3.3 AIR QUALITY

This section presents a discussion of existing air quality conditions, a summary of applicable laws and regulations, and an analysis of potential construction and operational air quality impacts that could result from potential campus development associated with implementation of the 2021 LRDP. Mitigation measures are recommended as necessary to reduce significant air quality impacts to the extent feasible.

Public comments on the NOP (Appendix B) included concerns regarding the air quality impacts associated with growth planned under the 2021 LRDP, construction, toxic air contaminants (TACs) and odors from proposed uses, and consistency with regional growth plans. Concerns related to growth focused on the potential for the 2021 LRDP to result in increased vehicles emissions as new students and staff would be expected to live outside of the City of Santa Cruz (City) due to limited housing availability on-campus and within the City. All of the applicable issues are addressed in the impact analysis below.

3.3.1 Regulatory Setting

Air quality in the vicinity of the project is regulated by the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and Monterey Bay Air Resources District (MBARD). Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both state and local regulations may be more stringent.

Concentrations of several air pollutants—ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and lead—indicate the quality of ambient air and are therefore used as the basis for regulatory standards. These pollutants, which are the most prevalent air pollutants known to be harmful to human health, are referred to as criteria air pollutants because both EPA and CARB have established specific public-health-based and welfare-based criteria, or standards, for what is considered acceptable human exposure to these pollutants. The effects of criteria pollutants on human health have been studied and documented through several years of research and epidemiological studies (Landrigan 2018, Shah 2013, Sioutas 2005, Kim 2013, Delfino et al. 2005, Dominici 2006, Levesque 2011). These air quality standards are listed in Table 3.3-3.

Air quality regulations also focus on TACs (also known as hazardous air pollutants [HAPs] in federal regulations). In general, for those TACs that may cause cancer, all concentrations present some risk and there is no safe level of exposure. In other words, there is no threshold level below which adverse health impacts may not be expected to occur. EPA and CARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum achievable control technology (MACT) or best available control technology for toxics (T-BACT) to limit emissions. These statutes and regulations, in conjunction with additional rules set forth by MBARD, establish the regulatory framework for TACs. EPA regulates HAPs through its National Emission Standards for Hazardous Air Pollutants (NESHAPs) for various source categories, as authorized by Section 112 of the CAA. The regulations are published in Title 40 of the Code of Federal Regulations (40 CFR), Parts 61 and 63. CARB regulates TACs largely through its Airborne Toxic Control Measures (ATCMs) for several source categories that are codified in the California Code of Regulations (CCR).

Applicable regulations associated with criteria air pollutants, TACs, and odors are described below.

FEDERAL

Criteria Air Pollutants

At the federal level, EPA implements the national air quality programs. EPA air quality mandates are drawn primarily from the federal Clean Air Act (CAA), enacted in 1970. The most recent major amendments were made by Congress in 1990.

The CAA requires EPA to establish National Ambient Air Quality Standards (NAAQS). As shown in Table 3.3-3, EPA has established NAAQS for the following criteria air pollutants: ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead (CARB 2016a). The primary standards protect public health and the secondary standards protect public welfare. The CAA also requires each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The federal Clean Air Act Amendments of 1990 (CAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA reviews all state SIPs to determine whether they conform to the mandates of the CAA and its amendments and whether implementing them will achieve air quality goals. If EPA determines a SIP to be inadequate, a Federal Implementation Plan that imposes additional control measures may be prepared for the nonattainment area. If the state fails to submit an approvable SIP, sanctions may be applied to transportation funding and stationary air pollution sources in the air basins.

Hazardous Air Pollutants and Toxic Air Contaminants

TACs, or in federal parlance, HAPs, are a defined set of airborne pollutants that may pose a present or potential hazard to human health. A TAC is defined as an air pollutant that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

A wide range of sources, from industrial plants to motor vehicles, emit TACs. The health effects associated with TACs are quite diverse and generally are assessed locally, rather than regionally. While many TACs can cause cancer, some TACs can also cause long-term, chronic health effects such as birth defects, neurological damage, asthma, bronchitis, or genetic damage; or short-term acute affects such as eye watering, respiratory irritation (cough), running nose, throat pain, and headaches.

For evaluation purposes, TACs are separated into carcinogens and non-carcinogens based on the nature of the physiological effects associated with exposure to the pollutant. Carcinogens are assumed to have no safe threshold below which health impacts would not occur. This contrasts with criteria air pollutants for which acceptable levels of exposure can be determined and for which the ambient standards have been established (Table 3.3-3). Cancer risk resulting from exposure to TACs is expressed as the increase in cancer cases per one million exposed individuals, typically over a lifetime of exposure, based on the cancer potency factor of each TAC. Non-cancer risks are measured in terms of health hazard indices, which indicate whether a TAC concentration is above its reference exposure level (REL), and by how much. RELs are classified as acute, 8-hour, and chronic, depending on the exposure period. California's Office of Environmental Health Hazard Assessment (OEHHA) publishes standard cancer potency factors and RELs for TACs, along with information about which organ systems may be affected when RELs are exceeded (OEHHA 2009, 2019).

Corporate Average Fuel Economy Standards

In October 2012, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHSTA), on behalf of the Department of Transportation, issued final rules to further reduce greenhouse gas (GHG) emissions and improve corporate average fuel economy (CAFE) standards for light-duty vehicles for model years 2017 and beyond (77 Federal Register [FR] 62624). NHTSA's CAFE standards have been enacted under the Energy Policy and Conservation Act since 1978. This national program requires automobile manufacturers to build a single light-duty national fleet that meets all requirements under both federal programs and the standards of California and other states. This program would increase fuel economy to the equivalent of 54.5 miles per gallon (mpg) limiting vehicle emissions to 163 grams of carbon dioxide (CO_2) per mile for the fleet of cars and light-duty trucks by model year 2025.

Safer Affordable Fuel-Efficient Vehicles Rule

On August 2, 2018, the National Highway Traffic Safety Administration (NHTSA) and EPA proposed the Safer Affordable Fuel-Efficient Vehicles Rule (SAFE Rule). This rule addresses emissions and fuel economy standards for motor vehicles and is separated in two parts as described below.

- Part One, "One National Program" (84 FR 51310) revokes a waiver granted by EPA to the State of California under Section 209 of the CCA to enforce more stringent emission standards for motor vehicles than those required by EPA for the explicit purpose of greenhouse gas (GHG) reduction, and indirectly, criteria air pollutants and ozone precursor emission reduction. This revocation became effective on November 26, 2019, restricting the ability of CARB to enforce more stringent GHG emission standards for new vehicles and set zero emission vehicle mandates in California. EMFAC2017 is CARB's most recent version of the EMFAC model series and considers effects of known policy implementation and economic forecasts, such as the implementation of the CAFE standards and Advanced Clean Cars program.
- Part Two addresses CAFE standards for passenger cars and light trucks for model years 2021 to 2026. This rulemaking proposes new CAFE standards for model years 2022 through 2026 and would amend existing CAFE standards for model year 2021. The proposal would retain the model year 2020 standards (specifically, the footprint target curves for passenger cars and light trucks) through model year 2026, but comment is sought on a range of alternatives discussed throughout the proposed rule. The proposal addressing CAFE standards is being jointly developed by NHTSA and EPA, with EPA simultaneously proposing tailpipe carbon dioxide standards for the same vehicles covered by the same model years. The final SAFE Rule Part Two was released on March 31, 2020. The outcome of any pending or potential lawsuits (and how such lawsuits could delay or affect its implementation) are unknown at this time.

Ultrafine Particulate Matter

Ultrafine particulate matter (UFP) refers to the subfraction of currently regulated $PM_{2.5}$ and PM_{10} that is most often defined as particles having an aerodynamic diameter smaller than 0.1 micrometer, or 100 nanometers (HEI 2013:1; CARB 2019a; Kleeman et al. 2007:1). Several research studies indicate that that UFP may be more toxic than larger particles (Zhu et al. 2002a:4324; Li et al. 2003:455), much of diesel PM is composed of UFP (Benbrahim-Tallaa 2012), and exposure to UFP may lead to adverse health effects in animals and humans (HEI 2013:2; Froines 2006).

To date, no federal agencies, including EPA, have established official standards, policies, or guidance regarding concentrations of UFP, though CARB did consider amending its low-emission vehicle (LEV) regulations to incorporate a solid particle number measure of UFP emissions (CARB 2010). Due to the complexities of this metric and practical considerations of implementation, CARB staff decided further study of UFP was warranted and the amendment has not yet been adopted. However, UFP is a large component of diesel particulate matter (diesel PM) (Benbrahim-Tallaa 2012), to which TAC regulations apply, as discussed above.

STATE

Criteria Air Pollutants

CARB coordinates and oversees the state and local programs for controlling air pollution in California and implements the California Clean Air Act (CCAA), adopted in 1988. The CCAA requires CARB to establish California Ambient Air Quality Standards (CAAQS), which are shown in Table 3.3-3. CARB has established CAAQS for sulfates, hydrogen sulfide, vinyl chloride, visibility-reducing particulate matter, and the above-mentioned criteria air pollutants. In most cases the CAAQS are more stringent than the NAAQS. Differences in the standards are generally explained by the health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the CAAQS incorporate an additional margin of safety to protect sensitive individuals.

The CCAA requires that all local air districts in the state endeavor to achieve and maintain the CAAQS by the earliest practical date. The act specifies that local air districts should focus particular attention on reducing the emissions from transportation and area-wide emission sources. The act provides districts with the authority to regulate indirect sources, such as through the funding of transportation demand management programs and vehicle pooling services.

CARB also oversees local air district compliance with federal and state laws, approving local air quality plans, submitting SIPs to EPA, monitoring air quality, determining and updating area designations and maps, and setting emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Executive Order B-48-18: Zero-Emission Vehicles

On January 26, 2018, Governor Brown signed Executive Order B-48-18 requiring all State entities to work with the private sector to have at least 5 million zero-emission vehicles (ZEVs) on the road by 2030, as well as install 200 hydrogen fueling stations and 250,000 electric vehicle (EV) charging stations by 2025. It specifies that 10,000 of the EV charging stations should be direct current fast chargers. This order also requires all State entities to continue to partner with local and regional governments to streamline the installation of ZEV infrastructure. The Governor's Office of Business and Economic Development is required to publish a *Plug-in Charging Station Design Guidebook* and update the *2015 Hydrogen Station Permitting Guidebook* (Eckerle and Jones 2015) to aid in these efforts. All State entities are required to participate in updating the *2016 Zero-Emissions Vehicle Action Plan*, along with the *2018 ZEV Action Plan Priorities Update*, which includes and extends the 2016 ZEV Action Plan (Governor's Interagency Working Group on Zero-Emission Vehicles 2016, 2018), to help expand private investment in ZEV infrastructure with a focus on serving low-income and disadvantaged communities.

Executive Order N-79-20

Governor Gavin Newsom signed Executive Order N-79-20 in September 2020, which sets a statewide goal that 100 percent of all new passenger car and truck sales in the state will be zero-emissions by 2035. It also sets a goal that 100 percent of statewide new sales of medium- and heavy-duty vehicles will be zero emissions by 2045, where feasible, and for all new sales of drayage trucks to be zero emissions by 2035. Additionally, the Executive Order targets 100 percent of new off-road vehicle sales in the state to be zero emission by 2035. CARB is responsible for implementing the new vehicle sales regulation.

Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill [AB] 1807 [Statutes of 1983]) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588 [Statutes of 1987]). AB 1807 sets forth a formal procedure for CARB to designate substances as TACs. This process includes research, public participation, and scientific peer review before CARB can designate a substance as a TAC. CARB has identified more than 200 TACs to date, including 189 HAPs identified by EPA plus 21 additional compounds. Most recently, diesel PM and environmental tobacco smoke were added to CARB's list of TACs.

Once a TAC is identified, CARB then adopts an airborne toxics control measure for sources that emit that TAC. If a safe threshold exists for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If no safe threshold exists, the measure must incorporate the best available control technology (BACT) to minimize emissions.

CARB has adopted diesel exhaust control measures and more stringent emissions standards for various transportation-related mobile sources of emissions, including transit buses, and off-road diesel equipment (e.g., tractors, generators). Recent and upcoming milestones for transportation-related mobile sources include a low-sulfur diesel fuel requirement and tighter emissions standards for heavy-duty diesel trucks (CARB 2019b) and off-road diesel equipment (CARB 2016b) nationwide. Over time, the replacement of older vehicles will result in a vehicle fleet that produces substantially lower levels of TACs than under existing conditions. Mobile-source emissions of TACs (e.g., benzene, 1,3-butadiene, diesel PM) have been reduced significantly over the last decade and will be reduced further in California through a progression of regulatory measures (e.g., Low Emission Vehicle/Clean Fuels and Phase II reformulated gasoline regulations) and control technologies. Adopted regulations are also expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. As emissions are reduced, it is expected that risks associated with exposure to the emissions will also be reduced.

AB 2588 requires that existing stationary source facilities that continuously or intermittently emit TACs into the atmosphere and meet other criteria prepare an inventory of TAC emissions, update this inventory every four years, and potentially prepare a health risk assessment (HRA). These AB 2588 facility criteria include emitting any of over 500 listed toxic compounds identified by the act and being a major emitter of total organic gases, particulate matter, nitrogen oxides, or sulfur oxides; or being listed in any current air district toxics use or toxics air emission survey, inventory, or report. A facility meeting these criteria and included in the AB 2588 program is assigned a prioritization score, based on the cancer and non-cancer risks posed by its TAC emissions, and then categorized as a "high," "low,"

or "intermediate" priority facility. In the North Central Coast Air Basin (NCCAB), which is under the jurisdiction of MBARD, a priority score above 10 is considered "high," between one and 10 "intermediate," and below one considered "low" priority. High and intermediate priority facilities are required to perform an HRA, submit a toxic risk reduction audit and implementation plan, and provide public notification.

