	62.64	tonnes CH_4 $year^{-1}$
CH_4(EP) (CO_2e)	1,315.37	tonnes CO_2e $year^{-1}$

II.B.iv. Project Methane Emissions from Non-BCS-Related Sources

CH_4(nonBCS sources) (MT) =	0.00	tonnes CH_4 $year^{-1}$
CH_4(nonBCS sources) (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.v. Total Project Methane Emissions [Equation 5.5]

PE_{CH4} (MT)	74.89	tonnes CH_4 $year^{-1}$
PE_{CH4}(CO_2e) =	1,572.65	tonnes CO_2e $year^{-1}$

II.B.vi. Total Project Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00

II.C. Comparison of Modeled Methane Reductions to Total Quantity of Destroyed Methane

(BE_{CH4} (MT) - PE_{CH4} (MT)) =	170	tonnes CH_4 $year^{-1}$
$CH_{4,destroyed}$ (MT) =	98	tonnes CH_4 $year^{-1}$
Note: The Total Methane Reductions (below) will be equal to the lesser of the two values above.		
Total Methane Reductions (MT) =	98	tonnes CH_4 $year^{-1}$
Total Methane Reductions (CO_2e) =	2,065	tonnes CO_2e $year^{-1}$

II.D. Total Emission Reductions (CH_4 and CO_2) [Equation 5.1]

Total Emission Reductions (MT CO_2e/yr) =	2,065	tonnes CO_2e $year^{-1}$

Emission Calculations for the T.D. Dairy

Worksheet II: Emissions Summary

Legend:

Green	Automatically drawn from the other worksheets
Blue	Automatic calculations
Rose	Final Calculation Results

Offset Project Registry Project ID	**T.D. Dairy**
Reporting Period	**01/01/2017 - 12/31/2017**

II.A. Total Modeled Baseline Emissions

II.A.i. Total Modeled Baseline Methane Emissions by Livestock Category (L)

Livestock Category (L)	Total $BE_{CH4,L,y}$ (MT)	Total $BE_{CH4,L,y}$ (CO2e)
Dairy cows (on feed)	237.84	4,995
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.ii. Total Modeled Baseline Methane Emissions by Storage/Treatment Component (S)

Storage Component (S)	Total $BE_{CH4,S,y}$ (MT)	Total $BE_{CH4,S,y}$ (CO2e)
Uncovered anaerobic lagoon	237.84	4,995
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.iii. Total Modeled Baseline Methane Emissions [Equation 5.2]

BE_{CH4} (MT) =	237.84	tonnes CH_4 $year^{-1}$
BE_{CH4} (CO_2e) =	4,994.59	tonnes CO_2e $year^{-1}$

II.A.iv. Total Baseline Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00	tonnes CO_2 $year^{-1}$

II.B. Total Project Emissions

II.B.i. Project Methane Emissions from the BCS

CH_4(BCS) (MT) =	11.90	tonnes CH_4 $year^{-1}$
CH_4(BCS) (CO_2e)	249.88	tonnes CO_2e $year^{-1}$

IIB.ii. Methane Emissions from Venting Events

$CH_{4,vent,i}$ (MT)	0.00	tonnes CH_4 $year^{-1}$
$CH_{4,vent,i}$ (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.iii. Project Methane Emissions from the BCS Effluent Pond

CH_4(EP) (MT) =	60.83	tonnes CH_4 $year^{-1}$
CH_4(EP) (CO_2e)	1,277.51	tonnes CO_2e $year^{-1}$

II.B.iv. Project Methane Emissions from Non-BCS-Related Sources

CH_4(nonBCS sources) (MT) =	0.00	tonnes CH_4 $year^{-1}$
CH_4(nonBCS sources) (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.v. Total Project Methane Emissions [Equation 5.5]

PE_{CH4} (MT)	72.73	tonnes CH_4 $year^{-1}$
PE_{CH4}(CO_2e) =	1,527.39	tonnes CO_2e $year^{-1}$

II.B.vi. Total Project Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00

II.C. Comparison of Modeled Methane Reductions to Total Quantity of Destroyed Methane