UNIVERSITY OF CALIFORNIA

University of California Sustainable Practices Policy

At the direction of The Regents of the University of California, UC Office of the President (UCOP) developed a Sustainable Practices Policy which establishes sustainability goals to be achieved by all campuses, medical centers, and the Lawrence Berkeley National Laboratory within the UC system. The policy is regularly updated, with the most recent update occurring in July 2020. The policy goals encompass nine areas of sustainable practices: green building, clean energy, transportation, climate protection, sustainable operations, waste reduction and recycling, environmentally preferable purchasing, sustainable foodservice, and sustainable water systems (UCOP 2020). The policy includes the following provisions relevant to the air quality emissions reductions, primarily via zero emission transportation policies. Energy efficiency policies are relevant to air quality in so far as they reduce emissions from the combustion of natural gas and other on-site combustible fuels:

- Green Building Design
  - All new buildings projects, other than acute care facilities, shall be designed, constructed, and commissioned to outperform the California Building Code (Title 24 portion of the California Code of Regulations) energy efficiency standards by at least 20 percent or achieve energy performance targets, related to 1999 benchmarks, shown in Table 1 of Section V.A.3 of the policy.
  - All new buildings will strive to achieve certification of U.S. Green Building Council's LEED "Gold" and achieve a minimum of LEED "Silver" certification, whenever possible within the constraints of program needs and standard budget parameters.
- Sustainable Transportation
  - By 2025, zero emission vehicles or hybrid vehicles shall account for at least 50 percent of all new light-duty vehicle acquisitions.
  - By 2025, each location shall strive to reduce its percentage of employees and students commuting by single-occupant vehicle (SOV) by 10 percent relative to its 2015 SOV commute rates;
  - By 2050, each location shall strive to have no more 40 percent of its employees and no more than 30 percent of all employees and students commuting to the location by SOV.
  - By 2025, each location shall strive to have at least 4.5 percent of commuter vehicles be Zero Emission Vehicles (ZEV).
  - By 2050, each location shall strive to have at least 30 percent of commuter vehicles be ZEV.
- Sustainable Building Operations for Campuses
  - Each campus shall seek to certify as many existing buildings as possible through the "LEED for Operations and Maintenance" rating system, within budgetary constraints and eligibility limitations.
  - All new buildings will achieve a U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) "Silver" certification at a minimum. All new buildings will strive to achieve certification at a USGBC LEED "Gold" rating or higher, whenever possible within the constraints of program needs and standard budget parameters.
  - The University of California will design, construct, and commission new laboratory buildings to achieve a minimum of LEED "Silver" certification as well as meeting at least the prerequisites of the Laboratories for the 21st Century (Labs21) Environmental Performance Criteria (EPC). Laboratory spaces in new buildings also shall meet at least the prerequisites of Labs21 EPC. Design, construction, and commissioning processes shall strive

to optimize the energy efficiency of systems not addressed by the California Energy Code energy efficiency standards.

- No new building or major renovation that is approved after June 30, 2019 shall use onsite fossil fuel combustion (e.g., natural gas) for space and water heating (except those projects connected to an existing campus central thermal infrastructure).

- Clean Energy
  - Energy Efficiency: Each location will implement energy efficiency actions in buildings and infrastructure systems to reduce the location's energy use intensity by an average of least 2 percent annually.
  - On-campus Renewable Electricity: Campuses and health locations will install additional on-site renewable electricity supplies and energy storage systems whenever cost-effective and/or supportive of the location's Climate Action Plan or other goals.
  - Off-campus Clean Electricity: By 2025, each campus and health location will obtain 100 percent clean electricity. By 2018, the University's Wholesale Power Program will provide 100 percent clean electricity to participating locations.
  - On-campus Combustion: By 2025, at least 40 percent of the natural gas combusted on-site at each campus and health location will be biogas

LOCAL

As noted in Section 3.0.2, "University of California Autonomy," UC Santa Cruz, a constitutionally created State entity, is not subject to municipal regulations of surrounding local governments for uses on property owned or controlled by UC Santa Cruz that are in furtherance of the University's educational purposes. However, UC Santa Cruz may consider, for coordination purposes, aspects of local plans and policies of the communities surrounding the campus when it is appropriate and feasible, but it is not bound by those plans and policies in its planning efforts. However, because CARB, a state agency, is legally required to and has the responsibility to monitor and approve the plans of each air district, UC Santa Cruz is subject to the rules and regulations established by MBARD as a special district/local-regional planning agency that is tasked with maintaining or improving air quality and human health within the NCCAB.

Monterey Bay Air Resources District

MBARD attains and maintains air quality conditions in the NCCAB, which comprises Monterey, San Benito, and Santa Cruz counties. MBARD is responsible for air monitoring, permitting, enforcement, long-range air quality planning, regulatory development, education, and public information activities related to air pollution, as required by the CAA and CCAA. Projects in the NCCAB are subject to MBARD's rules and regulations. Specific rules applicable to the proposed project may include:

- Rule 400 – Visible Emissions. Limits visible emissions from sources in the District and provides exemptions.
- Rule 402 – Nuisances. Prohibits the discharge from any source whatsoever such quantities of air contaminants or other materials which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public; or which endanger the comfort, repose, health, or safety of any such persons or the public; or which cause, or have a natural tendency to cause, injury or damage to business or property.
- Rule 403 – Particulate Matter. Sets particulate matter emission limits for sources operating within the jurisdiction.
- Rule 424 – National Emission Standards for Hazardous Air Pollutants (NESHAP). Sets emissions standards for stationary source emissions, including asbestos emission from building demolition
- Rule 426 – Architectural Coatings. Limits the volatile organic compound (VOC) content of architectural coatings; specifically, limits the VOC content of flat coatings to 50 grams/ liter.

The CCAA requires that all air districts in the state endeavor to achieve and maintain the CAAQS in their region by the earliest practical date. The CCAA requires districts to submit air quality attainment plans (AQAP) for areas that do not meet state standards for ozone, CO, SO_2, NO_2, PM_{10}, and $PM_{2.5}$. The NCCAB is currently in attainment with all ambient air quality standards with the exception of ozone and PM_{10} California standards (CARB 2018). The attainment status for each pollutant is presented in Table 3.3-3.

In accordance with the CCAA, MBARD has developed the 2012–2015 Air Quality Management Plan (AQMP) for the NCCAB. The plan includes an updated air quality trends analysis, emission inventory, and mobile source programs. No new control measures were adopted, instead, MBARD is focusing on grant programs to reduce reactive organic gases (ROG) and NO_x emissions by offering incentives to reduce emissions from transportation sources, marine vessels, agricultural irrigation pumps, and off-road vehicles. The plan shows that the region continues to make progress toward meeting the state ozone standard.

At the local level, air pollution control or management districts may adopt and enforce CARB's control measures for TACs. Under MBARD Regulation II ("Permits"), Rule 218 ("Federal Operating Permits"), and Regulation IV ("Prohibitions"), Rule 423 ("New Source Performance Standards (NSPS)"), all sources that possess the potential to emit TACs are required to obtain permits from the district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source review standards (see Rule 423 above) and air-toxics control measures. Under MBARD Regulation IV ("Prohibitions"), PM dust resulting from construction, demolition, or agricultural operations is subject to Rule 402 ("Nuisances"), which prohibits the discharge from of air contaminants that may potentially cause injury to or endanger the health or safety of any considerable number of persons or the public. MBARD prioritizes the permitting of TAC-emitting stationary sources based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors and land uses.

In addition to complying with the statewide AB 2588 program, MBARD has adopted Regulation X ("Toxic Air Contaminants"), to prevent the emission of TACs that may contribute to increased mortality or cancer risk, or pose a hazard to human health. Per Rule 1000 ("Permit Guidelines and Requirements for Sources emitting TACs"), new or reconstructed major sources of TACs that require a permit are analyzed based on their potential to emit toxics above District cancer-risk and non-cancer health hazard thresholds, as determined by an HRA. If it is found that a project includes sources that may potentially emit TACs in excess of MBARD's thresholds of significance (see Section 3.3.3, below), the responsible party must implement T-BACT on the emissions source to reduce TAC emissions. If risk posed by a source cannot be reduced below the relevant significance threshold, even after T-BACT has been implemented, MBARD will deny the required permit to operate for that source. Although MBARD regulates sources that generate TACs, it does not regulate land uses that may be sited in locations exposed to TACs. Decisions regarding whether to approve projects in locations where new receptors may be exposed to TACs is typically the responsibility of the lead agency charged with determining whether to approve a project.

MBARD has not established rules, policies, or guidance regarding UFP.

3.3.2 Environmental Setting

UC Santa Cruz is located within the NCCAB, which includes all of Monterey, Santa Cruz and San Benito counties.

The ambient concentrations of air pollutant emissions are determined by the amount of emissions released by the sources of air pollutants and the atmosphere's ability to transport and dilute such emissions. Natural factors that affect transport and dilution include terrain, wind, atmospheric stability, and sunlight. Therefore, existing air quality conditions in the area are determined by such natural factors as topography, meteorology, and climate, in addition to the amount of emissions released by air pollutant sources present in, near or even at a distance from the air basin, as discussed separately below.

CLIMATE, METEOROLOGY, AND TOPOGRAPHY

The NCCAB includes an area of approximately 5,159 square miles along the central coast of California, comprised of several mountain ranges, valleys, and coastal plains. The Santa Cruz mountains are in the northwest and the Diablo Range is in the northeast. The southern portion of the Santa Clara Valley runs through the northern part of the air basin, and transitions into the San Benito Valley, which runs northwest to southeast and has the Gabilan Range as its western boundary. To the west of the Gabilan Range is the Salinas Valley. The western boundary of the Salinas Valley is formed by the Sierra de Salinas, which also forms the eastern boundary of the Carmel Valley. The eastern Santa Lucia Range defines the western side of the Carmel Valley.

The NCCAB is characterized by moderately wet winters and dry summers with fog and low coastal clouds. The local meteorology of the UC Santa Cruz main residential campus and surrounding area is represented by measurements recorded at the Western Regional Climate Center (WRCC) Santa Cruz Cooperative Station. The normal annual precipitation is approximately 29.33 inches. January temperatures range from a normal minimum of 38.8 degrees Fahrenheit (°F) to a normal maximum of 60.4°F. July temperatures range from a normal minimum of 51.1°F to a normal maximum of 74.6°F (WRCC 2016). Prevailing winds in the air basin are westerly most of the year shifting to east-southeast during the winter months, from November to February (WRCC 2017). The air basin is situated downwind of the San Francisco Bay Area Air Basin (SFBAAB). Transport of ozone precursor emissions from the SFBAAB plays a dominant role in ozone concentrations measured in the NCCAB (MBARD 2017).

Figure 3.3-1 shows the predominant wind direction and wind speeds (in meters per second [m/s]) in the project region based on five years of meteorological data (2014-2018) collected at the Watsonville Airport Station.

CRITERIA AIR POLLUTANTS

As stated before, concentrations of ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead are used as indicators of ambient air quality conditions and are referred to as criteria air pollutants. Criteria air pollutants are air pollutants for which an ambient air quality standard has been set by EPA and CARB based on protecting health and welfare.

A brief description of each criteria air pollutant's source types and health effects is provided below in Table 3.3-1. Additional information, including future trends and monitoring data at those monitoring stations located closest to the project site, is provided for ozone, NO_2, and PM, the key criteria air pollutants associated with the project analysis.

Table 3.3-1 Sources and Health Effects of Criteria Air Pollutants

Pollutant	Sources	Acute[1] Health Effects	Chronic[2] Health Effects
Ozone	Secondary pollutant resulting from reaction of ROG and NO_X in presence of sunlight. ROG emissions result from incomplete combustion and evaporation of chemical solvents and fuels; NO_X results from the combustion of fuels	Increased respiration and pulmonary resistance; cough, pain, shortness of breath, lung inflammation	Permeability of respiratory epithelia, possibility of permanent lung impairment
Carbon monoxide (CO)	Incomplete combustion of fuels; motor vehicle exhaust	Reduced capacity to pump oxygenated blood; headache, dizziness, fatigue, nausea, vomiting, death	Permanent heart and brain damage
Nitrogen dioxide (NO_2)	Combustion devices (e.g., boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines), industrial processes, and fires	Coughing, difficulty breathing, vomiting, headache, eye irritation, chemical pneumonitis or pulmonary edema; aggravation of existing heart disease leading to death	Chronic bronchitis, emphysema, decreased lung function
Sulfur dioxide (SO2)	Combustion devices (e.g., boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines), industrial processes, and fires	Irritation of upper respiratory tract, increased asthma symptoms, aggravation of existing heart disease leading to death	Chronic bronchitis, emphysema

Pollutant	Sources	Acute[1] Health Effects	Chronic[2] Health Effects
Respirable particulate matter (PM_{10}), Fine particulate matter ($PM_{2.5}$)	Fugitive dust, soot, smoke, mobile and stationary sources, construction, fires and natural windblown dust, and formation in the atmosphere by condensation and/or transformation of SO_2 and ROG into secondary PM	Breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, premature death	Alterations to the immune system, carcinogenesis
Lead	Metal processing, piston-engine aircraft or other vehicles operating on leaded fuel	Reproductive/developmental effects (fetuses and children)	Numerous effects including neurological, endocrine, and cardiovascular effects

Notes: NO_X = oxides of nitrogen; ROG = reactive organic gases

[1] "Acute" refers to effects of short-term exposures to criteria air pollutants, usually at fairly high concentrations.

[2] "Chronic" refers to effects of long-term exposures to criteria air pollutants, usually at lower, ambient concentrations.

Source: EPA 2019a

Ozone

Ozone is a photochemical oxidant (a substance whose oxygen combines chemically with another substance in the presence of sunlight) and the primary component of smog. Ozone is not directly emitted into the air in large quantities but is formed through complex chemical reactions between precursor emissions of ROG and NO_X in the presence of sunlight (EPA 2019a). It is a regional pollutant. ROGs are VOCs that are photochemically reactive. ROG emissions result primarily from incomplete combustion, such as from automobiles, and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that result from the combustion of fuels. Emissions of the ozone precursors ROG and NO_X have decreased over the past two decades because of more stringent motor vehicle standards and cleaner burning fuels (CARB 2014:3-4 and 4-46).