(BE_{CH4} (MT) - PE_{CH4} (MT)) =	165	tonnes CH_4 $year^{-1}$
$CH_{4,destroyed}$ (MT) =	95	tonnes CH_4 $year^{-1}$
Note: The Total Methane Reductions (below) will be equal to the lesser of the two values above.		
Total Methane Reductions (MT) =	95	tonnes CH_4 $year^{-1}$
Total Methane Reductions (CO_2e) =	2,005	tonnes CO_2e $year^{-1}$

II.D. Total Emission Reductions (CH_4 and CO_2) [Equation 5.1]

Total Emission Reductions (MT CO_2e/yr) =	2,005	tonnes CO_2e $year^{-1}$

Emission Calculations for the Van Ommering Dairy

Worksheet II: Emissions Summary

Legend:

Green	Automatically drawn from the other worksheets
Blue	Automatic calculations
Rose	Final Calculation Results

Offset Project Registry Project ID	**Van Ommering Dairy**
Reporting Period	**01/01/2017 - 12/31/2017**

II.A. Total Modeled Baseline Emissions

II.A.i. Total Modeled Baseline Methane Emissions by Livestock Category (L)

Livestock Category (L)	Total $BE_{CH4,L,y}$ (MT)	Total $BE_{CH4,L,y}$ (CO2e)
Dairy cows (on feed)	170.89	3,589
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.ii. Total Modeled Baseline Methane Emissions by Storage/Treatment Component (S)

Storage Component (S)	Total $BE_{CH4,S,y}$ (MT)	Total $BE_{CH4,S,y}$ (CO2e)
Uncovered anaerobic lagoon	170.89	3,589
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0
0.00	0.00	0

II.A.iii. Total Modeled Baseline Methane Emissions [Equation 5.2]

BE_{CH4} (MT) =	170.89	tonnes CH_4 $year^{-1}$
BE_{CH4} (CO_2e) =	3,588.70	tonnes CO_2e $year^{-1}$

II.A.iv. Total Baseline Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00	tonnes CO_2 $year^{-1}$

II.B. Total Project Emissions

II.B.i. Project Methane Emissions from the BCS

CH_4(BCS) (MT) =	8.55	tonnes CH_4 $year^{-1}$
CH_4(BCS) (CO_2e)	179.54	tonnes CO_2e $year^{-1}$

IIB.ii. Methane Emissions from Venting Events

$CH_{4,vent,i}$ (MT)	0.00	tonnes CH_4 $year^{-1}$
$CH_{4,vent,i}$ (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.iii. Project Methane Emissions from the BCS Effluent Pond

CH_4(EP) (MT) =	43.71	tonnes CH_4 $year^{-1}$
CH_4(EP) (CO_2e)	917.92	tonnes CO_2e $year^{-1}$

II.B.iv. Project Methane Emissions from Non-BCS-Related Sources

CH_4(nonBCS sources) (MT) =	0.00	tonnes CH_4 $year^{-1}$
CH_4(nonBCS sources) (CO_2e)	0.00	tonnes CO_2e $year^{-1}$

II.B.v. Total Project Methane Emissions [Equation 5.5]

PE_{CH4} (MT)	52.26	tonnes CH_4 $year^{-1}$
PE_{CH4}(CO_2e) =	1,097.46	tonnes CO_2e $year^{-1}$

II.B.vi. Total Project Carbon Dioxide Emissions $CO_{2(MSC)}$ (CO2e)

0.00

II.C. Comparison of Modeled Methane Reductions to Total Quantity of Destroyed Methane

(BE_{CH4} (MT) - PE_{CH4} (MT)) =	119	tonnes CH_4 $year^{-1}$
$CH_{4,destroyed}$ (MT) =	69	tonnes CH_4 $year^{-1}$
Note: The Total Methane Reductions (below) will be equal to the lesser of the two values above.		
Total Methane Reductions (MT) =	69	tonnes CH_4 $year^{-1}$
Total Methane Reductions (CO_2e) =	1,441	tonnes CO_2e $year^{-1}$

II.D. Total Emission Reductions (CH_4 and CO_2) [Equation 5.1]

Total Emission Reductions (MT CO_2e/yr) =	1,441	tonnes CO_2e $year^{-1}$