Carbon Monoxide

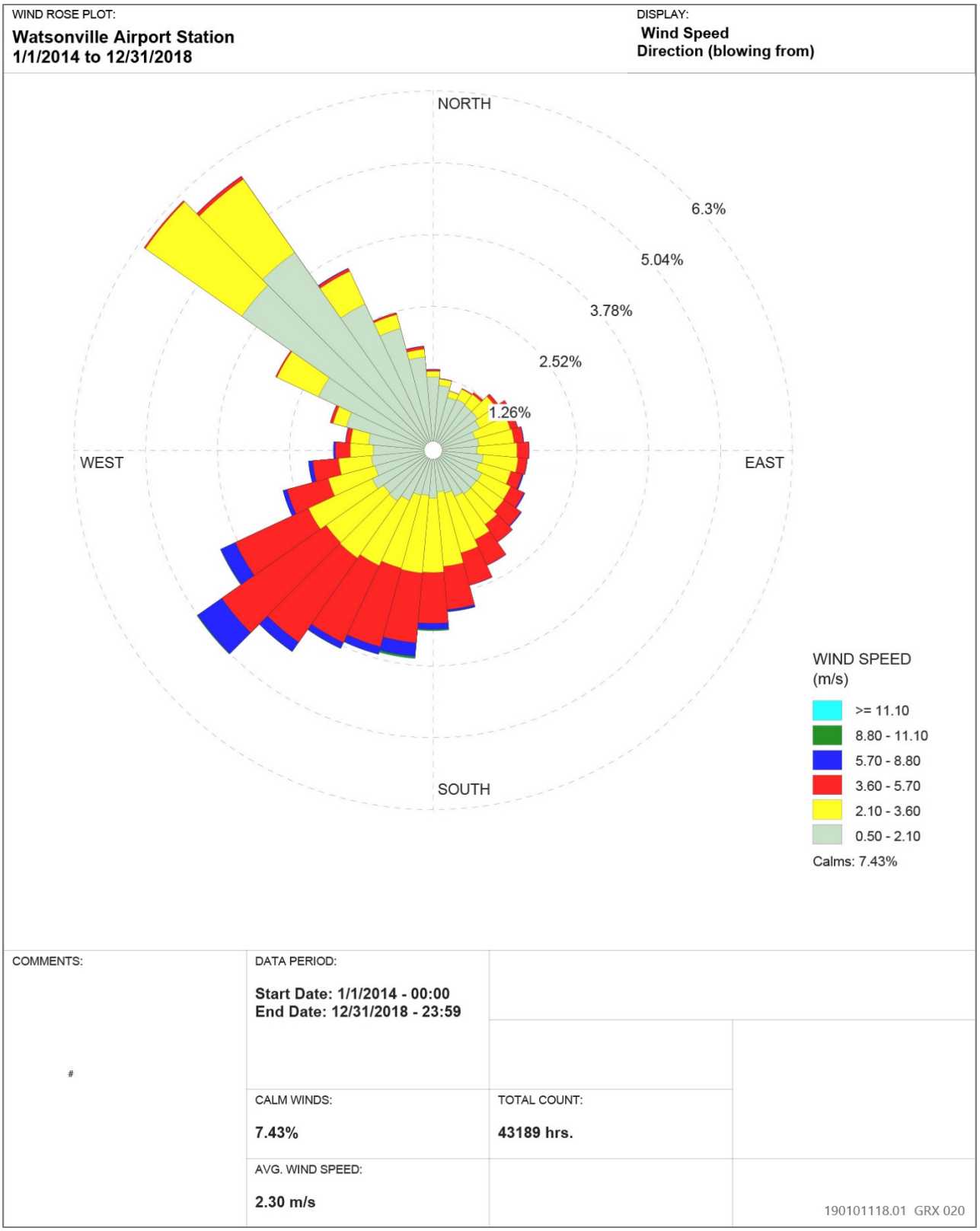
CO is an odorless and invisible gas. It is a non-reactive pollutant that is a product of incomplete combustion of gasoline in automobile engines. CO is a localized pollutant, and the highest concentrations are found near the source. Ambient carbon monoxide concentrations generally follow the spatial and temporal distributions of vehicular traffic and are influenced by wind speed and atmospheric mixing. CO concentrations are highest in flat areas on still winter nights when temperature inversions trap carbon monoxide near the ground. When inhaled at high concentrations, carbon monoxide reduces the oxygen-carrying capacity of the blood, which, in turn, results in reduced oxygen reaching parts of the body.

Nitrogen Dioxide

NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines. Combustion devices emit primarily nitric oxide (NO), which reacts through oxidation in the atmosphere to form NO_2. The combined emissions of NO and NO_2 are referred to as NO_X and are reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with photochemical smog (ozone), the NO_2 concentration in a geographical area may not be representative of the local sources of NO_X emissions (EPA 2019a).

Sulfur Dioxide

SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills as well as by the combustion of fuel containing sulfur. The major adverse health effects associated with SO_2 exposure pertain to the upper respiratory tract. SO_2 is a respiratory irritant with constriction of the bronchioles occurring with inhalation of SO_2 at 5 ppm or more (CDC 1978). On contact with the moist mucous membranes, SO_2 produces sulfurous acid, which is a direct irritant. Concentration rather than duration of the exposure is an important determinant of respiratory effects. Exposure to high SO_2 concentrations may result in edema of the lungs or glottis and respiratory paralysis.



Source: Ascent Environmental 2020

Figure 3.3-1 Wind Speed and Flow Vector Map for the LRDP Area

Particulate Matter

Particulate matter is a class of air pollutants that consists of heterogeneous solid and liquid airborne particles from human-made and natural sources. Particulate matter is measured in two size ranges: PM_{10} and $PM_{2.5}$. PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction activity, fires and natural windblown dust, and particulate matter formed in the atmosphere by reaction of gaseous precursors (CARB 2014:1-13 and 3-6). PM_{10} emissions are dominated by emissions from area sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, farming operations, construction and demolition, and particles from residential fuel combustion. Direct emissions of PM_{10} have increased slightly over the last 20 years and are projected to continue to increase slightly through 2035 (CARB 2014:3-7). $PM_{2.5}$ includes a subgroup of smaller particles that have an aerodynamic diameter of 2.5 micrometers or less. $PM_{2.5}$ emissions have remained relatively steady over the last 20 years and are projected to decrease slightly through 2035 (CARB 2014:3-6).

Lead

Lead is a metal found naturally in the environment as well as in manufactured products and is a potent neurotoxin that can cause increased chances of cancer and non-cancer health effects for adults and children. Lead is known to negatively affect child brain development and function. The major sources of lead emissions have historically been mobile and industrial sources but can occur in dust created by demolition or deterioration of lead-based paint. Lead-based paint is present on buildings built before EPA's ban on the use of such paint in 1978. EPA also phased out leaded fuels as of December 1995 resulting in an 89 percent decline in lead emissions from mobile sources between 1980 and 2010 (EPA 2020a; CARB 2001).

Monitoring Station Data and Attainment Area Designations

Criteria air pollutant concentrations are measured at several monitoring stations in the NCCAB. The 2544 Soquel Avenue monitoring station is in the center of the city of Santa Cruz and is the closest monitoring station to the UC Santa Cruz campus with recent data for ozone and $PM_{2.5}$. The next closest monitoring station that reports PM_{10} concentrations is the Fairview Road monitoring station located in Hollister, approximately 48 miles southeast of the UC Santa Cruz campus in San Benito County. In general, the local ambient air quality measurements from the Soquel Avenue monitoring station are representative of the air quality near the UC Santa Cruz campus given its similar meteorological conditions and urban surroundings. Table 3.3-2 summarizes the air quality data for the three most recent calendar years for which data are available (2016-2018).

Table 3.3-2 Summary of Annual Ambient Monitoring Data (2016-2018)

Pollutant	2016	2017	2018
Ozone[1]			
Maximum concentration (1-hr/8-hr avg, ppm)	0.064/0.058	0.082/0.075	0.075/0.061
Number of days state standard exceeded (8-hr)	0	1	0
Number of days national standard exceeded (1-hr/8-hr)	0/0	0/1	0/0
Fine Particulate Matter ($PM_{2.5}$)[1]			
Maximum 24-hr average concentration (µg/m^3)	12.7	47.3	92.0
Number of days national standard exceeded (calculated[2])	0	2.2	9.9
Respirable Particulate Matter (PM_{10})[3]			
Maximum 24-hr average concentration (µg/m^3)	44.3	80.9	95.9
Number of days state standard exceeded (calculated[2])	*	*	*
Number of days national standard exceeded (calculated[2])	0	0	0

Notes: µg/m^3 = micrograms per cubic meter; ppm = parts per million, * = insufficient (or no) data available to determine the value.

[1] Measurements from the 2544 Soquel Avenue monitoring station in Santa Cruz, CA.

[2] Measured days are those days that an actual measurement was greater than the level of the state daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

[3] Santa Cruz County data are unavailable; measurements from the Fairview Road monitoring station in Hollister (San Benito County).

Source: CARB 2017a, data compiled by Ascent Environmental in 2020.

Both CARB and EPA use this type of monitoring data to designate areas according to their attainment status for criteria air pollutants. The purpose of these designations is to identify those areas with air quality problems and thereby initiate planning efforts for improvement. The three basic designation categories are "nonattainment," "attainment," and "unclassified." "Unclassified" is used in an area that cannot be classified based on available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, called "nonattainment-transitional." The nonattainment-transitional designation is given to nonattainment areas that are progressing and nearing attainment. Attainment designations for the NCCAB as of 2018 are shown in Table 3.3-3 for each criteria air pollutant.

Table 3.3-3 Ambient Air Quality Standards and Attainment Designations for North Central Coast Air Basin

Pollutant	Averaging Time	California Standards[2] Primary[3]	California Standards[2] Attainment Status[4]	National Standards[1] Primary[3]	National Standards[1] Attainment Status[6]
Ozone	1-hour	0.09 ppm (180 µg/m^3)	N	–	U/A
	8-hour	0.070 ppm (137 µg/m^3)		0.070 ppm (137 µg/m^3)	
Carbon Monoxide (CO)	1-hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	U/A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	
	8-hour (Lake Tahoe)	6 ppm (7 mg/m^3)		–	
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	A	0.053 ppm (100 µg/m^3)	U/A
	1-hour	0.18 ppm (339 µg/m^3)		0.100 ppm	
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	–	A	0.030 ppm (80 µg/m^3)	U/A
	24-hour	0.04 ppm (105 µg/m^3)		0.14 ppm (365 µg/m^3)	
	3-hour	–		0.5 ppm (1300 µg/m^3)[5]	
	1-hour	0.25 ppm (655 µg/m^3)		0.075 ppm	
Respirable Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	N	–	U
	24-hour	50 µg/m^3		150 µg/m^3	
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	A	12.0 µg/m^3	U/A
	24-hour	–		35 µg/m^3	
Lead[7]	30-day Average	1.5 µg/m^3	A	–	–
	Calendar Quarter	–		1.5 µg/m^3	U/A
	Rolling 3-Month Avg	–		0.15 µg/m^3	U/A
Sulfates	24-hour	25 µg/m^3	A	No National Standards	
Hydrogen Sulfide	1-hour	0.03 ppm (42 µg/m^3)	U		
Vinyl Chloride[7]	24-hour	0.01 ppm (26 µg/m^3)	Not Available		
Visibility-Reducing Particle Matter	8-hour	Extinction coefficient of 0.23 per kilometer — visibility of 10 miles or more	U		

Notes: µg/m^3 = micrograms per cubic meter; ppm = parts per million; EPA=U.S. Environmental Protection Agency; CAAQS=California Ambient Air Quality Standards; CCAA=California Clean Air Act; CARB=California Air Resources Board

[1] National standards (other than ozone, PM, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM_{10} 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The $PM_{2.5}$ 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the EPA for further clarification and current federal policies.

[2] California standards for ozone, CO (except in the Lake Tahoe Basin), SO_2 (1- and 24-hour), NO_2, PM, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. CAAQS are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

[3] Concentration expressed first in units in which it was promulgated [i.e., ppm or µg/m^3]. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas. Secondary national standards are also available from EPA.

[4] Unclassified (U): a pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment.

Attainment (A): a pollutant is designated attainment if the state standard for that pollutant was not violated at any site in the area during a 3-year period.

Nonattainment (N): a pollutant is designated nonattainment if there was a least one violation of a state standard for that pollutant in the area. Non-attainment designations for ozone are classified as marginal, serious, severe, or extreme depending on the magnitude of the highest 8-Hour ozone design value at a monitoring site in a non-attainment area.

Nonattainment/Transitional (NT): is a subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

[5] Secondary Standard

[6] Nonattainment (N): any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.

Attainment (A): any area that meets the national primary or secondary ambient air quality standard for the pollutant.

Unclassifiable (U): any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

Maintenance (M): any area previously designated nonattainment pursuant to the CAAA of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under Section 175A of the CAA, as amended.

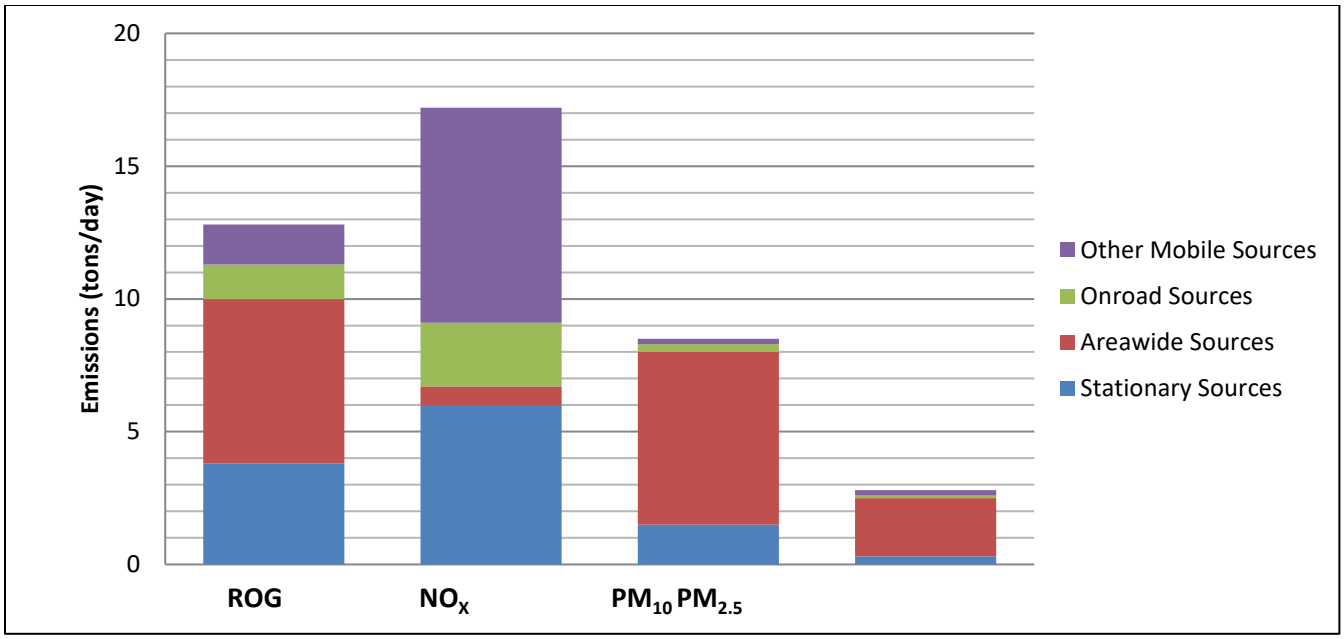
[7] CARB has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Source: CARB 2018; EPA 2017; data compiled by Ascent Environmental in 2020.

MBARD sets its criteria pollutant significance thresholds for daily and annual emissions based on the attainment status of the region. The thresholds are set with the purpose of achieving and maintaining attainment with the NAAQS and CAAQS. It is within MBARD's purview to update the significance thresholds to account for any changes in regional attainment status, however the currently adopted thresholds, based on the 2018 regional attainment status summarized in Table 3.3-3, will apply to the 2021 LRDP.

EMISSIONS INVENTORY

Figure 3.3-2 summarizes an estimated emissions inventory of criteria air pollutants projected for Santa Cruz County for various source categories in 2020 based on the 2016 SIP Emissions Projection Data from CARB. According to the emissions inventory, mobile sources are the largest contributor to the estimated daily air pollutant levels of NO_X, accounting for approximately 61 percent of the total daily emissions. Area-wide sources (i.e., sources that occur over a large area rather than at a point source [e.g., industrial exhaust stack] or mobile-source [e.g., tailpipe emissions]) account for approximately 76 percent and 79 percent of the county's PM_{10} and $PM_{2.5}$ emissions, respectively, due in part to the agricultural and semi-rural conditions in northern and southern Santa Cruz County. Area-wide sources also contribute to approximately 48 percent of total daily ROG emissions. This is the most current emissions inventory available for Santa Cruz County (CARB 2016c).



Source: CARB 2016c, data compiled by Ascent Environmental in 2020.

Figure 3.3-2 Santa Cruz County 2020 Criteria Air Pollutant Emissions Inventory Estimate

TOXIC AIR CONTAMINANTS

According to the *California Almanac of Emissions and Air Quality* (CARB 2014) most of the estimated health risks from TACs can be attributed to relatively few compounds, the most important being particulate matter contained in diesel exhaust (diesel PM). Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel PM is emitted by diesel-fueled internal combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emissions control system is being used. Unlike the other TACs, no ambient monitoring data is available for diesel PM because no routine measurement method currently exists. However, CARB has made preliminary concentration estimates based on a PM exposure method. This method uses PM_{10} values found in CARB's emissions inventory database, ambient PM_{10} monitoring data, and the results from several studies to estimate concentrations of diesel PM. In addition to diesel PM, the TACs for which data are available that pose the greatest existing ambient risk in California are benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene. Sources of these TACs vary considerably and include (but are not limited to) consumer products, vehicle exhaust, diesel machinery, welding operations, and other sources.

Diesel PM poses the greatest health risk among the 10 TACs mentioned. Based on receptor modeling techniques, CARB estimated its health risk to be 360 excess cancer cases per million people in the NCCAB in the year 2000, which when coupled with the average health risk within the NCCAB of 160 cancer cases per million people yields a total health risk of 520 cancer cases per million people. Since 1990, the health risk associated with diesel PM has been reduced by 52 percent. Overall, levels of most TACs, except para-dichlorobenzene and formaldehyde, have decreased since 1990 (CARB 2014).

According to CARB's Air Toxics "Hot Spots" Program (see Regulatory Setting above), stationary facilities that emit toxic substances above a specified level are required to prepare an inventory of toxic emissions, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures. There are only two existing facilities in Santa Cruz that emit substantial quantities of criteria pollutants, however neither one is a "Hot Spots" facility (CARB 2015). These include the City of Santa Cruz Wastewater Treatment Plant and Santa Cruz Energy, LLC. Minor stationary and/or area sources of TACs may also be in the project

vicinity and could include, but are not limited to: gasoline dispensing stations, auto body coating operations, and research and development facilities.

Major highways and roadways are also considered sources of TAC emissions, associated with the presence of diesel PM emissions from vehicle exhaust. State Route 1 (SR 1), a two-lane, largely coastal highway, passes approximately one mile south of the UC Santa Cruz main residential campus and SR 9, a rural two-lane, mountainous highway, passes approximately one mile east of the campus. Due to the relatively isolated location of UC Santa Cruz's campus, TAC emissions from major roadway traffic do not substantially affect air quality on campus.

Ultrafine Particulate Matter

Although UFP contributes only a small amount to total PM mass, the particle number concentration (PNC) is typically high, tens of thousands of particles per cubic-centimeter, and each ultrafine particle has a large surface area. Because of its small size, a given mass of UFP contains thousands to tens of thousands more particles, with a correspondingly larger combined surface area, than an equivalent mass of $PM_{2.5}$ or PM_{10} (De Jesus et al. 2019). Additionally, with such a small diameter, UFP behaves much like a gas and may be inhaled more deeply into the lungs than larger particles (Oberdörster 2001:1). Thus, a given mass of UFP can have a much greater impact on lung tissue than an equivalent mass of $PM_{2.5}$ or PM_{10} (Delfino et al. 2005:934).

Both laboratory and epidemiological studies indicate that exposure to UFP may lead to adverse health effects in animals and humans (HEI 2013:2; Froines 2006) and toxicological studies have concluded that UFP is more toxic than larger sized particles (Zhu et al. 2002a:4324; Li et al. 2003:455). Experimental studies suggest that the adverse health effects of exposure to UFPs differ from those of larger particles. Because of their physical characteristics, inhaled ultrafine particles differ from larger particles in their deposition patterns in the lung, their clearance mechanisms, and in their potential for translocation from the lung to other tissues in the body or to the brain (CARB 2019a; HEI 2013:3). UFP easily penetrates deep into the alveoli and passes rapidly into the human circulatory system, increasing the number of particles in the blood and thus increasing the exposure of other organs to UFP (Nemmar et al. 2002:411). UFP has been shown to contain many toxic components such as metals, inorganic carbon, and organic compounds which may initiate or play a role in several types of harmful cellular oxidative stress processes that can damage the heart, lungs, brain, and other organs (CARB 2019a; Oberdörster 2001:1; Donaldson et al. 2001:526; Stölzel et al. 2007:458). UFP has also been found to be more potent than $PM_{2.5}$ and PM_{10} in inducing cellular damage (Li et al. 2003:455 to 456). Observed effects in selected studies include lung function changes, airway inflammation, enhanced allergic responses, vascular thrombogenic effects, altered endothelial function, altered heart rate and heart rate variability, accelerated atherosclerosis, and increased markers of brain inflammation (HEI 2013:3, 36, 39, 45, 65). UFP, which is formed primarily during the combustion of fossil fuels, is found in the exhaust of on-road vehicles, diesel-powered generators and other equipment, off-road vehicles, and industrial stationary sources.

Naturally Occurring Asbestos

Asbestos is the common name for a group of naturally occurring fibrous silicate minerals that can separate into thin but strong and durable fibers. Naturally occurring asbestos, which was identified as a TAC by CARB in 1986, is located in many parts of California and is commonly associated with serpentine soils and rocks. According to the California Geological Survey (CGS) and U.S. Geological Survey (USGS), Division of Mines and Geology, naturally occurring asbestos have not been reported in Santa Cruz County; however, there are two reported unspecific fibrous amphiboles (i.e., fibrous crystalline material) in Santa Cruz county, located at the Kalkar Rock Quarry (201 Quarry Lane, Santa Cruz, CA, 95060) and the Gabbro body outcrops (74 Atherly Lane, Santa Cruz, CA, 95060). According to the CGS and USGS, the presence of fibrous amphiboles suggest that nearby geologic conditions are favorable toward the formation of asbestos. (Van Gosen and Clinkenbeard 2011).

Odors

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

The ability to detect odors varies considerably among the population and is subjective. An odor that is offensive to one person may be acceptable to another (e.g., fast food restaurant). It is important to also note that an unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word strong to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the odorant concentration decreases. As this occurs, the odor intensity weakens and eventually becomes so low that the detection or recognition of the odor is quite difficult. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the detection threshold means that the concentration in the air is not detectable by the average human.

Land uses that are major sources of odor typically include wastewater treatment and pumping facilities, sanitary landfills, transfer stations, recycling and composting facilities, major livestock facilities, and various industrial uses such as chemical manufacturing and food processing. Currently, UC Santa Cruz has no major sources of odors on or adjacent to the main residential campus or the Westside Research Park and there have been no odor complaints filed (Searson, personal communication 2020).

Sensitive Land Uses

Sensitive land uses generally include uses where prolonged exposure to pollutants could result in health-related risks to individuals. Residential dwellings and places where people recreate or congregate for extended periods of time such as parks or schools are of primary concern because of the potential for increased and prolonged exposure of individuals to pollutants. Hospitals, childcare centers, schools, and assisted-living facilities are examples of sites where sensitive receptors congregate. Sensitive receptors on these land uses include, but are not limited to, children, the elderly, those with respiratory conditions, and those using outdoor athletic facilities where occupants have relatively higher breathing rates.

Existing sensitive land uses located adjacent to or within the UC Santa Cruz main residential campus include one on-campus childcare facility at Student Family Housing and two off-campus schools. The childcare centers on the UC Santa Cruz campus is located on the western edge of campus, in the Family Student Housing (FSH) area. Off-campus, West Lake Elementary School and Coastal Community Preschool are located just adjacent to each other on High Street, approximately 2,000 feet south of the campus border. The Santa Cruz Waldorf School is located on Empire Grade Road, approximately 3,500 feet northwest of the core campus. Families with small children may also reside in on-campus student, faculty, and staff housing, including FSH. Families with small children and elderly may reside in the neighborhoods to the south and east of the main residential campus and within the Cave Gulch neighborhood located along the western edge of the main residential campus. The Westside Research Park is surrounded by open space and industrial uses. Residential receptors are present in apartments to the northwest, single-family homes to the east along Natural Bridges Drive and to the southeast, and mobile homes southwest. Pacific Collegiate School, a charter school is also located approximately 500 feet north of Westside Research Park.

3.3.3 Environmental Impacts and Mitigation Measures

ANALYSIS METHODOLOGY

Construction Criteria Air Pollutants and Ozone Precursors

Construction-related emissions of criteria air pollutants and ozone precursors were calculated using the California Emissions Estimator Model (CalEEMod) Version 2016.3.2 computer program (CAPCOA 2016a), as recommended by MBARD. Modeling was based on project-specific information (e.g., land use types, traffic modelling, building space), where available, reasonable assumptions based on typical construction activities, and default values in CalEEMod that

are based on the project's location and land use type. CalEEMod accounts for known policies and regulations that may affect emissions calculations, such as state and federal emission standards for diesel off-road equipment and local air district's architectural coating VOC limits (CAPCOA 2016b).

Estimates of criteria air pollutant and precursor emissions associated with the construction of roadways, trails, and pedestrian bridges were calculated using the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Road Construction Emissions Model (RCEM), Version 9.0.0 (SMAQMD 2018). SMAQMD's RCEM is the only publicly available emissions model specifically designed to estimate emissions from linear construction activities in California, such as roadways and pipelines. Although from an air district outside the NCCAB, the RCEM is recommended for linear construction modeling by multiple air districts outside the Sacramento Valley Air Basin, such as the Bay Area Air Quality Management District (BAAQMD) and the South Coast Air Quality Management District (SCAQMD) (BAAQMD 2012, SCAQMD 2020). Thus, its use to model activity in the NCCAB is acceptable (Kim, pers. comm., 2020b).

Construction activities considered in the 2021 LRDP are anticipated to commence in 2022 and continue through 2040, for a period of about 18 years, and will include building, roadway, and trail construction. Additionally, it is assumed that over the years 2022-2031, one pedestrian bridge would be constructed, and over the years 2032-2040, two pedestrian bridges would be constructed. For a detailed description of model input and output parameters, and assumptions, refer to Appendix D1.

The 2021 LRDP does not specify the timing of potential construction activities other than they would occur as early as 2022 and last through 2040.

Based on the overall building program, as shown in Chapter 2, "Project Description," annual and maximum daily construction emissions are based on the combined results of CalEEMod and RCEM runs for the construction of approximately 312,700 assignable square feet (asf) (approximately 481,100 gross square feet [gsf]) of various land uses per year (not including parking lots), amortized over 18 years to estimate average annual construction activity, associated annual emissions, and maximum daily emissions that may occur within a year of construction.

Table 3.3-4 summarizes the project-related activities for which emissions were estimated; the model, protocol, and source of emission factors used; and the key input parameters on which each activity's emissions were determined.

Operational Criteria Air Pollutants and Ozone Precursors

Operation-related emissions of criteria air pollutants and precursors from building energy use, area sources (i.e., architectural coating, consumer products, and landscaping), stationary sources, and mobile sources were calculated using a variety of models and reports. CalEEMod Version 2016.3.2 was used to estimate emissions from area sources (except for laboratory sources), combustion-based stationary sources, and mobile sources. CalEEMod accounts for certain policies that may affect operational emissions factors, such as state and federal vehicle emission standards, discussed further below. These policies are accounted for in modeling results, unless otherwise noted. Stationary fugitive emissions from laboratories and a gasoline storage tank were based off modeling conducted for the HRA.

Additional off-model adjustments were made to the consumer product ROG emissions modeled in CalEEMod to account for updates to CARB's consumer product VOC standards. According to Appendix E of the User's Guide for CalEEMod Version 2016.3.2, CalEEMod applies statewide average consumer emissions factors calculated from the State's 2008 consumer product emissions inventory for residential and non-residential buildings; CalEEMod applies a separate emissions factor for parking lots. Since 2008, CARB has made more stringent several consumer product VOC standards, which are set based on a percent VOC limit by weight. Based on UC Santa Cruz's chemical inventory data, consumer products used by UC Santa Cruz include a variety of aerosol and non-aerosol products such as: adhesives, adhesive and paint removers, solvents, soaps, cleaners, and disinfectants, hairsprays (for theater production), lubricants, polishes, sealants, and insecticides and herbicides (Carpenter, pers. comm., 2020, WAXIE 2020). Chemicals used for laboratory research purposes are not considered consumer products and are accounted for separately.

Using the inventory of consumer products purchased by UC Santa Cruz available from the university and CARB's pre- and post-2008 VOC standards, a weighted average reduction in VOC content of 31 percent was applied to the non-residential, non-parking lot consumer product emissions modeled in CalEEMod (CARB 2019c, SCAQMD 2017:E-8). This reduces the default consumer product emissions from all sources by approximately 17 percent. This method

assumes that consumer product emissions generally emit up to CARB VOC standards and all products emit VOCs at equal rates. Although emission rates vary by product, the estimated percent reduction is applied to the default emissions factor, which is based on a statewide average rate that captures those variabilities. Residential consumer products were excluded because and the inventory of residential product usage on campus was not readily available. As such, it was conservatively assumed that residential consumer product emissions would remain unchanged. The calculation details of how the reduction in VOC standards affect are shown in Appendix C.

Landscaping emissions modeled in CalEEMod were also adjusted off model based on information from UC Santa Cruz that 85 percent of landscaping equipment on campus is currently electric. It was assumed that the number of equipment is proportional to the emissions from landscaping equipment. Accordingly, CalEEMod default landscaping emissions, which do not assume electric equipment, were reduced by 85 percent.

With respect to the effect of UC policies on operational emissions, the list below describes how specific policies of the Sustainable Practices Policy are reflected in the modeling of operational criteria pollutant emissions, as a co-benefit of reductions in energy consumption and GHG emissions. In general, the modeling of operational emissions reflects sustainability policy language that specifically requires UC Santa Cruz to achieve a certain level of energy consumption or GHG emissions reduction target, versus targeting a certain level of sustainability with no set requirement.

- Green Building Design
  - Criteria pollutant emissions reductions resulting from achieving the energy performance targets related to 1999 benchmarks, as shown in Table 1 of the *UC Building 1999 Energy Benchmarks by Campus* (Sahai, et al. 2014), are accounted for through reduced energy consumption in modeling.
- Sustainable Transportation
  - Strategies to reduce GHG emissions from fleet activities and other sustainable transportation strategies are not accounted for in modeling. However, as part of Transportation Mitigation Measure 3.16-1, traffic demand model (TDM) performance standards will be implemented that result in the reduction of total VMT per capita to 15 percent below current campus average and the total employment VMT per employee to 15 percent below the countywide average. This reduction is accounted for in calculation of mitigated criteria pollutant emissions.
- Sustainable Building Operations for Campuses
  - Per the Sustainable Practices Policy Sustainable Building Operations policy, no new building or major renovation that is approved after June 30, 2019 shall use onsite fossil fuel combustion (e.g., natural gas) for space and water heating (except those projects connected to an existing campus central thermal infrastructure). This policy was not accounted for in modeling, as there is no way to predict the total number of building or renovation projects to be approved in the foreseeable future, nor which projects will be allowed to utilize fossil fuel combustion.

Project-related activities for which emissions were estimated; the model, protocol, and source of emission factors used; and the key input parameters based on which each activity's emissions were determined are summarized in Table 3.3-4.

Table 3.3-4 Parameters Used to Estimate Project-Related Construction and Operational Emissions of Criteria Air Pollutants and Precursors

Land Use/Source	Model/Protocol/ Source of Emission Factors	Key Input Parameter(s)
Construction Emissions		
Academic and Administrative Designated Land Use	CalEEMod	62,632 asf/year of Research and Development land use 71,691 asf/year University/College land use
Other Land Use Types (recreational, additional housing, infrastructure)	CalEEMod	33,784 asf health club space/year 3,217 asf general light industry/year 104,238 asf/year parking lots 473 mid-rise apartments/year (104,722 asf/year) 31 low-rise apartments/year (36,667 asf/year)
Campus Roads, Trails, and Pedestrian Bridges	RCEM	2 miles/year roads; 2 miles/year trails; 1 bridge between 2022-2031; 2 bridges between 2032-2040
Operational Emissions		
Area Sources	CalEEMod	Default parameters based on land use inputs except for hearths. Non-residential consumer product emissions adjusted by changes in CARB VOC standards since 2008. Assumed no fireplaces or wood-burning stoves. Landscaping equipment assumed to be 85% electric.
Stationary Sources - Natural Gas	CalEEMod	Assumes buildings meet 2019 Title 24 building energy efficiency standards
Stationary Sources – Laboratory Fume Hoods	UC Santa Cruz laboratory chemical inventory	Maximum daily emissions based on annual emissions used for the HRA analysis, divided by 287 FAD equivalents[1].
Stationary Sources – Gasoline Storage Tank	MBARD Prioritization Score Assessment for UC Santa Cruz	
Mobile Sources	EMFAC 2017 and VMT data modeled by Fehr and Peers	Emission factors from EMFAC 2017 applied to VMT data provided by Fehr and Peers. VMT based on travel demand model and on-site traffic counts/trip generation.

Notes: asf = assignable square footage; CARB = California Air Resources Board; MBARD = Monterey Bay Area Air Resources District; VOC = volatile organic compound; VMT = vehicle miles travelled; HRA = health risk assessment; FAD = full academic day

Models: CalEEMod v.2016.3.2, EMFAC 2017, RCEM v. 9.0.0.

[1] Accounts for UC Santa Cruz's academic schedule, holidays, and enrollment levels during summer and regular academic quarters.

Source: UC Santa Cruz 2005; Kim, pers. comm., 2020a; Carpenter, pers. comm., 2020; MBARD Data compiled by Ascent Environmental in 2020

Toxic Air Contaminants, Carbon Monoxide, and Odors

An HRA was conducted to estimate the health risks associated with construction- and operation-related TAC emissions that would be generated as a result of the 2021 LRDP. To assess the potential human health risks posed by the TAC emissions from campus development under the proposed 2021 LRDP, the HRA followed the methodologies outlined in the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2015). As recommended by the 2015 OEHHA guidelines, CARB's Hotspots Analysis and Reporting Program, Version 2 (HARP2) was used to perform the OEHHA Tier 1 HRA for the project. Dispersion modeling was conducted using the CARB-approved American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee modeling system (AERMOD), Version 19191 (EPA 2019b). Other model assumptions and additional details can be found in the full HRA located in Appendix D2.

For both construction and operational health risk calculations, a receptor grid with 100-meter spacing was overlaid across the plan area and within 400 meters of the main residential campus's southern border and main haul routes extending along High Street and Bay Drive from the southern campus border to Highway 1. Average annual and

maximum hourly emissions were derived from the annual and maximum daily emissions from the CalEEMod, RCEM, and trail construction modeling conducted for the criteria air pollutant and GHG analyses. Operational emission rates were based solely on the CalEEMod results, which modeled the operational emissions from new buildings and parking lots. The RCEM and trail construction models did not have maintenance-related emissions rates. It is assumed that operational emissions associated with the maintenance of the proposed roadways, bridges, and trails would be minimal and, thus, are excluded from modeling. Maintenance of these components would only occur a few times per year at most, would be temporary in nature, and are assumed to be encompassed by normal operations-and-maintenance-related activities associated with campus operation.

Health risk from construction-related emissions was assessed based on the proximity of diesel PM-generating construction activity to off-site sensitive receptors, the number and types of diesel-powered construction equipment being used, and the duration of potential TAC exposure. Construction-related risks were based on an 18-year exposure period to characterize impacts across the 2021 LRDP implementation period and on annual and maximum hourly emissions derived from diesel PM_{10} exhaust results from criteria air pollutant modeling. According to Appendix D of OEHHA's 2003 HRA guidance, PM_{10} is the basis for OEHHA's potential risk calculations for diesel PM (OEHHA 2003, CARB 2020a). Thus, estimated emissions of PM_{10} from diesel combustion sources were used as a proxy for diesel PM in the risk assessment. Comprehensive details and results of the HRA are included in Appendix D2.

The level of health risk exposure from operational TAC sources was based on the new and modified existing sources that would be operated under the 2021 LRDP, including both stationary and on-road mobile sources. Depending on the type of source, the number of existing sources were scaled up by the anticipated growth in students and building square footage, and additional sources were based on the growth anticipated under the 2021 LRDP (e.g., estimated growth in energy use and building area, estimated additional VMT). The placement of these new sources was based on development areas shown in in Figure 2-4 in Chapter 2, "Project Description" and conceptual siting of structures within envisioned development areas. Any modified existing sources were not assumed to be moved from their current positions (e.g., natural gas turbines, gasoline storage tank). The exposure parameters were based on default assumptions within HARP2 for residential and worker receptor types – 30-year and 25-year exposure durations, respectively, which are conservative parameters. Although most students would reside on campus for short terms (e.g., four years), faculty housing is also located on campus and could house long-term residents.

A description of the modified and proposed sources under the 2021 LRDP are shown in Table 3.3-5.

Table 3.3-5 Proposed and Modified Existing Toxic Air Contaminant Sources Quantified Considered in the Health Risk Assessment

Construction or Operation[1]	Proposed or Modified Existing	Source	Assumed Activity under 2021 LRDP for modeling purposes[2]	Emissions Scaling method from Existing conditions
Operation	Proposed	Boilers	Three new natural gas boilers	Scaled by growth in natural gas use
Operation	Modified	Natural Gas Turbines	Current natural gas turbine at cogeneration facility to increase output by 30 percent	Scaled by growth in total energy use (turbines generate both heat and electricity)
Operation	Proposed	Emergency Generators	27 new natural gas emergency generators	Scaled by growth in electricity use
Operation	Proposed	Standby Generators	Four new natural gas standby generators	No scaling method used. Number of new standby generators were proposed by UC Santa Cruz
Operation	Proposed	Fume Hoods	New chemical emissions anticipated from potential laboratories in development areas, attributable to approximately three new buildings.	Scaled by increase in instruction and research building square footage
Operation	Modified	Gasoline Storage Tank	Current gasoline storage tank to increase usage/storage by 50 percent	Scaled by increase in total building square footage

Construction or Operation[1]	Proposed or Modified Existing	Source	Assumed Activity under 2021 LRDP for modeling purposes[2]	Emissions Scaling method from Existing conditions
Operation	Proposed	Diesel Mobile Sources	Net increase in diesel-powered VMT generated under the 2021 LRDP	Scaled by increase in VMT
Construction	Proposed	Off-Road Equipment	Diesel off-road equipment activity associated with 2021 LRDP construction	Activity based on modeled emissions for construction.
Construction	Proposed	Haul Trucks	Diesel on-road haul truck activity associated with 2021 LRDP construction	Activity based on modeled emissions for construction.

Notes: VMT = vehicle miles travelled

[1] Sources that will continue through 2021 LRDP implementation

[2] See Appendix D2 for a detailed explanation of the scaling methods used to estimate new source activity.

Source: Data compiled by Ascent Environmental in 2020

Impacts associated with exposure from CO hotspots were evaluated using screening criteria consistent with MBARD guidance. Odors were evaluated qualitatively based on proposed land uses and their relative location to existing sensitive land uses.

Ultrafine Particulate Matter

Health effects associated with exposure to UFP are based on the results of the TAC analysis included in the HRA. UFP is a subset of PM, and the list of recognized TAC pollutants in the HRA includes diesel PM and other pollutants that can manifest as PM.

SIGNIFICANCE CRITERIA

Based on Appendix G of the State CEQA Guidelines, an air quality impact is considered significant if implementation of the proposed 2021 LRDP would do any of the following:

- conflict with or obstruct implementation of the applicable air quality plan;
- result in a cumulatively considerable net increase of any criteria air pollutant for which the project region is in nonattainment under an applicable National or State ambient air quality standard (including emissions that exceed quantitative standards for ozone precursors);
- expose sensitive receptors to substantial pollutant concentrations (including TACs); or result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

As stated in Appendix G of the State CEQA Guidelines, the significance of criteria established by the applicable air quality management or air pollution control district may be relied upon to make the above determinations. For development projects, MBARD has set forth mass-based emissions thresholds that lead agencies may use to evaluate the significance of a project's air pollutant emissions. For local plans, such as the 2021 LRDP, MBARD recommends demonstrating consistency with the AQMP in order to claim a less-than-significant impact on air quality in the NCCAB (MBARD 2008:5-10). The University has elected to use both consistency with the AQMP and mass emissions-based thresholds to evaluate the significance of LRDP-related air emissions. Thus, the proposed 2021 LRDP would result in a potentially significant impact on air quality if it would result in any of the following during either short-term construction of projects or long-term implementation of the 2021 LRDP:

- cause criteria air pollutant or precursor emissions to exceed 137 pounds per day (lb/day) for ROG or NO_X, 82 lb/day of PM_{10}, 55 lb/day of $PM_{2.5}$, or 550 lb/day of CO emissions;
- cause odorous emissions in such quantities as to cause detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which may endanger the comfort, repose, health, or safety of any such person or the public, or which may cause, or have a natural tendency to cause, injury or damage to business or property (MBARD 2008); or
- Be inconsistent with the adopted AQMP.

For the evaluation of TAC emissions, MBARD considers the contribution of TAC emissions of a project to be substantial, during either the construction or operational phases, if it would:

- Result in a maximum individual cancer risk (MICR) in excess of 10 in a million;
- Result in an acute or chronic non-cancerous health hazard index (HI) greater than 1.0.

ISSUES NOT EVALUATED FURTHER

All issues applicable to air quality, as outlined by the significance criteria above, are evaluated below.

IMPACTS AND MITIGATION MEASURES

Impact 3.3-1: Construction-Generated Emissions of Criteria Air Pollutants and Precursors

A quantitative analysis was performed to estimate the emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ that would be generated during an average year of on-campus construction under the proposed 2021 LRDP. Emissions were assumed to result from demolition, site preparation (e.g., excavation, clearing), off-road equipment use, material and equipment delivery trips, worker commute trips, and other construction activities (e.g., building, asphalt paving, application of architectural coatings), as well as trail and roadway construction, and the occasional construction of pedestrian bridges. Construction-generated daily NO_X emissions could occasionally exceed MBARD's significance threshold of 137 lb/day due to overlapping construction activities. Thus, construction emissions would have the potential to conflict with air quality planning efforts and result in a cumulatively considerable net increase of ozone for which the project region is nonattainment under the NAAQS and CAAQS. This impact would be **significant**.

Campus construction activities would result in emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ from demolition, site preparation (e.g., excavation, clearing), off-road equipment, material delivery, worker commute trips, building construction, asphalt paving, and application of architectural coatings. Fugitive dust emissions of PM_{10} and $PM_{2.5}$ are associated primarily with site preparation and grading and vary as a function of soil silt content, soil moisture, wind speed, acreage of disturbance, and VMT on and off the project site. Emissions of ozone precursors, ROG and NO_X, are associated primarily with construction equipment and on-road mobile exhaust. Paving and the application of architectural coatings result in off-gas emissions of ROG. PM_{10} and $PM_{2.5}$ are also contained in vehicle exhaust.

Typical construction activities would require all-terrain forks, forklifts, cranes, pick-up and fuel trucks, compressors, loaders, backhoes, excavators, dozers, scrapers, pavement compactors, welders, concrete pumps, concrete trucks, and off-road haul trucks, as well as other diesel-fueled equipment, as necessary. As the UC Santa Cruz main residential campus is heavily wooded in some areas, tree removal will be part of site preparation for some projects.

Construction activities could begin as early as 2022 and are estimated to occur through 2040, with the 2021 LRDP operating at its full forecasted capacity by 2040. Construction occurring as part of the 2021 LRDP would total to an average 207,493 square-feet per year (not including parking lots), consisting of the various land uses listed in Table 3.3-4. This average sf value was estimated based on 18 years of construction, from 2022 to 2040, assuming that construction activities would be relatively similar from year to year. Construction under the proposed 2021 LRDP would result in daily emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$. Estimated maximum daily construction emissions are summarized in Table 3.3-6, below. As discussed above under Methodology, these values were calculated using CalEEMod and RCEM models to estimate the daily construction emissions based on the average annual amount of construction in one year, and the distribution of typical construction phases over one year. Refer to Appendix D1 for a detailed summary of the modeling assumptions, inputs, and outputs.

Table 3.3-6 Summary of Modeled Emissions of Criteria Air Pollutants and Precursors Associated with 2021 LRDP Construction Activities – Unmitigated

Year(s) of Construction	Maximum Daily Emissions ROG (lb/day)	Maximum Daily Emissions NO_X (lb/day)	Maximum Daily Emissions PM_{10} (lb/day)	Maximum Daily Emissions $PM_{2.5}$ (lb/day)
2022 – 2040	45.3	238.1	49.0 (9.6)[1]	27.4 (8.8)[1]
MBARD Thresholds of Significance	137	137	82	55
Exceed Threshold of Significance?	No	Yes	No	No

Notes: Modeled values represent maximum daily emissions that would occur over the duration of the construction period. See Appendix D1 for detail on model inputs, assumptions, and project specific modeling parameters.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; MBARD = Monterey Bay Air Resources District

[1] Numbers in parentheses represent the portion of PM emissions from exhaust. Numbers not in parentheses represent fugitive and exhaust emissions combined.

Source: Modeling conducted by Ascent Environmental in 2020.

As shown in Table 3.3-6, construction of the 2021 LRDP components could result in an exceedance of the daily NO_X threshold during years 2022 through 2040. This exceedance of the NO_X threshold would occur during overlapping phases of construction, including building and other land use construction, as well as roadway, trail, and bridge construction. See Appendix D1 for further details related to the sources of construction-related emissions.

As the estimated construction emissions associated with proposed development under the 2021 LRDP would potentially exceed MBARD daily NO_X threshold during some days of the year, this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.3-1: Reduce Construction-Generated Emissions of NO_X

Per contract specification requirements, UC Santa Cruz shall require that the contractor(s) develop and implement a plan demonstrating that the off-road equipment used on-site to construct 2021 LRDP projects would achieve a fleet-wide average 45 percent reduction in NO_X exhaust emissions, compared to uncontrolled aggregate statewide emission rates for similar equipment. One feasible plan to achieve this reduction would include the following:

- At least 80 percent of diesel-powered off-road equipment operating on the project site for more than two days continuously shall be equipped with engines meeting US EPA emissions standards for Tier 3 engines or equivalent;
- Use of renewable diesel or other zero emissions alternative (e.g., electric) construction equipment to the degree available and feasible;
- Plan construction projects such that bridge construction will not occur on the same days as other construction activities; and
- Alternatively, if UC Santa Cruz can demonstrate through preparation of an air quality assessment report prepared by an air quality specialist that large or contemporaneous 2021 LRDP construction projects would not exceed MBARD thresholds, then the above mitigation requirements may be waived.

Significance after Mitigation

Tier 3 engines have been certified by the EPA as having cleaner burning engines and lower emissions, reducing NO_X emissions from the unmitigated scenario modeled in CalEEMod. Applying the Tier 3 engine mitigation alone would result in a 41 percent reduction in maximum daily NO_X emissions, reducing NO_X emissions to 140 lb per day, which is still above the daily MBARD NO_X threshold. Separating the schedule for bridge construction from other 2021 LRDP construction activities would reduce an additional 70 lb NO_X per day from the maximum daily construction emissions. Renewable diesel can reduce NO_X emissions by another 10 percent, according to a staff report from the California Environmental Protection Agency (CalEPA) (CalEPA 2015:14). These measures would reduce maximum daily NO_X emissions to 126 lb NO_X per day, which is below the daily MBARD NO_X threshold. In addition to reducing NO_X

emissions, the implementation of Mitigation Measure 3.3-2 would also reduce ROG, PM_{10}, and $PM_{2.5}$ emissions from construction activity.

Assuming the implementation of Tier 3 equipment (e.g., excavators, cranes, graders, forklifts), separation of bridge construction, and use of renewable diesel pursuant to Mitigation Measure 3.3-2, the potential resulting mitigated emissions are presented in Table 3.3-7.

Table 3.3-7 Summary of Modeled Emissions of Criteria Air Pollutants and Precursors Associated with 2021 LRDP Construction Activities – Mitigated

Year(s) of Construction	Maximum Daily Emissions[1] ROG (lb/day)	Maximum Daily Emissions[1] NO_X (lb/day)	Maximum Daily Emissions[1] PM_{10} (lb/day)	Maximum Daily Emissions[1] $PM_{2.5}$ (lb/day)
2022 - 2040	33	126	30 (5)[2]	16 (4)[2]
MBARD Thresholds of Significance	137	137	82	55
Percent Reduction from Unmitigated Scenario	-26%	-47%	-39% (-53%)	-43% (-50%)
Exceed Threshold of Significance?	No	No	No	No

Notes: Modeled values represent maximum daily that would occur over the duration of the construction period. See Appendix D1 for detail on model inputs, assumptions, and project specific modeling parameters.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; NA = not available; MBARD = Monterey Bay Air Resources District

[1] Assumes that bridge construction would not occur on the same days as building, roadway, or trail construction.

[2] Numbers in parenthesis represent the portion of PM emissions from exhaust. Numbers not in parenthesis represent fugitive and exhaust emissions combined.

Source: Modeling conducted by Ascent Environmental in 2020.

Implementation of Mitigation Measure 3.3-1 would reduce the generation of NO_X emissions related to construction under the 2021 LRDP to below MBARD significance criteria. Table 3.3-7 shows the modeled emissions after mitigation, assuming building, roadway, trail, and bridge construction were not to occur concurrently, that the use of at least 80 percent of construction fleets would include Tier 3 or better engines, and that renewable diesel would also be used in place of conventional diesel. As a stop gap, this mitigation measure requires contractors to demonstrate a minimum reduction of NO_X emissions by 45 percent or below MBARD daily thresholds. Thus, under Mitigation Measure 3.3-1, maximum daily NO_X emissions would not exceed the MBARD threshold. Therefore, this impact would be **less than significant**.

Impact 3.3-2: Operational Emissions of Criteria Air Pollutants and Precursors

Implementation of individual projects under the 2021 LRDP would result in long-term project-generated emissions of criteria air pollutants, particularly emissions of the ozone precursor, ROG, from the use of consumer products and cleaning supplies. Incremental long-term, operational ROG and PM_{10} emissions would exceed MBARD thresholds of significance (137 lb/day and 82 lb/day, respectively). Thus, operational emissions would conflict with the air quality planning efforts and result in a cumulatively considerable net increase of ozone and ambient PM_{10} concentrations, for both of which the project region is in nonattainment under the CAAQS. This would be a **potentially significant** impact.

The 2021 LRDP would result in new mobile sources and area sources associated with new residential land uses, academic building space, and recreational and athletic facilities. New and expanded existing stationary sources, such as boilers, emergency generators, and natural gas turbines, could be added to support energy needs of the expanded campus. Although development projects on the campus would be completed and begin operations as time progresses from the start of construction considered in the 2021 LRDP (i.e., from 2022 through 2040), new operational emissions that would result in 2040, when the forecasted 2021 LRDP capacity is reached, are analyzed below in order to evaluate and disclose the maximum impact. Operational emissions in the years preceding 2040 would be lower than those reported for 2040 conditions at full build-out.

The MBARD-adopted mass emissions thresholds apply at the individual project level and are cumulative in nature; that is, they identify the level of project-generated emissions below which the project's emissions would not be cumulatively considerable, or above which would be considered cumulatively considerable. Thus, the analysis set forth here reflects a conservative approach as it applies an individual project's mass emissions threshold to the evaluation of the total operational emissions that are estimated to result from all 2021 LRDP projects.

Operational emissions are discussed by source, below.

Area Sources

Area sources of emissions during 2021 LRDP operation include reapplication of architectural coatings for building maintenance, consumer products, and landscaping equipment. Architectural coating, consumer products, and landscaping emissions result from typical residential and non-residential building operation through regular building maintenance and occupancy. Consumer products used by the residential and non-residential land uses on campus contain various solvents that emit ROG and include cleaning supplies, toiletries, adhesives, adhesive and paint removers, solvents, cleaners, and disinfectants, lubricants, polishes, sealants, and insecticides and herbicides (CAPCOA 2016b:41, Carpenter, pers. comm., 2020, Waxie Sanitary Supply 2020). Landscaping emissions include exhaust emissions from the use of landscaping equipment such as gasoline-powered lawn mowers and leaf blowers. ROG emissions also result from the application of architectural coatings. Modeling data of operational 2021 LRDP emissions from area sources indicate that consumer products are responsible for an estimated 80.3 percent of ROG emissions, architectural coatings are responsible for 19.1 percent of ROG emissions, and landscaping equipment is responsible for 0.6 percent of ROG emissions.

Stationary Sources

Stationary sources during 2021 LRDP implementation would include natural gas combustion equipment (such as furnaces, boilers, natural gas turbines, and emergency generators) and fugitive emissions from potential future laboratory space, which operate fume hoods; and expanded gasoline tank storage.

Combustion of natural gas in new facilities under the 2021 LRDP would result in increased emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$. While the UC Sustainable Practices Policy states that new buildings will not use natural gas or other fossil fuels for on-site combustion, the policy allows some flexibility for campuses to use natural gas in new buildings that are connected to the existing campus central thermal infrastructure or when otherwise necessary, provided an explanation is given. The UC Sustainable Practices Policy states "Projects unable to meet this requirement shall document the rationale for this decision…" (UCOP 2020:9). Due to this flexibility in the policy, it is conservatively assumed that the additional buildings would use natural gas at a rate typical for the types of proposed land uses, as modeled through CalEEMod. It is assumed these demands would be met by a combination of natural gas equipment, including furnaces, boilers, cogeneration turbines, and emergency generators.

Stationary sources from fugitive emissions include those from research activity in new laboratories and expanded on-site gasoline storage. These sources result in various ROG emissions, including those commonly associated with cleaning solvents, coatings, gasoline vapor emissions, as well as chemical solutions specific to the type of research being conducted at laboratories.

Emissions from new stationary sources are controlled through MBARD's permitting process through Rule 423, New Source Performance Standards. As with the campus' existing permitted sources, these new sources within UC Santa Cruz would be required to apply BACT. UC Santa Cruz would also be required to purchase emission reduction credits (ERCs) to offset emissions from new sources per MBARD guidance. The level to which emissions would be offset through ERCs would be determined at the time of the permit application process for new sources under the 2021 LRDP. Additionally, an HRA was prepared, which includes an identification of stationary sources and an estimate of their contribution to operational TAC emissions, discussed in Impact 3.3-5 below.

Mobile Sources

Mobile-source emissions of criteria air pollutants and ozone precursors would result from employee and student commute trips, campus-operated fleet, and trips made to the campus by vendors and visitors. LRDP-generated mobile-source emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ were modeled using LRDP-specific data and applicable

emission rates by modifying the default assumptions in CalEEMod to match the daily trip rates presented in the transportation study. Daily VMT were adjusted to annual VMT using a conversion factor of 287 which accounts for UC Santa Cruz's academic schedule, holidays, and enrollment levels during summer and regular academic quarters.

Table 3.3-8 summarizes the modeled operational emissions of criteria air pollutants and precursors under 2021 LRDP implementation conditions in 2040. As shown in this table, operational emissions of ROG and PM_{10} associated with implementation of the 2021 LRDP would exceed the established MBARD daily threshold. The MBARD thresholds are designed to ensure that new development does not result in emissions that would interfere with the attainment of federal and state air quality standards, nor conflict with or obstruct implementation of any regional air quality plan. As the estimated operational ROG and PM_{10} emissions associated with proposed development under the 2021 LRDP would potentially exceed MBARD daily ROG and PM_{10} thresholds during some days of the year, this impact would be **significant**.

Table 3.3-8 Summary of Modeled Operational Emissions of Criteria Air Pollutants and Precursors Associated with 2021 LRDP Implementation (2040) – Unmitigated

Emissions Source	Maximum Daily Emissions ROG (lb/day)	Maximum Daily Emissions NO_X (lb/day)	Maximum Daily Emissions PM_{10} (lb/day)	Maximum Daily Emissions $PM_{2.5}$ (lb/day)
Land Uses under 2021 LRDP				
Area Sources[1]	121.9	0.2	0.1	0.8
Consumer Products	*100.6*	*0.0*	*0.0*	*0.0*
Architectural Coatings	*20.7*	*0.0*	*0.0*	*0.0*
Landscaping Equipment	*0.6*	*0.2*	*0.1*	*0.8*
Stationary Sources	3.6	23.3	1.8	1.8
Natural Gas Combustion[2]	*2.6*	*23.3*	*1.8*	*1.8*
Laboratories[3]	*1.0*	*0.0*	*0.0*	*0.0*
Gasoline Storage Tank[3]	*<0.1*	*0.0*	*0.0*	*0.0*
Mobile Sources[4]	26.6	55.3	105.8	28.5
Exhaust	26.6	55.3	*0.4*	*0.4*
Fugitive Dust	*0.0*	*0.0*	*105.3*	*28.1*
TOTAL	152	79	108	30
MBARD Thresholds of Significance	137	137	82	55
Exceed Threshold of Significance?	Yes	No	Yes	No

Note: Summation may not equal totals because of rounding. See Appendix D1 for detail on model inputs, assumptions, and project specific modeling parameters.

[1] Modeled in CalEEMod 2016.3.2.

[2] Under the UC Sustainable Practices Policy, all new facilities are prohibited from using natural gas or fossil fuels; however, there is flexibility in the policy that allows campuses to use natural gas or fossil fuel sources if they are unable to comply. As a conservative assumption, calculations assume natural gas use would continue in new buildings under the 2021 LRDP.

[3] Based on annual emissions used in HRA modeling divided by 287 full academic day equivalents, accounting for UC Santa Cruz's academic schedule, holidays, and enrollment levels during summer and regular academic quarters.

[4] Based on modeling with VMT data from Fehr and Peers and emission factors from EMFAC 2017.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; LRDP = Long Range Development Plan; MBARD = Monterey Bay Air Resources District

Source: Data provided by Ascent Environmental in 2020.

Mitigation Measures

Mitigation Measure 3.3-2: Reduce Operational Emissions of ROG and PM_{10} from All Sources

The majority of ROG emissions are a result of aerosolized and evaporation of consumer products, which include cleaning solutions, personal care products, and pesticides. The calculation of ROG emissions from consumer products was based on the ability to control personal products over the use of consumer products, such as personal care products and household cleaners used off-campus. However, UC Santa Cruz is responsible for facility-related purchases, such as commercial cleaning and sanitizing solutions. Additional measures should also be taken to reduce ROG emissions from other sectors, such as mobile sources, landscaping equipment, and architectural coatings.

As such, UC Santa Cruz shall make every effort to reduce ROG emissions generated under the 2021 LRDP. With respect to the new construction and operations that would occur under the 2021 LRDP, UC Santa Cruz shall implement the following measures for on-campus activities:

- Use zero or low-VOC consumer products and cleaning supplies that exceed CARB's consumer product VOC standards (as defined in CCR Title 17, Division 3, Chapter 1, Subchapter 8.5, Articles 1 through 5), such as those using electrolyzed water, where available.
- Use zero-VOC architectural coatings with a VOC content no greater than 5 grams per liter.
- Increase the level of zero emission landscaping equipment, such as electric lawnmowers, leaf blowers, and chainsaws, on campus such that 95-100 percent of landscaping equipment is used.
- Choose zero emission vehicles for all new light-duty fleet purchases.
- Choose zero or low emission vehicles for all new heavy-duty fleet purchases, where available and feasible.
- Encourage the use of zero emission vehicles by installing electric vehicle charging stations in parking facilities.
- Reduce campus vehicle speed limits to the extent feasible and install traffic calming or signal coordination to reduce the intensity of vehicle braking and acceleration.

Mitigation Measure 3.16-1: Implement Transportation Demand Management Program and Monitoring

(Refer to Section 3.16, "Transportation")

Significance after Mitigation

Mitigation Measures 3.3-2 and 3.16-1 would reduce the generation of ROG and PM_{10} emissions related to implementation of the 2021 LRDP. As a result, ROG emissions would not exceed MBARD significance criteria, however the mitigated PM_{10} emissions would still exceed MBARD significance criteria. Table 3.3-9 shows the modeled emissions after mitigation, quantifying all reductions resulting from the proposed measures within Mitigation Measure 3.3-2, except for consumer product mitigation, that are under UC Santa Cruz's direct control. Consumer product mitigation was not quantified due to the uncertainty related to the VOC levels of products that residents within the LRDP area may use.

As shown in Table 3.3-9, implementation of Mitigation Measures 3.3-2 and 3.16-1 would reduce total maximum daily ROG emissions by 24 pounds per day, from 152 pounds per day to 128 pounds per day, and PM_{10} emissions by 10 pounds per day, from 108 pounds per day to 98 pounds per day. Although ROG emissions can be mitigated to below the threshold, the PM_{10} emissions rate remains above the MBARD threshold of significance.

With the majority of PM_{10} emissions result from roadway fugitive dust, additional mitigation of these emissions from non-university operations (e.g., motor vehicle use), beyond the actions described above in Mitigation Measure 3.3-3 and 3.16-1, is not considered feasible. According to Appendix A of the CalEEMod User's Guide, daily roadway fugitive dust emissions from paved roads are calculated based on a formula that accounts for roadway particle sizes, road surface silt loading, average vehicle weight, local precipitation levels, and VMT. This formula is based on EPA's AP-42 compilation of emission factors (EPA 2011). None of these variables can be feasibly changed except for VMT, which is already mitigated under Mitigation Measure 3.16-1. Many studies have indicated that the contribution of roadway

activity to roadway fugitive dust is not well understood and that the actual roadway fugitive dust emissions are highly variable depending on individual roadway conditions and silt levels (Kuhns 2001, Pant 2013). Although some studies also show that vehicle speeds are positively correlated with roadway fugitive PM emissions, the exact relationship between the two variables varies by study area (Pirjola 2009, Kuhns 2001). For this reason, reducing campus vehicle speed limits is recommended under Mitigation Measure 3.3-3 but the associated PM emissions reductions are not quantified.

Table 3.3-9 Summary of Modeled Operational Emissions of Criteria Air Pollutants and Precursors Associated with 2021 LRDP Implementation (2040) – Mitigated

Emissions Source	Maximum Daily Emissions ROG (lb/day)	Maximum Daily Emissions NO_X (lb/day)	Maximum Daily Emissions PM_{10} (lb/day)	Maximum Daily Emissions $PM_{2.5}$ (lb/day)
Land Uses under 2021 LRDP				
Area Sources[1]	101.4	0.0	0.0	0.0
Consumer Products	*100.6*	*0.0*	*0.0*	*0.0*
Architectural Coatings	*0.8*	*0.0*	*0.0*	*0.0*
Landscaping Equipment	*0.0*	*0.0*	*0.0*	*0.0*
Stationary Sources	3.6	23.3	1.8	1.8
Natural Gas Combustion[2]	*2.6*	*23.3*	*1.8*	*1.8*
Laboratories[3]	*1.0*	*0.0*	*0.0*	*0.0*
Gasoline Storage Tank[3]	*0.1*	*0.0*	*0.0*	*0.0*
Mobile Sources[4]	22.8	47.4	95.9	25.8
Exhaust	*22.8*	*47.4*	*0.4*	*0.3*
Fugitive Dust	*0.0*	*0.0*	*95.6*	*25.5*
TOTAL	128	71	98	28
MBARD Thresholds of Significance	137	137	82	55
Exceed Threshold of Significance?	No	No	Yes	No

Note: Summation may not equal totals because of rounding. See Appendix D1 for detail on model inputs, assumptions, and project specific modeling parameters.

[1] Modeled in CalEEMod 2016.3.2.

[2] Under the UC Sustainable Practices Policy, all new facilities are prohibited from using natural gas or fossil fuels; however, there is flexibility in the policy that allows campuses to use natural gas or fossil fuel sources if they are unable to comply. As a conservative assumption, calculations assume natural gas use would continue in new buildings under the 2021 LRDP.

[3] Based on annual emissions used in HRA modeling divided by 287 full academic day equivalents, accounting for UC Santa Cruz's academic schedule, holidays, and enrollment levels during summer and regular academic quarters.

[4] Based on modeling with VMT data from Fehr and Peers and emission factors from EMFAC 2017.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; LRDP = Long Range Development Plan; MBARD = Monterey Bay Air Resources District

Source: Data provided by Ascent Environmental in 2020.

UC Santa Cruz has little direct control over fugitive PM emissions from roadway dust nor the use of zero-emissions vehicles from non-university mobile sources. Further PM_{10} reductions would require mitigation of these sources of PM_{10} emissions. Therefore, this impact would be **significant and unavoidable**.

The calculations shown in Table 3.3-9 do not include reductions associated with zero emissions fleet because VMT projections were not broken down by fleet and non-fleet activity, meaning that estimating the reductions associated with a zero emissions fleet would be speculative. However, a review of UC Santa Cruz's 2018 GHG emissions shows

that fleet activity (Scope 1 mobile emissions) accounted for eight percent of total mobile source emissions in 2018 (Second Nature 2018). For informational purposes, assuming the level of fleet activity relative to total mobile emissions remains the same under the 2021 LRDP as under existing conditions, selecting 100 percent zero emission vehicles for all new light and heavy-duty fleet purchases under the 2021 LRDP would result in an additional reduction of 7 pounds per day of PM_{10}. These additional reductions would reduce total PM_{10} emissions to 84 pounds per day but would not likely reduce impacts to less than significant.

Critically, these calculations also do not take into account additional reductions in VMT resulting from on-campus housing projects that have been approved but not yet constructed (refer to Chapter 4, "Cumulative Impacts.") The Student Housing West project and the Kresge Housing project, as well as the Crown College Major Maintenance Project, will collectively provide 2,175 additional student beds on campus, contributing toward meeting existing need for on-campus housing. These projects are not being proposed as part of this 2021 LRDP, but were instead approved based on the 2005 LRDP; therefore, they are treated as cumulative projects in this EIR and are not accounted for in the project impact analysis above. However, UC Santa Cruz intends to construct these projects well before full implementation of this 2021 LRDP. With those two projects constructed and an additional 2,175 students living on campus—instead of off campus—in 2040, VMT will be significantly reduced, and this impact would be less-than-significant. In other words, while at a project level this impact is significant and unavoidable, under the cumulative scenario—which represents actual conditions likely to occur in 2040—the impact is less than significant.

Health Impacts Related to Project-Generated Pollutants of Concern

With respect to the potential health impacts associated with the one pollutant that cannot be mitigated to less-than-significant, direct emissions of PM_{10}, air districts develop region-specific thresholds of significance based on existing attainment status of the CAAQS and NAAQS in the air basin (see Table 3.3-3.) As noted in that table, the NCCAB is in non-attainment for the PM_{10} standard. The ambient air quality standards were developed based on scientific evidence related to the acceptable pollutant concentrations above which human health may be adversely impacted. These concentrations are the cumulative effect of all pollutant sources in the air basin. MBARD considers projects with emissions below the thresholds of significance to have a minor or negligible impact on the regional cumulative emission concentrations that would exceed the ambient air quality standards (MBARD 2008). Projects that exceed an applicable threshold could contribute to the continued nonattainment designation of a region or potentially degrade a region from attainment to nonattainment resulting in acute or chronic respiratory and cardiovascular illness associated with exposure to concentrations of criteria air pollutants above what EPA and CARB consider safe. Elevated PM concentrations have been linked to aggravated asthma, premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, decreased lung function, and increased respiratory symptoms (e.g., coughing or difficulty breathing) (EPA 2020b).

As shown in the analysis above, 98 percent of estimated PM_{10} emissions would come from roadway fugitive dust. The exact location and magnitude of specific health impacts that could occur as a result of project-level construction- or operation-related fugitive dust PM_{10} emissions is infeasible to model with a high degree of accuracy. Roadway fugitive dust concentrations vary considerably depending on roadway silt levels, precipitation, vehicle speeds, vehicle weights, and roadway conditions and configurations that affect tire wear, brake wear, and resuspension of roadway dust. Additional factors include meteorology, topography, air flow, etc. Given the large number of variables considered, modeling is subject to high levels of inaccuracy and speculation.

While such modeling may be warranted when considering extremely large projects that exceed thresholds by multiples, they are of questionable value, and are, in fact, often misleading when considering projects such as the 2021 LRDP, which exceed the significance standard by a very small margin. Further, while dispersion modeling of project-generated PM may be conducted to evaluate resulting ground-level concentrations, localized impacts of directly-emitted PM do not always equate to local PM concentrations due to the transport of emissions. Therefore, it is simply not possible, based on current modeling technologies, to model specific health impacts of this exceedance with a reasonable degree of scientific certainty, and doing so would not provide reliable, credible informational value to decisionmakers or the public.

From a broader perspective and in terms of the trends in PM_{10} concentration in the region, the average annual concentration of PM_{10} has been steadily declining in the NCCAB between 1997 and 2019 at a rate of about 1 percent per year, although concentrations have remained relatively the same since 2008 (CARB 2020b). PM_{10} concentrations in the NCCAB have not exceeded the PM_{10} standards since 2011 (CARB 2020b). Table 3.3-9 shows that operation of the 2021 LRDP after mitigation would exceed PM_{10} thresholds of significance by 11 percent, and the majority of these emissions are from fugitive roadway dust, which would be dispersed along roadways in and around the LRDP area. A review of existing literature suggests that, although there have been documented health effects related to roadway fugitive PM (Denier 2013), the current research is extremely limited and additional study is needed to determine the health effects that could be caused by incremental increases in PM_{10} fugitive dust concentrations in the NCCAB.

Furthermore, the forecasted VMT increase used in this analysis is based on the comparison of the 2019 Existing and 2019 Project VMT scenarios, as analyzed in Impact 3.16-2 of Section 3.16, "Transportation." This comparison and resulting VMT estimates are conservative and do not include anticipated improvements in the roadway network that may further reduce VMT generated by the 2021 LRDP. Of note, the improvements are included as part of the cumulative scenario (refer to Chapter 4, "Cumulative Impacts"). Accounting for the cumulative scenario could lower the net change in VMT used for this analysis by at least 20 percent. Thus, although regional trends in PM_{10} concentrations have been declining, the health effects related to the exceedance of the PM_{10} threshold is uncertain, but may be overstated due to the use of a conservative VMT scenario used in this analysis.

Impact 3.3-3: Conflict with or Obstruct Implementation of an Applicable Air Quality Plan

MBARD has developed its *2012-2015 Air Quality Management Plan* (AQMP) to guide the region toward achieving attainment of the California 8-hour ozone standard. The plan is based on an inventory of existing emission sources as well as projections about the future level of land use development in the NCCAB. With implementation of the 2021 LRDP, on-campus improvements related to promoting pedestrian/bicycle modes of transportation and decreasing on-campus parking are consistent with objectives of the AQMP. Further, new buildings planned for development would be consistent with the UC Sustainable Practices Policy. However, operational ROG and PM_{10} emissions resulting from implementation of the 2021 LRDP would exceed MBARD's daily emissions thresholds. For this reason, the project would conflict with MBARD's long-term air quality planning efforts to achieve and maintain attainment with the ozone and PM_{10} CAAQS, and this impact would be **significant**.

Santa Cruz County is in an area of nonattainment for ozone and PM_{10} with respect to the CAAQS. Because of this, MBARD is required to develop an air quality plan to achieve and maintain the state ozone standard by the earliest practicable date. As a means of reducing regional ambient ozone concentrations, MBARD sets daily and annual significance thresholds for emissions of ozone precursors ROG and NO_X, as specified in the AQMP.

MBARD's AQMP addresses the attainment and maintenance of the NAAQS and CAAQS by outlining strategies to reduce ozone precursor and PM_{10} emissions from various sources. The plan includes a stationary source control program, administered by MBARD for permitted stationary sources, as well as transportation and land use management strategies to reduce mobile-source emissions. In addition, local jurisdictions prepare population forecasts, which are used by MBARD to forecast emissions and progress towards air quality attainment.

A consistency analysis with the AQMP is required for a program-level environmental review. For such programs or plans, evaluation of consistency is partly based on a comparison of the plan with the land use and transportation control measures and strategies outlined in the AQMP. If the plan is consistent with these measures, the plan is considered consistent with the AQMP. Additionally, consistency with regional growth projections, such as those developed by the Association of Monterey Bay Area Governments (AMBAG), is considered as part of the overall AQMP consistency analysis.

The 2021 LRDP was guided by overarching sustainability principles and the goal of wise resource management is reflected in features and policies throughout the 2021 LRDP. The UCOP Sustainable Practices Policy, which UC Santa Cruz would adhere to during the development of the 2021 LRDP, contains several provisions relevant to the air quality emissions reductions:

- Zero emission transportation policies, such as D.1a, D.3a, and D.3b, would reduce criteria air pollutants from mobile sources.
- Clean energy policies B.1, B.2, B.3, and B.4, including LEED requirements for new facilities, would reduce criteria air pollutants through improved energy efficiency and the use of natural gas and other on-site combustible fuels.

All of these efforts would reduce air pollutant emissions and be consistent with MBARD's AQMP. Regarding growth in the county attributable to UC Santa Cruz expansion and as noted in Section 3.13, "Population and Housing," AMBAG projects that UC Santa Cruz will grow to 27,000 to 28,000 FTE students by 2040 (AMBAG 2018), which aligns with the 2040 FTE student population estimated in the 2021 LRDP. MBARD utilizes AMBAG growth predictions in its AQMP projected emissions estimates; therefore, the growth projected in the 2021 LRDP is consistent with the growth accounted for in the AQMP. However, the second part of consistency with MBARD's AQMP is whether a project exceeds established thresholds for ROG and NO_X. As shown below, the ROG emissions associated with implementation of the 2021 LRDP are projected to exceed the MBARD daily threshold of significance (see Impact 3.3-3). The thresholds are established for the purposes of achieving and maintaining attainment with the NAAQS and CAAQS, which is the primary air quality goal of the AQMP. The AQMP specifically states that a project that emits more ROG or PM_{10} than the specified threshold would conflict with implementation of the AQMP. As campus-related development under the 2021 LRDP would result in ROG and PM_{10} emissions that exceed the established daily thresholds, this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.3-2 (above): Reduce Operational Emissions of ROG and PM_{10} from All Sources

Significance after Mitigation

Table 3.3-9 shows the modeled emissions after mitigation, quantifying all proposed measures within Mitigation Measure 3.3-2 that are under UC Santa Cruz's direct control. Mitigation Measure 3.3-2 would reduce the generation of ROG and PM_{10} emissions related to implementation of the 2021 LRDP, however the reduced emissions would not fall below MBARD significance criteria. As shown in Table 3.3-9, implementation of Mitigation Measure 3.3-2 would reduce total maximum daily ROG emissions by 24 pounds per day, from 152 pounds per day to 128 pounds per day, and PM_{10} emissions by 10 pounds per day, from 108 pounds per day to 98 pounds per day. Although ROG emissions can be mitigated to below the threshold, the PM_{10} emissions rate remains above the MBARD threshold of significance. While implementation of the Sustainable Practices Policy would result in further emissions reductions, these practices are applied only when feasible, thus no definitive mechanism exists to ensure their application. As a result, this impact would be **significant and unavoidable**.

Impact 3.3-4: Mobile-Source CO Concentrations

Operational mobile-source emissions of CO generated by additional traffic to and from the campus under the proposed 2021 LRDP would not violate an air quality standard or contribute substantially to an existing or projected air quality violation or expose sensitive receptors to substantial pollutant concentrations. As a result, this impact would be **less than significant**.

Traffic-congested roadways and intersections have the potential to generate localized high levels of CO, which is produced in greatest quantities from vehicle combustion and is usually concentrated at or near ground level. Localized mobile-source CO emissions near roadway intersections are a function of traffic volume, speed, and delay. Transport of CO is extremely limited because it disperses rapidly with distance from the source under normal meteorological conditions. However, under certain specific meteorological conditions, CO concentrations near roadways and/or intersections may reach unhealthy levels and affect nearby sensitive land uses, such as residential areas, schools, and childcare facilities. Over the past several decades, though, CO emissions from vehicles has been dramatically reduced, and is only a potential problem in rare instances of extremely high vehicular volumes at intersections. As a result, CO is analyzed at the local level.

MBARD has a project-level CO threshold of 550 pounds per day, which may be indicative of a localized impact when this level of CO is produced by an individual project, but is inappropriate for a LRDP, where these CO levels would be dispersed throughout the campus area. A more accurate threshold at the plan level is tied to congestion at a particular roadway intersection coupled with a high volume of cars. Because they do not have CO significance criteria directly related to intersection traffic volumes, MBARD was consulted for approval to use screening criteria for CO emissions at high-volume intersections developed by SMAQMD. MBARD verified that it would be appropriate to use SMAQMD screening criteria as they relate to the magnitude of intersection volumes affected by the 2021 LRDP (Frisbey, personal communication 2020). Screening criteria for SMAQMD were developed based on a conservative analysis of local intersections and are considered appropriate for a preliminary screening analysis. If the SMAQMD criteria are exceeded for the project, a detailed dispersion modeling analysis would need to be performed based on local data. These screening criteria have been developed in a manner such that, if they are met, local development-generated, operational mobile-source emissions of CO would not violate an air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations.

According to SMAQMD, a project would result in a less-than-significant CO impact if the following criterion is met (SMAQMD 2016):

- The project would not result in an affected intersection experiencing more than 31,600 vehicles per hour.

Whereas the SMAQMD screening criteria reference intersection vehicle volumes of 31,600 vehicles per hour or more, the intersection volumes in the project vicinity do not exceed 10,000 vehicles per hour even under Cumulative with Project conditions (refer to Section 3.16, "Transportation").

As a result, development-generated, operational local mobile-source emissions of CO would not violate an air quality standard or contribute substantially to an existing or projected air quality violation or expose sensitive receptors to substantial pollutant concentrations of CO. Thus, this impact would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.3-5: Short-Term Construction Emissions of Toxic Air Contaminants

Construction activities would result in temporary, short-term project-generated emissions of TACs, particularly diesel PM. Construction TAC emissions would not result in a HI greater than 1.0 or in an incremental increase in cancer risk that exceeds 10 in one million. This impact would be **less-than-significant**.

Construction activities associated with projects under the 2021 LRDP would result in temporary, short-term emissions of diesel PM from the exhaust of off-road, heavy-duty diesel equipment used during demolition, site preparation, building construction, paving, and application of architectural coatings and the exhaust of on-road haul truck travel. For construction activity, diesel PM is the primary TAC of concern. Demolition and renovation of older facilities may also result in the release of airborne asbestos because of the disturbance of asbestos-containing material that may be present in older buildings.

Based on the emissions modeling conducted for the criteria air pollutant analysis, construction activities under the 2021 LRDP would result in an average annual emissions of 0.59 tons per year (1,195 lb per year) and a daily maximum of 9.6 lb per day of PM_{10} emissions from diesel exhaust. Assuming a 9-hour workday, this would translate to a maximum hourly emission of 1.1 lb of diesel PM per hour. These emissions are assumed to occur across all development areas and near sections of main haul truck routes (High Street and Bay Drive between the main residential campus and up to Mission Street/Highway 1). Based on these emission rates and assumed modeling parameters, the HRA concluded that the temporary construction activities under the 2021 LRDP could result in an incremental increase in the probability of contracting cancer of up to 8.4 in one million the maximally exposed individual resident (MEIR) (i.e., the modeled receptor location at a residential land use that has the highest risk), which is located in the vicinity of College Nine and Ten apartments (See the results in Appendix D2). The MEIR for the non-cancer health impact (HI), located in the vicinity of the UC Observatories/Lick Building, would have an HI no greater

than 0.002. These results are both below MBARD's thresholds of 10 in one million for cancer risk and an HI of 1.0 for non-cancer risk. Health effects associated with UFPs from construction activity are assumed to be included in the health effects related to diesel PM.

Additionally, renovation and demolition of existing structures would potentially result in the airborne entrainment of asbestos due to the disturbance of asbestos-containing materials. Asbestos is listed as a TAC by CARB. The risk of disease is dependent upon the intensity and duration of exposure. Exposure to asbestos fibers may result in health issues such as lung cancer, mesothelioma (a rare cancer of the thin membranes lining the lungs, chest and abdominal cavity), and asbestosis (a non-cancerous lung disease which causes scarring of the lungs) (CARB 2017b). These activities would be subject to the Federal EPA Asbestos NESHAP regulation and MBARD Rule 424 (Asbestos). The rule requires UC Santa Cruz and its contractors to notify MBARD of any renovation or demolition activity at least 10 working days prior to commencement of demolition/renovation. When removing any Regulated Asbestos Containing Material (RACM), MBARD regulations must be followed. This notification includes a description of structures and methods utilized to determine whether asbestos-containing materials are potentially present. All RACM found on the site must be removed prior to renovation activity and there are specific requirements for surveying, notification, removal, and disposal of material containing asbestos. Therefore, projects under the 2021 LRDP that comply with MBARD Rule 424 and Federal regulations would ensure that asbestos-containing materials would be disposed of appropriately and safely and unsafe exposure to asbestos would not occur.

Projects under the 2021 LRDP would comply with Rule 424 and unsafe exposure to asbestos would be avoided; and the cancer and non-cancer risks from construction TAC emissions would be below MBARD thresholds. As such, construction activities following the implementation of the 2021 LRDP would have a **less-than-significant** impact.

Mitigation Measures

No mitigation is required.

Impact 3.3-6: Operational Emissions of Toxic Air Contaminants

The 2021 LRDP would result in additional sources of TACs (e.g., laboratories, boilers); however, the additional risks associated with these sources would not exceed MBARD thresholds of 10 in one million for cancer risk nor a HI of 1.0 for both acute and chronic exposures. Therefore, this impact would be **less than significant**.

New sources of operational TAC emissions associated with the 2021 LRDP implementation would likely include new stationary sources such as additional boilers, emergency and standby generators, laboratories, increased vehicular traffic, and increased gasoline storage. New facilities that have the potential to generate stationary source emissions would be required to obtain a permit from MBARD. For facilities that have the potential to generate health risks above established risk levels, MBARD is required to distribute public notifications to notify families of children enrolled and all persons within 1,000 feet of the source before approving any permits (Health & Safety Code §42301.6) (MBARD 2008). Health effects associated with UFPs from construction activity are assumed to be included in the health effects related to diesel PM.

With regards to TAC levels under the 2021 LRDP, the HRA concluded that the probability of contracting cancer for the MEIR would not exceed 1.8 in one million and ground-level concentrations of TACs would result in a HI no greater than 0.1 for the MEIR (See Appendix D2 for the HRA analysis). These results are less than MBARD's thresholds of 10 in one million for cancer risk and a HI of 1.0 for non-cancer risk. Thus, the 2021 LRDP would not result in additional stationary and mobile sources of TACs that would significantly contribute to the existing risk level in the project area. This impact would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.3-7: Exposure of Sensitive Receptors to Odors

The 2021 LRDP may introduce new odor sources into the area, such as new research facilities and diesel-related exhaust from delivery trucks. The new odor sources would be similar to existing sources that operate in and around the UC Santa Cruz campus. As a result, impacts would be **less than significant**.

The occurrence and severity of odor impacts depends on numerous factors, including: the nature, frequency, and intensity of the source; wind speed and direction; and the sensitivity of the receptors. While offensive odors rarely cause any physical harm, they still can be unpleasant, leading to considerable distress among the public and often generating citizen complaints to local governments and regulatory agencies. Projects with the potential to frequently expose a substantial number of members of the public to objectionable odors would be deemed to have a significant impact.

Minor odors from the use of heavy-duty diesel equipment and the laying of asphalt during project-related construction activities would be intermittent and temporary and would dissipate rapidly from the source with an increase with distance. Construction activities would be spread over a relatively long-term period (approximately 18 years), and odors resulting from construction activity would occur in different areas of the 2,000-acre main residential campus at different times over the 2021 LRDP period, not exposing any single area or individual receptor to construction-related odors for extended periods of time. Additionally, the UC Santa Cruz central campus is relatively distant from surrounding residential neighborhoods in the City of Santa Cruz and embedded within a forested area, factors which also help prevent any possible odors from reaching nearby receptors. However, there is the possibility that construction may occur near student and faculty housing for short periods of time, and that new facilities, with the potential to generate odors, may be located on the lower campus, which is adjacent to nearby residential areas.

Operational uses under the 2021 LRDP would result in various levels of odorous emissions, ranging from odors associated with motor vehicle operation to food preparation. Diesel-fueled delivery trucks would haul materials to and from the academic and administrative, residential, recreational, and retail areas; however, these types of sources are not different from those that currently deliver materials to existing land uses in the LRDP area and other parts of the City. No odor complaints regarding UC Santa Cruz have been received by MBARD in recent memory (Searson, pers. comm., 2020), thus it is unlikely similar sources under the 2021 LRDP would result in new complaints. The 2021 LRDP may include operation of new restaurant kitchens, but any odors potentially generated by the kitchens are not typically considered to be objectionable and are also not different from the restaurant kitchens in the project vicinity.

Other potential sources of odors include research activities, such as through general laboratory research and handling of volatile organic materials. These odor sources would be contained within buildings in the campus core and not likely result in objectionable odors affecting a substantial number of people.

Thus, implementation of the 2021 LRDP would not result in major sources of odor that could create objectionable odors affecting a substantial number of people. This impact would be **less than significant**.

Mitigation Measures

No mitigation is required.